Interdisciplinary Information Seeking Behaviour:
A Naturalistic Inquiry

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Abstract

The thesis begins with an introduction to the study, interdisciplinarity and information seeking behaviour. A review of the literature pertinent to information-seeking behaviour and interdisciplinarity leads to the suggestion that existing research is insufficient to address questions about the information behaviour of interdisciplinary researchers. From this review questions relating to the nature of interdisciplinary information behaviour and the shape of a model of interdisciplinary information seeking behaviour, and how this relates to existing single discipline models are developed. The methodology of the study followed a naturalistic inquiry approach to the subject using interviews and inductive analysis, while addressing validity within the Lincoln and Guba framework and is based around a sample of 45 academics, selected using a combination of purposive and snowball sampling techniques. This thesis traces the development of the results in a sequence of chapters detailing core processes (Opening, Orientation, and Consolidation) and what may be termed "general influences" relating to Cognitive Approach, Internal Context and External Context. There are therefore three core processes and three levels of general influence, each composed of several individual activities and attributes. Further chapters discuss the relationship of the core processes and general influences and their position in a model. The behavioural patterns identified are analogous to an artist's palette, in which activities remain available throughout the course of information seeking, each process iteratively leading back to a new selection from the palette. The interactivity and shifts described by the model show information seeking to be non-linear, dynamic, holistic, and flowing. A non-linear model of interdisciplinary information behaviour is put forward. The resulting model presents an alternative framework for understanding interdisciplinary information seeking behaviour with wider implications based upon transferability of the findings to other contexts and plans for further research to develop the model.

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1 Introduction

The study presented here of interdisciplinary information seeking behaviour arose from an uneasiness with existing models of information seeking behaviour. While engaged in research within Information Science and interviewing many academics a pattern again and again emerged to suggest these interdisciplinary researchers were different, even if indefinably so. Stimulated into reading more widely on the subject of interdisciplinary research, issues were highlighted related to the context of interdisciplinary research, information seeking, information retrieval, and ultimately the study of those contexts and issues. However, the existing research and commentary on interdisciplinary researchers failed to provide sufficient explanation or description of the information seeking behaviour of interdisciplinary researchers. The remainder of this first chapter will define the main concepts used, provide an overview of the literature salient to the study, and highlight the questions which arose and to which this study addresses itself.

1.1 Historical and academic contexts of interdisciplinarity

The academic life of the modern university revolves around organisational structures that we call faculties and departments based broadly on disciplines. Occasionally special interest research groups come into being, but the concept of separate discipline based departments recurs within those research groups. Few universities have adopted a structure that is interdisciplinary, though interdisciplinary institutes or groups do appear in many locations. Yet the organisation of research and teaching by 'discipline' is historically at variance with the growth of human knowledge.

Historically the absence of fixed disciplines, as oppose to the existence of strong disciplinary identities, can be identified throughout the last three thousand years. Examples from the lives of Greek philosophers and of the later medieval scholars are illustrative of early study of this kind. The picture of the medieval scholar created by historians such as Heer (1962: 190) suggests that disciplinary boundaries were less significant than the "the habit of disciplined thinking, followed by systematic investigation". The pattern was prevalent in intellectual circles until at least the mid-eighteenth century.

Disciplines or ring fenced knowledge fields do not start to appear until the beginnings of the industrial revolution in the eighteenth century. Industrialisation came hand in hand with specialisation on smaller parts of what was becoming a considerable body of knowledge, a body of knowledge that individuals could grasp only in part and which encouraged the formation of

separate disciplines. Although within this process of disciplinary development Scott (1984) suggests that constant fracturing and restructuring occurred as new specialities formed from the peripheral parts of other disciplines.

1.1.1 Twentieth and twenty-first century developments

Despite an interdisciplinary, one might say "non-disciplinary" heritage, the acceptance of interdisciplinarity as something more than a peripheral activity within modern academia has been both slow and partial. However, with reference to recent years Klein (1996) suggests that interdisciplinarity is now on everyone's agenda and the visibility of interdisciplinarity as a word appearing in any literature search certainly confirms this. In an article primarily setting the scene for further discussion Klein discusses the development of interdisciplinarity (Klein, 1996: 135-137) with a broad sweep with the conclusion that interdisciplinarity has left the periphery of academia (Salter and Hearn, 1993; Klein, 1996) as interdisciplinary research becomes more visible within universities.

The change in how interdisciplinarity is perceived in academia occurred alongside significant changes in information seeking caused largely, though not exclusively by information technology. Electronic information resources in all forms from OPACs and CD ROMs available in libraries through on-line databases such as BIDS and DIALOG/DATASTAR and the World Wide Web (WWW) have opened up the potential for interdisciplinary information seeking. The Internet, as the most widely accessible electronic information resource, contributes to the interdisciplinary impulse as it draws searchers into many new disciplinary areas as examination of results from simple searches on Yahoo, Infoseek, or any of the growing number of search engines readily demonstrates (Cory, 1999).

Electronic sources are opening up possibilities for access to information about information as well as direct access to content along with which go information overload and information saturation even within a single discipline (Akin, 1997). At no time since the eighteenth century has it been so easy for anyone to access information about any aspect of knowledge and this in itself may have consequences for the use and presentation of information (Floridi, 1995). The potential consequence of this is the existence of a growing body of information that is also increasingly "invisible" (Jones and Rosenfeld, 1992). Jones and Rosenfeld (1992) see "invisible" information as arising from an increased volume of information, the information technology used for distribution, and the use of bibliographic methods that do not reflect logical links between information.

1.2 Scope of the study

The scope of the present study area of information seeking behaviour is itself quite large. The area of interdisciplinarity also has its own debates and diversions. The present study is concerned purely with the information seeking aspects of interdisciplinarity, and more particularly with modelling information seeking behaviour.

Within this boundary, the most important consideration was the derivation of working definitions of disciplinarity and interdisciplinarity. These two words are crucial to defining the scope and in terms of identification of population and sample.

However, much of the debate amongst the academic community is about what disciplinarity and interdisciplinarity mean as political and bureaucratic concepts within universities. Much of the debate is beyond the interests of the present study, but different uses of the words interdisciplinarity and disciplinarity must be resolved to set a firm foundation for the study of interdisciplinary information seeking behaviour.

1.3 An overview of the thesis

This thesis begins with a literature review to establish definitions, existing views of interdisciplinarity, and an overview of information seeking behaviour models. These are presented in Chapter 2. Chapter 3 introduces the methodology and discusses the process of developing the research from pilot study through to final study, with descriptions of the sample and of the rationale behind the methods adopted. The chapters then progress through a presentation of the results. The chapters relate to the core processes that form the central elements of a new Model of Interdisciplinary Information Seeking Behaviour. Concepts are described and where necessary are cross referenced to other parts of the discussion. The presentation of data begins with the perceptions of interdisciplinarity held by participants (Chapter 4). Subsequent chapters present relevant findings and discussion relating to the process of the model, namely Opening, Orientation, Consolidation, Cognitive Approach, Context, and Timing. These form the detail of the model which is introduced as a whole in Chapter 11.

Throughout the presentation of interview data the convention used provides a unique identifier. For example the label: P27: 27:1 (4:7) indicates a quotation from a Participant coded as number 27, quotation number 27:1, and an indication of line numbers within the transcript.

2 Literature review

In this study the literature review performs two functions. In the first instance priority was given to establishing the definition and number of interdisciplinary researchers, as this is later crucial to establishing the population and sample. In the second, literature provides an introduction to interdisciplinary information seeking and models of information seeking. Discussion in later chapters also draws in literature relevant to the results and emergent model.

This chapter contains two substantial sections, the first creating an overview of current understanding of interdisciplinarity and the second considering work that has made a significant contribution to the understanding of information seeking behaviour.

2.1 Defining discipline and interdiscipline

The concept of interdisciplinarity contains within it the concepts of inter and discipline. To appreciate the full meaning of interdisciplinarity one also needs to understand the nature of disciplines. The Oxford English Dictionary defines a discipline as "a branch of instruction or education; a department of learning or knowledge; a science or art in its educational aspect" (Oxford English Dictionary Second Edition, 1989).

Many discussions of universities and academic life offer definitions of "discipline", hence Nissani (1995) suggested that a discipline is 'any comparatively self-contained and isolated domain of human experience which possesses is own community of experts, with distinctive components such as shared goals, concepts, facts, tacit skills, and methodologies'. A discipline therefore "...implies both a domain to be investigated and the methods used in that domain" (Pfinster, 1969: 25). The theme of a 'separate domain' is further emphasised by Kochelmans (1979: 127) who defines discipline as a

> "branch of learning or a field of study characterized by a body of inter-subjectively acceptable knowledge, pertaining to a well-defined realm of entities, systematically established on the basis of generally accepted principles with the help of methodical rules or procedures: for example mathematics, chemistry, [and] History".

Running throughout the definitions of discipline is the notion of isolation, a conceptualisation that is brought to the fore in the work of Becher (1989; 1994), who talks of separate "academic tribes". The idea of culture held within the idea of tribe reflects the relative importance of differences in data, method, administration, and status of individuals within the discipline. Gozzer (1982: 286) defines disciplinarity in a similar way.

> "Disciplinarity appears to be a compartmentalization determined by the need to gain thorough knowledge of the various aspects of each cognitive area: thus, criteria of reflection and study

appropriate to each sector are determined, and there is a certain crystallization of the various fields of inquiry, defined by their characteristics of observability, method, and application".

The definition of a discipline contains the concepts of separation, difference, and isolation and is typified by a shared culture as much as by any other measure (Kuhn, 1970:44).

For the present research the definition of discipline is subsumed within a larger scale problem, that of defining interdisciplinary activity. The debate over the meaning of component words is one part of this. The simplest definitions appear in the Oxford English Dictionary and Collins English Dictionary. The Oxford English Dictionary defines interdisciplinary, as "mutual or reciprocal action or relation, or with sense 'among' or between" (Oxford English Dictionary, 1964: 634) and Collins define *inter* "1. Between or among; e.g. international; 2. Together, mutually, or reciprocally, e.g. interdependent" (Collins, 1964: 760) or alternatively Collins (1979) "involving two or more academic disciplines" and the related concept of multidisciplinarity as "relating to the study of one topic, involving several subject disciplines" (Collins, 1964: 967). Using this basic literary tool Nissani (1995, para. .2) states that "The word interdisciplinarity is actually made up of two words: inter and disciplinarity...interdisciplinarity may be defined as combining in some fashion components of two or more disciplines".

However, the pure dictionary definitions are open to various interpretations and for Ralston and Edwin the distinction between multidiscipline and interdiscipline represents two very different relationships. They suggest that "a distinction can be drawn between (1) "'multidisciplinary'" research, "'in which researchers from [different disciplines] apply their differing methodologies to a common problem'" and (2) "'interdisciplinary'" research, in which - in addition - researchers from different disciplines "'inform their own studies with results of investigations from the complementary disciplines'" (Ralston and Edwin, 1993: 185-189)

Fish (1990, cited in Bartolo and Smith, 1993) suggests that interdisciplinarity may be defined as "...the name of difference – of the recognition of perspectives, materials and interests excluded from the disciplinary focus – that one calls for interdisciplinary work, for work that insists on looking into the other fellow's backyard" (Bartolo and Smith, 1993: 345). Similarly, Berger (1972: 25-26) defines interdisciplinarity as

> "an adjective describing the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data, and organisation of research and education in a fairly large field" .

The work of both Scott (1979: 307) and Davis (1995: 4) suggests that the meaning of 'inter-' in the word interdisciplinarity represents an interaction of two, or more, disciplines. The product of successful integration and substantial research in an interdisciplinary area, in Scott's (1979) view, was the creation of a new discipline. Westbrook (1999: 26) similarly views interdisciplinarity as an integration and defines it as

"the purposeful weaving together of two or more disciplines that are usually considered to be quite unconnected in order to reach a new understanding, create a new academic end product, or advance research on a particular question".

The theme of multiple definitions continues in the definition of interdisciplinarity as a range of activities, hybridisation, dual, or multidiscipline subjects and areas that fall between any disciplinary categorisation (Klein, 1996). Sometimes that falling between indicates a transitive stage in the formation of new disciplines. However, interdisciplinary subjects do not necessarily indicate the existence of a transitive stage.

"General education, liberal studies and professional training; social, economic and technical problem solving, social political and epistemological critique; holistic systems and trans-disciplinary approaches; cross-fertilization or borrowing and sub-disciplinary interactions; new fields, hybrid communities, and inter-institutional alliance; faculty development and institutional downsizing" (Klein, 1996: 135).

Further distinctions aimed at creating more terminology have been created to some degree in the work of Robles and Schliefer (1998) and Schliefer (no date) whose work further points to the debate over the meanings of pluri-disciplinary and cross-disciplinary work. The difficulty of such terminology, and of any definition, becomes more complex when the concept of interdisciplinary collaboration is considered. As suggested by Rustum (1979: 169) in the case of Higher Education the definition of discipline often equates to department and

"A serious lack of discipline in the use of terminology has hampered progress in analysing the Sociology of interdisciplinary and multidisciplinary organizations. There is no agreement on what a discipline is, let alone what distinguishes terms such as inter-, multi- or cross-disciplinary from each other".

These definitions see interdisciplinarity as an organisational or intellectual movement between academic departments, disciplines or individuals. The definitions imply the presence of multiple levels of disciplinary connection, ranging from superficial encyclopaedic searches, through to complex connections where disciplinary methods are utilised.

The core of these definitions is one unified concept: the idea of separate bodies of information, or knowledge, drawn together in one research problem. The synthesised definition applied in the present study takes interdisciplinarity to cover topics by single researchers where the primary knowledge domain is either clearly focused and related to one or more other knowledge domains, or has no single domain focus and appears as a composition or hybrid subject reliant to varying degrees on several sub-disciplines or partial elements of disciplines.

Interdisciplinary researchers to whom the definition applies exist by the very nature of their diverse reasons for coming to an interdisciplinary topic as an incoherent grouping, not all of whom belong to interdisciplinary research groups or advertise their interests explicitly. The adoption of this definition of interdisciplinary researchers is important later in selecting the initial sample of participants. The issue of identifying a sample is discussed in more detail in the section on methodology and sampling.

The definition of interdisciplinarity forms a key part of the study presented. The matter of definition in the literature is complex and the synthesised definition derived from the

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literature is only a starting point. The perception of interdisciplinary researchers both as to how they would describe themselves and how they would define interdisciplinary research are presented in Chapter 4. Initially identified by the definition above, the participants themselves provide a secondary confirmation of the disciplinary status and a further insight into the subject.

2.2 Estimating the number of interdisciplinary researchers

Questions arise when considering interdisciplinarity relating particularly to how many researchers actually engage in interdisciplinary research, whether they are a small group, or are highly prevalent within our university system. A recent study by Evaluation Associates (1999) addresses the question of numbers as part of its work related to the Research Assessment Exercise. The study was instigated following comments from the Scottish Universities Research Policy Consortium (1997) such that:

> "Interdisciplinary research is increasingly important for practical, academic and social reasons, but is currently difficult to deliver. There is widespread belief that many internal pressures of ethos and structure in higher education institutions, reinforced by the external pressure of the Research Assessment Exercise, tend to favour research in traditional academic disciplines at the expense of interdisciplinary developments" (Scottish Universities Research Policy Consortium, 1997).

While the National Committee of Inqûiry into Higher Education (the Dearing Committee) recommended that:

> "...Funding Bodies and the Research Councils commission a study to evaluate the funding of interdisciplinary research, including the incentives and disincentives. The report should be ready to inform the next Research Assessment Exercise". (Dearing, 1997)

The purpose of Evaluation Associates' study was an assessment of the 1996 RAE with a view to improving the treatment of interdisciplinary researchers during future Research Assessment Exercises. Results gathered from 5505 academic researchers and heads of department within the Higher Education system were included in their dataset. The results usefully included estimates of the number of interdisciplinary researchers.

The results show a rather high 80 per cent estimate as the number of researchers who participate in interdisciplinary research either wholly or at some time in their careers, with only 20 percent working wholly within single disciplines as shown in Figure 1 below.
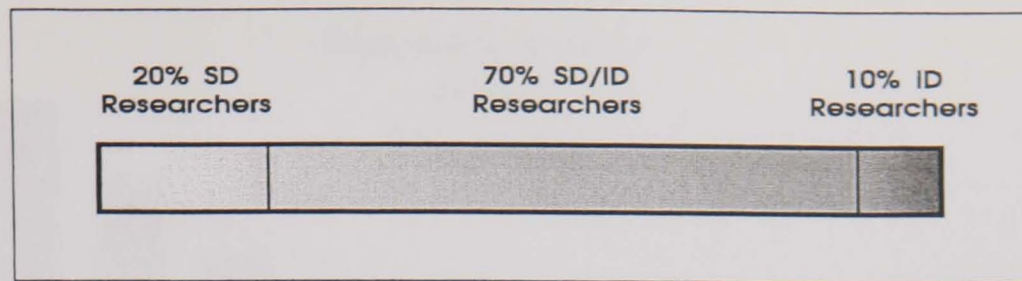
Figure 1. The 20-70-10 Model (Evaluation Associates, 1999: 7)

The definitions applied in the Evaluation Associates study have limitations as they tend to be rather inclusive to include work in interdisciplinary teams and lone research, as befits the RAE focus on publication activities. The definitions provided for their questionnaire were as follows:

> "**Single disciplinary research.** Projects conducted with like-minded colleagues who share considerable common knowledge and skills. You or your colleagues will often specialise in particular sub-fields or methodologies. Individuals may carry out single disciplinary research as lone researchers. **Interdisciplinary research** (includes multidisciplinary and cross disciplinary research). Projects that draw together people and knowledge from discrete fields, each providing a distinctive contribution to the overall field or project. The aim is to bring together diverse perspectives, skills and methodologies from different fields, and subjects. Researchers work in intellectual space between and across fields, and may forge new research fields. Individuals may carry out interdisciplinary research as lone researchers" (Evaluation Associates, 1999: 4).

By including teams in their questionnaire the difference of focus for the present doctoral research emerges. The present study views lone researchers as different from those in multidisciplinary teams. The information problems associated with working in teams are different from the lone researcher for whom issues and information seeking are the product of one mind. Unfortunately, the study did not break down the data into lone and team interdisciplinarity. The figure for lone interdisciplinary research experience would be somewhat lower, though estimates are not possible.
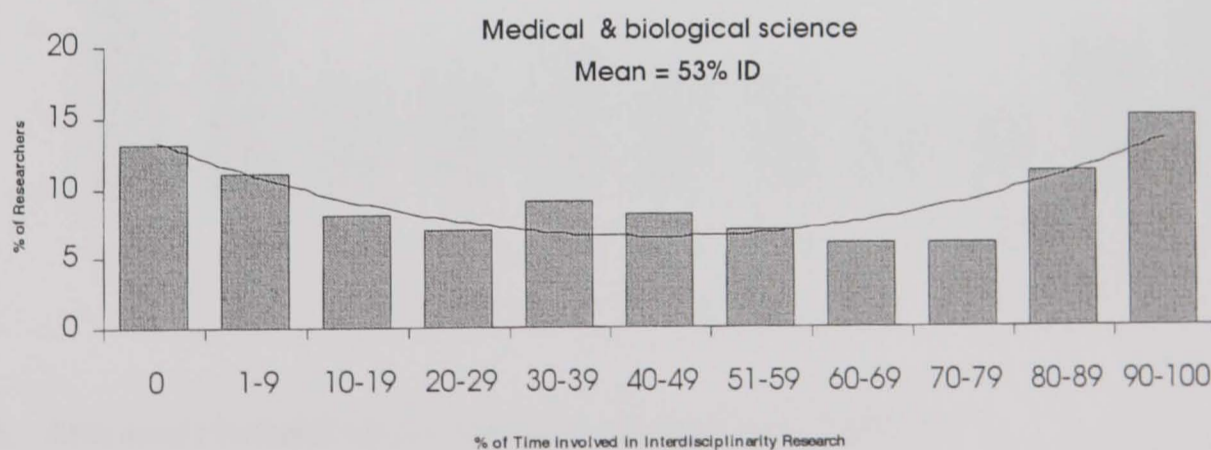
Figure 2. Medical and Biomedical Sciences (Evaluation Associates, 1999: 7)
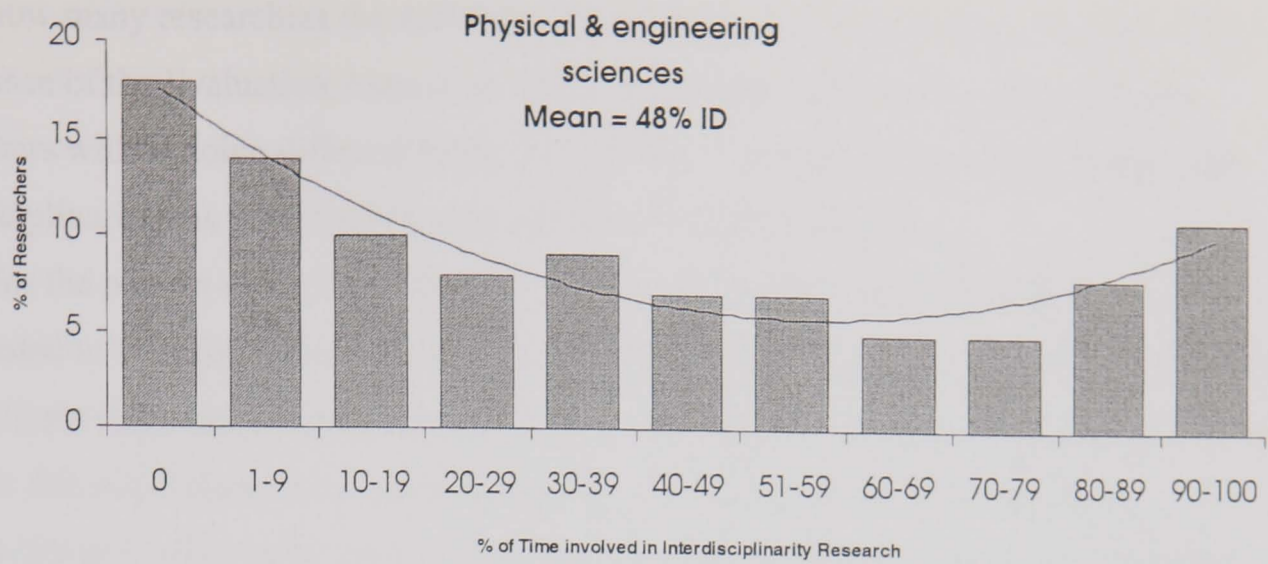
Figure 3. Physical and Engineering Sciences (Evaluation Associates, 1999:7)
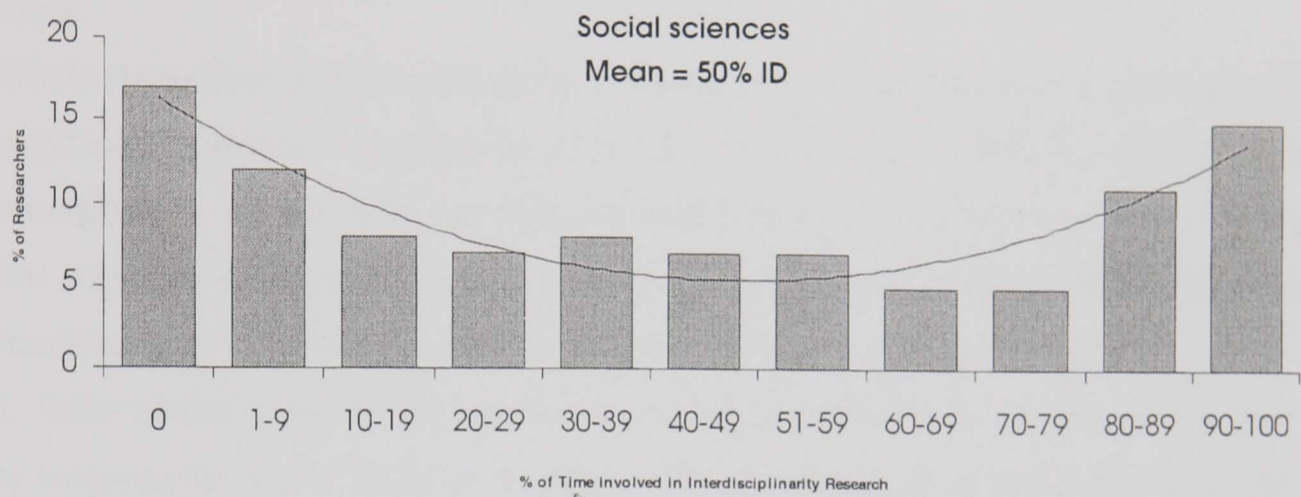
Figure 4. Social Sciences (Evaluation Associates, 1999: 7)
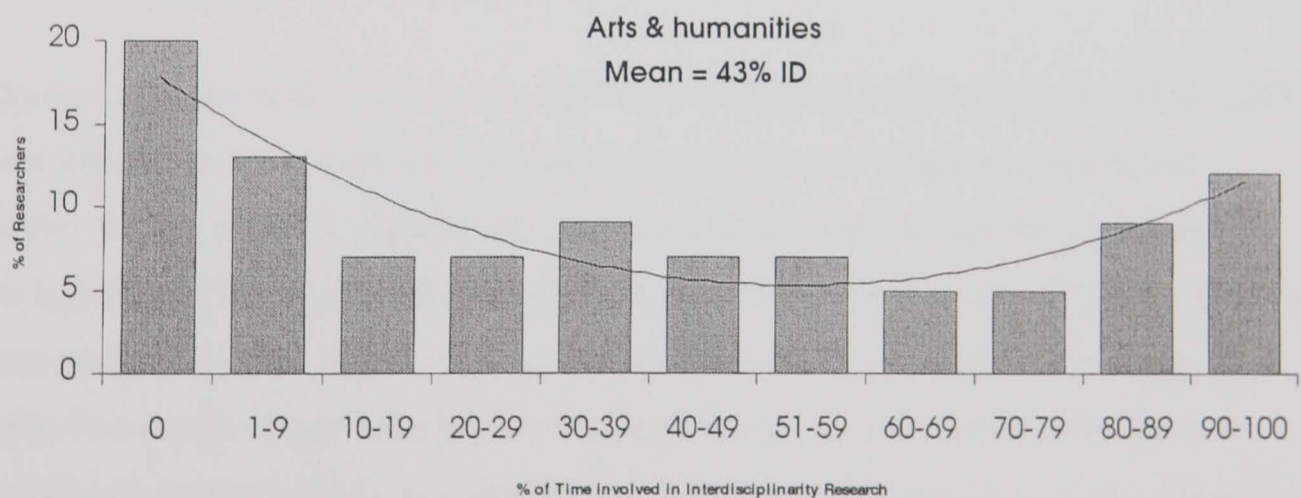
Figure 5. Arts and Humanities (Evaluation Associates, 1999: 7)

The importance of these studies of interdisciplinarity goes beyond the theoretical elements of activities, problems, and frameworks, as up to 70 per cent of researchers experience interdisciplinarity for some period of their academic lives (Evaluation Associates, 1999). Apart from a theoretical definition of interdisciplinarity, the study by Evaluation Associates (1999) offers a contribution towards understanding the type of interdisciplinary activity taking place,

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and to how many researchers the definition of interdisciplinarity potentially applies. The importance of the Evaluation Associates study is in emphasising that at different times researchers will be doing different types of research. A study of information seeking and interdisciplinarity has potentially a wide audience of interested parties.

For the present research the high number of researchers who participate or have participated in interdisciplinary research suggests that the interdisciplinary mode of research is of significant importance within the universities of the United Kingdom. Figures 2, 3, 4 and 5 illustrate this importance and suggest that many researchers are likely to engage in interdisciplinary information seeking behaviour at some point in their careers. Therefore, further investigation of interdisciplinary information seeking behaviour, looking specifically at interdisciplinary topics and issues, will highlight issues of salience for up to 80 per cent of researchers.

Given current practice and changes in technologies and the number of researchers with interdisciplinary experiences as described by Evaluation Associates (1999) studies focused on single disciplines or a comparison of single disciplines may prove inadequate. To study single discipline information seeking behaviour alone could miss significant variations in experience, yet research looking at interdisciplinary information seeking has been the subject of very few studies. Some studies have addressed interdisciplinary research, but in contrast to the large quantity covering the area of information behaviour, information needs and even that relating to models of information seeking behaviour, there are few substantial studies in existence.

2.3 Studies of interdisciplinarity

Early research considering interdisciplinary information seeking includes Mote (1962). Mote was among the first to identify interdisciplinary topics as containing significant differences. Mote's research suggests that in "high scatter fields the number of different subjects is great and the organization of the literature is almost non-existent" (Mote, 1962: 170). The Mote study revealed a higher number of inquiries for scattered (interdisciplinary) as opposed to low scatter (single disciplinary) research fields. In reflecting on the nature of interdisciplinary research fields, as scattered, and with limited organisation of information, Mote acknowledges the problems of interdisciplinary knowledge organisation.

Packer and Soergel (1979) further examined the question of low-scatter and high-scatter research problems. The results verified Mote's 1962 study in the case of chemists and added an appreciation of the difference in information seeking strategies amongst interdisciplinary researchers: particularly they found that different information seeking strategies could be linked with effectiveness in low- and high-scatter fields. The work did not specify in detail the

activities and behaviours but provided the suggestion of difference in the behaviour that *might* be necessary for success in an interdisciplinary area.

The issue of strategies and concepts of difference is a theme occurring from other perspectives, such as that of information providers. Searing, in work on library classification systems, noted that interdisciplinary material "must be squeezed into pre-existing outlays of knowledge that no longer fit the shape of current scholarly output" (Searing, 1992: 9-10). The problem as portrayed here is the degree of fit between existing categories or resources and the information needs of the interdisciplinary researcher.

Other issues arising from reviews of specific areas of information are provided by writers, such as McDermott (1998) and Stoss (1991), who provide a useful insight into some issues surrounding interdisciplinary information seeking and information organisation and concur in a broad sense with the theme that Colson (1988: 20) speaks of when he suggests that a "proliferation of ...[information] ...complicates rather than simplifies the on-line searching environment". Too much information, in the form of 'information overload', also appears as an important issue in the work of Wilson (1996) especially for researchers attempting to master an interdisciplinary field, and particularly lone researchers. The complexity of a topic adds to the issue of information overload, as Klein raises the concept particularly as it relates to use of language and unpredictability in interdisciplinary subjects.

> "Activities may be interconnected in a shifting matrix, replete with feedback loops and unpredictable synergistic relationships" (Klein, 1996: 148-149).

Taking a broader view Bates suggests that many differences for interdisciplinary researchers would arise from three main categories:

> "Scholars are at centre of extensive social and documentary infrastructure; academic fields develop a common vocabulary and research style, establish journals and institutions; and libraries reflect the established disciplines and fields and are developed in scholars own libraries" (Bates, 1996: 156).

These are social and organisational differences or gaps that "could reasonably be expected to have a substantial impact on the conduct of research" (Bates, 1996: 156).

> "It certainly seems to be a reasonable preliminary hypothesis that scholars in interdisciplinary fields may have to engage in both substantially more information seeking – and of a different kind - than scholars in a conventional discipline" (Bates, 1996: 159).

Bates also provides details of some potential sources of difference and possible areas for research.

> "Altogether, the mix of research and library techniques needed by scholars and students in interdisciplinary fields may be unique to such fields" (Bates, 1996: 163).

The themes that Searing, Klein and Bates highlights reflect a view of interdisciplinary researchers working within the context of a single discipline organisational and informational structure.

A study by Bartolo and Smith (1993) used Kuhlthau's Information Search Process model, as described in the next section, to compare the impact of manual and online search methods on

interdisciplinary search tasks. The study looked at two senior journalism classes, one using manual search methods and one using online search methods within the theoretical framework of Kuhlthau's stage model. Specifically Bartolo and Smith sought to address the question of how search method, online or manual, affects the relevance of retrieved items, user effort, user satisfaction, user confidence and future use. Citing Stanley Fish's definition of interdisciplinarity, they consider interdisciplinary work as presenting library users with

> "...challenges different from those of disciplinary research. When researchers from one discipline borrow materials from another discipline, they must borrow intelligently to ensure success of their project. First, users embarking outside their territorial lines must be aware of current developments in other disciplines. Second, this awareness of new developments encourages sensitivity to where different but related disciplines can converge. Finally, in interdisciplinary work the user must identify the appropriate terms and principles to borrow from another discipline....while Kuhlthau contends that all searches undergo some degree of anxiety, those involved with interdisciplinary projects risk experiencing an even greater sense of frustration and anxiety than those involved with disciplinary work. The duality of the interdisciplinary search task – the need to find information and the lack of knowledge of another discipline potentially heightens the level of uncertainty and anxiety for the researcher". (Bartolo and Smith, 1993: 346-347)

The challenges, presented by Bartolo and Smith as fixed points raise questions of how manual or online search methods affect the successful completion of interdisciplinary projects. Results based on analysis of student bibliographies and questionnaires showed manual searching produced slightly more results, but in t-tests to compare the means of the two groups, online searching was shown to be more accurate. Online searching was also seen to be easier, quicker, and providing a little greater confidence. "The study suggests that there is a relationship between superior performance of interdisciplinary researchers using online searching methods and low levels of anxiety" (Bartolo and Smith, 1993: 352).

The Bartolo study's greatest significance to the present doctoral research is in reiterating the basic assumptions about the challenges of interdisciplinary research and in raising questions for further investigation relating to what was it about online searching that offered an opportunity for superior performance, was it related to interdisciplinarity or would the results be the same regardless of disciplinarity?

Westbrook studied Women's Studies information seeking (1999) and identified some areas of interest to understanding something of the context of interdisciplinary information seeking. Westbrook argues that interdisciplinary scholars are confronted with the problem of identifying bibliographic references scattered across many sources with no central defining structure to simplify access (1999: 39). The focus of Westbrook's work puts forward the increased use of electronic communication and electronic resources as an aid in the exchange of scholarly information. The specification of an "ideal information technology" (1999: 60) included portable customisable tools to piece together information and research and the development of "genuinely interdisciplinary electronic information systems" (1999: 150).

Palmer's (1996a, 1996b, 1999) work on interdisciplinarity offers a more detailed approach has explored some of the features of interdisciplinary scientists, addressing some questions related to how researchers find and use information from areas outside their core disciplines. Palmer's study considered the boundary crossing inquiries of 25 humanities scholars and 34 scientists using in-depth interviews during two separate studies (Palmer 1996a; 1999; Palmer and Neumann, 2000; Palmer, 2001). A central tenet of Palmer's research held that an interdisciplinary research topic is necessarily complex and boundary crossing and emphasised the nature of people as members of institutes and networks. In the first study of scientists, Palmer found that "researchers who work across disciplines often have wider topical orientation than those addressing problems from a disciplinary perspective. Clearly, this complicates the research process, and researchers must take steps to manage this complexity" (Palmer. 1996: 166).

Interdisciplinary scientists are fitted into four research modes that illustrate "the different ways that the scientists go at it from all angles..." (Palmer, 1999: 247-248). modes that Palmer sees as emerging from discussions of how they address and investigate research problems.

Research Mode	Team Leader	Collaborator	Generalist	Problem-Oriented
Approach	Managerial	Cooperative	Individualistic	Multi-modal
Information Practices	Gathering	Finding	Probing	Gathering and Probing
Knowledge Strategies	Recruiting	Consulting	Learning	Consulting and Learning
Scope	Breadth	Depth	Breadth	Moderate Breadth and Depth
Outcome	Productive	Productive	Integrative	Productive and Integrative

Table 1. Palmer's Research Roles and Information Practices (Palmer 1999, 248)

The modes referred to particular research roles and highlighted a number of information practices.

> "Finding information has to do with locating specifics, which can range from finding a paper recommended by a colleague to finding out how to apply a new method....Probing is exploratory in nature – searching for the unknown, often in unfamiliar domains"(1999: 248).

Palmer described 'Probing', as similar to, but wider than, the "surveying" activity described by Ellis (1987), "as a way of becoming familiar with the literature in an area" (Palmer, 1999: 249). Palmer's knowledge strategies referred to recruiting, which was described as enlisting experts in a given topic area, consulting, as a practice of seeking information and guidance from colleagues and "building one's own personal knowledge base is achieved by learning" (1999: 248). The scope of research was pinpointed in terms of breadth and depth. The concept of learning was an added dimension suggesting that researchers must expand their knowledge to understand "the history, surrounding context, and the current status of the material" (Palmer, 1996: 176). Outcomes were seen as being either productive or integrative.

In the second study of humanities scholars Palmer and Neumann (1999) identified humanities scholars as needing to develop strategies, for example eclectic reading and active browsing, for extending the scope of their information field. Humanities scholars relied on "push" information sources, such as listserv, reviewing activities, and used many additional resources, such as reference works and textbooks (Palmer and Neumann, 1999: paragraphs. 6,7,8). The information sources and activities identified for scientists also noted the diverse range of informal and formal networks, reliance on intermediaries, personal networks as most important, conferences, volume of material, broad reading, through to footnote chasing and name searching (Palmer, 1996a: 172-173). The main differences between humanities scholars and scientists were summarised by Palmer to consist "document modularity, terminology exchange and collaborative information spaces" (Palmer, 1999, para. 2).

The studies by Palmer offer some indication of the wider context of information seeking behaviour, particularly as regards Ellis's model (1987), though this is not presented in greater depth. However, the identification of interactivity between the processes of finding, gathering, and probing, and changes to information sources used and shifts in problem focus was Palmer's most significant finding.

Palmer and Neumann (2002) continued their investigation of interdisciplinarity in a later study of interdisciplinary humanities scholars. Identifying several processes of interdisciplinary work covering "Extending the intellectual sphere", "Priming for future discovery", "Learning the language of other fields", "Crafting texts for new audiences" (2002: 102-106) Palmer and Neumann defined these into larger categories: Exploration and Translation. Exploration was composed of Extending which built on scanning and receiving, and Priming which was built on retooling, eclectic reading and anchoring. Translation involved Learning, based on consulting, apprenticing and schooling and Crafting which was based on contextualising and converting information. In discussion Palmer and Neuman arrive at the conclusion that there is a "distinct dynamic in the flow and use of information in the humanities" (2002:109).

Collectively the research performed by Palmer and Neumann expands understanding of interdisciplinary processes, but has limitations when considered as an explanation of information seeking.

Elsewhere, interdisciplinary information seeking has been studied from an information retrieval perspective, that is, from the point of view of retrieving information and designing better databases, not that of human information seeking behaviours, or a perspective that would encompass the social and psychological actions involved in seeking information. Studies which approach the area in this manner include those by Walker (1988; 1990) "Searching the humanities: subject overlap and search vocabulary" highlighted some of the issues surrounding the use of interdisciplinary information sources as they pertain to the humanities, particularly as regards the value, both in the relevance of indexed terms and, writing in 1990, the number of

such sources that were available. Walker notes the benefit of searching across databases and disciplines, especially in offering a "widened range of sources" (1990, para 4). In a similar vein, Cory (1999) comments on the difficulty of accessing subjects that do not contain a fixed terminology, such as the humanities, in essence hidden information contained within databases.

A recent study by Spanner (2001) performed a small scale statistical survey of 23 interdisciplinary academics recording details of characteristics of their information seeking. The study highlighted difficulties with vocabularies reported by respondents with an indication (2001: .356) that until scholars had learned some of the terminology their searching was less effective and more time consuming and confirmed that they felt they had to know more information than single discipline scholars. Other issues included difficulty managing the amount of time needed for interdisciplinary research. Resources formed the last major issue, the researchers in Spanners's study found provision of information resources for their interdisciplinary work was low. Spanner also identified methods used, and found browsing citations in journals was ranked as the number one method by half of the sample, followed by "using databases and "personal recommendations" (2001: 355), while browsing was found to be common across faculties. The study was useful as part of the collective view of interdisciplinarity.

Writing from an information retrieval perspective, Weisgerber (1993), presented a report on interdisciplinary searching listing problems and remedies for this group of researchers from a retrieval perspective. The focus of the study was very much on retrieval aspects of interdisciplinary searching rather than the behavioural aspects. The Weisgerber study was useful in highlighting again the problem of "fit", as Searing (1992) had described, when it commented on the coverage and content of technical databases, the textual content, bibliographic information, numeric information, file organisation, and issues connected with searching on multiple hosts.

Walker (1990), and others including Tenopir (1982), Sharma, (1982), Epstein and Angier (1980), Meyer (1983) and Buck and Nicholls (1991), note that the past 20 to 30 years have been a period of exploration and description of the differences between disciplines and the behaviour of scientists and social scientists without a complete picture being created.

The picture of interdisciplinarity that is presented by these studies suggests that it is associated with the need to use a diverse range of strategies including information probing, use of informal and formal networks, broad reading, footnote chasing and name searching, and an equally diverse range of sources including personal networks, conferences, and intermediaries (Palmer, 1996a). This diversity is linked with a higher number of search inquiries (Mote, 1962), and with variations in the success of strategies applied (Packer and Soergel, 1979). In addition there are problems that arise in the form of "fit" within classification and resource structures (Palmer, 1996a; Bates, 1996), overload (Colson, 1988; McDermott, 1998; Stoss, 1991),

complexity (Wilson, 1996; Palmer 1996a; Bartolo and Smith, 1993), and difficulties (Spanner. 2001), all issues which many such as Palmer (1996) would attribute primarily to 'boundary crossing'.

Collectively these studies touch on information seeking issues. some indeed focus upon them, as in Palmer, ultimately, however, none develop into a full model of interdisciplinary information seeking behaviour.

2.4 Studies of information seeking behaviour

The focus of information seeking behaviour research has been the whole human experience at cultural, social, cognitive, affective levels and in terms of processes. strategies, contexts. The volume of research reflects the importance of information behaviour (Ellis. 1993; Klein, 1996; Klein and Newell, 1996; Wilson, 1997) in Information Science and across many other disciplines as illustrated in Wilson's interdisciplinary overview of information behaviour (Wilson, 1997).

A definition of the field is provided by Wilson (2000). He defines information behaviour as

> "the totality of source and channels of information, including both active and passive information seeking, and information use. Thus, it includes face-to-face communication with others, as well as the passive reception of information as in, for example, watching TV, advertisements, without any intention to act on the information given". (Wilson, 2000: 1)

while Information Seeking Behaviour was defined as

> "the purposive seeking for information as a consequence of a need to satisfy some goal. In the course of seeking the individual may interact with manual systems or with computer based systems". (Wilson, 2000: 1)

and Information Searching Behaviour as

> "the 'micro' level of behaviour employed by the searcher in interacting with information systems if all kinds. It consists of all the interaction with the system, whether at the human computer interaction or the intellectual level". (Wilson, 2000: 1)

The literature of information seeking behaviour involves the results of research examining what goes on between identification of information need and completion of a topic. Vakkari (1998) provided a succinct definition of information seeking behaviour as "a process of searching, obtaining and using information for a purpose" (Vakkari, 1998: 35). Information seeking behaviour was defined by Krikelas as

> "....any activity of an individual that is undertaken to identify a message that satisfies a perceived need. In other words, information seeking begins when someone perceives that the current state of possessed knowledge is less than that needed to deal with some issue [or problem]'" (Krikelas, 1983: 6-7).

Information behaviour appears as the broadest level and Information Searching the most focused.

Information seeking and the nature of the processes of which it is composed have captured the attention of many researchers, most prominently in the models developed by Ellis (1987) and Kuhlthau (1991) and the information retrieval work of Ingwersen and Saracevic (Ingwersen, 1996; Saracevic et al., 1988; Saracevic and Kzinto, 1988). Each has come to the problem of information seeking or information searching from a different starting perspective and has created his or her own framework for understanding retrieval or information seeking behaviour patterns. These are considered as part of a larger conceptual model of information behaviour by Wilson (1997; 1999).

Although the size of the literature suggests at first sight that the area of information behaviour has been mapped and explored several times over, it is instead an area that has evolved to incorporate more than the act of searching, so that it now includes thoughts, feelings and uncertainty (Kuhlthau, 1993), cognitive style and individual differences (Wilson, Ellis, Ford and Foster, 1999), context (Vakkari, 1998; Sonnenwald, 1999; Introna, 1999) and discipline (Ellis, 1987; Ellis, Cox and Hall, 1993).

The literature of the last thirty years is composed of studies that have identified information seeking on several levels. These levels appear as activities in which specific tasks and activities are described; studies of information need and information source use within particular groups; studies that have identified cognitive or affective aspects of information seekers; theoretical and descriptive general models of either information searching, information seeking or information behaviour.

The last category, models, presents a suitable focus to gain an appreciation of the extent to which information seeking behaviour has been described and explored. However, the extent of the literature disguises the fact that the study of information behaviour has produced relatively few general models applied to information behaviour, and within this even fewer that have examined information seeking behaviour. The literature referring to models, or suggesting frameworks for information seeking behaviour has remained small, and that body of literature referring to interdisciplinary researchers is considerably smaller still. Some contexts of information seeking are incompletely considered in the research literature. The context of interdisciplinary information seeking is one such area that has been covered in a limited sense in previous research.

In the broader literature, single discipline information seeking behaviour appears dominant, especially within the more developed models. Developed models, models that are tested and applied in multiple studies, include Ellis's behavioural model of information searching strategies (Ellis, 1989; Ellis, Cox and Hall, 1993); Kuhlthau's (Kuhlthau, 1991) model of the stages of information-seeking behaviour; and at a theoretical level of information

behaviour Wilson's (Wilson, 1997) expansion of his earlier model (Wilson. 1981). In each of these models information seeking behaviour has been represented in models based upon the conception of information seeking as a process in which information needs are met and in which problems solving takes place.

There are a number of excellent reviews of the literature of this area. Each naturally has a different purpose, but the overviews contribute significantly to the synthesis of a view of the field. Valuable reviews in general include Wilson (1999), a review by Beaulieu (2000). an early review by Wilson, Streatfield and Wersig (1982) and a review by Westbrook (1993) that attempted a non-empirical synthesis of models into a five stage model composed of Needing. Starting, Working, Deciding and Closing. In the following sections some of the key contributions to the fields of information seeking, information searching and information behaviour are briefly reviewed to provide a context for the present research.

2.4.1 Kuhlthau's Information Search Process

Kuhlthau's model of the information seeking process incorporates information need. cognitive and affective variables, and information behaviours, in one coherent view of the Information Search Process (Kuhlthau and Turock, 1988; Kuhlthau, 1988a; Kuhlthau, 1988b; Kuhlthau, 1988c; Kuhlthau, 1989a; Kuhlthau, 1989b; Kuhlthau, 1989c; Kuhlthau. Turock, George and Belvin, 1990; 1991; Kuhlthau and Cool, 1992a; Kuhlthau and Cool, 1992b; Kuhlthau, 1993). Kuhlthau's research was based on a grounded theory approach but with a theoretical background informed by the frameworks of Belkin (1980) and Kelly's Personal Construct Theory (1963).

Kuhlthau's research suggests that library users, as a sample of information seekers, continue to collect and seek information throughout their information-seeking process, using or requiring different types of information. conducting different types of searches, and using different search terms and strategies at different stages of an information seeking process (Kuhlthau and Cool, 1992a).

> "The studies revealed common patterns in the users' experience in the information search process that may be described in a series of phases or stages: initiation, selection, exploration, formulation, collection and presentation. Each stage represents the task considered most appropriate to move the process on to the subsequent stage" (Kuhlthau, 1993a: 342).

The model incorporates a longitudinal view of the search process and identifies six evolving stages: Initiation, Selection, Exploration, Formulation, Collection, and Presentation, each of which was related to cognitive and affective states, and to the search activities of the users. The incorporation of cognitive and affective states adds another dimension to the model as illustrated in Table 2.

Tasks	Initiation	Selection	Exploration	Formulation	Collection	Presentation
Feelings (affective)	Uncertainty	Optimism	Confusion, Clarity, Frustration, Doubt	Clarity	Sense of Direction, Confidence	Satisfaction or Disappointment
Thoughts (cognitive)	Vague	Vague	Vague	Vague/Focused Increased Interest		
Actions (physical)	Seeking relevant information Exploring			Seeking pertinent information Documenting		

Table 2. The Kuhlthau Model (adapted from Kuhlthau, 1993: 343)

Reading the model, stages of an information seeking project appear across the top from left to right with related feelings thoughts and actions shown as occurring at each stage. As Kuhlthau described (1993a, 342)

> "The model of the information search process incorporates three realms of human experience: the affective (feelings), the cognitive (thoughts) and the physical (actions) within each stage...."

The model stresses the process of moving from identification of an information need through a series of cognitive, affective and physical processes that work towards satisfaction of information need and ultimately the resolution of uncertainty with understanding. Kuhlthau suggested that the model is only "an approximation of common experiences" (1991: 370) though the theme of stages is strong throughout the descriptions of the model. Kuhlthau described the stages as 1) initiation - "when a person becomes aware of lack of knowledge, information and understanding"; 2) selection - "when the task is to identify and select the general area or topic to be investigated"; 3) exploration - "the task is to investigate information on the general problem in order to extend personal understanding"; 4) formulation - "to form a focus from the information encountered in exploration"; 5) collection - "to gather information pertinent to the focused problem"; and 6) Presentation - "to complete the search and resolve the problem" (Kuhlthau, 1993: 339-355).

2.4.2 Ellis's Behavioural Model

Ellis's Behavioural Model (Ellis, 1987; Ellis 1989; Ellis, Cox and Hall, 1993; Ellis and Haugan, 1997) originally developed with reference to the Social Sciences was expanded through further research to cover physicists, research chemists and in its latest application industrial engineers and research scientists. The focus, in contrast to that of Kuhlthau's model, was on the information searching activities themselves.

The Ellis model defines the information seeking activities characteristic of researchers in the fields studied. Based on a grounded theory approach, Ellis's model defines the following characteristics of information seeking behaviour without typifying these as stages: Starting,

Chaining, Browsing, Differentiating, Monitoring, Extracting, Verifying, and Ending. Indeed it is possible to consider Ellis's thesis on a close reading as representing possible activities from which information seekers may use all or any combination.

Ellis described the activities (Ellis Cox and Hall, 1993, 361; Ellis and Haugan, 1997: 395-400) as Starting, which includes the activities; Chaining, typically following chains of citations or other forms of referential connection between material; Browsing, semi-directed searching in an area of potential interest; Differentiating, using differences between sources as filters on the nature and quality of the material examined; Monitoring, maintaining awareness of developments in a field through the monitoring of particular sources; Extracting, systematically working through a particular source to locate materials of interest; Verifying, activities associated with checking the accuracy of information and Ending, activities characteristic of information seeking at the end of a topic or project. Verifying and Ending were added to the model as part of the later study of physical scientists. These activities were found to be the same across social science and physical sciences in both academic and industrial contexts. A later study provided for a variation of the model with eight categories: (1) Surveying; (2) Chaining; (3) Monitoring; (4) Browsing; (5) Distinguishing; (6) Filtering; (7) Extracting; and (8) Ending. Within this extended pattern Verifying was considered a "sub-aspect of chaining" ((Ellis and Haugan, 1997: 396). The inter-relation of activities such as Browsing, Monitoring and Surveying was throughout emphasised further in this development of the model. Differentiating developed into Distinguishing and Filtering. Distinguishing was described as activities of ranking "according to their relative importance based on the respondents' own perceptions" (1997: 399). Filtering was the application of criteria to "make the information as relevant and precise as possible" (1997: 399).

Ellis's model is described in several works and specifies each element to a deeper extent than the 1987 version of the model would suggest. Some of the associated needs, activities and position of characteristics are given in Table 3 below, which provides an abstract of significant points from the various descriptions of the model found in the literature. Of these details it is noteworthy that Chaining and Starting are closely associated and that Starting is associated with networking as well as starter references. Informal networks also contribute to Monitoring.

Ellis Model Characteristic	Associated needs, activities, comments
Starting	Embryonic, something to be added to with passage of time; Starter references; Networking; Reviews; Previous knowledge; Secondary Services; Files of useful references; Library Catalogue.
Chaining	"Starting can change almost immediately to chaining" (Ellis, 1987: 83); Backward chaining of references; Source Identification as possible side effect; Forward chaining of citations.
Browsing	Current Awareness; Semi directed scanning of current sets; Familiarisation; Source Identification (1987: 94); Differentiating.
Differentiating	Source selection
Monitoring	A continuous process based on some knowledge; Journals and other sources; Informal contacts
Extracting	Close relationship between monitoring and extracting; Extracting from a particular source.
Verifying	
Ending	

Table 3. Ellis's Behavioural Model (Extracts from Ellis 1987; 1989; 1993)

The presentation of the behaviours in Ellis's model suggest a degree of connectivity and inter-relatedness, clearly following a framework consistent with a beginning and with an end. Ellis in no way suggests that these are a series of stages. However, the intervening position appears less rigid than in the Kuhlthau interpretation. This may be to do with the focus of the Ellis model, the search episode level, rather than the higher level Information Behaviour or Information Seeking level in which a bigger picture is envisaged.

The relation between the Kuhlthau and Ellis models has been the subject of some comment by Wilson (1999: 262), who suggests that the stage process of the Kuhlthau model may be viewed as closely related to the Ellis model characteristics. Hence, in this view, the activities of Chaining and Monitoring are seen as a deeper specification of Kuhlthau's "Collection" stage. Wilson's (1999) view places the Ellis and Kuhlthau models in a symbiotic, rather than competitive, relationship.

The difficulty of accepting the Wilson viewpoint of a "deeper specification" comes if one takes Ellis's interpretation of his data as a set of characteristics which implied no significant chronological sequencing. In contrast to this the Kuhlthau model takes a view of stages drawn from work on the problem solving process. Of all differences the stage aspect appears strongest in the comparison of Ellis and Kuhlthau, even accepting the different representations claimed for the models.

The principles in the general models of Kuhlthau and Ellis are validated in the case of single discipline researchers through multiple follow-up studies. Nevertheless, the original

studies and subsequent verifications and expansions of the models have a common feature: they consider only single discipline researchers or comparisons of separate disciplines. For example, Ellis (1993) in "A comparison of the information seeking patterns of researchers in the Physical and Social Sciences" looked not at multidisciplinary research topics but at a comparison of different *single* discipline researchers.

The themes or characteristics described by the Kuhlthau and Ellis studies suggest that it would be possible to examine interdisciplinarity in the light of these models and either validate them in the context of interdisciplinary information seeking behaviour or contribute to a further understanding of information seeking behaviour.

2.4.3 Other studies of information seeking behaviour

Other studies that approach a framework for understanding information seeking behaviour, offer further conceptual understanding of particular activities or a selected few behaviours, but when considered in full offer a much too general or broad overview of information behaviour as a whole, lack follow-up studies to validate their findings or offer limited details, each of which limit their value in any comparative study of single and interdisciplinary information seeking behaviour. Yet, the conceptualisation of information seeking behaviour and the frameworks put forward in such works do permit consideration of different aspects of information seeking behaviour and possible approaches to further research.

2.4.3.1 Krikelas

Early conceptual work (Krikelas, 1983) developed the idea of stages. Krikelas described information seeking and information gathering as being a stage process driven by information need. In Krikelas's framework the starting point of a perceived need is followed by a series of activities pursued to satisfy that need, and ends with change of perception, that the information need no longer exists.
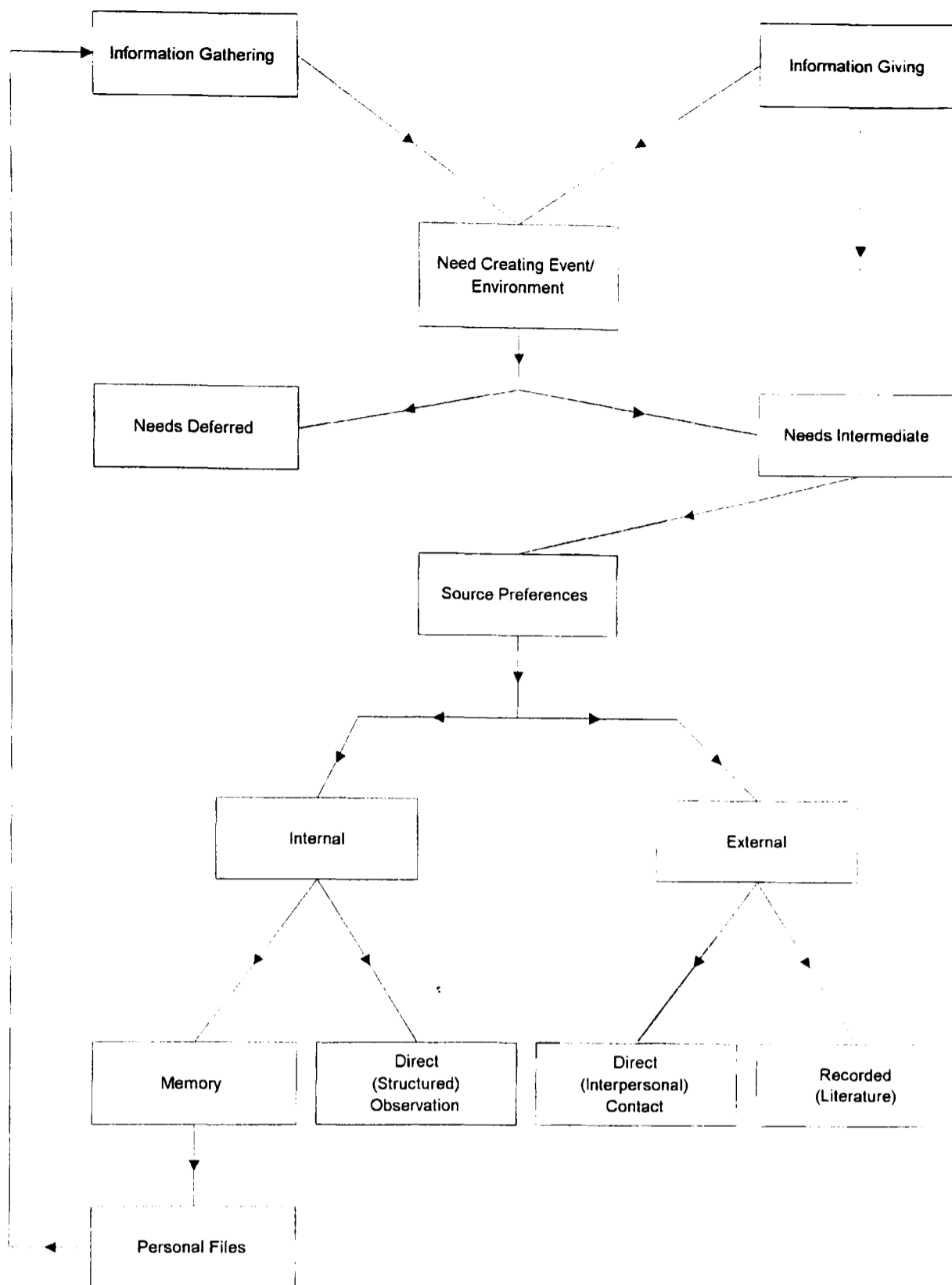
Figure 6. The Krikelas Model of Information Seeking Behaviour (Krikelas, 1983: 17)

2.4.3.2 Bates "Berrypicking Model"

Empirical studies resulting in models of information seeking and information retrieval are the central theme of this literature review. There are however studies that have conceptualised processes from a theoretical perspective and yet have significance in the field of Information Science. Bates' Berrypicking Model is one such key example (Bates 1986; 1989).

Bates reviewed classical retrieval models in which a query is formed and remains static throughout information retrieval and saw these lacking. Bates suggested instead that in "real life" searches in manual sources that

"end users may begin with just one feature of a broader topic, or just one relevant reference, and move through a variety of sources....At each stage they are not just modifying the search terms used in order to get a better match for a single query. Rather the query itself (as well as the search terms used) is continually shifting in part or whole. This type of search is here called an evolving search" (1989: 409-410).

The model represented a leap forward in conceptual thinking and reflected an interpretation of real life information retrieval. It still contains a conception of information seeking and searching as a serial chain of events, though it allows for inputs and diversions throughout searching.

"The focus of the model...is the sequence of searcher behaviours. The continuity represented by the line of the arrow is the continuity of a single human being moving through many actions toward a general goal of satisfactory completion of research related to an information need" (1989: 410).

However, the model has sufficient flexibility as illustrated in Figure 7 to allow the conceptualisation of information retrieval as a flexible process in which serendipity and browsing are important, and that search processes are cumulative and constantly changing (Bates 1986; 1989).
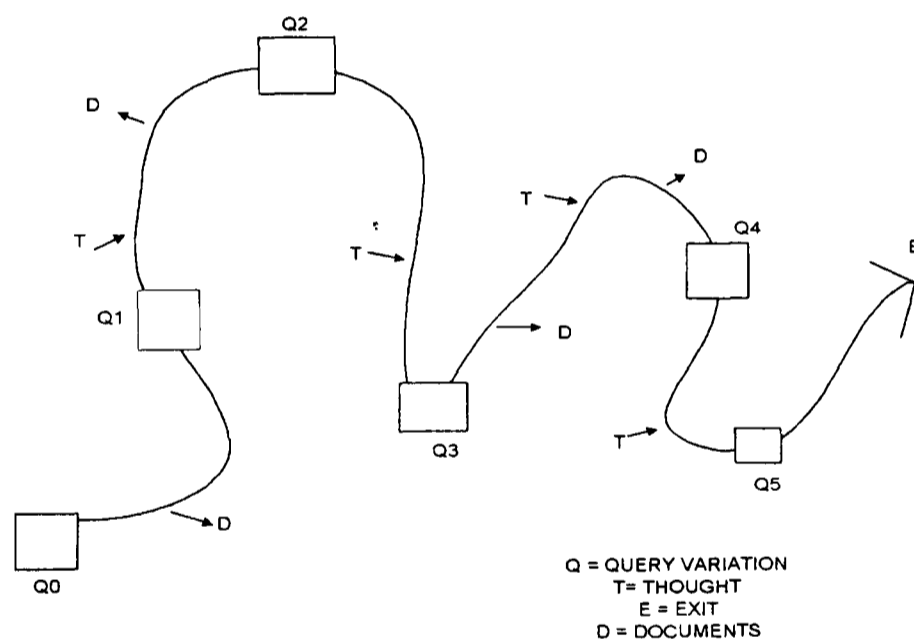
Figure 7. The Bates Berry Picking Model of Information Retrieval (Bates, 1989)

Key implications of this model are the presentation of information searching as containing an evolving query and that a berrypicking pattern should be considered instead of the traditional single best retrieved set. The model has no empirical basis, but extensive citations of previous literature are used to support the claim that footnote chasing, citation searching, journal runs, area scanning, subject searching and author searching were key elements of berrypicking. It should be noted that browsing and berrypicking are not seen as synonymous (1989: 415).

2.4.3.3 Ingwersen

Ingwersen (1996) as an information retrieval researcher contributes to the frameworks available to understand information seeking behaviour through the development of a Cognitive Information Retrieval (IR) model. The model attempts to place the user within a framework of contexts and cognitive models of the search environment. Ingwersen "seeks to represent the current user's information need, problem and knowledge states and domain work task or interest in the form of contextual structures of causality" (1996: 4). The empirical background is described in earlier work (Ingwersen, 1992; Ingwersen and Wormell. 1986).
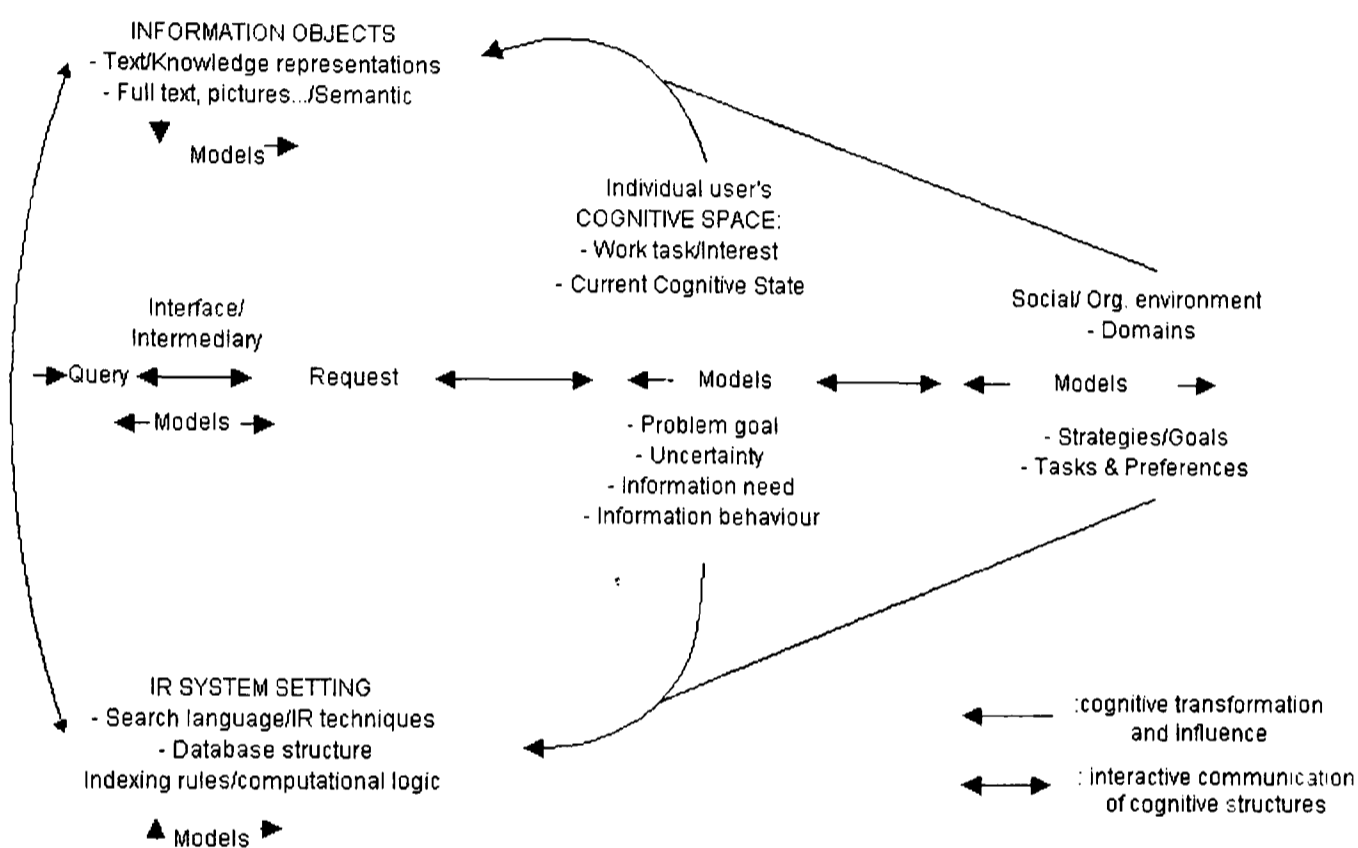
Figure 8. Ingwersen's Cognitive IR Model (1996: 9)

Within this model an individual user's Cognitive space exists at the centre of groups of Information Objects, which include the text, knowledge, full text, pictures and models and the user's model of them, the information retrieval system setting which is composed of search language, information retrieval techniques, database structure, indexing rules and computational logic. All of these features exist within the social and organisational environment, consisting of domains, strategies, goals, tasks and preferences.

Ingwersen describes a complex cognitive framework that underpins the cognitive interaction information retrieval model. The most important feature of the model for the purposes of the present research is the presence of cognitive models. As Ingwersen describes:

"The cognitive point of view in Information Science implies that each act of information processing - whether perceptual or symbolic - is mediated by a system of categories which, for the information processing device constitute a world model" (1996: 5).

World models represent the information searcher's understanding of the information problem and the information seeking process. There are potential parallels with understanding the behaviours of information seekers.

The model suggests a comprehensive approach to modelling information searching, yet as Wilson (1999: 260) notes, the model has a fundamental weakness in subsuming the whole of information behaviour under the heading 'users's cognitive space', thus reducing its value for information behaviour research. With this limitation in mind the model may still offer some contribution to place the present research in perspective.

2.4.3.4 Leckie and Pettigrew

Models of different contexts of information seeking behaviour also offer an insight into variations of that behaviour and approaches to understanding it. Hence the work of Leckie and Pettigrew (1996; 1997) in a study of engineers, health care professionals and lawyers described a model of information seeking applicable to all professionals, as opposed to the models of academic scholars or students put forward by Ellis (Ellis 1987, 1989) and Kuhlthau (1993). The model was based on analysis and interpretation of empirical studies of the information habits and practices of the three professions resulting in a six component model based on a description of work roles, associated tasks, characteristics of information needs, awareness, sources, and outcomes. The synthesis provides little of specific value to the study of information seeking behaviour and as a model is largely indicative of possible relationships rather than specifying a precise model. The single most interesting feature is the notion of a "feedback loop" in which information seeking and outcome are described as multidimensional events composed of feedback and refinement, much as successive searches might be perceived in the work of Spink (Spink, 1999) and reiterative cycles appear in the Ellis model (Ellis, 1987, 1989). Additionally the model highlights a role for *awareness of information* as a part of information seeking behaviour by explicitly placing this within the model's feedback loop.
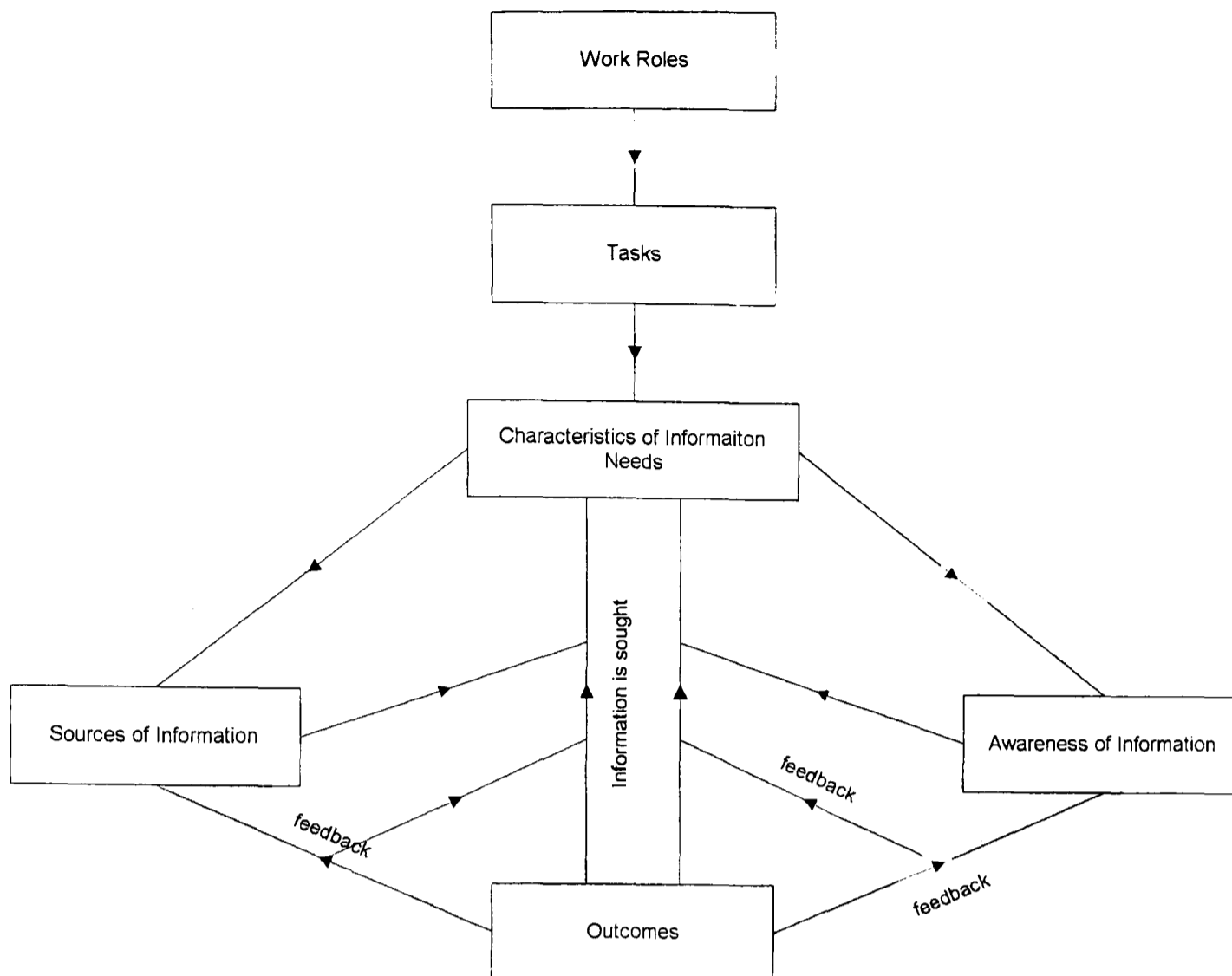
Figure 9. Information Seeking of Professionals (Leckie and Pettigrew, 1996: 196-187)

2.4.3.5 Dervin

Dervin (Dervin, 1983; 1997) took a more general and methodologically novel "sense-making" approach to the study of information seeking behaviour. The Dervin model goes beyond information seeking to become a representation of a methodology and a theoretical approach to research. The core features as applied to information problems are defined as a "situation" within which an information problem arises, which relates to a "gap", an "outcome" or result of activities which themselves are contained in the concept of a "bridge", which may include information seeking activities. Though providing a further general model of information seeking behaviour the low level of detail presented in the model reduces its value in interpreting the information seeking behaviour of interdisciplinary researchers.

2.4.3.6 Marchionini

Marchionini (1995) considered the process of information seeking within the online search environment and made the distinction between his work and that of information retrieval researchers on the basis of looking at the "process in which humans purposefully engage in order to change their state of knowledge" (Marchionini, 1995: 5). For Marchionini, a synthesis

of models of information seeking factors took into account the information seeker, the task, the search system, the domain, the setting and search outcomes. These factors appear within a stage model replete with reiterative loops based on stages labelled as "Define Problem", "Select Source", "Formulate Query", "Execute Query", "Examine Results", "Extract Information", "Reflect Stop".

The model on the one hand offers little beyond those presented by Kuhlthau, Ellis in terms of defining activities, strategies and their relationships, but on the other hand, Marchionini's suggestion that 'transitions' from one stage to another are either "analytical" or "browsing" (1995: 73) is of value in highlighting approaches to searching. Browsing strategies for Marchionini were opportunistic, data driven, heuristic, informal and continuous, as opposed to analytical strategies that were planned, goal driven, deterministic, formal and discrete. Marchionini's conception of browsing is especially worthy of note as he viewed browsing as part of "get[ing] to know an intellectual neighbourhood" in interdisciplinary information seeking (Marchionini, 1995: 73). By implication this suggests that interdisciplinary information seeking relies upon the characteristics of browsing, defined by Marchionini in Table 4 below.

Analytical	Browsing
Planned	Opportunistic
Goal driven	Data driven
Deterministic.	Heuristic
Formal	Informal
Discrete	Continuous

Table 4. Marchionini: Searching as Analytical or Browsing (Marchionini, 1995: 73)

2.4.3.7 Brown

Brown (1991) proposed a general model of information seeking behaviour based on a review of the literature and incorporated the concepts of 'condition', 'context' and 'process' to create a view of information behaviour as a

> "cyclic flow not only through the conditions to the process and back to the conditions, but outward from the self through the role to the environment and back....these flows are like the gases of the sun: a body moving at various speeds on its own surface. Information seeking is a dynamic mechanism of dynamic flows" (Brown, 1991: 11).

However, the Brown model merely provides a synthesis of some original models and fails to provide an information seeking behaviour model of sufficient detail to be considered comparatively. The idea of a cyclic flow becomes a common theme in many such models and

empirical studies both as representations of the process itself and of the place of information seeking within a larger view of information behaviour.

2.4.3.8 Spink

Spink modelled the search process at the information retrieval level, similar to Kuhlthau's information search process model in which search strategies move forward through continuing cycles over time and applying in this movement changes or shifts in search tactics which themselves rely on user judgements. The Spink framework permits understanding "information retrieval in an information seeking context" and allows for a "Plane of Judgement with a Plane of Interaction within a Plane of Time" (Spink, 1999: 21). The plane of time was related to Kuhlthau's conception of time in terms of a stage within a search and also to "time within a search episode ...[and]... number of successive searches over time" (Spink, 1999:28). Spink (1999: 32) acknowledges the limitations of the conceptual framework as "the model is ... specifically related to the IR context, not information-seeking in general" and is suggested to be a framework useful in further research. The framework suggested by Spink's work serves the present research in highlighting the necessity to view information seeking behaviour as an activity existing in *time as a context* for understanding information seeking behaviour or information retrieval and in its appreciation of different activities taking place over time in the process Spink refers to as "successive searching" (1999:28).

2.4.3.9 Wilson

The models described above contribute to a general understanding of different components of information seeking behaviour and provide frameworks for consideration of further issues. The most inclusive overview of information behaviour, which in Wilson's own definition includes information seeking and information searching, developed by Wilson (1981; 1997; 1999) provides a broader and more comprehensive view of the whole of what "information behaviour" is and how information seeking behaviour, situation and context might be conceived as fitting together.
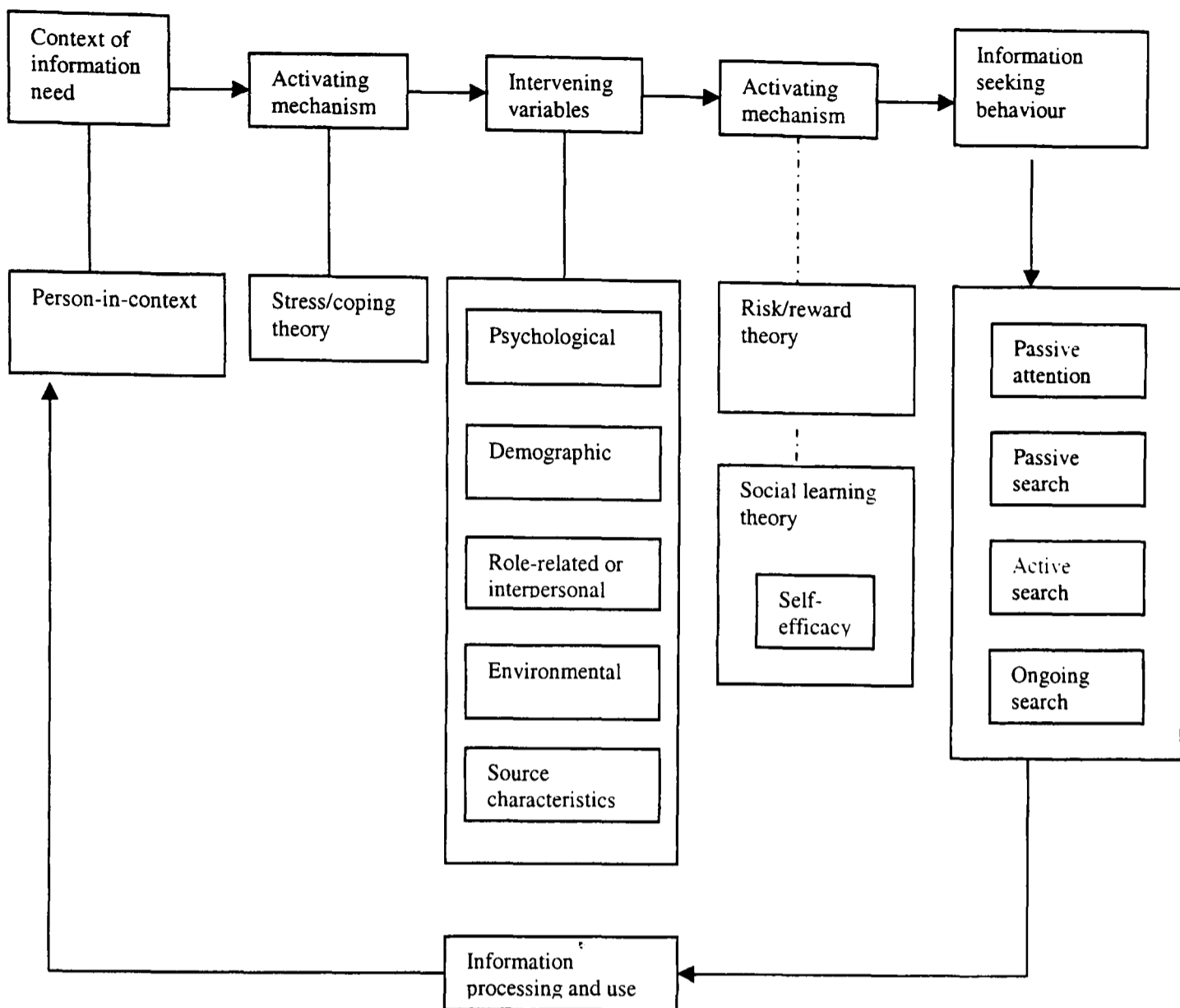
Figure 10. Wilson's Information Behaviour Model (1999)

Wilson's (1999) model (Figure 10) covers a greater whole and categorises information seeking behaviour as but one part of a whole called "information behaviour". For Wilson information seeking behaviour may be passive attention, passive search, active search or ongoing search, whereas Ellis and Kuhlthau focused on active searching. The whole framework of Wilson's model suggests that psychological, demographic, environmental, and source, are aspects of "intervening variables", and that these work with the "activating mechanisms" of stress/coping theory, self-efficacy, and risk/reward theory, each of which contributes to a larger view of information behaviour. Wilson's framework contributes a perspective of information behaviour in terms of mechanisms and components. The Wilson model servers the present research as a reminder of the importance of intervening variables in describing information behaviour.

2.5 Discussion

The existence of preliminary work on interdisciplinarity highlights the questions raised by Bates (1996), in the section above "Studies of Interdisciplinarity", and raises more questions that should be considered and have yet to be explored and indeed compared with mainstream generic models of the information seeking behaviour.

Existing studies of interdisciplinarity have not achieved the clarity of the single discipline models of information seeking behaviour of theorists such as Ellis, Kuhlthau, Wilson, Saracevic and Spink and others and have left some questions to be addressed. Each model has focused on a different goal, Ellis on identifying search behaviour characteristics, Kuhlthau on identifying the information search process, Wilson in building an overview of information behaviour and Spink in building a framework for understanding successive searches.

These models provide an opportunity to consider many features of human information behaviour. Characteristics of behaviours are well defined in a wide range of contexts and user groups. However, collectively existing research presents only a partial image of information seeking behaviour, and an even smaller coverage of interdisciplinary information seeking behaviour. Neither implicitly, nor explicitly does there exist in the current literature more than a part-formed image of information seeking behaviour in interdisciplinary research topics.

The core questions raised by Bates (1996: 157-160) remain to be answered:

> "Could it thus be the case that a researcher in an interdisciplinary field could have ten times as many problems with the process of gathering information as people in conventional disciplinary fields?.... Are there differences between interdisciplinary fields and conventional disciplines in the information needs and information seeking behaviour of their member scholars?....Or do compensatory mechanisms develop, mechanisms unique to interdisciplinary research, that make the scholar's tasks no more difficult than that of scholars in conventional fields?"

These questions are joined by others in this study that relate specifically to the identification of particular problems and strategies of information seeking related specifically to interdisciplinarity; to the identification of a model of interdisciplinary information seeking, and how such a model would compare with single discipline models.

The importance of these are questions are clear in the present context of increased interdisciplinary activity in universities and industry, and the continued development of electronic information resources. Additional support for further investigation arose during personal communications with Ellis (February 1999) who indicated that interdisciplinary researchers, though present in his studies at the earliest stages, were excluded from the theoretical sampling as beyond the focus of his earlier research. The concept of difference was found by the present researcher through many informal discussion with academics and information professionals in another context (Wilson, Ford, Ellis and Foster, 1999).

2.6 Aims

The aims of this study are to define interdisciplinarity; to develop an understanding of interdisciplinary information seeking behaviour, from within the faculties of arts and humanities, social science, science, engineering, and medicine; to develop a model of interdisciplinary information seeking behaviour; and to compare that model with single discipline models existing in the literature.

2.7 Research questions

1. What are the activities, strategies, contexts and behaviours used and perceived to be used by interdisciplinary information seekers?

2. What is the relationship of the processes, contexts and behaviours as part of interdisciplinary information behaviour?

3. How can the information-seeking behaviour of interdisciplinary researchers be represented in an empirically grounded, theoretical model?

These research questions are addressed throughout the remaining chapters of this thesis.

3 Methodology

3.1 Introduction

Information seeking behaviour as a manifestation of human actions and reactions has the potential for study from a number of methodological perspectives. This study initially adopted a pluralist approach. However, the pilot study results, and the nature of the population, suggested the necessity of revising the methodology to adopt a naturalistic inquiry approach to achieve the aims of the study.

This chapter initially explores the logic of the approach taken in the pilot study and details shifts between modes and perspectives following the pilot study for the main study. Population and sampling are described and issues trustworthiness are addressed.

3.2 Theoretical paradigms

The methods used in any study are the top level, visible components, which are rooted in an underlying layer of theoretical paradigms which contain sets of assumptions and conceptual understandings about the "world" and the way in which the world might therefore be studied. From the basis of the theoretical paradigm adopted many features such as appropriate methods of data collection and analysis, the questions to be asked, sampling and questions of validity, credibility and reliability arise. The model of paradigms described by Burrell and Morgan (1979) provide a useful conceptualisation of the "meta-theoretical assumptions about the nature of social science and the nature of society" (Burrell and Morgan, 1979: viii) and, as Taylor and Bogdan summarise, the importance of the theoretical paradigm itself is in illustrating that "when stripped to their essentials debates over methodology are debates over assumptions and purposes, over theory and perspective" (Taylor and Bogdan, 1998:3).

The model of theoretical paradigms as Burrell and Morgan present it, consists of four levels. First the *ontological*, that is the view of the world as either something objective and concrete or subjective and variable depending on the observer's or participant's position in reality (Burrell and Morgan, 1979: 1). Secondly, the *epistemological* level in which the nature of what knowledge itself means and what form knowledge about the world might take. A third level considers *human nature* and the extent to which humans shape their environment or are a product of circumstance, that is voluntarism versus determinism. The fourth level is the *methodological*, the choice of methods that is based upon the product of all of the assumptions

belonging to the first three theoretical levels (Burrell and Morgan, 1979: 1-5). Burrell and Morgan, as shown in Table 2., state that all studies are a composite of these four paradigmatic assumptions that in their extremes represent the following:

Subjective	← Level →	Objective
Nominalism	← Ontology →	Realism
Anti-positivism	← Epistemology →	Positivism
Voluntarism	← Human Nature →	Determinism
Ideographic	← Methodology →	Nomethetic

Table 5. Burrell and Morgan's Theoretical Paradigm (1979:3)

The polarisation present in the theoretical paradigms, represented by the subjective-objective categories, highlights the debate over methodological validity: the compatibility of subjective and objective approaches. Theoretical approaches have developed particular "schools of thought" representing various mixes of the subjective-objective attributes. Burrell and Morgan highlighted functionalist, radical humanist, radical structuralist, and interpretative; while Olaisen (1991) describe empirical, materialistic action and clarified subjectivity. Guba and Lincoln (1994) suggest four paradigms: positivism, post-positivism, critical theory and constructivism, while Orlikowski and Baroudi (1991) describe positivist, interpretative and critical positions at an epistemological level.

Such views of the philosophical and theoretical debate present a picture of extremes in which objectivity and subjectivity are so far removed from each other at every level that integration of methodologies or pluralist approaches are impossible and inappropriate. The paradigms, and particularly Burrell and Morgan's, highlight the complexities of theory and many interpretations of the social world at a philosophical level. The existence of contrasting and competing understandings of reality, human nature, and the nature of knowledge have in very real terms affected the way in which research in the Social Sciences has developed.

Although there are many sub-definitions and further sets of assumptions the focus here is on the positions that were important in shaping the research design of this thesis.

The positivist approach assumes an objective reality which transcends individual perceptions while at the same time implying that the objective world is therefore capable of measurement and producing statistical measures indicative of that objective reality. This represents a theme originally described in the Social Sciences by Durkheim (1982) who sought facts and scientific method. The view may be expressed as believing that "there are only

regularities, successions of phenomena which can be systematically represented in the universal laws of scientific theory" (Keat and Urry, 1982: 4). The positivist, objective view creates "an epistemology which seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements" (Burrell and Morgan, 1979: 5). Hirschheim (1992: 36) summarised positivism as composed of accepted scientific method, reductionist in its aim to identify cause and effect in human relationships, a belief in empiricism, that is that valid data must be objective, value free, mathematical and logical. When researchers speak of 'being scientific' or using 'scientific method' within the Social Sciences the strengths they hope to gain are those of validity, reliability, and repeatability claimed by scientists. These principles are worthwhile. They transformed social science studies from opinion oriented diaries and logs into much more rigorous framework of analytical data collection, data recording and data processing and data presentation.

The scientific method of Durkheim has dominated much research within the Social Sciences. The study of social phenomena with scientific methods and principles and the aim to make the study of human culture into a science consumed much of nineteenth century and twentieth century epistemological debate. A more recent, and one might say ontologically opposing, twentieth century development was the growth of interpretivism.

In contrast, the interpretivist approach assumes reality to be subjective and best seen through the eyes of the subject. Downes and Rock describe the position of the interpretivist, or interactionist as it is sometimes described, as follows:

> "The interactionist takes his job to be the documentation of the social worlds that constitute society. He methodologically plots the connections between communication, meaning, symbolism and action. He would claim that there is little profit in imposing alien interpretative schemes on a world: people do not build their lives on the logic of Sociology or the sensibilities of foreign groups. They have their own methods of doing things". (Downes and Rock, 1986: 143)

The interactionist point of view, sometimes appearing as 'anti-positivism', arose as a philosophical challenge to the idea that the human or social world could be reduced to causal relationships and mathematical expressions described in positivism. There are many questions and issues that such an approach raises when applied to the study of human behaviour. Most significant are questions that ask how appropriate and truly informative quantitative studies really are when the area being researched is of novel content, is of new uncharted areas, and how are questions identified as important? How are data analysed to as to highlight important issues? Quantitative studies have a role to play in confirming an established and measurable framework, but interpretivists would hesitate to use them for exploration of new and unexplored contexts.

Interpretivist methods have their origins in ethnography and field study from the sociological and anthropological traditions. The aim of the approach is to gain understanding of humans in context and as far as possible from their own perspective and to understand the

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meanings underlying their processes and interactions (Blumer, 1969: 539). Therefore interpretivist methods permit the evaluator to study selected issues, cases or events in depth and detail without the constraints of predetermined categories and hypotheses. (Patton, 1987: 9). Interpretivist methods are particularly oriented toward exploration, discovery and inductive logic. Inductive designs begin with specific observations and build toward general patterns. Categories or dimensions of analysis emerge from open-ended observations as the evaluator comes to understand existing patterns. Reneker summarised this as "develop[ing] concepts, insights and understanding from patterns in the data, rather than collecting data to assess preconceived models, hypotheses or theorists" (Reneker, 1994: 499).

One well developed example of an interpretivist approach is Naturalistic Inquiry by Lincoln and Guba, who defined it as inductive, generative, constructive, and subjective (Lincoln and Guba, 1985: 334). The work of Lincoln and Guba went far along the road of establishing the anti-thesis of positivism as a valid alternative for quantitative research. The core principles, or axioms, of naturalistic inquiry were described as:

> "Ontological Level: Axiom 1: The nature of reality is multiple, constructed and holistic. Epistemological Level: Axiom 2: The relationship of knower to known is interactive and inseparable. Axiom 3: The possibility of generalisation does not exist, only time and context bound working hypotheses are possible. Axiom 4: The possibility of causal linkages does not exist, all entitles are in a state of multiple simultaneous shaping, so that it is impossible to distinguish causes from effects. Axiom 5: The role of values in inquiry: Inquiry is value-bound". (Lincoln and Guba, 1985: 37-38)

From the axioms at the ontological and epistemological level there flow logical arguments in favour of particular methods, design and presentation of studies. The structure for applying the interpretivist approach presented in "Naturalistic Inquiry" by Lincoln and Guba (1985) also suggested ways in which interpretivist methods of data collection and analysis can be adopted to improve trustworthiness of results using a combination of internal and external validity checks. These are summarised as credibility, transferability, dependability, and confirmability.

The presence of these different ontological and epistemological values present the researcher with a choice. Clearly where strong ontological and epistemological views are held to an extreme of Burrell and Morgan's (1979) subjective-objective scale this might make choice of methodological approach 'easy'. However, in seeking to maximise understanding of a subject there are circumstances where divergent epistemological views may co-exist, either in the same study, or in different studies by the same researcher: a pluralist approach.

3.2.1 Pluralism

The idea of one study incorporating positivist-objective and interpretative-subjective elements is seen by epistemological purists as incompatible at an ontological and epistemological level. Patton described the debate at a methodological level as follows:

"Advocates of methodological purity argue that a single evaluator cannot be both deductive and inductive at the same time; one cannot be testing predetermined hypotheses and still remain open to whatever emerges from open-ended, phenomenological observation..." (Patton, 1980: 62).

An alternative to this view of the world comes about in the work of Hirschheim in a description of post-positivism, others of a post-modernist approach, and Wildemuth (1993) who advocated methodological pluralism. The key to understanding this view is that no position holds the answer. All positions offer something of value.

"post-positivist thought is more a belief about knowledge. it is not a particular school of though with any agreed set of propositions or tenets,...part of post-positivist though is its belief in what might be termed 'methodological pluralism'....The correct method is contingent on the problem being studied, the kind of knowledge described, and so on" (Hirschheim, 1992: 60).

The point raised focuses on the ontological and epistemological differences highlighted by Burrell and Morgan. On the ontological level, the very basis of what reality is, and the subject of study come under scrutiny. Can a researcher combine ontological perspectives? Is it ever appropriate to consider multiple epistemological positions in the same research? A number of researchers and theorists have considered these questions at both practical and philosophical levels.

Hirschheim certainly considered "Methodological pluralism...[as] one theme that we can and should support regardless of our epistemological biases" (1985: 36). Ford, writing within Information Science, and looking from a pragmatic position frowned upon the separation of paradigms when "the arguments for pluralism seem to make sense" (1999:1145). Wildemuth similarly claims potential success for a pluralist approach with the suggestion that

"...interpretative research can be combined effectively with positivist research, in spite of the fact that the two approaches take very different views of reality and how one comes to know about or understand reality" Wildemuth (1993:466).

From a pragmatic position, that research questions should be approached from as many directions as possible, Ford (1999) is in favour of a balanced approach to research.

"Much research in Information Science has arguably provided highly reliable answers to highly meaningless questions. The take-up of qualitative research approaches is now widespread in user-oriented research. But without critical interaction with complementary perspectives the increasing use of subjective analysis introspections using small samples of information users threatens to supply highly meaningful questions with highly unreliable answers. Some balance and integration must be achieved between the two extremes" (Ford, 1999: 1151).

Weaver and Gioia (1994) view integration as part of a larger whole; while Creswell (1994) puts forward five reasons for using combined methods. These were (1) to neutralise bias; (2) use of complementary approaches; (3) that one method informs another; (4) gaining a fresh perspective; and (5) seeking increased scope and breadth. These issues point firmly towards the adoption of different methods and approaches, as equal but different ways to achieve research aims and objectives (Lee, 1991).

Strauss and Corbin (1990: 34) advocate an interplay between positivist (quantitative) and interpretivist (qualitative) methods.

"Qualitative should direct the quantitative and the quantitative feedback into the qualitative in a circular, but at the same time evolving, process with each method contributing to the theory in ways that only each can".

They note however that the researcher should be conscious that because emergence from data is a central tenet of their grounded theory approach to theory building that "a researcher cannot enter an investigation with a list of preconceived concepts, a guiding theoretical framework, or a well thought out design. Concepts and design must be allowed to emerge from the data. Once relevant concepts and hypotheses have emerged from and validated against data, the researcher might turn to quantitative measures and analysis if this will enhance the research process" (Strauss and Corbin, 1990: 34).

The combination need not be without problems and the potential for difficulties must be considered in any research design, hence Hammersley and Atkinson provide a sharp warning that "one should not adopt a naively 'optimistic' view that the aggregation of data from different sources will unproblematically add up to produce a more complete picture" (1983: 199). Similarly, Wildemuth stressed the need for caution when applying widely divergent approaches.

"The results from interpretive studies cannot be employed in the same way as those from positivist studies. Positivist studies are designed to maximise generalisability of the findings on a larger population.... by contrast, interpretive studies are designed to maximise the richness of detail in the findings.....if these cautions are heeded, the results from positivist and interpretive studies can augment each other, making each more meaningful". (Wildemuth, 1993: 465)

Elsewhere the question raised is the suitability of different paradigms for different occasions. In this way positivist approaches; as acknowledged by virtue of their particular strengths and weaknesses may be suitable, at least on some occasions, where the 'opposing' paradigm would be unfitting. Hence the view that,

"...while it is feasible to describe or analyse changes in knowledge in response to new information qualitatively, to attempt to do the same quantitatively seems to have no tenable theoretical or practical foundation and represents a similar unsuitable research goal". (Ellis, 1996: 33)

While such views in favour of pluralism exist, opposing views see purity within paradigms as essential. Burrell and Morgan typify the approach to purity when they described the paradigms as separate, isolationist traditions that need developing, not merging, integrating or synthesising with other paradigms to form something less than the value of the individual paradigms (1979: 396-402). In their view, and that of others, "...synthesis is not possible, since in their pure forms they are contradictory, being based on at least one set of opposing meta-theoretical assumptions" (Burrell and Morgan, 1979: 25).

At their extremes the two perspectives are incompatible, the very diversity of objective, repeatable measures versus subjective qualitative encounters offer a whole range of possibilities for incompatibility. The pro-pluralist view allows the possibility of a topic arising in which both quantitative and qualitative might co-exist as equally useful and valid paradigms offering different insights into the same phenomena.

Ultimately, the key to adopting a successful theoretical approach rests wholly on the nature of the topic, the resources available and the specific aims of the research and on the strength of the researcher's ontological and epistemological feelings. With the range of possibilities in mind pilot studies may offer an opportunity to test the appropriateness of methods and approaches in each case.

3.3 Initial research design: A pluralist pilot study

The previous sections of this chapter suggest that both interpretivist and positivist approaches are potentially appropriate. The development of the present study initially appeared to require a balance between methods and the subject matter, interdisciplinary information seeking behaviour.

In favour of a positivist approach it could be argued that the number of previous studies of information seeking had produced a sufficient range of variables to test against a new subject of investigation.

In support of naturalistic inquiry it could be equally argued that interdisciplinary information seeking was sufficiently different to warrant a fresh look unhindered by pre-existing variables, frameworks and assumptions. Further, ideas of combining approaches also hold much appeal in the search for a deeper unified understanding of information seeking behaviour using the tools of two widely variant epistemologies.

A pilot study presents an opportunity to explore the possibilities and opportunities that a particular scenario of study offers. When the situation of interdisciplinary information seeking behaviour was considered, the researcher's initial view was that the pluralist standpoint was the strongest approach available.

The initial view was particularly influenced by Denzin (1970) and Patton (1990) who suggested that the application of multiple methods for data collection and analysis as offering the best way to obtain the widest possible data set as well as offering opportunities for flexible and inductive analysis of the resulting data. Denzin presented "...empirical reality ...[as]... a reality of competing definitions, attitudes and personal values" (1970: 300) and held that to counter these different realities multiple methods and theoretical approaches must be used. Patton encapsulated the idea such that

> "no single method ever adequately solves the problem of rival causal factors...Because each method reveals different aspects of empirical reality, multiple methods of observation must be employed...I now offer as a final methodological rule the principle that multiple methods should be used in every investigation". (Patton, 1990:197)

This view echoes the approach found in Wildemuth (1993), Ford (1999), Hirschheim (1985) and others who have contributed to the 'pluralist' debate.

The initial research design sought to combine a qualitative strand based on semi-structured interviews with a quantitative strand based on re-analysis and extension of an existing data set. Questionnaires were to be administered following semi-structured interviews. A pilot study was used to test the usefulness of the two approaches and the value offered by the two distinct instruments of data collection and to test the possibility of running them in parallel.

3.3.1 Pilot study quantitative strand

The selection of methods available was influenced by the availability of pre-existing questionnaires, and by the opportunity to use and extend an existing data set. The questionnaires were the same as those applied in the recent Uncertainty in Information Seeking project (Wilson, Ellis, Ford and Foster, 1999). The data set consisted of questionnaire data and interview transcripts from 198 participants, of whom 111 were based at the University of Sheffield.

The adoption of these instruments and data aimed at minimising instrument development time and offering an opportunity to collect data relevant to a direct comparison of interdisciplinary and single discipline information seeking behaviour.

3.3.2 Pilot study qualitative naturalistic strand

Following the work of Lincoln and Guba, Naturalistic Inquiry was considered as a suitable counterbalance to the quantitative strand. The central axioms of the Naturalistic Approach are detailed in section 3.2. The choice of method flows logically from these axioms. Table 6 illustrates fourteen implications for research as described by Lincoln and Guba (1985: 39).

Axiom	Implication for Research
1. Natural setting	The researcher collects data within the context or setting of the subject to maximise contextual richness and minimise fragmentation.
2. Human instrument	A human instrument, an interviewer, is the only way to collect data in a responsive, flexible, interactive manner implied by the axioms.
3. Utilisation of tacit knowledge	The "intuitive" or "felt" knowledge of the investigator and respondent are acknowledged.
4. Qualitative methods	To enable sensitive and adaptable interaction between investigator and respondent.
5. Purposive sampling.	To maximise the investigator's ability to devise grounded theory by increasing the scope or range of data exposed, and to take account of local conditions, local mutual shaping and local values.
6. Inductive data analysis	To enable full description of setting, interactions, and multiple realities and interactions.
7. Grounded theory	Any theory must emerge from the data, be grounded in data, and to reflect contextual elements and values found rather than investigator values.
8. Emergent design	Research design cannot be fully determined before investigation; it must develop as the data and interaction dictate.
9. Negotiated outcomes	That outcomes from analysis are discussed with respondents, as hey are in a better position to interpret the context and values than the investigator.
10. Case study reporting mode	Case studies may be used to reflect interactions with the subject and forms the basis of thick description.
11. Idiographic interpretation	Conclusions will be in terms of the particulars of a case rather than generalisations and rules.
12. Tentative application	Findings are tentative and case specific.
13. Focus-determined boundaries	The focus of the study emerges from the inquiry not from preconceptions.
14. Special criteria for trustworthiness	Traditional conceptions of trustworthiness are inconsistent with the naturalistic approach. Alternative procedures are applied.

Table 6. Fourteen implications of Lincoln and Guba's axioms for Naturalist Inquiry (1985: 39)

Each element of the naturalistic strand of the pilot study was accepted, and was justifiable, within the axioms. Following the axioms the research instrument was required to be an open and flexible, qualitative research tool designed to reveal as much about interdisciplinary information seeking as possible. An interview provides such a tool and the human instrument complements this selection. The practicality of interviewing with minimum disruption suggested interviewing in the workplace of participants. An interview guide was adopted to set a broad agenda within a semi-structured format to the process.

3.3.3 Results of the pilot study

The pilot study applied the pluralist research design described above, in what looked to be a promising line of enquiry. The method chosen, which allowed for an extension of a previous data set, that of the "Uncertainty in Information Seeking" project (Wilson, Ellis, Ford and Foster, 1999) enhanced the analysis with a pluralist combination of data sources. The original pluralist approach was to have triangulated quantitative and qualitative data and analysis to strengthen the whole composite picture.

3.3.3.1 Naturalistic strand

The qualitative element proved capable of gathering rich material which was of immediate interest while also proving the benefit of flexibility in an investigation of interdisciplinary information seeking. Changes to the interview guide are noted in section 3.4.2.

3.3.3.2 Quantitative strand

The quantitative strand presented problems during the pilot study. In applying the questionnaire to interdisciplinary researchers, there was always a possibility that the instruments would be shaped by the needs of the original study, that is investigating existing models of information seeking behaviour. The questions asked could then only echo the original tests determined by the previous study.

Also, the interdisciplinary participants in the pilot, unlike the single discipline participants in the earlier study, identified issues with the proposed instruments; specifically they felt unable to fully answer many of the questions. Typical examples relating to subject knowledge elicited responses of "Which part of the subject should I answer about?" and similar responses. Some questions resulted in textual answers not capable of statistical analysis. Comments after questionnaires were completed were noted to include "This doesn't really fit what I do", "Can I fill in more than one box?", and particularly "Which part of the topic does this question apply to?"

The key problem was found in trying to reflect differences in topics and encapsulating the complexity of experience across several or many disciplines simultaneously with limited instruments. A greater degree of refinement was needed in the instrument to enable a quantitative response to be made. These illustrations from responses suggested that the questionnaire approach would need a considerable revision. Such a rewriting would lose the value of extending the pre-existing data set.

3.3.3.3 Practical problems in the pilot study

Problems also relate to the length of time required for the combination of questionnaires and interviews. The initial research model required questionnaires of at least half an hour and in-depth interviews of forty-five minutes to an hour in duration to gain the richest data. Even where participants would gain a literature search in return, there were limits to the extent to which participation could be obtained without imposing significantly on their goodwill. The pilot served to illustrate the problem of accessing a group of busy professionals for whom time was an extremely valuable commodity.

3.3.3.4 Methodological change: From pluralist to naturalistic inquiry

Following initial qualitative data collection and analysis it became apparent that the qualitative data was providing rich and substantial themes that immediately began to point to other variables of relevance to a model of interdisciplinary information seeking behaviour. In the light of the pilot study the pre-existing data set, and instruments, were shown to be a compromise that would affect any analysis of the difference between interdisciplinary and mono-disciplinary researchers' information seeking behaviour.

The choices that became available in view of the pilot study were: to carry out the Naturalistic investigation alone, or to carry out Naturalistic and quantitative elements as two serial episodes of data collection, the second built on the data of the first. A parallel approach utilising existing questionnaires and building a large and directly comparable data set was no longer practical, nor indeed justifiable given the findings of the pilot study.

The success of the Naturalistic Strand and the problems and comments raised during questionnaire filling, tended to indicate that interdisciplinary researchers would be better represented by a solely Naturalistic inquiry free of reference to previous models, assumptions and frameworks of understanding. The research following the pilot study therefore was based on Naturalistic Inquiry and utilised the pre-existing data set as one of several points from which an initial sample could be obtained.

3.4 The main study

The main study adopted a purely qualitative approach based upon the interpretivist and naturalistic framework described by Lincoln and Guba (1985). Important features of the main study were dictated by the subject of research and by the naturalistic approach adopted in the study: Choice of data collection method; Interview guide development; Population and

sampling; Coding and Analysis; and Questions of Validity and Reliability. These elements are discussed in the following sections.

3.4.1 Research design and naturalistic inquiry

The notion of a "research design" was alien to the pattern put forward in Lincoln and Guba (1985: 226). Instead, the guiding force in the research programme was to be the subject and emergent data. However, the axioms and 14 "logical dependences" (1985: 39), as illustrated in Table 6, do lead to a broad shape for a naturalistic study and a guide for the present research.

The choice and design of instrument was derived from these axioms. In this case a human instrument and interviews were selected. The study drew its direction from a focus on interdisciplinary information seeking behaviour, but held no prior hypotheses. Furthermore, decisions relating to the analysis and presentation of results, and methods of ensuring validity followed the guide of Lincoln and Guba's axioms.

The study followed a similar course to that shown in Lincoln and Guba's "Flow of Naturalistic Inquiry" (1985: 188) as shown in Figure 11.
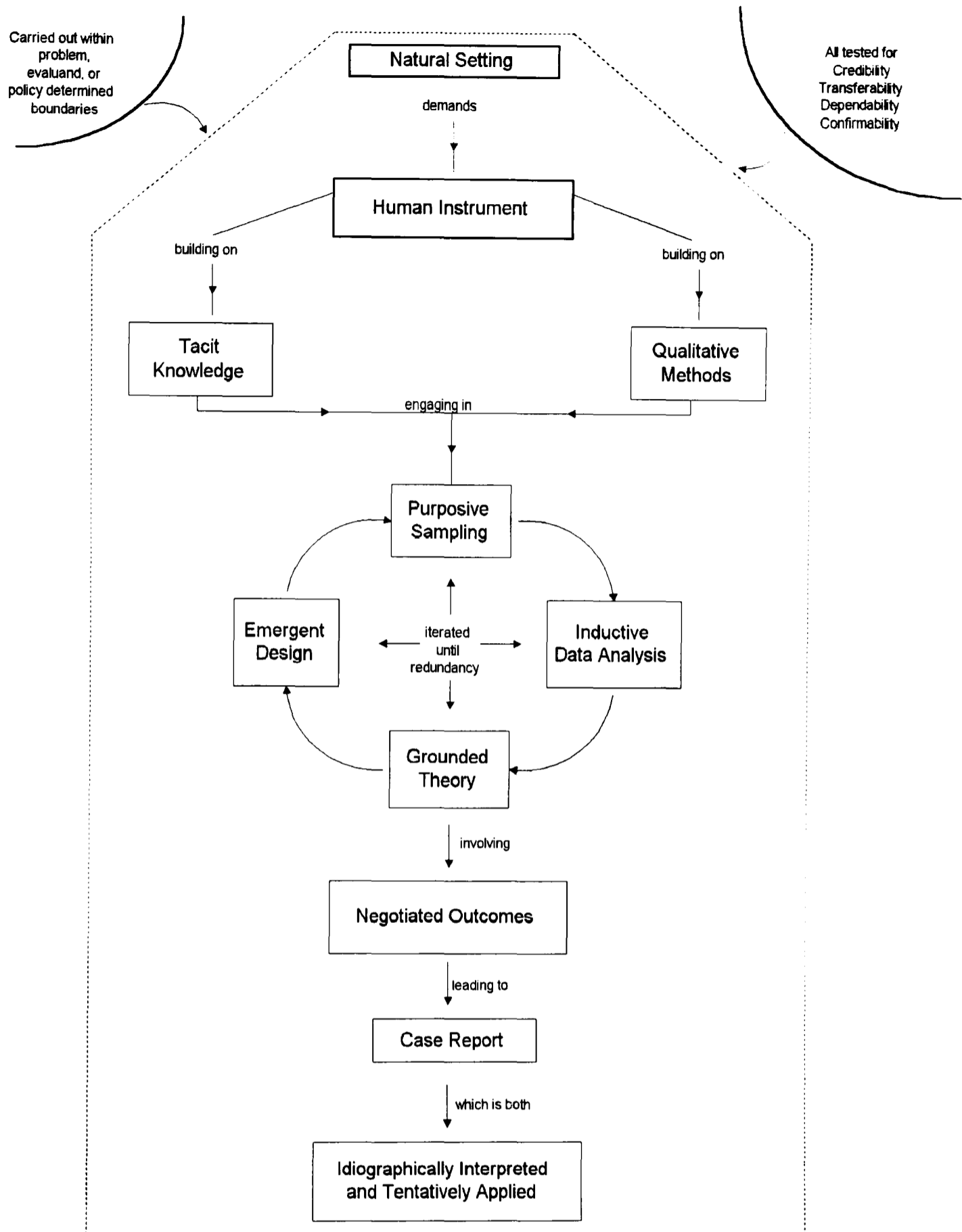
Figure 11. Lincoln and Guba's "Flow of Naturalistic Inquiry" (1985: 188)

The key elements of this are that the research should take place in the participant's natural setting, with a human instrument. Other elements are discussed as they relate to sampling and analysis and trustworthiness in later sections. The present study contains each of the elements shown in the diagram and deviates only in the presentation of results, which rather than a case report, describe a model of interdisciplinary information seeking behaviour.

3.4.2 Interviews and interview guide

As a central part of naturalistic inquiry, interviews were a vital element of data collection. Interviews offered the opportunity to explore the experience of the participants and to react, by probing, into new themes as they emerged. Secondary factors in the choice of interviews were the feasibility and minimal time impact of an interview as compared to diaries, work logs, or other self-reporting methods. Similarly, observation was impractical given the busy nature of academic life.

Lincoln and Guba recommend interviewing in the natural setting of the participant. This was included in the study with visits to participants in their workplace. The benefit of this became clear throughout the study as conversation frequently brought in bookshelves, boxes of documents and paper cuttings. Even websites and databases were shown in the course of interviews. These acted to convey to the interviewer more of the reality of the subjects and in being receptive to these "diversions" often themes of interest arose and were probed.

The decision to use an interview guide allowed a basic structure for interviews. Patton (1990:187) describe interview guides "not as a structured schedule or protocol. Rather it is a list of general areas to be covered with each informant. In the interview situation the researcher decides how to phrase questions and when to ask them". A range of materials suggested the basic form of questions and how questions should be phrased, ordered and probes added (Seidman, 1991; Holstein and Gubrium, 1995; Kvale, 1996; Chenail, 1997; Gillham, 2000). The interview guide developed for the pilot study was envisaged as an instrument that would evolve to allow the investigation of themes and concepts as they arose in interviews.

The literature review presented in this study contributed directly to the development of an interview guide and provided the basis of theoretical sensitivity (Strauss and Corbin, 1990) to allow identification of a range of significant points and questions that should be examined in a study seeking to enable a comparison of mono and interdisciplinary information seeking behaviour. Questions were aimed at an exploration beyond the frameworks of existing information seeking models. They were designed to identify interdisciplinary researcher experience, particularly as it related to differences between interdisciplinary information seeking behaviour and single discipline information seeking behaviour; processes, activities and stages; particular features or aspects of information behaviour specific to interdisciplinary research; and to place these within the social and organisational context of interdisciplinary information seeking.

Following the pilot study, and in response to positive experiences with the pilot instrument, minor changes to the interview guide were made. The changes made to the interview guide were as follows:

- In the first section under the subheading "Definition", additional questions relating to area, length of time researching were added.

- The second section on "Approach" was moved from the end of the interview to the beginning of the interview. The logic moving the summary of thoughts from the end to an introductory line of questioning with specific prompts relating to characterisation of approach, and definition of topics.

- Questions relating to "Changes Over Time" were strengthened with the addition of probing questions to further tease out how strategies and activities worked together.

- Questions relating to "Information Need" were refined with particular probes relating to possible differences between information needed and information actually looked for.

- "Information Source" questions were amended to include questions relating to relevance and range of sources.

- One question on the "Perception of Stages" was added as a final question following the pilot as initial analysis suggested perceptions would be of interest.

Collectively these changes improved the flow of interviews rather than substantially altering the nature of the material or themes discussed. A copy of the final interview guide is included in Appendix B.

3.4.3 Tape recording and transcription of interviews

In selecting data collection methods it was essential to plan the recording of data. Over several decades qualitative researchers have moved from shorthand and longhand notes to full tape recording and verbatim transcription of interviews. Tape recording of interviews forms an excellent method of increasing the accuracy of data, and to obtain rich and accurate, quotations. Particularly this last element is important in Naturalistic Inquiry.

Patton (1987), Finch (1990), and Hakim (1990) are amongst experts who consider tape recording and full transcription to be valuable for qualitative research. Note taking to record every word is both distracting to interviewee and interviewer. The resulting conversations are restructured and an interviewer concentrating on note taking is unable or at least unlikely to be intellectually engaged in following up emergent ideas with probes and suitable interaction. Naturalistic Inquiry stresses that the interview process in a two-way interaction. As a researcher that interaction should be optimised.

To minimise the intrusion of the tape recorder, a battery powered recorder and battery-powered amplified microphone enable the tape machine to be set up with minimum disturbance. Fortunately most interviewees were comfortable with the idea of being tape recorded. Other samples from a non-academic context might be less so with the process and other methods adopted. Interviews took place at the workplace or office of interviewees. Interviews were

between forty-five minutes and two hours in duration reflecting the diversity of the sample. All interviewees were asked for their consent to be tape-recorded and all agreed. The interviewer made some non-intrusive notes to support the interviews and provide direction in coding.

The tape recordings were transcribed in full by the researcher. The transcription process took approximately 4 to 6 hours per interview and in this proved immensely time consuming, working out at an estimated 70 hours of interview contact time and 180 hours of transcription for the whole study. Transcription took place soon after interviews so that new probes and developing concepts could be investigated. However, the time was well spent in familiarising the interviewer with the data and with emerging concepts. It was also beneficial in allowing interviewer performance to be considered and improved throughout the data collection process.

3.4.4 Coding and analysis

Data collection aimed at an impartial, yet theoretically sensitive, exploration of interdisciplinary information seeking behaviour. The interview guide was focused on exploration and allowing the emergence of concepts from respondents. Analysis was informed by knowledge of the general nature of information seeking models rather than by specific expectations. Naturalistic inquiry analyses should be inductive and most often use the constant comparison method, as described in Glaser and Strauss (1967) and recommended by Lincoln and Guba in their book (1985). Constant comparison was described originally by Glaser and Strauss (1967: 106) simply as "while coding an incident for a category, compare it with the previous incidents in the same category". Coding is the label provided by qualitative theorists to the process of data conceptualisation. That is, a transcript contains an idea which the researcher recognises as belonging to a significant concept and labels or indexes the material to indicate a link between data and concept. Advice on inductive coding came from the books by Miles and Huberman (1994), Denzin and Lincoln (1994) and Strauss and Corbin (1990). The dominant guide was Lincoln and Guba who described the coding process in terms of unitizing and categorising.

In this study, coding took place around a core of three main iterations taking place over time. Initial coding of each interview transcript began with manual annotation of scripts during a process of close reading, line by line, to highlight each concept and label it. This process equates to the unitising or open coding process. Subsequent iterations of reading and coding of each interview transcript used constant comparison with previous interview transcripts. The development of coding, including the renaming and definition of categories and themes, was encouraged by the flexibility of the Atlas-ti software used to manage the coding process. Codes were named with a combination of in-vivo labels, descriptive single words, and phrases. Examples of coding are provided in Appendix C.

Coding processes were supported by the use of Atlas-ti "Comments" and "Memos", these were text notes attached to any quotation or code within the analysis. Examples are provided in Appendix C. These features were of particular value in annotating transcripts and coding to define the meaning of codes, the reasoning that went into their definition, and to log the questions that arose during analysis. The use of "Comments" and "Memos" contributed to consistency (section 3.7.15) and dependability (section 3.7.3).

As analysis progressed, a valuable contribution came from the use of visualisations of the codes and their relationships in "network views", or concept maps of the analysis. At the lowest level, network views were used to compare the quotations attached to each code, and at the highest, related to the core categories appearing in the final model. Illustrations of network views are included in chapter 10 as part of the written up data, and further examples from the analysis process are provided in Appendix C. The graphical and memo functions of Atlas-ti enhanced the task of coding and theory building and were complemented by use of the extensive text retrieval functions of Atlas-ti, particularly in allowing tests for multiple and complex tests for co-occurrence of coding to be made and new codes to be generated from those results. Further aspects of coding and trustworthiness are described in section 3.7.

3.5 Population and sampling

3.5.1 Population

The population from which the sample was drawn consisted of all academic and postgraduate researchers at the University of Sheffield. This included members of 100 (estimated[1]) research groups and departments listed as belonging to the faculties of arts and humanities, social science, engineering, and medicine. Within this body a sub-population of interdisciplinary researchers were to be the specific group from which a sample was drawn.

3.5.2 Sampling methods

The subject of the study, interdisciplinary researchers, was a major factor in choice of sampling method. Specific problems identifying the target population within the larger population of academics suggested that probability-based sampling would be infeasible. Probability-based sampling methods were discounted because they demanded full knowledge of

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[1] The figure in the region of 100 groups is an estimation based on University of Sheffield publicity materials, the exact figure was not available and considered to be continually changing.

the population. Lincoln and Guba particularly suggest that in naturalistic inquiry, the investigator "is likely the eschew random or representative sampling in favour of purposive or theoretical sampling because he or she thereby increases the scope or range of data exposed..." (1985: 40). These factors limited the sampling methods available to the study. The remaining options were all non probability-based , these would include convenience. purposive. most similar/dissimilar cases, typical cases, critical cases. snowball and quota sampling (Henry. 1997; Wright, 1997).

A combined sampling method was adopted, taking account of both population and methodological context. The first stage of sampling applied was Purposive. Purposive Sampling is the selection of a sample on the basis of their contribution as information rich cases for in-depth study (Patton, 1990). In this study criteria were specified to guide the growth of the sample to the population of interest. The criteria were developed to allow a rich sample that comprised two central characteristics (a) identification as interdisciplinary researchers and (b) (to ensure richness of data) being a qualitatively representative sample drawn from across the University faculties. Purposive Sampling applied in this way met the practical and methodological constraints of the study and maximised the potential contribution of a rich and diverse population of interdisciplinary researchers. Following Patton (Patton, 1990) who described combinations of sampling methods to achieve a desired shape and size, the study combined Purposive Sampling with Snowball Sampling, which allowed the researcher to generate a larger sample. Snowball Sampling had the benefit of utilising participants as a knowledge base as they were best able to identify interdisciplinary colleagues. For those identified using Snowball Sampling in this way the Purposive Sampling criteria were also applied.

Purposive sampling techniques were based around a definition of Interdisciplinarity. Interdisciplinarity was defined for the purpose of this study as covering research topics where the primary knowledge domain was either clearly focused, and related to one or more other knowledge domains. or had no single domain focus. and appeared as a composition or hybrid subject. reliant to varying degrees on several sub-disciplines or partial elements of disciplines. This definition (see also Bartolo and Smith. 1993; Davis. 1995; Klein, 1996; and Scott. 1979) was supplemented by classification of potential participants based on four processes: (a) The interviewees described their own topics as interdisciplinary in response to an interview question asking specifically for a definition. (b) The interviewer considered the participants' research problems and the areas they described as providing appropriate material. (c) Following the work of Saracevic and Kzinto (1988: 180), interviewees' problems were classified based on the subject domains listed in the DIALOG databases DIALINDEX/OneSearch categories. This approach highlights a theme mentioned by Palmer (1996a: 131) who proposed that interdisciplinary users can only be identified by research problem and the way that problem is

defined. (d) The interviewer's own notes prevented the acceptance of merely ill-defined topics or of topics that were merely subfields of a larger discipline.

These criteria resolved two potential problems with a purely discipline-based sample selection. First, disciplines that operate in an interdisciplinary fashion do not necessarily consist entirely of interdisciplinary research topics one hundred per cent of the time and, second academics who do some interdisciplinary research may not publicly describe or privately perceive themselves to be interdisciplinarians.

Once identified, potential participants were contacted by letter, and subsequently engaged in a brief meeting, to ensure that all participants did indeed meet the criteria. The pilot study confirmed that the sampling methods functioned in the ways expected.

3.5.3 The pilot sample

The initial sample was chosen by reviewing participants from a previous British Library study involving the present doctoral research student and a study of academic researchers at the University of Sheffield. Researchers were phoned by the researcher and asked if they would participate in a further interview. They were initially identified by their self-identification as interdisciplinary during interviews for an unrelated project, and were subsequently checked against the definitions of interdisciplinarity derived in section 2.1.

Applying the definitions described below to analyse interview transcripts from the pre-existing data set permitted identification of two distinct groups within the data set: single discipline researchers of whom there were 58 and interdisciplinary researchers of whom 40 were identified as possible interdisciplinary contacts from 21 academic departments across the range of faculties. Five of these were drawn from Sociology, Information Science, Management, Ageing and Rehabilitation, and dual Management and Music. A sample of snowball-referrals were also gathered to test the second component of the sampling method.

3.5.4 The main sample

The choice of initial sample applied definitions of interdisciplinarity as developed from review of the literature. Initial contacts were made with academics known to the researcher in the departments of Information Studies, Sociology, Management, Geography and Architecture during the pilot study. Further contacts were made using the snowball referral method. The process of snowballing presented potential contacts first in the Social Sciences, linking to Arts and Humanities, Science and Engineering, and back through Social Science, Humanities, and Science. Recommendations were received from participants and from academics known to the researcher from previous research. Each candidate was vetted through application of the definition. Wherever feasible an initial conversation aimed to eliminate wrongly identified candidates from the process.

The intention of sampling was not representativeness, as in a quantitative study, but to achieve a level of understanding of information seeking across the major "classical divisions" of academe, while focusing on the identification of interdisciplinary researchers. As the sample was focused on interdisciplinarity, rather than disciplinarity, coverage of each major disciplinary grouping was broadly stratified. Hence similar numbers were considered from each major grouping: science, social science, humanities. Additionally, as the study worked to a naturalistic paradigm saturation of concepts was the aim of the study, not a set sample size. The final sample size and disciplinary origins are illustrated in Table 7.

Department	Participants (by department)
Pure, Applied and Medical Sciences	
Ageing and Rehabilitation (CARS)	2
Animal and Plant Science	3
Biomedical Science	2
Civil and Structural Engineering	1
Psychology	1
Mental Health and Learning Disability	1
Arts and Humanities	
English Language and Linguistics	2
English Literature and English Language	4
History	7
Music	1
Social Science	
Architecture and Landscape Design	2
Education	2
Geography	1
Human Communication Science	1
Management	4
Leisure Management	1
Sociology	1
Dual Faculty	
Information Studies (Social Science./Pure Science.)	8
Management and Music Dual (Social Science./Arts)	1
Total Number of Participants	45

Table 7. Composition of Sample

The sample covered the range from relatively new researchers through to experienced senior academics. Age and status were not found to be a factor in this study as academic researchers' experience varied greatly, from relatively young but highly active interdisciplinary

researchers to senior but less active interdisciplinary researchers. The age distribution of the sample is shown in Table 8.

Age Range	Number	Percentage
21-30	6	13
31-40	15	33
41-50	17	38
51-60	7	16
Total	**45**	**100**

Table 8. Age distribution of the sample

Some subject areas tended to be studied in the sample only from within a single faculty, others appeared in the sample in the work of researchers from two or more research areas. These included Geography, Psychology, Education and Learning, Management, Sociology, Marketing, Business, Computer science, Archaeology, Philosophy, Landscape, Speach and Language Therapy, Architecture, Ecology, Genetics, Risk Assessment and Anthropology.

Table 14 in Appendix A: Participants and the use of disciplines, provides a more detailed breakdown of the disciplines used by participants.

3.6 Validity and trustworthiness

In an earlier section (3.2) the variation in epistemological approaches and the "paradigm of choices" was introduced. The choice of epistemological foundation has great significance when the findings of a study are compared and discussed with other studies from contrasting epistemological traditions.

The strength of any study derives from the criteria that are applied from beginning to end that ensure that it is a true and worthy account reflecting the subject, be that by use of positivist or interpretivist methods. Whichever approach is taken studies rely upon establishing the audience's confidence that the study is trustworthy. The strength of any study therefore relates to how factors affecting trustworthiness are addressed. In Lincoln and Guba (1985), the issue of trustworthiness is addressed at length. A consideration of the qualitative process is presented in which the original goals of scientific method are acknowledged as unsuitable, but transformable beyond original positivist criteria into something more appropriate to qualitative naturalistic inquiry.

In this section the concept of trustworthiness and the methods put forward by Lincoln and Guba to improve trustworthiness are discussed. The measures of trustworthiness applied in the present study are described in section 3.7.

3.6.1 Conceptualisation of validity and trustworthiness

Traditional conceptions of validity have viewed scientific methods as of prime value. All other conceptualisations have been viewed as ephemeral, unsubstantiated and subjective.

At the heart of traditional conceptualisation is the positivist axiom that reality is fixed and objective capable of observation and measurement once it has been identified and labelled by the observer. From this conception of reality a problem situation may be chosen, a hypothesis made, and tested, the results either proving or disproving the hypothesis. Theory develops from proven hypotheses. The hypothesis testing model is a key element of positivist studies.

When examining the trustworthiness of studies from this perspective the emphasis most prominent is upon validity. Trustworthy results within the conventional positivist framework consist of four 'tests': internal validity, external validity, reliability, and objectivity.

Hammersley (1987:69) defines validity as "An account is valid or true if it represents accurately those features of the phenomenon, that it is intended to describe, explain or theorise". Hammersley's definition clearly assumes a single recognisable reality against which a study may measure success. Winter's (2000) review of the literature found validity to be commonly defined in terms of the method of measurement, and the accuracy thereof. Questions of validity also arise from the goal of positivist studies, that of creating generalisable theories. The degree of generalisability is seen as a crucial measure of success. Lincoln and Guba (1985: 289-331) note that internal validity and external validity in positivist research are both subject to potential problems arising from the instruments used, from application of tests over time and to the same individuals, while external validity may suffer from sampling, context and history effects.

Reliability and Objectivity are the last components of validity and trustworthiness from the positivist perspective. Studies are expected to be repeatable on the same or other groups and to be consistent and predictable in application. The second part of this is objectivity, in repeating a test an independent observer should arrive at the same results.

Validity and trustworthiness in a traditional sense therefore imply instruments and variables that are clearly definable from the beginning of a study and that will remain stable throughout a study. As objective accounts of a single "reality" no influence from the researcher is acceptable.

Qualitative research based on interpretivist principles has been considered the anti-thesis of the scientific approach. Interpretivist research does indeed offer an opposite position to the objective-deterministic-measurable scientific extreme. Interpretive research is criticized for

"not being something it never intended to be, and is not given credit for its strengths" (Borman, LeCompte and Goetz, 1986: 42)

An Interpretivist looks at the social reality and seeks to gain understanding from the social reality itself. Validation of results therefore involves not the measurement of alleged causal relationships but the exploration of relationships induced from the social reality itself. Given these objectives it is clear that interpretivist, qualitative, naturalistic inquiry will necessarily fail when viewed by any traditional measure of validity, as indeed was pointed out by Lincoln and Guba.

Achieving trustworthiness was the subject of extended discussion for Lincoln and Guba (1985) and culminated in the creation of a new definition of trustworthiness suitable for qualitative research. Faced with the issue of trustworthiness Lincoln and Guba (1985) took the traditional concepts of internal validity, external validity, reliability and objectivity, down to their core meanings of truth value, applicability, consistency and neutrality to enable a reconstruction suitable to naturalist inquiry. Lincoln and Guba considered trustworthiness in terms of four aspects arising in traditional validity:

Truth value   = Internal Validity;

Applicability   = External Validity;

Consistency   = Reliability;

Neutrality   = Objectivity.

The pattern used by Lincoln and Guba is reviewed by Creswell (1998: 197-204) who notes that the pattern adopted by Lincoln and Guba had also been debated by LeCompte and Goetz (1982) who utilised the internal validity-external-validity-reliability-objectivity model to establish quality and verification using quantitative terms in ethnographic research. Elsewhere the framework was also used to illustrate a break away from positivist criteria, for example both Phillips (1987) and Zelditch, (1962) adopted alternative terms.

Lincoln and Guba's assessment of the key elements of trustworthiness led to new parallel concepts for defining that trustworthiness and are identified with a new terminology to delineate them.

1) Truth value and credibility takes the logic of "naïve realism" present in positivist studies which place a value on highlighting a single "discovered truth" and replaces this with a concept of reality from the interpretivist school, which rather differently places reality as a social construction; that the observed and the observer interact to arrive at a position where "multiple constructed realities" are possible. Lincoln and Guba turn the question around to ask "does the research finding represent those multiple constructed realities adequately" (1985: 289-331). In the language of Lincoln and Guba, we would say, whether the findings are credible to

the subject (1985: 301). Credibility becomes the first component of Lincoln and Guba's model of trustworthiness.

2) **Applicability and transferability.** External validity states that a study should produce a generalisable result that will work across other examples of the subject group. The difficulty with the application of external validity to an interpretivist study is not aimed at achieving a classical generalisation: the rich data, the "thick description" obtained from naturalistic inquiry is focused on understanding the specific context in depth. Where application of the findings may be applied "at best only working hypotheses may be extracted, the transferability of which is an empirical matter, therefore generalisation is not a valid aim for naturalistic inquiry" (Lincoln and Guba, 1985: 27). Generalisation may not be a stated aim of naturalistic inquiry however, the provision of sufficient "thick description" about the phenomena and context allow tentative application of theories and comparison with other contexts.

3) **Consistency and dependability,** and reliability are closely related in the positivist literature (Winter, 2000) such that a valid study is of necessity a reliable study. Key elements in the positivist model are sampling, use of instruments and methodical application of analysis tools. Equivalent processes for naturalist inquiries were discussed by Lincoln and Guba. As interpretivist research allows changes over time to instruments and development of themes within data collection the naturalist draws consistency and dependability from recording the research process.

4) **Neutrality and confirmability.** Positivists view objectivity, that is neutrality, as essential, while breaches are viewed as flaws. Interpretivists acknowledge the interaction as inevitable and accept that the sum of his/her experience will contribute at some level, even if this is in how rapport and trust with subjects is achieved. In accepting a different, interactive, interpretation of data collection, a further step is involved in developing trustworthiness: confirmability. Confirmability is introduced by researchers by making explicit the interpretation of data in such a manner that it should be confirmable by independent observers or the subjects themselves.

The revised view of trustworthiness put forward by Lincoln and Guba (1985: 300) appears as follows in Table 9 below.

Aspect of Trustworthiness	Lincoln and Guba	Conventional Positivist
Truth value	Credibility	Internal validity
Applicability	Transferability	External validity
Consistency	Dependability	Reliability
Neutrality	Confirmability	Objectivity

Table 9. A revised view of trustworthiness

3.6.2 Strategies for enhancing trustworthiness

From identification of parallel concepts for trustworthiness, Lincoln and Guba outlined a number of possible strategies from which researchers could select to enhance the credibility, transferability, dependability and confirmability of naturalistic studies. Table 10 summarises the relationship between the new criteria for trustworthiness, research methods, the research and the researcher's part in executing them.

Concept	Strategy	Purpose	Actor
Credibility	Prolonged engagement	To gain understanding.	Researcher
	Persistent observation	To build depth.	Researcher
	Triangulation	To enhance strength of findings	Researcher
	Peer debriefing	An external check on the inquiry process.	External observer
	Referential adequacy	Archiving "raw" unprocessed data to be tested independently against the interpretations and findings of the study.	External observer
	Negative case analysis	Aimed at finding cases within the context that do not fit existing hypotheses, thus allowing refinement of hypotheses.	Researcher identifies negative cases
	Member checking	A direct test of findings and interpretations with the human sources from which they have come.	Interaction between researcher, the report and participants
Transferability	Thick description	Presentation of rich detail of subject and context to enable possible transfer to other contexts.	Researcher
Dependability	Establishment of credibility	As in positivist studies establishment of 'validity' also entails 'reliability'	Researcher as above
	Triangulation	As part of dependability triangulation provides broader base for findings.	Researcher
	Stepwise replication	Only practical in multiple-researcher studies	Researchers
	Inquiry audit	To show that the data, interpretations and findings are internally coherent.	Researcher prepares
	Reflexive journal	A diary of events, thoughts, comments, during the study.	Researcher
Confirmability	Inquiry audit	Similar to that used in Dependability	Researcher prepares
	Triangulation	Benefit of providing additional viewpoints within the study.	Researcher
	Reflexive journal	Similar to that used in Dependability	Researcher

Table 10. The relationship between trustworthiness, research and the researcher

The methods put forward by Lincoln and Guba suggest a palette of valuable tools for increasing trustworthiness. The core elements set up procedures to maximise data collection on the one hand and provide accountability on the other. The recurrence of these principles and methods and strength of this combination are suggested by the recurrence, with minor variations, of the principles and methods. in other texts. Merriam (1988), for example, listed six strategies for enhancing validity in a case study that echoes those of Lincoln and Guba (1985), and elsewhere Kuzel and Like (1991) provide four criteria based on member checks. negative cases, triangulation and thick description.

Patton (1990: 461) highlights that credibility of research is a composition of rigorous techniques, credibility of researchers and philosophical belief in the paradigm applied to the study. Patton (1990: 461) noted differences in the emphasis taken by different methodology writers: Lincoln and Guba (1985) have emphasised the understanding and acceptance of the naturalistic paradigm, Miles and Huberman (1984) the application of rigorous methods even to the extent of applying positivist assumptions to qualitative research. Patton proposed a combination of these very different perspectives on how best to "enhance the "quality and credibility of qualitative analysis" (Patton, 1990: 460).

3.7 Trustworthiness and the present study

In the light of the case put forward by Lincoln and Guba in their framework for trustworthiness for naturalistic inquiry and the present study's adoption of a naturalistic approach, the procedures adopted for the present study will be described in the context of that framework.

3.7.1 Credibility

Credibility may, in the first instance, be enhanced by the means of data collection. As gathering data may be seen as the first function of the researcher, methods directed at increasing the credibility of data are discussed first. Lincoln and Guba suggested prolonged engagement. persistent observation and triangulation.

3.7.1.1 Prolonged engagement.

To enable the researcher to become familiar with culture of the subject group. reducing potential distortions caused by misunderstanding. In Lincoln and Guba's words becoming

"oriented" (1985: 302) or familiar with the subject reduces the possibilities of suffering misinformation, misconstruing situation motives and perceptual distortions.

In the present study the nature of academics' schedules and the focus of interest, information seeking, precluded any possibility of becoming familiar with the subjects via "prolonged engagement" in a formal sense. The researcher had extensive previous experience of the target population gained through (a) work as a researcher within the same academic environment as the subjects, (b) previous research with the population (see Wilson et al, 1999), and (c) through professional and social links with members of different disciplines. In achieving a degree of familiarity, the researcher was also conscious of maintaining a professional distance from the subjects, in case bias be introduced in this way.

The combined "familiarisation" process allowed distortions to be minimised and clearly recognised within interviews, and the way in which potential participants were approached, and the way in which "smart" but non-threatening clothing was chosen for contact with participants reflected a conscious attempt to portray the researcher as a normal, potentially useful "part of the university". In conversing informally prior to interviews the researcher's own education from Arts and Social Science through to Information Technology allowed participants to feel they would be understood and would not – as the subject was information seeking – be judged, which was something several participants initially felt self conscious about. In this way the theme of data collection being an interactive process between participant and researcher was utilised to best effect, in creating a comfortable atmosphere in which participants could express without inhibition their thoughts and feelings.

3.7.1.2 Persistent observation

Lincoln and Guba go on to recommend "persistent observation", in which "the purpose...is to identify those characteristics and elements in the situation that are most relevant to the problem or issue being pursued and focusing on them in detail". (Lincoln and Guba, 1985: 304). The opportunity for persistent observation relies upon the nature of the subject and the participants. It was realised from an early stage in the research that information seeking was not something that could be studied by continuous observation, over time. The nature of activities meant that they would occur at times not associated with conventional definitions of a "working day". Nor, indeed would the schedule of academics really permit a degree of involvement over a period of time.

Persistent observation in this study was derived from an alternative combination of resources, firstly through the use of lengthy in-depth interviews during which participants drew on their most recent experiences and examples from their work; and secondly through gathering data from a larger number of participants than might strictly be considered necessary for a naturalistic inquiry. The combination provided an opportunity to meet Lincoln and Guba's

criteria of depth of data for increased credibility. These methods were supported by using an interviewer familiar, in the sense of professional experience of online searching and collaboration, with the academic disciplines involved.

3.7.1.3 Triangulation

A limited element of triangulation as described by Patton (1990), Lincoln and Guba (1985) and Denzin (1970) was built in. Triangulation "...leads to credibility by using different or multiple sources of data (time, space, persons), methods (observation, interviews, videotape, photographs, documents), investigators (single or multiple) or theory (single versus multiple perspectives of analysis)". This study adopted triangulation of multiple sources of data covering different faculties, for example science and arts, academic research topics from narrow to broad, and differing academic status. The benefits of triangulation in the present study enabled a picture of academic researcher's information seeking behaviour and context to be built from multiple positions within the university. Thus themes were illustrated from more than one type of participant as measured by status, and also differences by department, faculty and primary discipline group. Other methods that would have provided useful components of a triangulation, such as logs and diaries, were limited by the nature of the participants working styles and habits. For example it would be difficult to use observation methods other than in extremely narrow and limited circumstances that would contribute little to understanding the subjects but would have taken a disproportionate amount of resources in the process. Similarly other methods failed to provide the flexibility and depth of semi-structured interviews.

3.7.1.4 Peer debriefing

Peer debriefing, listed by Lincoln and Guba as "exposure to a disinterested peer in a manner paralleling an analytic session and for the purpose of exploring aspects of the inquiry. The aims are to "keep the inquirer honest", expose the researcher to searching question and to probe for biases, meaning and interpretation, and to test working hypotheses on an outsider. In terms of a true "outsider" or "disinterested peer" the only accessible contributor was the researcher's doctoral supervisor with whom the doctoral candidate discussed and debated the process of the research itself and the emergent analyses at length on a regular basis. These sessions fulfilled the aim of critical and constructive debate. Discussion was also used to independently confirm interpretations and coding decisions which was especially valuable in the development of categories.

3.7.1.5 Referential adequacy and negative case analysis

Two strategies put forward by Lincoln and Guba as being of potential value in increasing credibility were not available as viable methods for the doctoral research presented here. As a potential objective where resources permit, referential adequacy was view by Lincoln and Guba as a method to improve confirmability and credibility. The mechanism of referential adequacy works by archiving a selection of unprocessed, "raw" data for later analysis by an independent researcher once tentative findings have been reached. Application of this method depends on an excess of data collection opportunities and the availability of an independent researcher to check that independent analysis of findings would reach the same conclusion.

The limitations of the approach were note by Lincoln and Guba,

> "...the referential adequacy approach does not recommend itself well to the more practical minded or resource poor. Nevertheless, when resources and inclination permit, the storage of some portion of the raw data in archives for later recall and comparison provides a rare opportunity for demonstrating the credibility of naturalistic data". (Lincoln and Guba, 1985: 314).

In view of the single researcher nature of doctoral research and the limitations placed by resources referential adequacy was not pursued in the present research. However, copies of interview transcripts in an unprocessed format were maintained and referred to periodically to check initial conceptions and coding and to re-analyse them in the light of emergent themes.

Issues of consistency and confirmability in coding were addressed by including three iterations of coding spread through a period of a year. Each coding session considered the transcript and the application of coding in the light of later analysis and the growing perceptions of the researcher. The confirmation of quotations on multiple occasions added to the strength of the researcher's interpretation. In this practice confirmation of coding took place at different times by the same researcher, if not as would indeed have been desirable, by a different researcher.

Negative case analysis, in which the primary "object is to continually refine a hypothesis until it accounts for all known cases without exception" (Lincoln and Guba, 1985: 309), offered another method of establishing trustworthiness. However, in discussing the application of negative case analysis, Lincoln and Guba take the step of proposing a high proportion of "fit" as indicating that a hypothesis would be considered accurate. In the present study the viewpoint held by the researcher was that the data collection should include a wide range of participants, some of whom were atypical, and would not fit a general view. Analysis gave greater credence to views and experiences held by the larger proportion of participants, but also ensured that less common aspects were represented as well and checked in subsequent interviews to ensure suggested variations from the larger picture were not merely under-reported by participants. These variations and the discussion they stimulated are presented in the study.

3.7.1.6 Member checking

The fact that two methods could not be applied in the ways described by Lincoln and Guba, is more than balanced by the fact that the method considered most important by them, and which is put forward by many other qualitative researchers, was used to full and good effect: member checking.

Member checking was identified by Lincoln and Guba (1985; see also Erlandson, 1993) as the single most important method of increasing the credibility of qualitative research. The present study utilised member checking in four ways.

First, member checking at the pilot stage contributed the thoughts and opinions of a sample of five interdisciplinary researchers who were interviewed and who candidly discussed the questions following each interview. In this way the initial pilot interviews began with an initial framework onto which member checking permitted feedback on questions asked, and highlighted the perception of themes explored and other themes that were important to the interviewees that needed to be brought into the questioning. Using member checks in this way gave the participants a way to contribute and to be connected with the process.

Second, member checking took place throughout interviews as the interviewer fed ideas back to participants to refine, rephrase and interpret the data.

Third, all respondents were given the opportunity to discuss findings in an informal post-interview session. These sessions allowed comments on themes and expression of emerging patterns that contributed to the results. It was using this process that as a model emerged that ideas were tested and notes made on positive and negative feedback.

A fourth member check involved gathering a sample of five participants who were willing to contribute to a further formal session in which they were asked for feedback on the transcript of their own interview and evaluation of the analysis and model as a report of their own experience. Comments were recorded by note-taking rather than tape-recorded, which some had commented made the process a much more intimidating occasion. Off tape respondents felt free to comment in an unrestrained manner.

The adoption of member checking entailed decisions of who should be included in member checking, how many would be necessary, and how to choose participants for the member checking process. For the first three elements of member checking the answer was full member checking of every participant. With the fourth, and final, member checking the sample was chosen by two criteria (a) the willingness of participants to contribute to a further interview, and more importantly, that (b) the original interviews were articulate and data rich, thus indicating a good potential for discussion of the final transcripts and analysis. The size of the final member checking sample took account of the extent, and value, of the earlier member checking and balanced this against the amount of time that each of the final member checks

would add to the data collection and analysis. These factors suggested a small sample of five participants would contribute to the trustworthiness and allow completion of the study on time.

3.7.2 Transferability

The core view of the naturalist is that only working hypotheses may be abstracted, "the transferability of which is an empirical matter, depending on the degree of similarity between send and receiving contexts…". This contrasts with the positivist paradigm that stipulates achievement of high internal validity within one sample will allow generalisation about other samples (1985: 297). In naturalistic inquiry transferability is the process of applying the inferences of one context to another. Lincoln and Guba maintain that this can occur only by studying both the original context and the new context to generate a more complete picture of the different contexts (1985: 297).

Transferability of the analysis is facilitated by clear descriptions of hypotheses and thick description of the phenomena and the context. Thick description was defined by Lincoln and Guba as "a thorough description of the context or setting within which the inquiry took place and with which the inquiry was concerned…[and] a thorough description of the transactions or processes observed in that context that are relevant to the problem…" (Lincoln and Guba as quoted in Kuzel, and Like, 1991: 153 citing Lincoln and Guba). Thick description serves to enhance credibility where the description illustrates how the final analysis was obtained, and to ensure this Sanjek (1990: 401) recommended the "accounting of the relationship between field notes and the ethnography based upon them…".

In practical terms this may be interpreted as including the "working out" of emergent concepts, and discussion of emergent hypotheses and their part in the final analysis. Patton placed thick description and reporting of processes as "…an obligation to be methodical in reporting sufficient details of data collection and the processes of analysis to permit others to judge the quality of the resulting product" (Patton, 1990: 462). This study includes details of methods and analysis and extensive quotations changes to maximise the potential for transferability.

3.7.3 Dependability and Confirmability

Dependability and confirmability are closely related in terms of the methods used to achieve them. Dependability refers to consistency of the inquiry over time and builds on the same aspects that create "credibility". Key aspects recommended by Lincoln and Guba are audit trails for the study. These make explicit sampling, data collection and analysis procedures (1985: 319).

The study sought dependability in documenting the purposive sampling process and detailing the criteria applied in judging potential participants suitable subjects for the study. Also transcripts of interviews, were checked against interviewer notes and were verified with interviewees where ambiguous statements made data unclear and all raw data and analysis were retained for potential inspection or subsequent reference. Emergent code categories were tested with a specific view to dependability and confirmability. In generating themes tests for co-occurrence of concepts using text retrieval tools within Atlas-ti allowed a large range of tests to be applied to the coding. The results of co-occurrence were checked by reading them in context and in the form of a list of quotations. In this way the categories and relationships were checked and any inconsistencies or errors highlighted. The use of Atlas-ti allowed multiple views of coding and the relationships between codes, a feature which was used as a further element of testing used diagrams illustrating code relationships to visually identify and compare patterns (categories) and any inconsistencies. Confirmability issues are addressed in the present study by maintaining archives of transcripts, Atlas-ti coding and the maintenance of notes referring to decisions and analysis that contributed to the analysis and writing up process.

3.8 Conclusion

In this chapter the basis of methodological theory has been reviewed and the development of the study's methodology from pluralist pilot study through significant changes leading to the adoption of Naturalistic Inquiry have been described.

Details of population and sampling procedures demonstrate the nature of sampling methods adopted and illustrate the size and structure of the sample used in both pilot and main studies. The chapter completes the overview of the methodology with sections relating directly to the trustworthiness of the results of the study.

4   Perceptions of interdisciplinarity

In looking at the literature of interdisciplinarity a coherent working definition of interdisciplinarity was derived (see section 2.1). That definition gave the basis for identification of the study's sample. As a Naturalistic Inquiry the perceptions and definitions held by the subjects of the study were important in developing a rich view of interdisciplinary information seeking behaviour. Each interview began with the interviewee's perception and definition of interdisciplinarity and the question "What do you understand by the word interdisciplinarity?" Participants' definitions and illustrations serve a dual purpose in the research. Firstly as a tool for member checking the definitions were compared with the literature derived definitions, in doing so the interviewees validated their status as interdisciplinary and secondly in defining their understanding of what interdisciplinarity was about. This chapter presents the perceptions of interdisciplinarity expressed by participants.[2]

4.1 Number of disciplines

At the most simple level interdisciplinarity was found to be purely the use of more than one discipline in the completion of an academic project, be that teaching or researching. Simple though definition by numbers may appear it strikes at the heart of the conceptualisation of interdisciplinary research: The theme of a multiplicity of disciplines.

> "Any subject that is informed by a number of different areas of academic interest". P8: 8:1 (5:5)

> "Oh, covering a wide range of subjects, well it could be narrow, so within a discipline it could be covering Anatomy, Physiology, Life Cycles, Genetics, these topics within the broad subject area of Biology, or it could be wider than that and cover Biology, human aspects of Biology like medical, Historical maybe even Archaeological and Poetry and Folklore". P27: 27:1 (4:7)

> "I see it as crossing many disciplines, and by disciplines, I mean areas of study". P7: 7:1 (6:6)

The numeric categorisation of work as interdisciplinary or mono-disciplinary was a superficial definition that was joined by more descriptive, in-depth, and indeed useful, definitions used amongst members of the sample. From analysis of transcripts three main interpretations were identified.

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[2] Throughout the presentation of interview data the convention used provides a unique identifier. For example the label: P27: 27:1 (4:7) indicates a quotation from a Participant coded as number 27, quotation number 27:1, and an indication of line numbers within the transcript.

4.2 Bridging

A further definition obtained from interviewees was that of working in one area and accessing information by bridging across the gap into other disciplinary areas. Highlighted particularly in the need to work in more than one area while being based in another.

"I would suggest that interdisciplinary means that you are actually crossing the boundaries of several definable areas of research or expertise or investigation which in other words you are going beyond your own area of competence and expertise, you are going into a completely different area. That is where I would put interdisciplinary, you are probing outside a lot more". P16: 16:4 (72:79)

"Well interdisciplinary I imagine is research that cuts across different boundaries, my own actual position is a conglomeration of Sociology, Psychology, Marketing, and all other subsections within communications. So I guess I am a good example of what I understand as interdisciplinary. Multidisciplinary is I think a similar thing without the interconnections - lots of different research areas but not necessarily overlapping or integrating". P22: 22:4 (32:37)

Boundaries imply different academic traditions, academic traditions which each have their own questions, interests, methods and philosophical underpinning.

"Well, I suppose that I see it in two ways, one is coming from different academic traditions and education, sort of set-ups in a way, so that you have been schooled in different functions and secondly I suppose it is also crossing different mind sets as well, the two can go hand in hand but not necessarily". P3: 3:1 (11:14)

Working across areas that would not normally be connected, a conscious effort.

"Yes, I would understand that [interdisciplinarity] to mean that one is working in more than recognised discipline or one area, obviously I suppose the key definition, is how far does a discipline extend and that is going to vary enormously. I suppose multidisciplinary for me at least means working across areas which would not normally be connected and are therefore connected by whoever is working in that area as a conscious act". P5: 5:1 (5:9)

"Interdisciplinarity to me, means crossing what are known as traditional subject boundaries. For instance, the cross between Geography and Geology where you are starting to wander into the fields of Geomorphology". P21: 21:1 (5:12)

The movement through disciplines and across the boundaries also included crossing over the barrier to material beyond traditional academia.

"I think anything that crosses out of English Literature into other fields such as science or History or Modern Languages, but also out of academia into the Media, Advertising and Journalism and so I would see it as having different ways. Disciplinary as in going to more than one discipline but also interdiscipline by going outside academia". P37: 37:3 (4:7)

Throughout the focus on a connection between disciplines was apparent in the working definitions described.

"Well, the one that I am working in which is management and music, in the real world the management of music is quite normal, but in terms of study and academic work, the two are very unrelated. So it doesn't mean to say that they are necessarily disciplines that don't have some contact somewhere, but in the environment in which one is choosing to work they are unlikely to be connection. That doesn't that they can't be connected, just that circumstances have dictated that they aren't connected". P5: 5:3 (14:19)

"I suppose different areas of specialisms, it might be the Social Sciences, Health Sciences, and so you would have to look in different areas for your information, but there would be common strands". P17: 17:9 (155:169)

Those connections were described as drawing upon information, knowledge, experts, techniques from across areas in a pattern which implicitly assumes institutionalisation of disciplines hasn't occurred. The information seeking exercise was therefore a connection building, or bridging, exercise.

> "It must be work which draws from whatever is understood, which I would tend to equate with the structure of the university, in other words I have no very very strict definition of what a discipline is, in other words, I would take as read that a discipline is defined as in the university structure. I think probably coming from different disciplines as oppose to relevant to different disciplines. As oppose to single disciplinary having implications for different disciplines, but to me multidisciplinary research actually draws upon techniques, knowledge, and approaches inherent in more than one discipline". P9: 9:1 (3:13)

The connections highlighted were not necessarily all one way, the interaction of disciplines as a conversation suggests a more involved way of working.

> "I think most of my research has been interdisciplinary, I suppose a conventional definition of interdisciplinary would be literally a conversation between different disciplines identifying an approach which in my case would draw on Geography, Anthropology, Sociology, Cultural Studies,... So I am interested in something which goes across the disciplines rather than something that brings a series of disciplinary distinct perspectives to a problem...". P12: 12:1 (6:16)

The theme of interaction and indeed generation of new ideas continued in other definitions:

> I think interdisciplinarity is an attempt to create a process of thinking, researching and teaching which attempts to bring into play in a creative tension a number of different perspectives. The emphasis is upon the creative tension and part of the interdisciplinary task is on the one hand to explore presuppositions underpinning these different perspectives on the one hand and on the other to begin to recognise where the contradictions and commonalties are and thirdly to begin to learn to be able to respect people who you work with but who you disagree with. So rather than close down debate, differences are the life blood of interdisciplinarity. P19: 19:1 (5:13)

4.3 Integration

Concepts and discipline specific knowledge are at the heart of the idea of bridging described in the previous sections. Another perception of interdisciplinary research was that of integrating concepts from different disciplines to build a new disciplinary area in the interstice of the original disciplines. In this variation of definition, interdisciplinarity was seen by interviewees as being both between disciplines and combining more than one.

> "I am trying to understand in a way, I am trying to marry concepts here from the computer world and bring it into an understanding of the Marxist economics concepts". P2: 2:63 (46:49)
>
> "...but when you have to combine different things to make your topic, then one database, or even two is not going to be enough, and if you need to expand in other areas and think of your topic from different angles". P24: 24:32 (54:57
>
> "Well, different disciplines are different areas of science and medicine and interdisciplinary is combining those different disciplines to produce a synergistic outcome. In terms of, like building a jigsaw, adding all of the different disciplines can produce a complete picture which wouldn't be possible with just one or two of the pieces". P13: 13:1 (5:8)

The idea of integration, of merging two or more disciplines into a new product, was widely acknowledged.

> "Well, interdisciplinary to me, conjures up a form of practice or research which draws upon concepts and principles, theories, models, whatever, from more than one recognisable academic discipline...". P23: 23:23 (5:15)

> "I suppose, interdisciplinary, and to pinpoint it, interdisciplinarity, is the integration of material which ostensibly at least derived from different methodological or theoretical approaches which have been rarefied as disciplines over the years, which in my case in particular would be History, and Archaeology, but also a bit of Anthropology and at this point I could recite a mini lecture on the relationship between History and Archaeology". P35: 35:3 (7:11)

The biggest obstacle linked to this variation of interdisciplinarity was the nature of knowledge and information held within disciplines. Interdisciplinarity could be viewed as the natural state for information and for which integration of concepts was in fact a re-integration of concepts.

> "That is a very difficult, but perceptive question, if I may so, in a sense I suppose, I assume that knowledge is indivisible, and that you are in separate disciplines, but they are just for convenience, like Biology, zoology, History, Psychology, Politics, a label, because otherwise one wouldn't know a particular part of the territory, but in a way a discipline is an artificial construct, there have been disciplines that were taught in universities a hundred years ago that no longer exist, and then there are new disciplines such as Biomedics and yet two generations ago the people wouldn't possibly have known what was being referred to. But, therefore interdisciplinary, if you accept the convenience of having conditions - i.e. working across those divisions, then questions the artificiality or not of the division". P40: 40:2 (5:16)

4.3.1 Borrowing and the definition of interdisciplinarity

Within the definition of interdisciplinarity a further distinction was made, interviewees suggested that interdisciplinarity could be equated with borrowing information. In essence interviewees described their acquisition of the information of disciplines without contributing to the original disciplines, merely obtaining the parts that matched their present criteria. As noted in a later chapter, section 9.3.5.1.2, this borrowing could be interpreted as pillaging by members of disciplines.

> "Well, it is a practice of research which draws on the research of people outside of your own discipline, the discipline in which you have been trained, but also employs the methodology of those researchers outside of your discipline. So it is about information and method I think". P31: 31:2 (4:7)

> "It means taking insights and concepts from more than one discipline...". P33: 33:2 (6:9)

4.4 Conclusion

The multiple definitions of interdisciplinarity come together as a coherent whole, a single perception of interdisciplinarity, when viewed within the context of academic research. Bridging and Integration may be considered two standpoints for consideration of a topic. The

first, Bridging, suggested more connectivity with a 'Home' discipline, whereas Integration suggested a middle ground without a strong connection to the disciplines pertinent to a problem.

In considering the definitions of interviewees and how they relate to the working definitions applied for sample selection there are strong similarities between interviewee self conception and researcher judgements during sample selection. In essence the definitions confirm the validity of the sampling technique adopted by the study.

5 Core process: Opening

5.1 Introduction

Opening is the first of three core processes revealed by the analysis. The concept of an "opening" may seem familiar and bring to mind starting, initial moves or initialising operations found in some other models as the first step in information seeking behaviour (Ellis, 1989; Kuhlthau, 1993a). That is to say, generally models of information behaviour have all described starting points. Starting points in these models entail a number of activities or processes such as problem definition, initial searching and exploring and are often seen to exist at the beginning of a search.

However, Opening as defined here was not merely about beginning. Opening appeared in the data as continuously looped or cycled with other core processes. Opening was central to the model and represented much of the active and holistic understanding of the researchers studied. Interviewees used the word "Opening" as the term that best fitted how they developed their topics through information seeking and described their activities as a non-linear sequence, dependent upon the Cognitive Approaches (Chapter 8) and Contexts (Chapter 9) associated with the information seeking of interdisciplinary researchers.
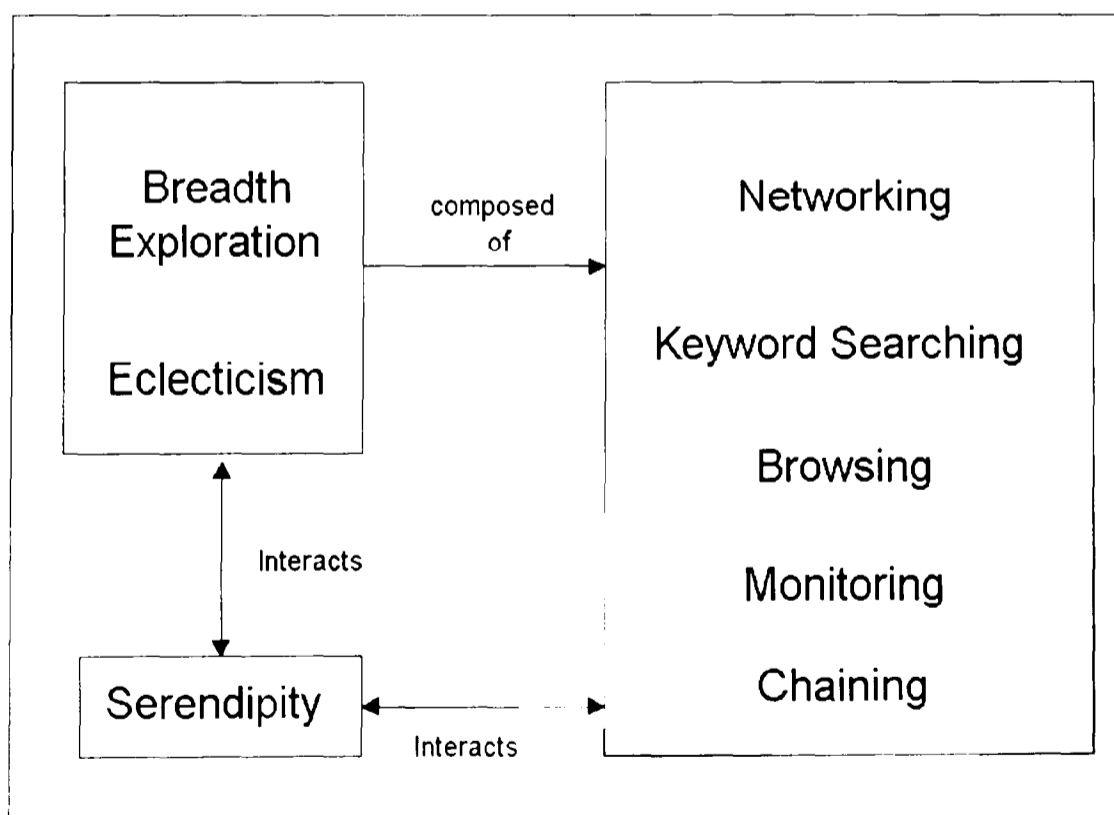
Figure 12. An Overview of the Activities and Strategies of Opening

5.2 Strategies and activities

5.2.1 Breadth Exploration

Breadth Exploration appears here as a strategy, or approach, to information seeking. As a strategy Breadth Exploration was identified in the data as a conscious expansion of searching to allow exploration of every possibility. Emerging early within the interviews Breadth Exploration developed into an identifiable strategy associated with a distinct definition, information needs and use of information seeking techniques. Breadth Exploration emerged in the analysis as a strategy based on several activities. The strategy appeared most strongly at the point where new disciplines or new ideas and concepts were required. These needs appeared at all points except final writing up of research, prior to which interviewees felt that they should be ready and indeed pursue all aspects potentially salient to their research.

5.2.1.1 Definition

The concept of breadth was most graphically illustrated in its effect with reference to a conscious strategy of seeking breadth of exposure.

> "A kind of splatter gun approach and see what is out there...". P11: 11:33 (270:276)

> "...Part of a conscious search strategy that I would start out more broadly and then if I discovered that that wasn't working I would find ways to work it down a bit until it did produce reasonable results". P39: 39:19 (129:131)

> "...Or I might have deliberately started with a broader search so that I could narrow it down". P39: 39:18 (120:126)

Breadth exploration, as opposed to exploration, was identified within the interviews as conscious, deliberate, strategy of expanding information horizons to bring within range information types, information sources, concepts and disciplines. At the simplest level descriptions focused on describing the breadth of information seeking.

> "It would probably be a bit broader than the original area just to spark off ideas". P9: 9:33 (149:150)

> "Well, rather than naming the gene, maybe you name the particular condition, or something like that, e.g. pancreas, sugar and how far back you go". P14: 14:17 (105:106)

Variations within descriptions highlighted perception of creativity, as in the quote from interview P43, and the meshing together of strategies, results and subsequent actions suggested in the quote from P14. External factors were mentioned as influencing behaviour as in P24's description of doctoral research. Context is discussed further later in the thesis chapter (Chapter 9, page 214) as one of the major factors affecting information seeking behaviour.

> "...There is a creative phase where one is really trying to look around a whole lot of areas...". P43: 43:29 (350:355)

> "...and then start general and that may bring up issues and I may know people in particular fields and it may be appropriate to contact them". P14: 14:4 (19:21)

5.2.1.2 Breadth Exploration and Information Needs

The Breadth Exploration strategy was found to play a particular role in meeting the information needs of the interviewees. Information needs were described as being for a "big picture", "broad picture", shaped the strategy by defining the focus and quantity of information required. Interviewees indicated that short projects were likely to be the subject of less Breadth Exploration than more substantial projects. Breadth Exploration was perceived by interviewees to be a product of the type of topic and of their knowledge level. P24 exemplified the search for a "big picture".

> "...you need to be able to draw the big picture and so you have to be able, so you have to start by trying to find as much information as you can, try to draw different areas that would be included in your bigger area of research and probably try to step back and see the picture from a distance and probably make an effort to identify yourself in there.... For me I would rather have the big picture and try to draw that and be rather holistic and then try to narrow down and focus on certain areas of interest". P24: (24:36)

Development of a full understanding was seen as a necessary step in interdisciplinary information seeking. Without the overview to present interesting leads, and indications of where effort would be profitable, some interviewees considered themselves less likely to pursue fruitless leads, as in this quote from interviewee P9.

> "I have got to get the broad picture, in other words I am very unlikely to dive in and start reading in great detail, particularly looking at new aspects, I have got to be assured of the overall 'where does this fit in' I am very unlikely to commit effort and time to something that won't subsequently be useful...". P9: 9:55 (89:95)

However, breadth also implied finding more than could possibly be useful, but viewing this as essential. For respondent P11 this was highlighted by creating a large surplus of material within which localised Browsing could occur (discussed in section 5.2.5, page 97).

> "...I don't trust search engines and I don't trust my own ability to be able to hit the right words I tend to be a browser, so I tend to have a memory of going away for a weekend as a PhD student with the green printouts we used to get from printers and sitting in a mates garden with her reading a novel and me leafing through these BIDS titles looking for something to catch my eye, just browsing really, I think that is probably not very efficient, though I often don't know what question I am asking at the start, and that is probably why". P11: 11:39 (308:318)

However, Breadth Exploration was not directly driven by an information need or created from an originating Problem Definition (discussed in section 6.6, page 165). Indeed, Problem Definition arose as something that tended to follow Breadth Exploration and could occur quite late in a project.

> "For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason. I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. But in a way I haven't absolutely defined it yet, I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it". P7: 7:12 (86:99)

5.2.1.3 Activities associated with Breadth Exploration: Directed Stepping Back

When considering activities in Breadth Exploration, it is important to consider that there is often a background level of information, or knowledge, present in the information seeker. Such a factor affects a number of functions from Source Selection (Section 6.5, page 152), Keyword Identification (Section 6.4, page 148) and Sifting (Section 7.2.3, page 184).

> "It is very seldom that one ever has a kind of blank sheet to begin with. Almost the fact that one has an interest in it means that has picked up background pieces of information along the way. So it is largely a matter of developing those seeds. So my standard route would be reading pretty widely so chaining things through the library, web of science and search engines of that description, bibliographies, references etc.". P34: 34:5 (22:27)

The conscious decision to reveal a bigger picture and allow information that was otherwise hidden to become visible drove this Breadth Exploration. In coding this was identified as "Directed Stepping Back". It was identified as a property of the practical approach to Breadth Exploration adopted by respondents.

> "Well, I think I probably try to take a step back from the specifics and ask myself what are the issues, what are the real issues of the whole situation and try to be as objective as I can about the importance of the different facets of it...". P16: 23 (123:133)

The theme of broad searching and drawing on a very wide range of sources was continued elsewhere by interviewees describing what their advice to others approaching the same subject areas would be. Respondents P9 and P28 were typical of the theme.

> "....Being widely read, in other words actually get in to the library, develop scanning techniques so you scan a lot of ground, and as regularly as you can look at a wide of journals and just sort of scan the contents lists, and if you subscribe to abstracting journals. I suppose I am talking breadth, be as wide as you can, even the popular science and nature I have occasionally found some useful stuff there. I suppose my own style is to work on a very broad front, it is the broad front that sparks off ideas". P9: 9:50 (303:315)

> "I would say search widely for one thing, which is an obvious thing to say, but I think looking widely, and read and write and try to get a grasp of the field really early on to try and get a grasp of who the main people are in the area and what is going on". P28: 28:16 (188:190)

> "I think the first thing given a problem is go for a literature search around the problem". P14: 14:3 (19:19)

In practice Breadth Exploration meant avoiding the specific area, even where initial knowledge was high enough to allow precise searching, in favour of breadth and diversity: this was accomplished through two channels identified within the interviewees description as essential to composing an overall big picture, they were: Choice of Keywords and Choice of Sources.

5.2.1.3.1 Choice of Keywords

Where respondents talked of breadth and broad results they were asked by the interviewer to describe the actions associated with that strategy. In the first instance this meant defining keywords (Section 6.4, page 148) that belonged to a more general, rather than specific

categorisation. If a menu hierarchy existed within sources then wider headings were selected first in preference to narrow ones. Using this method brought in new possibilities and conceptual groupings.

> "Well, it would be in terms of the concepts that I would start with a broader term, e.g. it would depend on the source that I was looking at, if it had a hierarchy I might start with a broader term and then go down to a narrower term conceptually, if it was there on a search engine sometimes it would be that but more likely it would be that I would start out with a range of alternative words. Then I might get an idea of the recall that I got from that and then play around with the words and see what I got, I might also start by using 'not' limiting it - but then search engines can limit by domain name or language, or year of publication". P39: 39:20 (133:146)

> "I think of the keywords, you can do sort of exploding an area where you put in one big umbrella area and then narrow it down, or you can start off more restricted and widen it out, or if you know that somebody has written a lot on an area and then look for citations. So if I find its quite narrow, then if you have a good reference then you can find other articles that cite their articles and be honing in on that area. But if you are new to the area, then you probably haven't got that and you probably have to start wide and work down". P4: 4:5 (49:54)

5.2.1.3.2 Choice of Sources: Source Selection and Stepping Back

Decisions as to the source used for searching were as diverse as the range and justification for selection of keywords. In Section 6.5 (page 152) Source Identification and Selection Decisions are highlighted separately.

Libraries and traditional text materials played a key role. Libraries, by providing browse and search enabled library catalogues along with, and more importantly for many, providing open shelf access suggested opportunities for movement from one subject to another and investigation of a range of materials without previous knowledge. Specific literatures included undergraduate basic texts along with editorials, and review articles from journals. Following this line of approach material of an introductory and general overview were obtained.

> "Things like undergraduate readers in social Anthropology, or History and Anthropology, picking and looking for editorials in the journals though I haven't pursued that very hard. but that might be something if I specifically wanted to push this further then that is where I would go – to pick up what seemed to be the leading journals in the field and then just stand somewhere in the library where there are open shelves and then stand and read the introductory editorials and if there are any and look in the journals for review articles which you tend to get. This is the kind of work that can only be done in a library where you have ready shelf access to the journals so you can just walk along the shelves. Some publish review articles every issue, some only do so every two or three years, if they have got an index it helps, but I tend to just do it by picking the things up". P30: 30:6 (103:113)

However, the Internet and online databases were seen as contributing the widest range of results. Traditional means were supplemented and paralleled by duplication of searches across databases, and across different disciplinary sources. In this role BIDS and the Internet Search Engines were valuable.

> "...and I duplicate my searches in the sciences and Social Sciences because I am right on the border between them. But that distinction isn't any good for me – it might work fine for biologists but some of my journals can be either. But if I did find, say Psychology is the best example, Psychology has a bit of an argument going on here then I would focus on that, but I

don't start off with a literature in mind, I am really searching for the literature to start with".
P11: 11:32 (270:276)

"I think I wouldn't focus on one particular area, I would use much broader strategies, talking about databases for example I would look at databases that covered all of the areas, so it would be BIDS, Medline, Cinahl, and the same if I was in the library I would look in all the sections".
P17: 17:10 (175:178)

Databases offered the flexibility to cover a wide spread of disciplinary sources quickly.
Web search engines enhanced this with new material from beyond the academic environment and in full text.

"...There are not many things that I don't try out on Google nowadays. If it is a library and information topic then at some point I will try it on LISA, and I don't think that there is one commercial database that covers all of my interests, so I'll use Information Science Abstracts, and GALE Trade and Industry which is full text, and business files and INSPEC as well". P39: 39:20 (133:146)

Once sources, such as journals appeared within initial searching the principle of accepting a breadth of possibilities meant following leads into new journals.

The theme of identifying leads through broad selection of sources was used to identify items, which appeared parallel to themes already known about, but for which keywords, and index terms failed to retrieve results.

"I try whatever I am doing to frame the question, if I am not searching for keywords in the title – if I am looking for something conceptual I try to frame it widely enough with the intention of being offered a lot of things that are no use, if everything is specific then I wonder if the question was good enough and then I try to broaden it out. ...I choose to keep on the list of things that I will pursue articles that at first sight will look at most tangentially relevant but I would still want to have been offered them. The other thing of course is that I might think that an article that came up in a collection of essays doesn't look incredibly helpful, but the essay collection as a title that might be quite promising and so I might find the volume and look what else was in it and the volume might be so arranged that it wouldn't otherwise be indexed. You can have just one or two papers in a volume that deals with something that is conceptually extremely interesting to me and then I might find I would choose the volume and I might read the ones that were about other [things]". P30: 30:33 (347:372)

5.2.1.3.3 Serendipity

Interviewees, conscious that there should be something at the edge of areas already covered, or in another field, found stepping back generated many serendipitous findings.

"A lot of times if you are very loose with your search terms in these things you can actually pull out the disciplines just by random. So rather than taking the approach that I am going to look for something extremely specific to limit my search, you can actually pull back and do something global". P14: 14:16 (99:101)

"I tend to go in with very simple questions to begin with and then from those questions I will start refining until I get to the pieces of information that I want. I actually even do that when I know immediately that I couldn't find it... because sometimes the randomness can throw up angles that you haven't thought about.... Yes, deliberate randomness...[but] you wouldn't go in and search for pigs when you wanted cows". P14: 14:27 (150:166)

In the drive to achieve breadth and identifying unknown serendipitous results were often closely associated in the data with the concept of directed stepping back particularly in the

deliberate choice of "random" or "less focused" keywords for use in databases and internet searches, and browsing visits to library shelves to increase material from tangential disciplines.

5.2.2 Eclecticism

5.2.2.1 Definition

Among the activities associated with the opening process interdisciplinary researchers within the study had a proclivity for eclecticism. Eclecticism as a broad coding follows the dictionary definition of the OED as "That which borrows or is borrowed from diverse sources. Also, of persons or personal attributes: Unfettered by narrow system in matters of opinion or practice; broad, not exclusive, in matters of taste" (OED Online Second Edition, 1989).

In the case of some research it is examples and lessons from other situations that are "borrowed" as well as more substantial information. In these cases some degree of mental agility was often called for in recognising those other instances, as serendipity of recognition. Respondents found searching for analogous problems to be a challenging pre-occupation, sometimes also resulting from serendipity, but also as a product of directing attention across broad exposure to areas, disciplines and sources in which the newly identified analogies might arise.

> "It is the systematic exploration of a topic which uses in an eclectic manner concepts and perspectives, concepts and perspectives are words that enable you to open up an angle of vision derived from different disciplines". P2: 2:1 (14:16)

> "So I have a mixed background of mixed disciplines and mixed methods. The other thing that has allowed me to be quite multidisciplinary in my work is that both of my post-docs I was hired for my qualitative data skills. So because I had experience of interviewing and manipulating qualitative data, and the first one was on strategy making with senior management and the second one was on innovation in high technology organisations....There are a number of literatures that I have ...contributed to. And now when I look at problems I am kind of thinking 'I wonder what people say about this' and 'ooh this problem must occur in this', so you are trying to match and pull threads together from very different disciplines to try and catch problems". P11: 11:2 (63:74)

Eclecticism complements other aspects of information seeking, particularly Networking and Serendipity, and appears here as a strategy for accessing vast amounts of information, across disciplines and from many information sources, and not only accessing but storing and filtering information for future incorporation into further information seeking activities.

5.2.2.2 Channels

The number of information channels participants exposed themselves to was an important part of Eclecticism. Eclecticism as a strategy was seen in the interviewees' motivation and drive to obtain information from as many channels as possible and to absorb as many "snippets

of information" as possible to reveal new concepts and ideas. Identifying a problem as containing a generic core appeared central to the success of this type of strategy. Serendipitous results came only after considerable thinking and exposure.

> "...I get stuff from all over, but once I can get into that it is just finding those communities I have to think to myself who would have a similar problem to this, because it is a new discipline, it can't be a brand new problem there must be problems like this, who would have problems like this, where would I find out how they have solved them and see if that helps me...". P11: 11:49 (219:244)

Hence, for interviewee P12 the nature of approaching a subject eclectically included a conception of looking across sources without restriction to places where possibilities of acquiring information bit by bit might be enhanced.

> "Well I think again as in economics there would be a very clear status hierarchy in terms of what the good journals and indeed what the journals they would look at on a regular basis would be, I am sure there are exceptions, I am sure there are economists who read Sociology and occasionally read Geography as well, but it is characteristic of a discipline like Geography that it doesn't restrict itself to a particular set of journals or to a particular set of sources - I think that it is much more eclectic. It is true of conferences as well – that some people will only go to their disciplinary conferences and I think others will go to conferences whether or not they are described as a Geography conference or not". P12: 12:6 (68:76)

While interviewees P19 and P36 were particularly keen to stress the range of possible sources that they would be interested in.

> "I think personally it is about a multiplicity of avenues which would include looking at the government thinking and policy related to the topic, the ways in which specific professional groups are involved in the topic". P19: 19:58 (267:272)

> "Quite eclectic, always thinking about 5 or 6 fields at once, there are also always certain interesting congenial authors to be looked out for". P37: 37:61 (246:247)

The contrast of respondents' interdisciplinary experience with their own single discipline experience, suggested that in single discipline work they found much less reliance on the Eclectic strategy than in their interdisciplinary research.

> ".... Looking at my own history of moving from single to multi-discipline I have to say that funnily enough single discipline work was much more related to the disciplines and journals and interdisciplinary work you really have to rely on journalism and the business press and everything that passes your desk because it is basically what journalists do better, not that they do it well, because they lack a kind of single disciplinary depth and sounding board in their own heads, and because they are not so restricted, they pick up anything that goes, so actually it makes for more lighter reading". P2: 2:36 (287:293)

5.2.2.3 Activities

Interviewees talked of their Eclecticism in such ways as to suggest that it had the potential to be both an activity and a strategy. As much as Eclecticism contained much that is passive in nature, it also contained elements of motivation and reliance that shaped its form in the behaviour of interdisciplinary researchers.

An Eclectic approach makes use of all activities of Opening category, of which it is a part, to retrieve information. Though, as respondent P9 commented "getting crumbs" is not always the most effective way to work.

"I would say it was a very eclectic muddling through process really. [*Can you explain that for me?*] I suppose I am taking bits here and bits there, there is no kind of order to it really, I am just taking or looking at sources that I either know about already, or somebody has told me about, I always imagine people do it in a more ordered way than I do, perhaps people don't perhaps they all muddle through too, perhaps as a new researcher or lecturer you always think others are doing it better than you. Though I do muddle through things, but I think that is a function of the job as a whole". P22: 22:33 (331:341)

Diversity in the type and range of source generating activity was a major theme in interviews.

"...I do regard a primary search strategy in very broad interdisciplinary research like mine as literally listening to Radio 4, watching television, crazy non-academic things... Just recently for example I tuned into radio 4 a researcher came on and was talking about brain lateralisation, it is highly unlikely that I would have come across this by searching, probably not by browsing the journals, within a couple of minutes I logged on to the web and found some new academic work on this new aspect of the research ....you know you are listening to something, you are talking to somebody, you are looking at a journal out of boredom, and you are looking at a journal in another section of the library and you turn up something that can later turn out to be quite key and give you quite a new direction. I am sure that I could do this more systematically, but in a context when you've got time. But in a context where you don't get to the library for three weeks, four weeks, you just pick up crumbs where you can, so rather like a pigeon in Trafalgar square, I think I resent not having the time to do it more systematically, so I am just getting crumbs, and you've got to put yourself about a bit to make sure you get lots of crumbs....". P9: 9:18 (68:85)

As in this quotation, from interviewee P9, Eclecticism may be characterised as "Pigeoneering", after the description of a pigeon collecting breadcrumbs to satisfy its hunger. Participant characterisations of Eclecticism tended to be coloured with metaphors. Hence, interviewees move from metaphoric Pigeons, to metaphoric Magpies, as shown in this quotation from interviewee P43.

"We had a flood here, but there is a box here of things that were rescued and there is a mixture of things here from course texts, from email, from all over the place, for example even an in-flight magazine, you would never randomly search for these things but in-flight magazines, aerial photographs, I discovered that somebody is actually putting together a world collection of major city centres that the airline flew into and so on. No one could have predicted that there was a source of these things. But, yes I would sort of fairly Magpie-like in gathering these sorts of things, I was sorting through stuff yesterday and came across something on an exhibition which was once on wire toys from Zimbabwe, and you wonder what has that got to do with it....and the source was an exhibition catalogue of these things, it is not scientific data, but faced with this I wonder how far could we get our young children working [the focus of the project] and doing something like this....it would certainly not be just from conventional academic sources". P43: 43:22 (230:257)

Interviewee P35 went further to cite the work of an 8th century scholar to highlight the idea of "flitting like a happy bee" from source to source.

"I do what I tell students to do, which is read other people's footnotes and when you stop seeing things in the footnotes that you don't know about you might be quite close to having done the reading. I am quite comprehensive in this and I like to read things which are meant to be rubbish or out of date because they sometimes suggest things that have fallen out of favour....I tend to jump around quite a lot in no particular order, and I don't organise my notes,

I am desperately un-organised they are all jumbled together. I am like a happy bee - someone I think Alcuin[3] said, moving from flower to flower collecting pollen, in my case it is information". P35: 35:12 (49:56)

Perhaps the characterisation most significant to sum up the eclectic approach was the "cooking pot" analogy. The way in which the eclectic approach fits in to the larger pattern of information seeking behaviour was illustrated in the words of respondent P2 in the following response to the question "As you progress are you looking for different things or change how you look for things?"

> "No, it is a bit like cooking in a pot, I keep adding things, and then at some point and I am now, going to draw up something like a taxonomy of characteristic features that are said to belong to this so called new economy and I kind of throw in there all the words because writers don't all write under the same name of the new economy that would be too easy, so you read something about the way business organisation is changing into the virtual firm, and you read something about connectivity and you read something about micro-entrepreneurialism, and you read something about venture capital and why America is so good at this and you start categorising them ...and you remember reading something from a long time ago about diminishing and increasing returns that I came across in something entirely different. So then you have this whole taxonomy so you see clearly...then you do get these more grooved passages into traditional orthodox disciplinary context because I do want to go beyond the journalists...". P2: 2:48 (219:243)

5.2.2.4 Passage of time

The use of analogy in interview P2 was particularly useful in conveying the idea of a passage of time throughout which Eclecticism developed and produced a useful resource. Eclecticism occurred over a period of time, as a sustained cumulative approach, rather than a short-term intensive method of information seeking. The time element was emphasised by respondent P2 who likened the method to a traditional German "rum pot".

> ".... For example I do actually browse in libraries and I don't really search, and I ask colleagues... and I keep it sort of filed away in my head for a while and then as a sort of constant signal to pick up things that I come across, like this current one, I will have it in the back of my mind for a very long time, months, maybe as much as a year, I am sort of thinking that will fit in there with my book I really must mention this, I mustn't omit this, and I read masses of journals, not so much journals as journalistic magazines more, but a huge amount passes my desk and then I read books because I come across a review and I sometimes think that sounds like it might be interesting. So it is a bit like maybe not a cooking pot, but perhaps the analogy should be perhaps like the old fruit and rum pot, like they have in Germany, where they start in the summer with the dirty old fruit and they just dump it in a barrel in the corner and add some brandy or rum or something and every time you come across something you just throw it in and by Christmas it has all fermented and beautifully melted together and kind of well it is there. So this is how it goes, and I do it with another topic [at the same time], so this is why I have a lot of clippings...". P2: 2:35 (266:281)

> "I will have to be selective in answering the questions because I am very eclectic in researching c17th century through to c20th century period theory and ...I am interested in as well is something called kidult....I'm still gathering things, whether or not they fit into the final

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[3] Alcuin, abbot (804) - an 8th century scholar, Alcuin of York, known as a great educator, took charge of York's cathedral school in 767. In 781 he accepted an invitation to take up residence at the court of Charlemagne at Aachen, whose educational and ecclesiastical adviser he became.

project, but it's not finished so I can't tell, but I have written five books and I've got a shelf full of nearly 200 items so I am constantly gathering new examples, newspaper clippings, ideas that I come across in other people's work". P37: 37:41 (134:139)

Eclecticism was in this way found to be a diverse strategy distributed over time and depending upon many individual activities and information sources.

5.2.3 Networking as information seeking

5.2.3.1 Definition

Networking was a pattern of communication by information seekers via various media and with varying degrees of formality and structure to obtain information from other human contacts. Networking was defined chiefly as talking to somebody, often a colleague, or someone with whom contact had occurred previously. A key element in the process was found in the description of information received from Networking: Networking was an interaction, not a one way process and was perceived as all the richer for that characteristic.

> "So it is partly experience and partly I'll go and have a chat with a colleague, talking to people if I'm stuck, so yes certainly thinking about the stuff on contemporary literature I would almost certainly go and talk to some of the people in the department who work on that area and ask them. I suppose for that very broad area it is best to ask somebody rather than try and head on in by yourself and not have a clue". P38: 38:35 (231:241)

> "Well not quite, because the problem arises again because of the language - accessing a person you don't really talk about accessing people. But I think it is very easy in a culture of processed knowledge and technology to use that term. What we really do is engage with people or relate with people, what happens is that we are different people - so someone else tells me about their knowledge and experience, and so straight away one understands it from my own perspective". P18: 18:9 (132:140)

Beyond colleagues and known persons information seekers ventured out into academic and industrial sectors to find people who might be of assistance.

> "On the other hand, if I feel like this is really largely well beyond my experience then I will probably try to find an individual, probably first within the department and then within the university and then perhaps I may even look for organisations either in industry or universities where I could contact somebody". P15: 15:11 (90:99)

5.2.3.2 The importance of Networking as Information Seeking

Networking as information seeking emerged within the first interviews and continued throughout to be a dominant component of the participants' information seeking behaviour. Networking was particularly strong as a method for opening up an area, especially where other methods had failed to achieve results.

Traditional searching and mainstream databases for disciplines offer a valuable source of information, but respondents recognised the value of networking as being a better tool for exploring their interdisciplinary subjects and opening new concepts and areas not revealed

through other means of searching. The fact that mainstream searching was perceived as lacking provided tacit encouragement of alternative resources.

"... What I found was, I don't know if it is true generally, but nobody in the university formally knew really, you had to find the experts in the field, in the country before you were able to get anything coherent, or of value, from colleagues. What I mean is that you can run through the normal stuff like BIDS and NME has something called the Music Index and both of those will give you a solid middle of the road background, but if you want a bit more a 'cherry on the cake' then you really do need to go to people who know about it and they may well at the drop a hat say 'well there is this or there is that' and off you go - at least that is how it worked for me." P5: 5:16 (99:103)

The emphasis on different methods of information seeking was continued in interviews such as in the case of respondent P12 for whom searching in databases likewise produced relatively little, whereas informal networking produced many links to information.

"...I am even more convinced that the stuff we found, that was interesting, we found through quite informal networks finding someone in a particular field and people who had recently visited an area we wanted to work in and were interested in, and going to conferences. So for example we found a book about clothing in India and we contacted the author and he put us in touch with a whole series of projects that we hadn't come across before, and we went to a conference in the States and came across someone from Anthropology who also had a network that we had not previously tapped. So it is quite a personal and I think quite informal process that I tend to use." P12: 12:12 (91:95)

Networking as Information Seeking was perceived by interviewees to be more important than other ways of accessing information, as in the experience of interviewee P36.

"[Database use detail omitted]... but it is actually a very small part of what I do. Networking is much more important and quicker' - humans have a better sense and range of answers. I developed my network slowly and unconsciously through this university and through conferences and now I am on editorial boards of journals". P36: 36:22 (195:202)

Similarly interviewee P30, after referring in various ways to asking people, was asked about networking, the response was clear.

"Very important, I can't think of anything that I have written that I didn't seek bibliographic guidance in the beginning in areas where I was not an expert, where I have not written emails to maybe two or three people...". P30: 30:43 (423:446)

Though occasionally, knowledge was seen as necessary as a preparation for Networking, as illustrated in interview P14, the value of Networking in providing assistance on a problem and prevent what interviewees described as "floundering".

"I would certainly still do the literature search first, so I knew enough to be comfortable enough to contact people within that field and then you would identify a part of that field and home in on that and focus the literature search and identify specialists from thereon in that we could contact. So yes, that is it really in a nutshell". P14: 14:5 (21:24)

".... If I have not asked people I feel that I have lost a lot of time because I flounder around in a sea of literature and material and if I had only gone to people - looking back over the years, I think if I had only gone to some people and asked their advice first place I wouldn't have messed around with stuff that has in fact turned out to be quite irrelevant. I can give an example of that - measuring people's self esteem is very very established in Social Psychology but before I had actually got in to making connections with social psychologists I read quite a lot of papers which I now realise were quite peripheral things and of no central use to me. So I think...using the experts is a central thing...I would say an hour chatting time with somebody would give you a slant on a subject area that will be of more use in the early stages than trying

to read a huge amount. Somebody who can direct you in a very focused way in the initial stages can equip you for developing things further". P10: 10:40 (232:237)

The solution of choice for interviewees who found themselves "floundering" was assistance from a social network. The relative value of networking created a perception of social networking as the main information seeking activity and essential to open an area with minimal time expenditure.

"[Traditional searching if some previous knowledge...] If it is a subject matter that I didn't know very much about I would probably look for a subject expert then I would go and ask them where to look. So, if I was going to do something in engineering, then I would go the library web pages and find out which librarian was in charge of that section in the library or email the engineering department saying what should I look at". P6: 6:7 (66:77)

Hence it is possible to see Networking as providing interdisciplinary researchers with a source of "initial knowledge" or a base line to open up their information seeking in unknown disciplinary areas, fields, or indeed information sources. In using this activity elements of time saving, decreased uncertainty (Uncertainty is discussed in Section 9.2.2.2, page 229), and the solution to "floundering", all come together to make networking a vital activity for interdisciplinary information seekers.

5.2.3.3   Networking and Information

Networking provided two types of information: providing the information needed, providing sources from where information might be acquired.

5.2.3.3.1   Networking as a source of information

The use of Networks for Information Seeking provided a number of key informational items. One of the most common informal items to arise was the generation of connections between topics, ideas and disciplines through conversation.

"Another thing that I do a lot is talking to other people, the way that I have done it over the last few years, I tend to be speaking to somebody about their research and make a link and think where our disciplines overlap. I get most from talking to people and how I frame questions nowadays". P11: 11:42 (321:324)

Help with understanding Language and Terminology (covered in Section 9.3.4.2) and with Identifying Keywords (Section 6.4) could similarly be attributed some of the time as a product of Networking.

"...somebody might point out a particularly good author or book and sometimes when you are just browsing in a subject area you come across a keyword several times. It then begins to loom that this is going to be an interesting lead to follow". P21: 21:5 (40:45)

Along with Keywords and Connections, related information types suggested directions for research and specific useful items.

"Well, I suppose, if I think about the Children and TV advertising. There are three others doing that as well. There is me, from the Marketing perspective, [name X] from Psychology and [name Y] from Journalism. The three of us have areas that we are more familiar with and

we use that to pull in the different strands of the different expertise if you like, so in that sense I am using colleagues to fill me in on what is happening in other areas, but a lot of the Marketing and Psychology overlaps anyway through journals like 'Psychology and Marketing', so I have got a foot in that camp anyway, so it is using people, like work colleagues to inform me or point me in the right direction for articles or whatever....". P22: 22:34 (83:97)

Beyond concrete examples of asking for information the collegial Network provided information in the form of unsolicited "clips and cuttings". As a source of information (An effect also commented on in connection with Eclecticism, Section 5.2.2.2) these were a valuable stimulus to interdisciplinary researchers and often provided opportunities to open up topics beyond that possible with other information seeking methods.

"Oh yes, but also like this, this business about the new economy is interesting, a couple of times it has been mentioned in the economist, in newspapers, a nephew even sent me a piece from the Dutch newspapers and I discovered that what was written was very similar from what I had already read...and I also asked a colleague in the business school if he had come across a theoretical model of the new economy, he hadn't but he thought it had something to do with institutionalism or materialism which gave me another concept and another colleague gave me a cutting from the Financial Times about an economics book on the subject which he thought might be of interest. So it does work amongst a small group of colleagues, bouncing off, and the more that I read these few bits and pieces that are tantalisingly thrown at me...". P2: 2:29 (196:217)

The generation of clips of information and keywords was supported by the use of Networking for comment on information that the information seeker was not able to judge for themselves, due either to lack of knowledge or inexperience of the fields involved.

"With information gathering it is not necessarily a problem, but I do find that I am more reliant on colleagues or collaborators in other areas when it comes to information gathering. Whereas in linguistics I can look in a database and look at the titles or at worst the abstract and be quite confident and make an instant judgement just based on intuition or whatever else you might call it - but its possible to say that's in and that's out. I am on much shakier ground with genetics and Archaeology and Biological Anthropology and various other literatures that I would need to look at". P33: 33:23 (195:212)

5.2.3.3.2 Information about sources of information

Information was not only gained in a direct form as in the previous section, Networking was equally important as a way to obtain Sources of Information from which information might later be extracted. In this way information sources for Breadth Exploration were generated from interactions.

"Well, it would depend on what it was, but it is partly way of bouncing ideas off people, and partly that they might come up with ideas about. They might suggest a book and say 'I've got a book about this', so they might come up with a specific source that I hadn't come up with, and also they might help to refine my ideas on where I might look next". P39: 39:8 (50:53)

"...One would be wanting people to be identifying sources to be read and thought through on a particular topic from their areas, what work has been going on, how do people approach it, what do they say are the assumptions underpinning their work, what are the outcomes, how can we understand this, what questions does this approach offer us, what questions does it detract from or not see as significant, what are its priorities". P19: 19:8 (94:103)

5.2.3.4 Humans as a final input

Finally, Networking goes beyond provision of information, or sources to provide an opportunity for interviewees to validate and check their interdisciplinary research ideas. Interviewees spoke asking for comments on their written interpretations of information and of asking for checks on the completeness of their coverage of an area.

> "I would use talking to people again, I would see, as being very important, not only from the point of view of getting information or access to sources etc but from the point of view of them actually validating the ideas that I have got because it is in another discipline, say Social Psychology, which isn't really my discipline, then I would really need to have somebody in Social Psychology area saying 'oh yes what you are saying is a valid, or what you are asking is valid question', it is not something that Social Psychologists would fall about laughing about. so I need the human support to validate my ideas, I think I would probably say that I have more faith in human beings saying 'oh yes that's a very worthy idea', than just extensive reading, you know, if I read for a year on the subject I would still need another human being to say 'why don't you look at that?', so that would be part of the process". P10: 10:11 (78:88)

5.2.3.5 Channels for Networking

Respondents illustrated their social networking as operating through many channels including conferences, social gatherings, colleagues, departmental research groups, in addition to which the value of networking via non-personal mechanisms, specifically found to be the Internet and Mailbase groups which were associated with increased possibilities for networking.

5.2.3.5.1 Networking as Information Seeking: Electronic communication

'Social networking' experiences significantly enhanced the information seeking of the interdisciplinary researchers, and it was often supported by the use of electronic networks. The ability to find others and make associations via the Internet, WWW and Email, was found to be a great enhancement to information seeking.

The Internet allowed some interdisciplinary researchers to gain wider opportunities for Networking and therefore increase their range of information sources.

> "Thinking about the Internet itself.... In terms of advantages it often allows you to find individuals who might be doing something similar and in that way you can set up a small network, so for example in Mental Health and Deafness one of the things that I came across a sign language interpreter ... and because he is keyed into the American journals and I am keyed in to the British journals and some of them don't cross the Atlantic and we can let each other know what is going on. I think finding individuals through the Internet is probably the biggest advantage and networking nationally and internationally is important". P6: 6:8 (79:107)

Staying in touch with a social or collegial network via electronic means improved the value of Social Networks.

> "But, not really searching, yes combing through journals that I don't subscribe to, and every couple of months going up to the library and just checking, but apart from that it is more knowing who is doing what from conferences and from email contact with colleagues". P33: 33:9 (78:80)

Use of the Internet and email offered interviewees an opportunity to make contact with little initial cost of time, and thus increase potential contacts.

"There is also the thing of contacting people as well, and people are often a better, or good complementary source. I have got more brazen about just emailing people out of the blue and again I'll probably do that via the Internet if I find they have a homepage and they say they have certain interests then I'll probably email them. That is very ad hoc and hit and miss, some people are great and others turn out not to have the same interests or whatever, I don't know those are the major ones". P42: 42:24 (97:104)

The email theme continued in the more formal use of email in Mailbase and Listserv groups. These appeared to support face-to-face networks and enlarge electronic interactions beyond them.

"The other thing that we have done as well, is we have set up a group of people who have an interest in this area as well, nationally, and we are meeting every four or five months to discuss issues and things, so there is another resource that I would use, and within the department as well there are three of us working in similar areas, and also we have set up an Internet email list where we post interesting Internet addresses and sites. I would also look at places like the Department of Health, the NHS, where Health Assessment sites have quite a few publications as well". P17: 17:23 (317:327)

"I would talk to people obviously, I would 'hang out', I would do lots of information encountering. I hang out on lots of mailing lists and discussion groups anyway anticipating discussion that might be relevant and maybe exchange of useful references and that kind of thing...". P23: 23:35 (136:145)

5.2.3.5.2 Networking as Information Seeking: Face to face

For potential Network users the role of electronic communication methods was great. However, electronic methods were complemented by making full use of networks of colleagues, conferences, face-to-face interpersonal contacts such as visiting colleagues, chatting, lunches, chatting in the corridor and other social gatherings. Respondents, such as P17, found face-to-face networking, supported by email lists worked well to support information seeking.

".... [Apart from database searching].... The other thing that we have done as well, is we have set up a group of people who have an interest in this area as well, nationally, and we are meeting every four or five months to discuss issues and things, so there is another resource that I would use...". P17: 17:25 (317:327)

"So, it is the systematic search, then there is the prep pre- the project and then an even more comprehensive search later on and then when I am talking to other people about the work, always people will come up with things - like 'that is like such and such' and my network of close people who I talk with cover a range of disciplines and they might led me on to think that I should explore an area and sometimes it is not of interest, and sometimes it is, all the work practice literature was just opened up to me just by a conversation with a colleague and then all the work articulation work led on from that, so I am always keen to follow leads". P28: 28:7 (71:91)

Within both electronic, and face-to-face communications, a distinction could be made between the formal and structured, such as conferences and Mailbase groups and the informal and unstructured casual emails and conversations. Interviewee P43 was particularly frustrated that an opportunity to Network had existed in a salient field and pointed out that disciplinary

conferences often lacked the Network Contacts that would benefit an Interdisciplinary researcher. Clearly, selection of conferences would be a major factor in their value.

> "Yes, I think so, and what I am kicking myself, is that I went to an EDRA conference because I was invited and that it was in this country, but they had been going on for thirty two previous years and I had not been to any of them, and I wish that I had been to them before… ". P43: 43:21 (221:228)

Formal face-to-face networking extended to use of experts such as specialist librarians

> "…If it is a subject matter that I didn't know very much about I would probably look for a subject expert then I would go and ask them where to look. So, if I was going to do something in engineering, then I would go the library web pages and find out which librarian was in charge of that section in the library or email the engineering department saying what should I look at". P6: 6:7 (66:77)

Similarly, examples of Networking as Information Seeking appeared in both passive as illustrated in the quote from Interview P23, the "wait until it is sent to me" approach and as an active "go and ask my colleagues" mode of information seeking behaviour described in much of this section.

> "I would not be particularly proactive, it would be just more a monitoring kind of effect, so yes, just hanging in there on the mailing list, checking stuff as it goes past, picking up on chance encounters with what might sound like relevant references - maybe through conversations with people, going to conferences, so it is a kind of state of alertness but it is not really information gathering as a principal activity". P23: 23:40 (169:173)

As an example of Networking, the quote below from interviewee P12 suggests an extremely active approach of Networking as Information Seeking.

> "Well, in one sector a colleague had just finished a project so we had a flying start with resources, in the other sector we had an overview of academic sources but also an industry overview as well to map the field before deciding on appropriate parts of it for our purposes…. Part of that involved quite conventional data sources so we found someone at the University of Reading in an Economics department who had done a very substantial survey of [names removed by request of interviewee] firms and not just fashion and food and whilst she wouldn't give us access to her database we went and interviewed here and talked her through the kind of project that we had in mind and took advice from her as well. We found her through the trace of a funded project in official sources and then we made the personal contact". P12: 12:13 (111:122)

5.2.4 Keyword Searching

5.2.4.1 Definition

Keyword Searching, as a label for activity is one of the most transparent code labels possible, it is literally, the application of keywords in an information source. As a form of behaviour Keyword Searching was circumscribed by the ability to Identify Keywords (Section 6.4) and subsequently to search using keywords. This effectively limits Keyword Searching to databases and Web Search engines, or similar keyword driven systems.

> "Well, I would use quite term, for example on rehabilitation, even though I am looking at all of the disciplines involved I would use a broad term to start the search. [Can you talk me through it?] If I started with something like rehabilitation then I would introduce other keywords and combine them - probably using therapy or therapist first and then refine that down to speech or

language therapist. I would consider as well perhaps using a condition e.g. stroke, with the rehabilitation as well and look at what I found...". P17: 17:13 (198:218)

"...From there I did in parallel to that the normal type of word searches on the systems that we discussed earlier [databases]". P5: 5:20 (124:126)

"I find the [Library Catalogue] at Sheffield extremely easy to live with because you can search by keyword as well as author and title and you can also go in at the very general level - so I actually find it very usable. The frustration now is that you find that there only two things on that particular topic". P33: 33:13 (118:121)

5.2.4.2 Purpose

The purpose of information seeking behaviour is taken to be fulfilment of a perceived information need. Keyword Searching fulfilled the goal of retrieving from sources material indicated by keyword indexes to be of some relevance. Identifying Keywords is covered in Section 6.4. Keywords were often perceived by interviewees to be the only way to access most databases. A few databases permitted rudimentary Browsing and these are discussed in Section 5.2.5.

Keyword Searching was used in two main ways. The first use was to assemble a quantity of references on the subject area(s). Key aspects of this involved exploration of possible areas through the use of keywords entered into various databases, acting as one of several strategies to investigate an area. Keywords in such exploration also contributed to the Breadth Exploration Strategy (Section 5.2.1), as in this quotation from interviewee P39.

"[*By starting more broadly, what do you do?*] Well, it would be in terms of the concepts that I would start with a broader term e.g. it would depend on the source that I was looking at, if it had a hierarchy I might start with a broader term and then go down to a narrower term conceptually, if it was there on a search engine sometimes it would be that but more likely it would be that I would start out with a range of alternative words. Then I might get an idea of the recall that I got from that and then play around with the words and see what I got, I might also start by using 'not' limiting it - but then search engines can limit by domain name or language, or year of publication". P39: 39:20 (133:146)

The second use of Keyword Searching covered the specific end of the spectrum, as shown in these examples from Interviewees P21 and P24.

"If I am looking for something specific what I would tend to do is identify major keywords that are associated with both and then try doing a search which brought up both, or connected the two in some way". P21: 21:4 (36:38)

"Then there is the internet and one of the things that is very useful to me that I had forgotten to mention Chadwick Heeley Literature Online Database which I am subscribed to and that is just brilliant, I have for example wanted four of the references to Arden in a play and in the end I capitulated in an argument with an editor and conceded he was right. Then I did make a contribution by thinking about localisation and also by thinking of some new references to Arden. Also the word "perspective" I think I got all of the references to perspective from about 1600 onwards". P32: 32:31 (195:207)

A use which also relates to adding material to fill emergent gaps in retrieved material and in checking that no gaps remain to be filled.

"The web, certainly Google and AltaVista and then obviously the MLA database - which is very useful to be able to search for words and authors and sometimes it might be the case that

you find somebody has already written something that you'd like to find if they had written anything else at all". P38: 38:25 (144:155)

"...But there is the other option which I also do, but not at the start of a project, but at some point in the project to reassure yourself that you haven't missed anything through all your informal networks you will go to Athens or Historical Abstracts and type in the keywords to see if there is anything else out there that you have missed". P41: 41:21 (172:175)

5.2.4.3 Sources

Keyword searching was utilised across a range of academic databases. Interviewees from core disciplines as traditionally diverse as Social Sciences, Arts and Sciences perceived value in both databases and the Internet. In this aspect there was a parity of opinion and usage patterns.

The interviewees ranked their sources by ease of access, breadth of coverage and flexibility. Databases and Catalogues that permitted a broad approach and were inclusive rather than specific were seen as highly desirable. Those with less accessible interfaces, less functionality or ease of use were dismissed (See also Source Selection, Section 6.5).

"Currently, I always start by searching through ABI/INFORM, INSPEC, those sort of big databases that we can get to easily through our university's digital library and that broadly covers the areas that I am interested in". P28: 28:9 (100:106)

The general swath of keyword searchable sources included databases specific to fields, online bookshops, and the use of Web search engines.

"Bibliographic databases, Library catalogues, History Bibliography CD ROM, TLS, Online Journals and also Amazon because that is bang up to date, History Database, the other thing I do is citation searches on web of science to see once I have picked something up if it has been discussed and so that I can at least read a review by an expert in that field and see what they think, but it is actually a very small part of what I do". P36: 36:22 (195:202)

The Internet in the form of Search Engines were a common first choice, followed closely by databases focused on each disciplinary component of the research topic.

"The web, certainly Google and AltaVista and then obviously the MLA database, which is very useful to be able to search for words and authors and sometimes it might the case that you find somebody has already written something that you'd like to find if they had written anything else at all. Then journals, I think journals are always kind of useful, things like Language and Literature which I get and then journals in the library and on the net. Again I use the bibliographies and stuff. *[So for every source if there is a loop to a reference and the bibliographic source you might follow that up?]* Yes, sometimes you might look and it won't be useful, but if you've found one useful article then see if that suggests something else useful". P38: 38:25 (144:155)

For others a favourite database often proved capable of providing starting literatures to stimulate further searches.

Where interdisciplinary research included humanities literature the impact of Keyword Searching had a mixed reception. For some the diversity and scope of possibilities opened up by searching using Keywords was immensely effective.

"Well, there is now a database of all works published in England up to 1800 - called the English Short Title Catalogue, which is on CD ROM, so that is actually really the place that you look for printed primary sources and perhaps 80 percent of them will be in the British Library, but not all of them. I think it is quite a new thing still, it makes quite a big impact in

research, being able to search a catalogue for keywords because you know, its only a few years that you have been able to search the British Library Catalogue.... so my point is that maybe particularly in social History where there aren't a lot of particular collections that are necessarily going to be relevant the advent of keyword searching has brought up all sorts of stuff that you wouldn't have even known was there in manuscript collections. I mean like the [topic name removed] thing, I came on [topic] because I was doing a study of homicide generally and I went to the British Library manuscript catalogue and I typed in something and I came up with all with stuff about duels, and then I typed in [topic name] of course and got a lot more and I realised that there was a huge amount of material there that I would never have been able to find without that kind of searching". P41: 41:18 (131:163)

Development of database access was noted by some interviewees as changing for the better and reducing the cost in time and effort of obtaining material. However, though there were benefits to be found for many participants, keyword searching, it was not universally effective. The coverage of databases was a factor in reducing the value of keyword searches. Two factors - the *skills* involved in using keyword searching and associated self-efficacy and the *content* of the databases limited the value of individual databases to interdisciplinary information seekers

"I think to start with, probably less so now because I have got a fair grasp of the basics, but at the start I had to look at lot more widely than people in a single discipline, I think things such as I would very rarely use CD ROM databases or library databases but for example BIDS when I last used it had only one or two tourism journals that I could get information from so it wasn't a lot of use. Whereas I think if you are in a more traditional discipline which has specific database to serve you, which some disciplines do, that it would be much more straight forward". P26: 26:11 (117:143)

"...So then I started doing a broad search, and starting off with just 'interpreter' and 'sign language' keywords and I was coming up with virtually nothing...". P6: 6:24 (170:188)

"[Explanation of strategies and activities used] But I am not a great one for entering keywords, I always get frustrated after about 15 seconds and go off and do something else. [*What is it that makes you frustrated?*] The way in which the information is organised, so the feeling that one gets is that you have to wade through 95% of stuff that is obviously rubbish and irrelevant to find 5%. I have never found anything useful by entering keywords like "religion" and "middle ages", it might work if I just typed Marseille or something but that is a failsafe mode that I use". P35: 35:17 (87:104)

Finally, Self-efficacy and Search Skills appeared as properties of Keyword Searching affecting the perceived value and use of this activity. Self-efficacy was explored in the data and is presented in Section 9.2.2.1.

5.2.5 Browsing

5.2.5.1 Definition

A definition of Browsing emerged from the language and descriptions of the activity in interviews. Browsing was found to mean scanning or looking at information sources or information and which was suggested in the data to contain two modes of Browsing with related goals, these were labelled 'open' and 'selective'. Typically Browsing was illustrated with regard to a context and information source as in these quotations from P30 and P21.

"The other thing that I do a great deal, and which I have ever since I was a research student is the Cambridge Catalogue by Subject so I can choose to go to the shelf to look at a volume that I know that I don't want in order to see what has been shelved beside it. I think everybody who has ever worked in Cambridge they have found serendipitously what turned out to be extremely important, because it is open access". P30: 30:39 (374:392)

"...Sometimes when you are just browsing in a subject area you come across a keyword several times. It then begins to loom that this is going to be an interesting lead to follow". P21: 21:5 (40:45)

For other interviewees Browsing was not considered to be "proper" searching or was even viewed as a "lazy" method of obtaining information.

"But, not really searching, yes combing through journals that I don't subscribe to, and every couple of months going up to the library and just checking...". P33: 33:9 (78:80)

"I do browse, but I browse in journals, not on the web.... for example I do actually browse in libraries and I don't really search...". P2: 2:28 (188:192)

"Well, sometimes they don't relate to each other, they relate to my research, I think that it is quite difficult, sometimes when you are chasing up in a bibliography because something is highlighted that you haven't found in any other ways of searching, so it is identifying new material as well as verifying material that is out there. Browsing is almost like a lazy term in some ways but it gives me, if I am browsing through journals I can see other keywords that might be relevant and it actually under this heading and so I need to use that type of wording, so it makes me go back and recheck what I am doing. So it all relates, but each method assists another method if you see what I mean". P1: 1:25 (194:202)

A number of parameters applied to Browsing relating primarily to mode of scanning and information sources applied, these are discussed in the following pages.

5.2.5.2 Importance of Browsing

However, it may be defined or perceived, Browsing was found to be an information seeking activity of high importance to interviewees, and appearing throughout interviews it was seen to contribute to different strategies and to the use of information sources.

The material retrieved from Browsing was of greatest interest to interviewees and highlights the role of Browsing.

"Yes, I do, in fact for art History, in order to think about some of the images that I have had to look at, I went to periodicals, I remember this very clearly, I went to the periodicals room in the Senate House Library, which is the University of London library, because they have them laid out very nicely on slanted shelves with the covers facing out, so it is readable and user friendly and I just went into the art section and found some great journals and of course that is current issues and then I could look at back issues. But next to the Art journals were the Garden History journals which I hadn't even thought of looking for, and they proved to be very valuable to me, so there is a fortuitous, luck, element, in some of the research that I have found information when I haven't actually been looking for it necessarily, though I have wanted it. So yes, browsing has been very important". P31:31:61 (142:153)

Some interviewees found that defining quite what the role of Browsing was difficult.

"[*Thinking about browsing as you have described, what part does Browsing does play in what you do?*] Well, I think it plays an important part, it is difficult to judge how important, but it certainly is an important part, sometimes coming across new ideas, and sometimes it is about finding something that you are already interested in. So there might be some sort of connection, no matter how tenuous, with it". P39: 39:22 (153:158)

However, though subject to circumstances Browsing was identified as a key process for accessing information by interviewees. It was found to be of most use to information seekers where changes between disciplinary focus and broad searching were needed. Key times when Browsing was described as happening were at the beginning of project, as in interviewee P8's experience of beginning a project and where changes between disciplinary focus were needed.

> "From the research that I am doing at the moment on ethnicity and open space design I suppose I am starting to look at, so like at the moment I have scribbled down to look at some ethnology journals just to have a flick through them I think and I think eventually it would be useful to work with other people from different backgrounds, but at the moment I am still trying to formulate it myself. Another thing I am doing is I am going to a conference where it involves planning and architecture and health professionals so that hopefully will be a place". P8: 8:6 (45:51)

> ".... I haven't looked in the Star Catalogue [University of Sheffield Library Catalogue]. I've used my previous knowledge and guided browsing [of bookshelves] and gained 30 to 40 references in this way and knows of more directly related to policy. Yeah. the bookshelves". P17: 17:7 (104:107)

5.2.5.3   Modes and Purpose of Browsing

Two modes of Browsing were found within the interview data, these were labelled Open Browsing and Selective Browsing. Each mode was associated with particular purposes and needs at the time.

> "I find sometimes if it is something that I have just come across, then I will just browse through it, so it will depend a bit on whether I have been there before, whether I am looking for something specific". P39: 39:14 (81:88)

5.2.5.3.1   Open Browsing

The first of the two Browsing modes was associated with general Browsing composed of Increased Exposure, Gaining Starting Points and Overviews, and Browsing For The Unknown.

5.2.5.3.1.1   Increased exposure

Interviewees suggested that this related to the difference between working in an interdisciplinary and a single disciplinary field. Specifically, the difference of working in interdisciplinary fields means a change from the familiar to a need to look more broadly to develop knowledge of what is available. Browsing was new to interviewee P31 who had been trained in History but moved outwards into multiple areas in the broader Arts and Social Sciences.

> "...I don't think I did browse before because when I was simply looking at History writing I had a sense that there was a corpus of material - an Historical canon - and if you wanted to know about family there were some very obvious books that you would go and look at and they would be your staple. But there is no canon when you are searching through other disciplines, or I don't have a sense of that. So I suppose browsing is just the best example

really. You know, looking at journals titles that you have never seen referred to in History books, e.g. the Journal of Garden History I have never seen before". P31: 31:23 (247:257)

The process of Browsing brought respondents into contact with an increased volume of information and allowed respondents to see their information problem within a wider perspective, as respondent P11 illustrated. Browsing in this manner also suggested self-efficacy was a factor in Browsing and acted to support other activities.

"and I end up with some dreadful long list, but I start to look at the titles almost, and browse the titles, and I soon learn that there are things that I can get out of my list like – recycling in rat guts for example, so now I want all of these things but not these things…. but my first approach because I think I don't trust search engines and I don't trust my own ability to be able to hit the right words I tend to be a browser…". P11: 11:39/11:41 (308:318)

Increased Exposure to information involved an increase in the volume of material covered than would be permitted by an in-depth reading of information found in the Browsing process.

"…I recommend browsing, just looking through, don't read any of the articles in full, just go and get a feel for what is there, and filter feed through this stuff…". P43: 43:32 (406:420)

5.2.5.3.1.2 *Gaining starting points and overviews*

Increased exposure was complemented by the use of Browsing to identify initial information that would provide an opening through which could begin exploration of a topic. Interviewees described how a low level of knowledge directed them towards more Browsing activity to establish the essentials of a subject. As highlighted in a later section, (Section 9.2.1) Knowledge and Understanding had a contribution to the Starting Points of information seekers.

Browsing was found to take place throughout projects, though it was particularly associated with the start of projects and changes of disciplinary focus.

"The other thing that I do a great deal, and which I have ever since I was a research student is the Cambridge Catalogue by Subject so I can choose to go to the shelf to look at a volume that I know that I don't want in order to see what has been shelved beside it. I think everybody who has ever worked in Cambridge they have found serendipitously what turned out to be extremely important, because it is open access. I often pick things up off shelves and wonder what it is, and of course it happens more when I am working away from my own specialism….Historical Sociology and Psychology then I might be quite uncertain about what kind of information that I should be looking up, and therefore what is on the shelves next to what I might look up is much more important than what I went to find…". P30: 30:39 (374:392)

As interviewees moved from discipline to discipline the same process of gaining an overview was found, this was discussed in relation to Orientation in Chapter 6. Interviewee P6 gave examples from recent experience.

"If I am starting off from no knowledge base or a little knowledge base then I probably do a lot more browsing and scanning than anything else because I tend to think 'ooh there is a paper or chapter or web page or whatever' that is written about the subject, and I would speed read it just to get the feel of what it is about, and as I am going through that process I find that my knowledge and understanding increases a little bit, and then going from that I will then have some sort of map of the subject in my head that I can link into with the areas that I am

interested in, because I sometimes find that although I have an interest in something fairly specific, that there is no literature about it, or there is not enough to make a worthwhile investigation...so I go to the literature and start looking for [topic x and topic y] ...and I start reading through it and what I find is that there is no work done on [topic x and topic y combined], so I come to a dead stop. So even though I take a broad brush approach I sometimes hit a brick wall". P6: 6:44 (150:166)

The access points provided by Browsing in different literatures permitted identification of new aspects and directions also figured prominently in interviews. Browsing was in this connected with creativity.

"I think I browse right at the beginning of a research project, I said that often what I am looking for is approaches and theories and concepts which I can then shape and choose from but use ultimately, and so at the very beginning - with History I'll have already looked at some of my sources and then I am going out to secondary material and yes it is at that point I'll be browsing, because it is at that point that there is creativity comes in. When you are trying to work out how you are going to bring this material alive and choosing which direction you are going to come from. It is then that you try to be as wide as possible in your searches as possible...". P31: 31:18 (179:192)

5.2.5.3.1.3 *Browsing for the unknown*

In Browsing to gain an overview interviews also indicated that Browsing was a good way into an area where it was unknown in what form suitable material would appear, or in what form a query would generate the desired material. Browsing therefore allowed identification of unknown aspects of information that they would otherwise not come across because it was indefinable or unspecifiable prior to retrieval. Associated with subject areas for which Keywords were inappropriate, as in interview P35.

"I don't really go looking for something in particular, if I don't know it, I am conscious and feel uncomfortable describing it, because I am conscious that my research does have a rather peculiar mix of accidental and completist strategies which don't make a great deal of sense, but which since they have generally worked I am reluctant to change, so my favourite is library which I greatly miss is the library in Oxford which has a new acquisition shelf and which is where I would go every couple of weeks, and I might see something that is totally irrelevant to what I am doing but it might suggest something else. But I am not a great one for entering keywords....I have never found anything useful by entering keywords like "religion" and 'middle ages'...". P35: 35:17 (87:104)

While self-efficacy acted as an influence on the desire to Browse through the results of Keyword Searches to prevent reliance on potentially ineffective keywords.

"...But my first approach because I think I don't trust search engines and I don't trust my own ability to be able to hit the right words I tend to be a browser...". P11: 11:40 (311:318)

The Browsing process was equated with serendipitous results in other research and the present study found a similar connection. Serendipity is discussed in 5.2.8.

5.2.5.3.2 Selective Browsing

The second mode of Browsing that emerged from interviews was Selective Browsing. Selective Browsing was associated with desire to find particular material or material from a

restricted range of information sources. Browsing within a defined area included, specific web pages, journals, or for example Browsing within specific Class Marks in the library.

> [*Do you browse?*] Yes, I certainly do do that, one useful thing I always think is if one is down on stack 4 looking for something, one has a class mark, I think one always looks automatically at whatever else is on the shelves a few books either side of the one you have actually found. These are a good example, take these records of Early English Drama volumes. I think these arrived as review copies or something like that, and I suppose this illustrates a search habit. I would go straight to the index especially for something like this - a book collection of documents - for any keywords of interest to me and I would look through those, so it is not a random browsing it is a kind of focused browsing....I think my browsing is more focused and directed than anything else". P45: 45:3 (265:281)

> "[*Do you ever Browse?*] Yes, usually with one particular goal in mind but open to the possibilities of things turning up". P34: 34:18 (93:95)

> "Or if I see a web address that I think will be useful but I don't go looking without knowing what I am looking for on the web I think that is what I am trying to say. I like some kind of indication first of what I am looking for and where I am going to find it". P22: 22:12 (114:117)

Particular reasons for Browsing selectively were found to be Identifying Keywords, Monitoring and Reassurance.

5.2.5.3.2.1 Identifying Keywords

Once an idea of a topic area developed the process of exposure to material through Browsing contributed to Identification of Keywords (Section 6.4), formative ideas of Problem Definition (See Section 6.6) and pointed to an idea of what would be relevant (Relevance is discussed in Section 7.2.1).

> "... If I am browsing through journals I can see other keywords that might be relevant and actually under this heading and so I need to use that type of wording, so it makes me go back and recheck what I am doing. So it all relates, but each method assists another method if you see what I mean". P1: 1:25 (197:201)

> "Usually it is a bit of serendipity, somebody might point out a particularly good author or book and sometimes when you are just browsing in a subject area you come across a keyword several times. It then begins to loom that this is going to be an interesting lead to follow". P21: 21:5 (40:45)

5.2.5.3.2.2 Monitoring

Selective Browsing also contributed to Monitoring activity, which is covered more fully in Section 5.2.6.

> "...I did that with certain journals that I knew were on my topic, so yes I guess going back to them to see if they had anything new, new articles and stuff". P24: 24:61 (200:206)

5.2.5.3.2.3 Reassurance

Browsing of specific information sources performed a role in reassuring interviewees that they had achieved an adequate level of coverage in their information seeking. In this function

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Browsing contributed to Reduction of Uncertainty which is discussed in the section on Feelings and Thoughts (Section 9.2.2) and contributed to aspects of Verifying (Section 7.4).

> [*Did you do any browsing through current journals?*] Well yes I did that, but it was a bit time consuming to be honest with you, but I did it just to ease my mind I guess, because I thought I should follow that route too, so I did that with certain journals too. I identified, and it is much easier now with the web, you can do that because most of the journals even if they don't have articles online they do have abstracts and stuff, so if you have identified like 20 or 30 key journals in your area it is not very difficult to go through that and do searches on that, but I did that really just to make sure that I had covered lots of things. But I am not sure if it is helpful. P24: 24:39 (159:168)

5.2.5.4 Influences on Browsing

Two major factors were found to influence the Browsing activity of interviews: These were Time and Access.

5.2.5.4.1 Time and Opportunity for Browsing

Throughout the interviews Browsing appeared as an activity that was flexible enough to be fitted in with a busy schedule whenever an opportunity arose, even where only five minutes of time were available and in doing so identify new information. The theme of time is further elaborated in section 9.3.1.

> "…. And if I am around here and a typical day here and I get a chance to go to the library then I will browse around the current journals. It tends to be more opportunity led rather than stage led. In other words no matter what stage that I am at I need to get to the library, I need to browse the current journals, I need to look at BIDS and things like that. It really is opportunity led. But maybe more than in other disciplines I am just as likely as I am finishing off one research idea to be also generating the next one…". P9: 9:41 (196:211)

> "Yes, I think I do quite a lot of browsing initially, but I do become more systematic as I go along, but I do still browse though, I sort of allocate different times to systematic searching, but the browsing I might do that if I have got half an hour that I wasn't expecting then I would be more likely to do that then". P17: 17:28 (356:360)

> "…If I am going to the library to drop off an interlibrary loan form, or to get a journal article I'll browse, ooh browse, you've got me there (laughs) then I'll usually look at the current shelves and I'll browse certain journals that are usually good for one or two articles on children or whatever like Journal of Advertising or International Journal of Advertising I'll have a quick flip through the contents pages". P22: 22:60 (130:151)

Although Browsing could fit in to schedules the possibility of unproductive or indeed over productive browsing was present among the interviewees. Yet Browsing could be time consuming because of the wide variety of sources that could be browsed and Internet Browsing was perceived as creating an overwhelming feeling of "too much" and of taking too much time.

> "Well yes I did that, but it was a bit time consuming to be honest with you, but I did it just to ease my mind I guess, because I thought I should follow that route too, so I did that with certain journals too. I identified, and it is much easier now with the web, you can do that because most of the journals even if they don't have articles online they do have abstracts and stuff, so if you have identified like 20 or 30 key journals in your area it is not very difficult to

go through that and do searches on that, but I did that really just to make sure that I had covered lots of things. But I am not sure if it is helpful". P24: 24:39 (159:168)

5.2.5.4.2 Access

Occasionally interviewees described topics as falling not only between or across established disciplines, and associated information organisation, they also fall physically into different libraries. The combined effect of physical and logical Dewey categorisation of materials acted as a deterrent for some interviewees who found Browsing unproductive.

Within libraries the Physical Organisation and most particularly the physical separation of subject areas that would be desirable to Browse was apparent in the descriptions of interviews P38 and P26 who each saw their experience of libraries as scattered and geographically inconvenient.

> "I would almost never just browse. Sometimes, but very rarely. In Sheffield it would be for teaching, I might find one area and then browse around it to see what else there was for example in discourse analysis. In the Cambridge library it is just so big that there just aren't relevant things next to each other, they have a different system, and so I don't very often browse there. Linguistics would be a very good example because you can pull the four most important books from Sheffield or Cambridge, but they tend to be very very scattered around in the library - you might have to go to 2 or 3 class marks to find some of them. Some of them will be counted under literature, and some of them will be counted under linguistics". P38: 38:19 (100:109)

> "It tends to focus on a few journals, if it was elsewhere it would be one off articles so you would have to really know, if I found an interesting article I would go and get it, but I wouldn't regularly go and read for example Psychology, on the off chance. I would rely on picking it up through looking at abstracts or bibliographies of other people, because clearly there are just so many journals and also I'm probably a bit lazy but they have moved all of our stuff down to St.George's (a branch library) now so I might browse through the Management journals, but I wouldn't browse through other disciplinary journals simply because they are just not there, they are in another (Branch) library". P26: 26:43 (109:115)

Physical organisation problems were also associated with the Dewey classification system as the basis of much organisation was also an obstacle to be overcome. One interviewee highlighted a scenario from recent experience of combining Geography, Philosophy, Politics and History.

> "[Do you ever browse out of those areas?] I don't think so, not unless I had a really good provocation to do so, I mean I have gone wandering into Eighteenth Century Cartography discovery of the South Seas etc., and you take yourself into areas that the cataloguer believes not to be yours but you go there because you have got the title or the author, not because you wonder what the 500s would have to show me. And obviously I use the 800s where John Jacques Rousseau is catalogued and you go down into the basement looking at the complete correspondence of Rousseau and you find yourself looking at what they think is literature, if Rousseau couldn't make his mind up if he was a novelist or something else that is his problem and that becomes Mr Dewey's problem". P44: 44:3 (186:196)

Beyond simple access to resources, the limitations of localised library holdings complicated the fulfilment of Browsing needs. Though Browsing was recognised as a desirable activity, for some topics material covering research areas was not always available for Browsing.

"[*Do you browse?*] Not really, and the reason for that is because the library's holding are relatively weak in my area ...and the order and classification system is not one that throws books together in a way that is particularly effective for my research. But having said that I do to a certain extent, but I don't spend a lot of time on this, if I pull a book off a shelf I will look at the books around it on the shelf. But I won't spend much time doing that, but I think you'd need a lot better library in order to make that worthwhile and of course you can't do that in the British Library". P41: 41:34 (247:253)

5.2.5.5 A Place to Browse

Browsing was undertaken in a range of information sources from the very broad WWW through BIDS and other online databases, current journal issues section of the library, journal runs and personal collections.

"Well, in terms of like keyword searching, and in terms of places library association and they are the obvious ones to flip through, and because they are the obvious ones to just flip through, and I think because they are done by information professionals you'd hope that indexes are all that they should be so that you can do quite a quick look through and find anything relevant". P1: 1:16 (117:121)

Prior to Browsing interviewees were seen to identify places to browse, without which Browsing was opened out even further to Source Identifying (Section 6.5). Hence it was noted that Browsing was more practical once basic sources were established.

"No, it is where I started off. I wouldn't go back to these libraries now, I would still search but I would be looking for much more specific information. It is at the start partly where you are exploring the topic in general, whereas I would be looking much more specifically. I still use the tourism and leisure abstracts, but I do that to try to keep up-to-date. I am subscribed to several Mailbase groups which send out information, Elsevier Science send out an index to their journals when they come out, so I get those for three of the journals I look at. If I am in the library then I browse through just the current journals in the index. It is much easier once you have got that basis, and also I get publisher's catalogues come in so you can, and the University of Leicester bookshop publishes a regular museum studies catalogue which they send out so you can look through and check what is new". P26: 26:8 (96:104)

Interviewees who possessed some prior knowledge found that places to browse were more easily identifiable or established.

"If it is a subject which is not entirely new, which I guess would be the case with most things that I would look at, I would go to what I would regard as up-to-date primary sources of information - review papers, to some extent books, but perhaps less so, and use those as a starting point...". P16: 16:14 (169:177)

Interviewees pointed to a number of resources that they particularly associated with Browsing. Of these, the library appeared as the major "information source" connected with Browsing. A recurrent theme of interviews was "the visit to the library" and Browsing activity.

"Well, one would be conventional information sources like going to the library, finding appropriate journals...". P10: 10:13 (91:95)

"No, but this is true, for example I do actually browse in libraries and I don't really search, and I ask colleagues and I keep it sort of filed away in my head...". P2: 2:33 (267:282)

Browsing was given a different aspect by interviewee P38 who characterised the analogous behaviour of Browsing the Internet or Electronic Resources and Browsing in Traditional media such as the library. Coded as "Surfing the Library", the interviewee's

description, gave an interesting aspect to how an information seeker perceived the role of various media and systems of obtaining information.

> "I suppose in some senses, kind of what I tend to do is look at the question and try to think about how it could be approached, so in a sense the area comes first and then I try to be flexible about thinking about what kinds of things would fit around it, rather than thinking about the area and try to come up with a question, that never really works....I do quite a lot of work in the library at the University of Cambridge and that is terrific for that kind of thing because you can start off in one place and you might find an article that is a bit interesting, and then you might look at some of the references in that area, and they might suggest something else and you might go off and do that. I think sometimes, you can't always do it when you need to get something done to a set time, but if I have got a bit of time, like when I am starting off in a new area it is quite nice to do. It is the equivalent of surfing the web, only in a library. Normally you might surf the web and come up with one thing, and then you follow it into another thing and another, and you don't perhaps know - you might find a dead end or something useful and in Cambridge library you can do just that because you are not having to travel and you are not having to order it in or anything. You can kind of just surf the library in some way". P38: 38:8 (41:80)

Within the context of the library, library shelves and current periodicals, journals and Internet, along with bookshops, book catalogues were important information sources. Library shelves provided the most direct form of browsing available. Books and volumes of journals that appealed to interviewees could be viewed immediately.

> ".... I'd rather go to the library and sit on the floor and drag down things that look promising as a starting point and then follow up references from that. Also other journals that I subscribe to that I know cover part of the things that I am interested in". P33: 33:7 (55:69)

In a similar way interviewee P30 stressed the necessity of instant access to shelves.

> "...and then just stand somewhere in the library where there are open shelves and then stand and read the introductory editorials if there are any and look in the journals for review articles which you tend to get. This is the kind of work that can only be done in a library where you have ready shelf access to the journals so you can just walk along the shelves. Some publish review articles every issue, some only do so every two or three years, if they have got an index it helps, but I tend to just do it by picking the things up". P30: 30:6 (103:113)

A more focused use of library shelves involved Browsing the "Current Periodical" shelves and specific runs of shelved journals.

> "...and I scan the pages of the Harvard Business Review which is already far away from my disciplinary home I have to say, where they do write up about different businesses, but yes I could do with, and I haven't a clue it is a good question, it will be in the business journal, and maybe I should scan, and sometimes I just stand there or walk about amongst the current shelves [Journals] and hope just to get an idea. I do browse but I browse in journals, not on the web...". P2: 2:67 (178:186)

> "I think that is most of it, but there is also scanning journals and conferences proceedings. In my case hard copy sources in predictable places". P40: 40:13 (169:172)

> "....and if I am around here and a typical day here and I get a chance to go to the library then I will browse around the current journals. It tends to be more opportunity led rather than stage led. In other words no matter what stage that I am at I need to get to the library, I need to browse the current journals, I need to look at BIDS and things like that. It really is opportunity led". P9: 9:90 (197:211)

Along with Journals and Current Periodical Shelves, New Book Catalogues and Bookshop Shelves were a focus for Browsing activity. Course Reading Lists gave another

access point to material for Browsing. Bookshops and Catalogues acted as a source of the most up to date material.

Electronic Sources including Databases, Library Catalogues and the Internet appeared in interviews as an increasingly relevant media for information seeking. Browsing on the Internet tended to be focused mixture of personal homepage and organisation website along with Browsing of search engine results were prominent.

> "The internet is quite handy for my stuff as well. The most recent thing I got was from an email magazine that I get, an emailed magazine, and there was one thing in it that seemed relevant on a web page and I printed that out and that has opened a whole new area for me". P7: 7:16 (117:123)

> "...In terms of places library association and they are the obvious ones to flip through, and because they are the obvious ones to just flip through, and I think because they are done by information professionals you'd hope that indexes are all that they should be so that you can do quite a quick look through and find anything relevant". P1: 1:15 (117:121)

5.2.6 Monitoring

5.2.6.1 Definition

Monitoring became apparent within the interview data as an activity of keeping track, watching, revisiting the same source of information of a period of time.

> "I suppose once I have found a good site, either a journal or a web site or a consumer site or whatever then I'll bookmark that - either on the website, or make a note of the journal or I might even subscribe to the journal or make sure that I check it when I wander in the library. Often that will feed off each other, when you find a good article in a journal then I will chase up those references in it and it will go on from there". P22: 22:17 (157:162)

> "...What I don't do is use search engines much or look for scholarly papers and the reason for that is that I know what the online journals are that I am interested in and I do have bookmarked sites that I am interested in and I go back to and I am alerted to the current contents by email and also I get book lists, so yes I do use the web, but I don't think that I have ever done a really systematic search that would parallel the kind of search that I do on databases". P23: 23:1 (261:269)

5.2.6.2 Sources and Monitoring

More than any other activity monitoring was dependent upon identifying a suitable source which consisted of relevant material, had produced related material and that periodically that source would be updated or develop over time. Suitable sources meeting those broad criteria, and those associated with monitoring, were books and journals, library current periodical shelves, new book catalogues, Internet Websites and Electronic Mailing lists were the main sources associated with monitoring activity and met the broad criteria for a source for monitoring.

5.2.6.3 Stimulus for Monitoring

Stimulus for a monitoring pattern came from identifying one item, an item of a type that would indicate other items would appear within the source. Hence, current journals or recent periodicals gave a clear target for monitoring activity. It was noted that of all aspects, identifying information sources was a major issue for the interdisciplinary researchers and is discussed specifically in section 6.5.

> "I sort of keep an eye on the current journals, more so now, and I do plan, I haven't yet, to set up one of those WebCrawler searches that keeps an eye on the literature for you with your keywords". P17: 17:27 (365:367)

> "Well, I think the periodicals that I take like C18th Studies, History of Political Thought, that would be where I would start, I also spend a certain amount of time when I do go to the library simply picking recent periodicals that I don't subscribe to off the shelf". P44: 44:2 (158:172)

Less obvious in the physical world was the use of Mailbase to maintain a state of "alertness" to new material, and the use of electronic journals, and alerting services.

> "I would talk to people obviously, I would 'hang out', I would do lots of information encountering. I hang out on lots of mailing lists and discussion groups anyway anticipating discussion that might be relevant and maybe exchange of useful references and that kind of thing, I don't think I have ever sent a request to any mailing list - saying 'can anyone recommend reading to me', other people do that and I monitor the exchanges that go on there to check that I am up-to-date, usually those kinds of requests come from graduate students perhaps and the responses come from academics and it is a kind of litmus test - am I aware of what the academics are recommending around those questions. You are asking about a new project, I might use it, with a project that I am more familiar with I would still use it to check". P23: 23:53 (137:145)

> "and I do plan, I haven't yet, to set up one of those WebCrawler searches that keeps an eye on the literature for you with your keywords". P17: 17:27 (365:367)

5.2.6.4 Monitoring and day to day patterns

Monitoring activity tended to be fitted in with other day-to-day patterns rather than as a time exclusive activity.

> "Yes, if I am going to the library to drop off an interlibrary loan form, or to get a journal article ...then I'll usually look at the current shelves and I'll browse certain journals that are usually good for one or two articles on children or whatever like Journal of Advertising or International Journal of Advertising I'll have a quick flip through the contents pages". P22: 22:16 (147:151)

> "The internet is quite handy for my stuff as well. The most recent thing I got was from an email magazine that I get, an emailed magazine, and there was one thing in it that seemed relevant on a web page and I printed that out and that has opened a whole new area for me. It was problem based learning which I already knew about, but it was actually problem based learning in design education and the link with 'The Effective Practitioner' and made the link with the anti-rationalist theory which I'm reading about and it all tied together". P 7: 7:16 (117:123)

The Interdisciplinary researchers interviewed found particular difficulties with Monitoring and were apt to give comparison with their experience of single disciplines. In its purest form Monitoring was more difficult where the definition of interest was interdisciplinary and hence potentially non-expert, and unsupported by parent departments.

"I think from a practical point of view it is probably easier to be a single discipline researcher - just from an information point of view for finding something that you would be interested in, and also being able to build up a level of expertise in an area, although that of course could be an area that is multi or inter discipline, but I imagine it is easier to get a grasp of all the new developments, of the literature, of the news, to keep an eye on a specific field. I think practically it is easier and from an academic point of view we are always being told by our department to build up an area of expertise that you can be recognised in, that you can gain a name for yourself in and not to spread your research net too widely, but to focus on a particular area, I think that is seen as a good thing, though I am not necessarily sure that it is a good thing, though the university seems to think that it is good to be focused on one particular area". P22: 22:65 (58:69)

The practicality of keeping track of multiple contributing disciplinary areas summarised much of the problem of monitoring an interdisciplinary field.

"Yes, I think it gives rise to a lot of uncertainty and misery to the extent that if you are working within a single discipline I would reckon that it is much easier to keep track of literature and secondary sources are easier to locate". P9: 9:7 (35:37)

Despite difficulties interviewees put forward Monitoring as an element of their work. if not as significant as some other activities it was important for them to grasp information sources and to "keep an eye on them" over a period of time. Hence, interview P23 gave advice to potential starters that embraced the Monitoring concept.

"...where in each of the areas articles have been published and then continue to keep an eye on those journals. Join mailing lists. Read publishers catalogues, that is something that I do that I haven't mentioned - I do that at least annually. There are publishers that publish in particular areas of interest. Probably bookmark a few online journals, and look for online journals in the areas of interest. Try to figure out what the key conferences in the areas are and keep an eye on the proceedings". P23: 23:56 (247:259)

5.2.7 Chaining

5.2.7.1 Definition

The activity of Chaining identified previously by Ellis (1989) is here enlarged. Ellis defined Chaining as forward or backward movement through citations or references. The data from interviewees in the present research found Forward and Backward chaining as only two facets of the activity. Chaining was additionally identified as 'lead idea' following and Source Chaining. The activity is part of opening as one reference leads information seekers from the known into the unknown, and opens the information horizon available to them. Over the course of three sets of chaining the origin may become widely different from current position.

Chaining may also be extended beyond pure bibliographic searching to include leads to potential network contacts as sources of information (Networking is discussed in Section 5.2.3). The principle of following a chain to identify information remains the same.

5.2.7.2 Backward Chaining

Respondents highlighted a pattern of behaviour for increasing the scope of their searching and information available to them through the use of references, footnotes and bibliographies within items either already known to them, recommended to them, tangential to the area of interest or in the broad area. Coded under the category Chaining, "Chaining: Bibliographic References Lists: Backward Chaining", Backward Chaining allowed material that could not be revealed by other methods to come to light. The significance of chaining becomes apparent in the context of other data coded under Knowledge and Understanding in section 9.2.1.

> "Well, sometimes they don't relate to each other, they relate to my research, I think that it is quite difficult, sometimes when you are chasing up in a bibliography because something is highlighted that you haven't found in any other ways of searching, so it is identifying new material as well as verifying material that is out there". P1: 1:24 (194:197)

Chains of bibliographic references would link books and articles from one to another through multiple iterations, each developing and feeding off the previous items.

> "...After a while, after you identify key books and articles another way of dealing with the topic is to try and follow the references given by these articles, which is another way of dealing with the topic, because a person who has recently produced a paper which is 1999, probably it will have included in this paper if it relevant to your topic quite a big amount of the bibliography that you need. I did that, I followed the references as well quite a lot". P24: 24:38 (152:157)

> "[Referred to different information seeking activities]...Often that will feed off each other, when you find a good article in a journal then I will chase up those references in it and it will go on from there". P22: 22:17 (157:162)

Chaining permitted identification of materials in different fields or focused differently from those of known fields. The effect of Chaining was to enhance opportunity to find relevant material, even where that material was least significant in the text used to begin Chaining.

> "At that point it is usually things which almost invariably no search engine is going to turn up. So cross-citation, looking what people are citing and discovering obscure things that they know of...". P34: 34:13 (51:58)

> "and reading their bibliographies and seeing where that material came from and pursuing it, in many ways I still find that as interesting a way as any of looking at people's footnotes and citations, because things that are not massively important in their work might be exactly the kinds of things that I am looking for - that kind of thing". P42: 42:23 (92:96)

Interviewees described Chaining as a particular method to overcome the problems of needing information from diverse and complex disciplinary sources.

> "Well, I suppose a single discipline topic will be more straight forward, there will be databases with the same title, which you can get straight into, interdisciplinary you have got to work out what is appropriate, what is relevant, and you may not come up with the right ideas to include something that you later find would be useful. So interdisciplinary topics are probably more difficult to find information about. I've never done any searches, apart from the way I have found relevant references, would be to find one paper somewhere in a journal e.g. the Journal of Animal Ecology say, and then I would snowball with a list of references. Or I would find a conference proceeding that was relevant, and so there is a recent 1998 conference on Gall Inducing Arthropods for example which some of the papers come from, it is published as a book and it has got loads of papers on different aspects of that subject and each of them would produce a list of relevant references that I would follow up". P27: 27:3 (17:30)

> "...sometimes it might the case that you find somebody has already written something that you'd like to find if they had written anything else at all....sometimes you might look and it

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won't be useful, but if you've found one useful article then see if that suggests something else useful". P38: 38:25 (144:155)

Backward Chaining was particularly of use in filling the gaps left by incomplete knowledge of terminology and keywords (See also Language and Terminology in Section 9.3.4.2)

"The approach that I would take would be fairly systematic and literature searching to start with, through all the resources that I was aware of, ...I find one paper or source and that leads onto another one, and just by chance takes me into a whole literature that I wasn't aware of and that hasn't arisen through systematic searching, because I wouldn't have known the language". P28: 28:4 (47:56)

5.2.7.3 Forward Chaining

In contrast to Backward Chaining found Forward Chaining, or Citation Searching as it is also known, was perceived to be a much more focused and difficult activity. Forward chaining involved information seekers in two sub-processes: first identifying an author or paper of interest, and second, finding work that cited the original author or paper.

"I think of the keywords, you can do sort of exploding an area where you put in one big umbrella area and then narrow it down, or you can start off more restricted and widen it out, or if you know that somebody has written a lot on an area and then look for citations. So if I find its quite narrow, then if you have a good reference then you can find other articles that cite their articles and be honing in on that area. But if you are new to the area, then you probably haven't got that and you probably have to start wide and work down". P4: 4:5 (49:54)

"Usually if it is social science I would look at social science citations index and see which ones are cited and most of it is just gut feeling and experience or you will talk to people and ask them what they consider to be the top rated journal". P20: 20:20 (169:171)

The value of citation searches was limited for many of the interviewees. For those who did find it useful it contributed a good way to open up information to obtain opinions and views from the target field.

"Bibliographic databases, Library catalogues, History Bibliography CD ROM, TLS, Online Journals and also Amazon (an online book supplier) because that is bang up to date, History Database, the other thing I do is citation searches on web of science to see once I have picked something up if it has been discussed and so that I can at least read a review by an expert in that field and see what they think, but it is actually a very small part of what I do". P36: 36:22 (195:202)

Chaining was generally considered to be one of the easiest options for information seeking, however citation searches were viewed as less useful and less easily used by some interviewees. As exemplified in the words of interviewee P11.

"I tend to go backwards just because it is easier, but if I find something that I like then I tend to move forwards as well through citation searches and say who cited this". P11: 11:34 (287:289)

In view of the perceived difficulty of citation searching, the presence of author name searching alongside Chaining may be understandable. Citation searching was balanced with author searching, which gave more links to the original author rather than new chains to other authors working in the same area. This involved identifying authors from bibliographies and

following them up by simple author searches, rather than looking for citations of the original work.

> "Very informally and unsystematically, there is a certain amount of name recognition, I know of historians who use literary theory and so I can go to their work and see what they have made of it, so if another historian with a similar problem has used a literary theorist then I'll go and look up that literary theorist, and secondly there are towering names who have written commentaries from other disciplines that you are aware of so I'll go and look in the library for their commentaries...". P36: 36:12 (54:62)

> "...and then I would probably search in more specific areas then, and I would really focus down, and perhaps chase up or look at the work of specific authors whose names keep coming up. I would probably look on Star more at that point, I always look there as a start, but as I am looking for authors more I would tend to go back and look there more as well". P17: 17:18 (245:252)

5.2.7.4 Source Chaining

The connection building and identification of new themes to pursue was as important as following authors, or bibliographies. In this example an advertisement for a book began a chain of information seeking, reading and Opening far beyond the initial stimuli (an advert and a book). Source Chaining was particularly important in movement between disciplines.

> "For me, I think it is an individual answer, yes of course I would try and use journals, in that you start to realise, once you see some parallels, one of the starting points might be to try and track the work of some of those people who are actually cross discipline themselves, so in their work and their writing it will give you access to where they have come from I suppose and you can recognise some important works or something that is relevant, then you file that piece of paper, thinking yes, that is interesting to me as well. Once you have made that sort of bridge, you can look back to the roots that they have come from and then you start to realise that there is a journal lets say which tends to carry quite a few of those pieces of work, which maybe you haven't used so much, but you begin to recognise which themes and which papers are relevant in that particular journal and then you may go down that route". P3: 3:9 (83:93)

Where literature was not easily accessed literatures that were accessible and offered some starting point were utilised before finding a link to the desired literature. Interviewee P2 chained from newspaper clippings to journals and books, stimulated by leads in the original texts where a book led off a whole new area of investigation inspiring networking, and further reading for the respondent.

> "...This business about the new economy is interesting, a couple of times it has been mentioned in the economist, in newspapers, a nephew even sent me a piece from the Dutch newspapers and I discovered that what was written was very similar from what I had already read, so I look in journals and in the Guardian....I can definitely say that it is the journalism that has led the way to the academic press". P2: 2:62 (194:217)

The sense of movement through material included transitions from one literature type to another as in the case of interviewee P39 and Grey literature.

> "Well, for my PhD because it is to do with person and information, I spent a year or two debating which discipline I was going to work in, I could look at the topic from an economic perspective or an information perspective. Certainly there is stuff in the Information Science literature and in the Marketing literature. But it is an area where there hasn't been much published academic research specifically on the area that I am doing, but a lot of it is also grey literature. It is also changing quite a lot and I need to do a thorough trawl over both disciplines

and as I go along I collect information of all kinds. I think there will come a point when I write the literature review up in full specifically for the PhD - that I will need to do another catch-up formal search, but because the area is moving fast you couldn't do just one search on this area. Also I think there is interaction between the disciplines which might send one back and forward following ideas from one database to another following slightly different angles". P39: 39:29 (196:204)

Chaining of sources, from a text that was of little value to an information seeker, but which contained references to material that was ultimately followed up, chained, and proved to be very important for the interviewee.

> "Primary sources would be different. Because I am interested in linguistic ideas, things that are grammars, or define themselves as philosophical attempts to look at, but it is true that primary materials occur in strange places and can be hard to find, and I would typically find them because they are mentioned in something else that is more central. So one example was some work that I found in Missionary Journals, but I found them through following footnotes and mention of them somewhere". P42: 42:32 (195:202)

The Chaining of sources was not always complex. Sometimes it followed a simple route to, as interviewee P28 described, "jump off" towards further information from a new angle and hence leads to a different source. For example in developing ideas from one article interviewee P40 moved from journal literature to the Census records.

> "I think something fairly similar to that. In a very minor way I would use Sheffield library and the dictionary if it were something that I hadn't heard of. Also I would be picking up mistakes in sources e.g. one of the sources had a person dying in 1914 but he died in 1924, and so, things like this become highlighted as you develop an area. The notes you make while looking at sources are also important in developing leads, for example I was looking at a trade unionist with a son who was an accountant and another source said the son was something different. So that led me to look at a census. I needed to check whether he had more than one son". P40: 40:27 (216:224)

> "Increasingly, I am looking at things on the web that are more working papers, and for my current work in usability there are a number of discussion groups and web sites that provide jumping off areas into other areas, and conference proceedings from the outset mainly from ACM Digital Library". P28: 28:9 (100:106)

5.2.7.5 Methods and sources

In practical terms Chaining necessarily began with some information, or an article, a source of places to Chain to. Interviewees particularly highlighted beginning with obvious, or easily accessible texts and from there moving in depth towards material that would be of value to them.

> "It is more the obvious mainstream book or primary source starting points and then the pursuit of other people's footnotes. That is my tradition. So in reading an article I would usually have a separate sheet of paper on which I will write down things in the footnotes or references of that book that might also be useful, so it builds into a kind of paper trail. As I read them I cross them off the list. I am not usually comfortable unless I hunt it down. This obviously has its limitations for more recent scholarship; I am not a great user, though I probably should be more of one, of electronic sources. I try to keep abreast of other obvious periodicals and read reviews. It is all terribly old fashioned really I think". P35: 35:16 (79:86)

To facilitate Chaining, library shelves and journals provided facilities to Chain from the known to the unknown.

"There are various things like linguistics abstracts that I had a good trawl through periodically, but that seems to fit into good old fashioned humanities research. I'd rather go to the library and sit on the floor and drag down things that look promising as a starting point and then follow up references from that. Also other journals that I subscribe to that I know cover part of the things that I am interested in". P33: 33:6 (55:59)

Within these media it was footnote and bibliographic lists that provided the basis of links to other material. The focus on these elements of footnote and bibliography for browsing suggested that access to the full text of material was essential. This itself implies a closer connection with the library or physical copies of material as in these examples from Interviews P42, P30, P11 and P27 who all stressed a strong association with the full text of documents.

"Something that I am interested in is following peoples' footnotes and you do need to have the book to be able to do that type of thing". P42: 42:8 (174:177)

"That search didn't do well on agriculture, but it did produce me some things and once you have got some titles then next stage is always to go to Cambridge, there is nothing here that is of any use, and so I go to Cambridge and have a photocopying orgy, I don't read anything while I am in Cambridge because I haven't got time, I am looking for things and trying to find them but what I do do is skim read all the footnotes to look and see if there is more and then you pull some of that in and collect that to bring it back". P30: 30:23 (232:238)

"What I do is get some papers next and start to follow them up and then I move away from the databases altogether and follow up things through the reference trail". P11: 11:33 (285:287)

"Well their titles, but also more important where they are referred to in the paper, so you are reading a bit of information, and a fact is thrown out by the author who refers to another paper which I want to know more about that fact, so I will get hold of that paper. So the text as well as the title will help". P27: 27:5 (43:46)

5.2.7.6 Following leads

Following Leads emerged from the data as closely related to Chaining of references and Chaining of sources and in many ways enlarging upon the activities involved in Chaining. Citation and reference chaining were joined by Chaining of lead 'ideas' from one source to another. The activity led researchers from single leads in known areas towards an opening information horizon. The process of taking an information link in the hope of finding something more suitable, in this leads are neither purely sources, nor references, they were rather presented by interviewees as information or concepts or inspiration triggering a Chain of information seeking towards attainment of salient information.

The similarity of following leads with Chaining is at the level of developing the items of information available as a creative process to move from information item to another.

"...So you start with what you know about a subject and move outwards from there following whatever leads occur...". P41: 41:19 (165:175)

"I do lots of chaining, reading what I had identified as a key paper or something that struck me as a key paper and identifying what seemed to me to be the most significant citations in that and I might go into STAR (library catalogue) and look up books and I might even look up course reading lists to see what other academics in this university suggesting to their students for courses on topics of relevance to my research, that seems to be quite a good way of quickly finding out about what is considered to be core reading in another area...". P23: 23:34 (121:135)

"Yes, I think, some keywords might give me clues, but you can sort of tell by how a title is structured, that goes for newer material, also if it is older then I would probably be interested in looking at it anyway because I think there is a different type of scholarship that went on for example in the 19th and early 20th centuries and often material that was published then is interesting because it is massively detailed and well documented and even if you just flick through it and it sends you off in all sorts of directions, whereas more recent material I would probably want it to seem to have more of the right perspective or spin on the material". P42: 42:31 (184:193)

In these ways interviewees described the process of following leads from known material, chaining a led from one place to another.

Use of the Internet saw Chaining between items leading from place to place through hypertext links that created new opportunities for information leads, but also indicated how Internet access influenced information seeking behaviour.

"...You find something interesting, you go and look for that, you look at the references on that, you go and look. You do that and it branches off all over the place. Every so often you have to stop and gather it all back in and work out if you have missed anything. I think it is a problem and benefit of working with the internet and everything online, that it is possible to use so much more information and get hold of it, but in a sense it increases the likelihood that you might miss something because it might not be listed on the internet; not everything is, and because there is so much more out there, I don't know, because you sort of follow links here and there, you might just not follow a link or the link might not be working". P26: 26:6 (53:66)

In following leads across interdisciplinary topics the decision of whether to follow up a potential lead with further searching or obtaining an item was described by interviewees as more inclusive than in their equivalent single discipline research.

"I don't think so, I think it's the other way around, I think perhaps I would be a bit more prepared to look more flexibly at titles in an interdisciplinary area because you just wouldn't be too sure what was covered in that, whereas in a single area I would have thought that a title would be a very good indication of what was included within the topic. So I would be just a bit more lenient with references or titles which seemed marginally relevant in the case of an interdisciplinary topic". P16: 16:16 (199:204)

However, the progression of following leads was also limited by interviewees in two ways: Firstly that information was leading back in a loop to known material.

"You stop following leads when you start getting the same information over and over again, when you aren't getting anything new. But, yes, you discover as you go along that "oh my goodness" I need to know about something about the History of something. So I might be in the British Library and obviously you are context specific in that you look for information where you happen to be, and if I happen to be in London then I'll look in the catalogue and found very few books, e.g. on fencing, so then, I emailed some people that I know and they suggested other people, and now I have got one or two books that finally I could look up if I were in London. So you follow the chains of links, but of course the key thing is to find something that has been published recently, so that the footnotes are up-to-date and there isn't much that is recent really". P41: 41:24 (188:197)

Secondly that the topic area appears so broad interdisciplinary areas that appear linked in the literature to several major fields are limited by focusing on fewer disciplinary components than might be necessary to fully explore the topic. The Context (The subject of Chapter 9) of information seeking was particularly relevant to such aspects of information seeking among the interviewees.

"But like Psychology, which is relevant to Education, now I mention it I know I ought to go off and look at the Psychology literature, but I haven't yet. The trouble with some of the other areas where that might apply, like 'topic name a' some of that I pick up because I belong to some Marketing discussion lists and follow up some of the literature and things like that, but also 'topic name b' which I don't look at explicitly but that I sometimes look at their journals. The trouble with 'topic name a' is that it is already quite broad without trying to find other bits". P39: 39:16 (100:105)

5.2.8 Serendipity

Data coded as Serendipity appeared early in the analysis of interview transcripts. The coding of interviewees initially accepted the word "serendipity" as it is defined in the Oxford English Dictionary, that is as an unexpected or accidental discover.

5.2.8.1 The Importance of Serendipity

The value of serendipity was in the minds of interviewees. Interviewee P19, for example, saw serendipity as a powerful addition to the information seeking tools that were available.

"...one would go through quite a number of channels that one would expect researchers to go through, but I also find that it is the chance factors that are interesting, you hear something on the wireless, and you hear someone say something and it is something that you haven't come across and you recognise it as important, and so you have got another avenue to pursue, or you meet somebody at a conference, and you start talking to them and they say - well have you seen so and so.... so there are very important chance factors that I find in my life now increasingly that become quite significant". P19: 19:11 (140:172)

Identified as "a reliance on randomness" by interviewee P7, the role of Serendipity was integrated into the information seeking patterns described in interviews.

"I look for my keywords, for my key subjects really, but those will change, by the sorts of results that I have, and develop some sort of understanding and then the random stuff will come through to give me new areas to look at in a more methodological stage, and that's probably a repeated cycle". P7: 7:28 (128:131)

Serendipity raised strong feelings and was viewed as greatly important as a means of gaining access to information or resources that were previously invisible to respondents, and in opening up something new coincided with the satisfaction of information needs that would be unlikely to be met in other more traditional searching.

"[*Do you ever find anything serendipitously?*] Yes, frequently, I think that is important, only connect is the way of writing things. [*Do you have an example?*] A recent one probably not, but when I was doing my thesis, it happened all the time, I would just pick a book up off the shelf and find something which was either directly relevant or related. I don't do it as much as I used to, but I am uncomfortable because I don't. So yes, I would say there has been a big part of serendipity. I think a lot of what I read is partly dictated by deciduous heaping up, not by an empirical approach, but certainly chance plays a big part and it is important to me at least that it does. I don't have a set order for reading stuff, and nor do I necessarily go to the library planning to read one thing - then if I see something else I'll read that too". P35: 35:29 (162:174)

Serendipity supported the research process in a variety of ways beyond information seeking. For example, for the following researcher, serendipitous information encounters "resonated" with previous knowledge:

> "Yes, I think that this is where multidisciplinary approaches we do find at the more superficial level of topics and issues as they crop up and you are more likely to find in the general press contributions by a variety of authors who could be professors of Sociology or Politics or economics and pick them up and say something about it, or in documentaries, but because I myself have 30 years of conceptual History, in several disciplines, but particularly of course Sociology, then something like that will make a resonance and hit something and then I will think "ooh my goodness" I had a very interesting example of this the other day when I was watching a programme on Archaeology ... on Vikings and Iceland and why a particular settlement went asunder at a particular time and they had pieced together an entirely sociological explanation coming from these archaeologists and it resonated with a huge amount of literature that I had ploughed through 25 years ago when I was talking about the Sociology of developing societies". P2: 2:44 (296:312)

Serendipity was seen in the context of Previous Knowledge as one method of rediscovering 'forgotten knowledge'.

> "I have been in the game for such a long time that I have forgotten a hell of a lot, discovery is remembering really isn't it, so it is probably something that I knew once and there are traces in ones mind. Serendipity can happen if you go along a book shelf - you can find something that you ought to have known about, if books are organised thematically and that is serendipity, but it is not exactly serendipity if you are using a big reference text fairly methodically". P32: 32:30 (187:192)

In utilising the "resonance" of serendipitous items respondent P2 went on to infer that great progress could be made. However, experience and long term knowledge of the fields involved meant serendipitous information could also change researchers' perspective of what was considered to be the full, or correct, body of information in the problem area.

> ".... but I don't think that we should underestimate that chance factor...And so I am working in this as hard as I can and I have a very big international dimension to my work and here I am in this situation that someone says this thing to me and I was amazed that I had never heard about it". P19: 19:11 (140:172)

The introduction of confounded and surprised responses in the case of experienced researchers along with the presence of high levels of uncertainty and low confidence levels may suggest a causal link worthy of future investigation.

Similarly, identifying the extent and shape of research in similar research areas through serendipitous discovery often contributed key concepts that helped in drawing together concepts and links to form a bigger picture and new directions. Researchers would search for parallels and analogies to their own research problems.

> "Whether or not they are the only communities that I need to know about – that's the hard thing to find....interlibrary loans – they must think that I am mad because I get stuff from all over...I have to think to myself who would have a similar problem to this....it can't be a brand new problem there must be problems like this, who would have problems like this, where would I find out how they have solved them and see if that helps me, once I get into them and hit on the terminology – usually by accident...". P11 :11:49 (341:345)

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Serendipity is dependent upon conditions and strategies covered in Cognitive Approach (See Chapter 8) and was particularly described by interviewees in connection with Breadth Exploration, Eclecticism, Browsing, Chaining, Networking and in aspects of Orientation and was frequently found as a product of those activities.

5.2.8.2 Divisions within Serendipity

In defining Serendipity and considering in-depth the relationship with Information Seeking further definition of the properties of Serendipity emerged. Four aspects of Preconception and Knowledge in the Occurrence of Serendipity were identifiable within the data, and coded for brevity as Types A2, A3, B2 and B3.

5.2.8.2.1 Serendipity type A2

Type A2 Serendipity derived from most restrictive framework where both object and location are conceived to some degree prior to occurrence of Serendipity. In this form the event borders with traditional searching. In the first example the interviewee had previously defined a research topic and was actively seeking sources of information on it and had independently identified a radio programme giving the type of information that might contain suitable material.

> "Well, the awful thing with quirky is that you tend to come across them by chance almost, a few I found like radio debates where there is a half hour slot on a radio show where readers give reviews of new books but that was only by chance that I found that because I was looking for reading groups". P1: 1:37 (261:265)

For interviewee P32 a valuable item was found that again indicated that something could be both generally anticipated and its general location defined prior to locating the item.

> "Yes, nothing like it, it is the reality, one has a family and teaching responsibility and an inadequate university library so absolutely. A recent example, yesterday I was writing something for an essay that I am writing against the clock, and it was Keith Thomas (book mentioned earlier) and a word came off the page that I spotted and lo and behold it was absolutely key, it was a reference to a passage in Max Weber and it just beautifully launched the next paragraph, I was writing about charisma, and I was reminding myself about what charisma means, which is in Greek - meaning a capacity to heal, and you can see how this would lead to heroic and I went from there to talk about the bit in Macbeth and there is a bit about the King's ability to heal those with scrofula by touch and I new a bit about that, and I forget the keyword the triggered me off, but it was total serendipity. But this was an essay, that was designed for undergraduates and research students and so it just seemed to me to be a very good way of moving from the point I was to the next point. It created a bridge and there was a degree of elegance in the way that the paragraph then worked. It also took me into other links that I hadn't thought of using, so serendipity most definitely". P32: 32:29 (167:182)

Experience of Serendipity in this narrow form is close to the experience of Searching for a defined object and should merely be indicative of Serendipity arising in the course of normal Information Searching activities.

5.2.8.2.2 Serendipity type A3

Serendipity defined in the context of searching or knowing something of the subject area with sufficient detail to know that a gap with certain attributes existed. However, normal searching would tend not to locate the items and possible sources and locations were unknown and remained undefined. In this interviewees described an anticipation of what they would find, if they could find it. Interviewee P6 gave an example of this experience of Serendipity.

> "I think, Northern General Hospital here at Sheffield, we have been thinking about setting up a link work with deaf people to actually work full-time as an interpreter and language advocate, so they wouldn't advocate all sorts of things, it would be just linked to making sure the people understood what was going on in terms of language communication and one of the things that I was interested in was had anybody else done it, so then I started doing a broad search, and starting off with just 'interpreter' and 'sign language' keywords and I was coming up with virtually nothing, I found a guy in America who does that kind of job, and so I asked if he knew anyone else who did it and he knew someone else, and that person knew someone in Wales so that involved writing to the trusts in Wales. Then one day I was just sort of sitting in a waiting room - waiting for a colleague and I just happened to pick up a fairly old nursing journal and flipped open a page and right there in front of me was a person doing the same job in Scotland that we were planning for Sheffield and what was nice about that paper were three old citations relating to interpreting but not to do with people working full-time". P6: 6:15 (175:188)

Both of the first two types of Serendipity, A2 and A3, highlight aspects of recognising the relevance of information with a defined object, if not a defined location for obtaining it. However, both were less common in interviewers than Serendipity types B2 and B3. The difference was perceived by interviewees to be part of interdisciplinarity and took the form of less expectation of what information gaps might exist.

5.2.8.2.3 Serendipity type B2

In type B2, Serendipity was identified in interviewees descriptions as arising where specific items were undefined, unknowable, unspecifiable, yet potential information sources to hold answers were identified. In interviewees with this pattern prior experience of information sources appeared higher. In the example from interviewee P21 books and authors were found by Browsing or Networking and in turn gave unexpected links to other areas and aspects of information.

> "Usually it is a bit of serendipity, somebody might point out a particularly good author or book and sometimes when you are just browsing in a subject area you come across a keyword several times. It then begins to loom that this is going to be an interesting lead to follow". P21: 21:5 (40:45)

For P31 use of a good library with a familiar layout and ease of access to materials allowed Browsing to reveal journals fulfilling a partially defined information need.

> "...I went to periodicals, I remember this very clearly, I went to the periodicals room in the Senate House Library, which is the University of London library, because they have them laid out very nicely on slanted shelves with the covers facing out, so it is readable and user-friendly and I just went into the art section and found some great journals and of course that is current issues and then I could look at back issues. But next to the art journals were the Garden

History journals which I hadn't even thought of looking for, and they proved to be very valuable to me, so there is a fortuitous, luck, element...". P31: 31:15 (142:166)

5.2.8.2.4 Serendipity type B3

The experience of interviewees most commonly reflected a situation in which a low level of knowledge, low level of problem definition, and low knowledge about potential information sources for an area combined to present an information need that was either unrecognised or partially recognised. Hence interviewees P7, P19 and P37 provide examples of low knowledge of possible objects or locations.

"I would say that the work that I am doing is a lot more random now really, someone I am speaking to might suggest a book, I'll read that and that will spark off a whole new area of interest, that will tie in to what I was doing, but I could have almost got to the end of my research without knowing it was there, or finish without even studying that area necessarily. So I would say that there is a lot more chance in it". P7: 7:3 (23:27)

"[*Does serendipity come into your information seeking?*] If you mean coming across by chance, rather than by tracking down, then yes I think in a way that that is the way I get material, though I'd like to be more methodical, something coming from out of the blue kind of fuels me rather than knocks me in a new direction, for example on the kidult fiction my paper took the form of a reading of six essays which had nothing to do with kidult but hit me broadside that these two things were the same. Other things like that might just be in a bookshop and I'll spot something that doesn't appear to be relevant but is tangential to what I am interested in and I'll bring that in too". P37: 37:42 (141:148)

Collectively these provide a framework within which to explore the experience of Serendipity in an Information Seeking context.

5.2.8.3 The Paradox of Purposive Serendipity

The definitions suggest that Serendipity occurs randomly and accidentally. However. the occurrence of Serendipity within a wider framework suggested a further dimension to Serendipity. In the process of analysis the emergent concept of Serendipity was flagged up as co-occurring with strategies and motivations. Re-reading the transcripts and the contexts in which Serendipity was discussed pointed in more detail to a relationship between Serendipity and strategies for finding information. Re-coding focused on serendipity and its context within the information seeking behaviour of the interviewees confirmed these initial indications.

5.2.8.4 Inducing Serendipity

Data coded as "Serendipity: purposive" in the initial analysis revealed a form of serendipity which interviewees perceived to be a phenomenon deriving not only from certain conditions, but also from active strategies. In other words, interviewees pursued deliberate actions that they perceived as eliciting serendipitous results. The purposive element consists of an awareness that certain activities or strategies will result in, or considerably increase the

probability of, the occurrence of serendipitous encounters. Many examples emerged from the interview transcripts, many of these appeared in connection with Serendipity appearing in the form B3.

Interviewees indicated that Serendipity was not entirely a random occurrence, it could in their perception, be induced. The first of these was a preparation, or openness to Serendipity occurring.

> "I think, some people have traits which are a barrier to it occurring. I suspect that the tighter your methodology the less likely that it is to occur. In computer science there are people whom I would refer to as theoretical fascists who are so tied down to the formalisms that they are very much in an abstract world where serendipity is unlikely to occur, but I am not a good enough mathematician to be in that world. [*So in effect, you are saying there is nothing positive that you can do to increase serendipity, but there are things that can block it?*] Yes, I think I get some of my best ideas for research, or I take a complex situation and backtrack the essence of the problem when I am walking the dog at night when I am just mulling things over in a fairly relaxed way and that is when you leave yourself open to these things. That is the inspiration side of that, yes it is the flash of inspiration...". P25: 25:25 (130:147)

5.2.8.4.1 Breadth

In more concrete terms, Breadth Exploration was cited as a particular strategy associated with Serendipity (Section 5.2.1.3.3). Interviewees linked activities with the generation of serendipitous results.

> "[*Do you think there are things that you do that would increase the chance of serendipity?*] Yes, I think belonging to discussion groups, I know that I do pick up information sources and ideas from discussion lists and also email newsletters and alerting services. So that is one thing that I have gone and consciously signed up for those. Also, scanning through journals as well, and just allowing myself to follow up interesting things once I have seen a mention of something interesting then I am more likely to follow it up if it is a URL than a book reference, but the chances are that I will immediately cut and paste it into the browser. Being distracted is part of my mode of working and so I allow myself to be distracted". P39: 39:24 (165:169)

> "Let me think about how I actually go about it, errm I refine, I am a refiner a I think, I tend to go in with very simple questions to begin with and then from those questions I will start refining until I get to the pieces of information that I want. I actually even do that when I know immediately that I couldn't find it. It is almost a deliberate process because sometimes the randomness can throw up angles that you haven't thought about. [*The randomness itself you mentioned earlier, that random things can be useful.*] Yes, serendipity I think. [*But at the same time as serendipity or randomness you are saying it is deliberate.*] Yes, deliberate randomness, we are into the field of chaos now. Yes, you have to define it – you wouldn't go in and search for pigs when you wanted cows, but you may say bovine instead of cow. I think you have to appreciate that a lot of search engines are fairly chaotic in themselves. They are being very literal, so even if you think you are being clever the search engine doesn't see that and there you go. P14: 14:27 (150:166)

5.2.8.4.2 Put yourself in the right places

Along with Breadth a perception of creating opportunities was present in the interview data.

> "... it would be accidental although you can put yourself in the right places on occasions...". P43: 43:25 (274:290)

5.2.8.4.3 Networking

In recognising the value of Networking interviewees linked the material received from network contacts to Serendipitous results. Thus some saw Conferences as a valuable source of Serendipity, others saw talking to people in any conversation as potentially rewarding.

> "I would say that the work that I am doing is a lot more random now really, someone I am speaking to might suggest a book, I'll read that and that will spark off a whole new area of interest, that will tie in to what I was doing, but I could have almost got to the end of my research without knowing it was there, or finish without even studying that area necessarily. So I would say that there is a lot more chance in it". P7: 7:3 (23:27)

> [*What are the most effective activities, strategies, sources, you can do to find information?*] Well, I think the systematic literature review is always effective, and I would always want to do that, but actually there is ...very often something that has come at me sideways has been very effective, somebody mentions something that they think that I should read, because of what I am interested in and yes lo and behold it is very interesting. Meeting people and hearing about their work is a very effective means of taking my own work forward. Whether it is information gathering I am not sure. B3 P23: 23:19 (230:235)

Finally, and despite all views to the contrary, organisation of resources was found to be at the heart of serendipity and entirely complementary to strategies and actions.

> "Yes, it isn't simply luck that I found garden History, because libraries are organised logically so that the garden History journals are next to the art History journals and then next to the architecture journals. So, I suppose it isn't just by chance, but that is one way in which I guess I am not narrowing what I find, but it is being narrowed for me, in that if I go to look at art journals I am very aware of what is around the edges, what is on the periphery and what is adjacent to. It is the same with books on shelves because of course using keywords and titles searches isn't actually a scientific strategy because many people have very bizarre titles for books and one way that I have found some is just that they were next to others that I was going to get". P31: 31:16 (158:166)

5.3 Discussion

The results illustrated in this chapter collectively represent the first of three Information Seeking processes defined by this study. As a product of Naturalistic Inquiry and particularly of inductive analysis, Opening emerged as a code category early in the analysis process. The label originates from the words of interviewees who in the earliest stages referred often to 'Opening'. Opening was an in viva code label that through successive iterations of constant comparison became a robust feature and a core process within the top level model.

Opening was formed around two strategies, Breadth Exploration and Eclecticism and a number of discrete activities. Strategies are taken here to mean a combination of activities working towards a single purpose, while activities refer to individual activities or behaviours that may exist without the presence of any other activity or purpose. These elements are now summarised and discussed in the context of existing literature.

5.3.1 Breadth Exploration

Breadth Exploration was highlighted here as a strategy whose goal was the conscious expansion of searching and exploration of every possibility. In Breadth Exploration, Opening was represented as a widening of horizons to generate material that was beyond current knowledge or expectations of information seekers, as participants explained "a conscious, deliberate strategy of expanding information horizons". Breadth Exploration was associated with a need to gain a "big picture" or "broad picture". Particular activities associated with Breadth Exploration included elements of Browsing and Networking, but the main and clearest activity was the concept labelled "Directed Stepping Back". "Directed Stepping Back" had a direct interaction with Orientation and particularly Choice of Information Source and Choice of Keywords.

In a simple sense Breadth Exploration reveals a process that details a point that Walker (1988; 1990) suggested would be of benefit to interdisciplinary information seekers, that of searching across "a widened range of sources". This provides an indication of a wider appreciation of breadth but does not fully develop the idea of a strategy illustrated in the results presented here.

Among previous models of information seeking Kuhlthau's model provides one very well developed view of exploration, that of Pre-Focus Exploration. For Kuhlthau the process of exploration "The task is to investigate information on the general problem in order to extend personal understanding. Thoughts centre on becoming oriented and sufficiently informed about the topic to form a focus or a personal point of view" (Kuhlthau, 1993a: 343). The overlap between Pre-Focus Exploration in Kuhlthau and Breadth Exploration in the present study appears superficially to be great.

Whereas Kuhlthau defined a problem solving stage from beginning with a Broad question to a later Narrow question, Breadth Exploration remains stable at any point within seeking the solution to information problems. Kuhlthau's view is more channelled and directed to an early stage of information seeking, yet Breadth Exploration in the present case exists in many more positions than considered elsewhere. In Ellis' Behavioural Model the concept of exploration appears within the concepts of Starting (1989) and Surveying (1997). In each expression of the concept the idea of obtaining an overview is present and integrated with other activities, such that informal networks were found to contribute to the process of "activities subsumed are those characteristic of the initial search for information to obtain an overview of the literature within a new subject field..." (1997: 395). Again the limitation of timing and role is present.

In studies of interdisciplinarity the concept of Breadth itself was present in research by Palmer (1999: 248) where it contributed to a framework describing the purpose and function of

research roles and the scope of research projects. More recently Palmer and Neuman (2002: 102) described information seekers as

> "Extending the intellectual sphere...their scanning mode of reading pushes the boundaries as they regularly browse for leads in areas outside their expertise. This type of exploratory scanning can be expansive, covering a wide range of resources and subject areas".

However useful previous studies are in highlighting some similarity between the findings of the present study and previous research, each has described exploration in a different way, and misses the essence of a larger strategy. Breadth Exploration as described in this study embraces a complex pattern of passive and active modes of information seeking to generate overviews, increased information horizons, and as a strategy that was not limited to an initial searching activity or stage supported all parts of the information seeking process.

5.3.2 Eclecticism

The study applies the Oxford English Dictionary definition of Eclecticism to information seeking. The data suggested that Eclecticism exists within the framework of interdisciplinary information seeking as a strategy not of breadth but of 'generality' and openness to multiple and unrestricted information sources and types. As a strategy Eclecticism was found as a drive to access a multiplicity of channels. Activities were a mixture of motivated-active and passive elements drawn from across the palette available in Opening. Interviewees spoke of analogies with Pigeons crumb collecting, of Magpies collecting shiny objects and Bees collecting nectar in their description of gathering information from "anywhere and everywhere". Eclecticism was particularly highlighted as a cumulative effect in which the passage of time was a crucial aspect to this information seeking.

The literature of Information Science has appeared reluctant to use the term "Eclecticism", however there are some parallels that on a reading of the literature offer a similar insight. Eclecticism embodies much that is identifiable in the concept of foraging. It represents an enabling process in the same way as foraging. Foraging theory, put forward in Stephens and Krebs (1986) suggests that a hungry animal has to make a choice between food opportunities and that animals make a choice that maximises benefit at minimal cost. Sandstrom was the first to apply the description of "subsistence foragers" in an information context with the construction of a view of scholarly information seeking in which "scholars and subsistence foragers face similar constraints" (Sandstrom, 1994: 415).

Other research has produced further analogous descriptions. For example Bates' view of information seeking as berrypicking stressed an analogy with the hunter-gather in showing that information seeking for interesting information could be like searching for scattered berries amongst bushes. Pirolli and Card (1995) similarly applied the principle of foraging theory and equate searching for the most profitable, fruitful sources as equivalent to looking for the most relevant items. The theme continues in Cronin and Hert (1995).

The principle is similar to that expressed by interviewees in the present study. The interdisciplinary aspect adds the dimension of information seeking across disciplines and sources for multiple goals. Nevertheless, as Sandstrom found, there are limits to the analogy. Each of these offers a similarity, without fully containing the same motivated prolonged strategy that Eclecticism was identified as in the present study. In this study, Eclecticism has an attribute of foraging in the extent of sources and pragmatism used to find the interesting items.

Other connections to eclecticism in a general form are found in a study by Palmer and Neumann (1999: paras 6,7,8) which identified humanities scholars as needing to develop strategies for extending the scope of their information field, and indicated that humanities scholars were "eclectic readers and active browsers who regularly probe for leads in outside domains".

Ultimately the complexity of Breadth Exploration and Eclecticism appear not in defining them as strategies, but in their incorporation of other activities to form a more complex whole than that represented by the individual components.

5.3.3 Networking

As a form of communication, Networking was not immediately associated with information seeking. However, interviewees cited Networking as the most valuable individual activity contributing across Opening and particularly in Breadth Exploration, Eclecticism. Networking therefore became a key element in the process of information gathering. Interviewees perceived their Networking as in their own words it was "better tool for exploring their interdisciplinary topics and opening new concepts and areas".

Networking was explained by participants in this study as way of overcoming the inadequacies of Keyword Searching, language, terminology, and knowledge difficulties. The channels used for Networking combined face to face, electronic, formal and informal communication means. Interviewees saw the World Wide Web and Email playing a greater part in their work of recent years. These offer a detailed indication of the extent and use of social networking in the case of interdisciplinary information seekers.

Previous research highlights social networking as an important aspect of information seeking. Social Networking is the subject of an extensive literature and is defined in a number of forms. Work specifying aspects of social networks as part of information seeking by Taylor (1991) and Chatman (1992; 1996) points to the importance of social networks as a source of information. Sonnenwald stands out in specifying social networks as "including a star configuration, chain or isolates (a social network of one)" (1999: 181) and described social networks as "Human information behaviour is woven around, i.e. is shaped by and shapes, individuals social networks, situations and contexts" (1999: 182).

The present study highlight networking as an important tool for identifying sources, obtaining information and developing a topic. Within this range of activity there is a great area of similarity in results. Networking in this study formed part of the increased information exposure, that was also identified by Sonnenwald who also found social networking to be a key part of the process of generating an information horizon (Sonnenwald, 1999: 184–185). The results in this chapter suggest a similar relationship and specify that relationship in the particular context of the interdisciplinary information seeker. Bystrom and Jarvelin (1995) linked networking to "general purpose sources" and in a similar result, one facet of networking found in the present study also identified social networking as a useful "general source" of information.

In explaining the prevalence of networking, the present study identifies Networking as the most important activity. Hence in research by Ellis (1987; 1989) informal contact, in other words social networks, were found to be an important means of support to monitoring, updating, and information gathering activities. In a later study Ellis found "The primary means of maintaining awareness is the established personal network within the company as a whole, in the form of easily accessible interdisciplinary knowledge about the technological developments in the market, derived from the many actors who keep up-to-date within the field.....To approach a new topic personal contacts are used as the predominant source, based on the respondent's own knowledge of whom to contact" (1997: 393). Research on interdisciplinary researchers by Palmer was also particularly clear about the role and importance of networking. Palmer (1996a: 172) identified networks as a crucial form of "feedback from knowledgeable sources" and for assistance in evaluating information. A further role in the use of conferences allowed "keeping up with information" and identifying possible collaborators (1996a: 172-174) and later included networking within an understanding of "Consulting is the practice of seeking information and guidance from colleagues" (Palmer, 1999: 248).

A more general review of social networking as it appears in earlier literature was provided by Cronin (1982). Further consideration of the literature highlights the work of Daft and Lengel (1986), Katz and Tushman (1979), and Webster and Trevino (1995) through which it is possible to consider social networking as more important for complex or difficult tasks. The interdisciplinary context could often be considered a complex or difficult information seeking position and therefore the literature would tend to support the role of Networking as found by the present study.

5.3.4 Keyword Searching

Defined as the application of search terms to an information source, Keyword Searching as a method of Information Seeking was circumscribed by the ability to Identify Keywords and to apply those keywords to compatible information sources. Perceived by participants as frequently the only effective way to use an information source, Keyword Searching had clear links to the Directed Stepping Back identified as part of Breadth Exploration in that it was directly influenced by the choice of keywords and types of searching carried out.

Databases and the World Wide Web were dependent largely upon Keyword Searching and 'favourite databases' were used to generate starting literatures to which other activities within Opening could be applied, for example Chaining. The internet was particularly favoured over disciplinary databases for broad Keyword searches. Participants identified poor database coverage as one key factor in reducing the value of Keyword Searching.

The prominence of Keyword Searching in the findings of the present study was unsurprising as many previous studies have discussed the central role of Keyword Searching. The description of Keyword Searching in the present study is not therefore unique for its description of Keyword Searching as an activity. It is unique in placing Keyword Searching as part of the interaction between Opening, Orientation, and within Opening between Keyword Searching and other activities and strategies.

Much of the literature is concerned with the effectiveness of Keyword Searching. The present study did not consider effectiveness, it considered Keyword Searching as an activity which was part of a larger process. However, existing research similarly confirms the findings of the present study in identifying the value of keyword searching and particularly that it is popular, useful and often more productive than other methods. The vast literature that is available does little to change the simplicity of the concept while still putting the present research findings in a broader literary context. Some indications of the scope of further reading include studies of users and usage of keyword searching. For example, Hildreth's (1997) study of Boolean searching found that keyword searching was very popular with searchers, even though many keyword searches fail. Other examples include Schrock (1977) who considered the use of keyword searching in search engines, while Tillotson (1995) in a study of search facilities in OPACs concluded that both keyword and subject search facilities were important for OPACs. Each of these examples highlights the value of Keyword Searching to information seekers.

The relative effectiveness of keyword searching with other types of information seeking points to the position of keyword searching as a tool compared with subject searching, browsing and Dewey decimal retrieval. Keyword searching compares favourably to subject searching in

some cases, as suggested by Markey (1985), Hedberg (1987) and Hagan (1987) keyword searching is put forward as the most effective and valuable way to access systems.

Later studies tend to confirm the relatively important position of keyword searching and subject searching, for example Hirsh and Borgman (1995) compared browsing and keyword searching and a study by Tsai (1998) compared keyword searching with Dewey decimal retrieval. Other studies have considered the role of user knowledge in the effectiveness of keyword searching. MacDonald (2001) stressed the need for proper search terms across different disciplines, though put this in the form of a guide to simple searches. The need for information seekers to understand how a system using keywords operates sits just below this surface discussion. Further literature on this activity has considered the practical elements of which users would tend to use keyword searching. For example Ensor (1992) considered which OPAC users used keyword searching), methods of teaching keyword searching; and York (1999) described teaching keyword searching to school teachers; and the appropriateness of keyword searching to different types of record for example musical works on sound recordings; was covered by Leazer (1992) are indicative of the lines of inquiry that go beyond the scope of the present study.

5.3.5 Browsing

A definition of Browsing emerged from the language and descriptions of the activity in interviews. In this chapter Browsing was described as scanning or looking at information sources or information. The analysis refined this definition further to identify two modes of Browsing with related goals, these were labelled Open and Selective. Browsing was of high importance to all interviewees and contributed to a range of different information seeking behaviours and provided large inputs to Serendipity, Breadth Exploration and Eclecticism.

Within a view of a whole research project Browsing was found to be particularly associated with a movement by information seekers between one focus or disciplinary element and another. The Context of information seeking was most visible in its influence on Browsing. Browsing was bound closely to available Time and Access, and particularly so as Browsing was frequently described as time consuming. Strongly favoured information sources for Browsing were the World Wide Web, current journal shelves, and library shelves which some participants referred to as "surfing the library".

The relationship of the findings to existing research identifies a large body of work interested in Browsing. Within information behaviour models Browsing was suggested to exist in the earliest stages of Kuhlthau's model and was particularly associated with the Initiation stage (1993a: 237) prior to an information seeker achieving a focus. The Ellis model places Browsing activity later and associates it with maintaining current awareness, semi-directed scanning of current sets and source identification, differentiation; and familiarisation (1987:94).

Browsing was summed up as "semi-directed searching in an area of potential interest" (Ellis. 1993: 357).

Opening as a core process defined the parameters allowing the possibility of Browsing to exist at the first and any subsequent moment of information seeking. In this there is a partial overlap with Kuhlthau and with Ellis, in first and some subsequent usage of Browsing. Though in the present study found Browsing was found to be continuously available and in use.

Browsing appears in the broader literature of information science and information retrieval as a fundamental component of information seeking behaviour in many previous studies both of information behaviour and information retrieval. However, familiar the word "browsing" is to the reader, there are a number of different interpretations of exactly what browsing means to information seekers.

Hancock-Beaulieu (1989) suggested that there was no general description of what browsing is, but it can be seen as drawn together in Twidale et al (1994, section 2.2) that browsing is recognisable: "By browsing we mean that activity when a user does not know in advance the item or items she is looking for, although she does know some of its properties".

Marchionini's suggestion that 'transitions' from one stage to another are either "analytical" or "browsing" (1995: 73) is of value here to highlight different approaches to searching. Marchionini (1995:8) defines Browsing and makes a distinction between browsing and searching. Browsing strategies for Marchionini were opportunistic, data driven, heuristic. informal and continuous, as opposed to analytical strategies that were planned, goal driven. deterministic, formal and discrete.

Marchionini's conception of browsing is also especially worthy of note as he viewed browsing as part of "get[ing] to know an intellectual neighbourhood" in interdisciplinary information seeking (Marchionini, 1995: 73). By implication this suggests that interdisciplinary information seeking relies upon the characteristics of browsing, defined by Marchionini.

Browsing was associated in Rice and McCreadie with the most pervasive information searching activity and said to exist in three forms, Search Browsing, General Browsing and Serendipity Browsing (1999a; 1999b).

Within the concept of Browsing, the present study identified Open and Selective modes. Previous research has similarly found divisions within Browsing activity and has a considerable volume of literature associated with it. Marchionini (1995:106) recognised three general types of browsing – directed, semi-directed and undirected. Marchionini drew on much previous work that clarified the existence of different types of Browsing.

Earlier studies considered Browsing to be represented by a range of modes. As early as 1960 Vickery described Browsing as discriminating (Vickery. 1960), while successive researchers identified a range of similar themes. Levine (1969) pointed to random browsing. quasi random, semi-deterministic unknown collection, previous explored area or searching in a

limited area; Morse (1971) described "Browsing may be defined as a search, hopefully serendipitous..." While continuing the distinction between modes of Browsing Herner (1970) suggested the identification of semi-directed, directed, undirected: Apted (1971) general, general purposive or specific and later Cove and Walsh (1988) suggested search browsing, general purpose browsing, and serendipitous browsing contributed to the view of Browsing as a complex of different modes and approaches. The link between serendipity and browsing is again present in Toms (1999: 191).

Bawden's definition of Browsing appears most cogent in connection with the findings of the present study. Bawden put forward "At least three kinds of browsing have been recognized: 'purposive' browsing, the deliberate seeking for new information in a defined (albeit broad) subject area; 'capricious' browsing, random examination of material without a definite goal: and 'exploratory' or 'semi-purposive' browsing, in search, quite literally of inspiration." (Bawden, 1986: 211).

Bawden's work also serves to highlight a link with the concept of "organisational scanning". From this direction Aguilar (1967) and later Weick and Daft (1983) adopted undirected viewing, conditioned viewing, informal search, formal search which was followed up in the work of Choo, Detlor and Turnbull (1999) incorporates Ellis's model with Aguilar's framework to develop a view of Web Browsing. However, these studies did not greatly enhance the basic definitions established in earlier research.

The more in-depth studies focused purely on Browsing are more valuable in considering the role of Browsing in the present study. The concept of Browsing as Open or Selective used here is comparable with previous research that has defined the nature of browsing as having modes. The utility of applying Open and Selective as appropriate labels to Browsing behaviour among interdisciplinary information seekers serves to extend the understanding of Browsing, while the links with Serendipity are strongly highlighted in the present study as separate but related concepts, in previous research Browsing and Serendipity tend to be considered Cause and Effect. Considering Serendipity separately offers considerably more opportunity to understand observations of Browsing.

Many previous studies have sought to build upon concepts of Browsing and definitions of different modes of Browsing, but significantly more studies have considered specific environments, for example Browsing is defined for hypertext environments by Marchionini and Shneiderman (1988), Marchionini 1987, Liebscher and Marchionini (1988), Carmel, Crawford and Chen (1992). Others have considered public access Browsing, for example Behesti (1992) in public access library catalogues; Virtual libraries in the work of Daniels (1997): Art gallery collections (Bechofer, Drummond & Goble, 2000) and Video browsing (Tse, Vegh, Marchionini & Schneiderman, 1999). Beyond these examples, further studies have considered

different user groups and Browsing, as for example in the work of Borgman (1995) and Thury (1998).

Collectively the literature supports in a broad sense the idea of browsing as a major form of information seeking. The literature also highlights that Browsing is considered to be a major source of serendipity. This study confirms that link, although it deals with Serendipity separately. The theme of Open and Specific Browsing confirm the two major divisions of Browsing put forward in previous literature and confirm the complex nature of different types of Browsing in the case of interdisciplinary information seeking behaviour.

5.3.6 Monitoring

An important role in Opening, Monitoring was defined as "keeping track, watching revisiting" an information source. Dependent upon identifying a suitable source and associated in this with any information source capable of supporting repeated use over time. Monitoring was also particularly affected by its relationship to time and access. The role of Opening was to generate material from within identified information sources. Effectively Monitoring maintained the use of information sources over time. Despite difficulties in its execution interviewees recommended Monitoring as a key activity.

Thematically Monitoring formed a part of Ellis and via Wilson (1997) in Kuhlthau's views of information seeking. Wilson (1999: 256) suggested that the stage process of the Kuhlthau model may be viewed as closely related to the Ellis model characteristics. Hence, in this view, the activities of Chaining and Monitoring are seen as a deeper specification of Kuhlthau's "Collection" stage. Kuhlthau does not mention monitoring activity which may reflect the use of school children as participants in the early studies, whereas Ellis focused on academics, which may account for the difference.

Ellis defined Monitoring as maintaining awareness of developments in a field through the monitoring of particular sources (Ellis, Cox and Hall, 1993: 359). As an activity it was particularly associated with journals and was defined as a continuous process within Ellis's broad framework.

The present study confirmed the use of Monitoring within the context of interdisciplinary information seeking and added particular aspects relating to use of sources. The stimulus for monitoring tended to be identification of useful items in a source and the hope that this gave of identifying further useful items over time. Hence a variety of information sources were used by information seekers in a monitoring behaviour pattern. Additionally Monitoring was an example of information seeking fitting in among other day to day patterns.

Many items in the literature focus on the applied psychology side of Monitoring and indeed refer to the area of stress and coping theory which will not be covered here. Examples of

this literature include the work of Miller (1987); VanZuuren & Wolfs, (1991); Muris, VanZuuren, DeJong, DeBuers, Hanewald (1994); Bartal (1994); and Myers (2000).

Monitoring in the form described by Ellis and found in the present study is significantly less common in the literature. This may be a reflection of the different groups of information seekers used by studies of information seeking and the nature of monitoring as a passive, rather than active search activity.

5.3.7 Chaining

Chaining was identified in this study along similar lines to that previously found by Ellis. Defined originally in Ellis (1993, 361; 1997: 395-400) typically following chains of citations or other forms of referential connection backwards and forwards was here expanded to include Chaining of "lead ideas" and Chaining of Sources.

As a component of Opening, Chaining in four dimensions dramatically increased the scope of materials available. The major change of emphasis in the present study was found to be Backward Chaining, Forward Chaining and Source Chaining. The latter may be thought of as a variation resulting from the interdisciplinarity displayed by the information seekers.

The perception of Chaining as a crucial point in information seeking permeated the results. Finding one good reference was a valued tool for findings other material. In the extended format of three-way Chaining interdisciplinary researchers saw their links and chains taking them into new areas, fields, disciplines, sources.

The Chaining of concepts and sources division particularly contributed to an increased range of information available. Literature referring to the problems of interdisciplinarity often points to the invisibility of information (Jones and Rosenfeld, 1992), while links generated by Chaining overcome such obstacles, for example linking into Grey literature. Implied within the process of Chaining was the presence of a closer reading of full texts to enable concepts and footnotes to be followed through, this also had implications for the desirability of access to full text records in retrieval systems or the original items.

Chaining was defined most clearly in Ellis (1993) but was placed within the Kuhlthau model by Wilson (1999) as a "deeper specification" of Kuhlthau's Information Collection stage. In the present study Chaining contributes to Opening as one of a range of activities generating both information and possible locations for information. These represent the main developments of the Chaining concept as related to the present study and to the area of information seeking.

5.3.8 Serendipity

Information seeking research has previously made little of the role of Serendipity. In contrast, the analysis here found the presence of Serendipity to be an important element of

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information seeking for interdisciplinary scholars. Subsequent readings and in-depth analysis suggested Serendipity was a complex part of Information Seeking Behaviour. This element of the work requires more depth to place it in context and to appreciate the novelty of the results presented in this chapter.

The data illustrated the importance of serendipity to the interdisciplinarian and the value of generating a "rediscovery" of knowledge from serendipitously occurring items. Results of analysis generated a framework of Serendipity in which Serendipity was seen to occur in four ways: A2, A3, B2, B3, referring to differences in "Preconceptions" and "Knowledge". That is to say interviewees had variable expectations and knowledge levels prior to occurrence of Serendipity. Varying from knowing an area to look in without knowing the information required to knowing both the shape and potential location of material. These distinctions also allowed consideration of a new concept: purposive serendipity, that is presented as a paradox, but within the emergent framework allows consideration of interviewees activity of "inducing serendipity". Identified particularly in connection with Breadth Exploration this concept was a particularly valued but complex part of information seeking.

Serendipity has a long history in the literature. In the context of information seeking, "serendipity" is something of a paradoxical concept. Whilst being perceived as valuable, it is at the same time elusive, unpredictable and – at least at first sight – not subject to either the understanding or the resultant control that would enable it to be "used" as a conscious information seeking strategy. Possibly for this reason serendipity does not figure prominently in current models of information seeking or behaviour, for example those of Ingwersen (1996), Wilson (Wilson, 1997), Kuhlthau (1993), Saracevic (1996), and Spink (1997).

Serendipity has been considered in the literature to form an integral part of the creative process in the arts and humanities, social sciences and the sciences. In each, however, the experience of serendipity may be different. Delgadillo and Lynch (1999), for example, confirm the essential value of serendipity in the work of humanities researchers such as historians. Cobbledick (1996) considers serendipity as an important source of artistic stimulation. Sometimes serendipity is described in terms of finding similar information to that already identified, as described by Buchwald (1999: 4): However, serendipity in the humanities may also have a role in revealing hidden connections or "hidden analogies", enabling creative connections to develop (Cory, 1999). The hidden analogies are revealed through serendipitous links between information sources. In the social sciences, serendipity appears in a similar "connection building" role. Merton (1968) describes this process within sociological research, and Fine and Deegan (2000) in a number of cases of anthropological and sociological fieldwork. Further discussion of the key role of serendipity in science may be found in Myerly (1980) and Senoff (1990).

A number of writers have hinted at an element of potential control. In science, serendipity has been thought of as the product of mental preparation, of an open and questioning mind. Thus, Rosenman (1988: 137), Roberts (1989) and Seifert et al.(1994) suggest that creativity originates in a preparation of mind that allows subsequent recognition of the serendipitous when it is encountered.

In all Serendipity would seem to be important across disciplinary areas for its role in connection building, discovery, and creativity. The literature presents serendipity as being in some way both passive and yet capable of "efficiency", or techniques by which hidden knowledge may be retrieved. Accounts of the creative process of research do not leave serendipity as Walpole's classic "fortuitous discovery", but hint at something more active, operating at the edge of consciousness.

The literature of information retrieval and information seeking has also provided some support for the view of serendipity as a purposive or active phenomenon. Gup (1997; 1998), for example, highlights the value of serendipity but perceives it to be under threat as electronic retrieval may tend to reduce the opportunity for serendipitous information encounters. This theme continues Cooper and Prager's (2000) study of digital collections and in Huwe (1999).

In the information retrieval literature serendipity has been seen to be of some importance, often considered as a by-product of browsing, hence thirty years ago Morse (1971) noted that "browsing may be defined as a search, hopefully serendipitous" and considered ways to increase the efficiency of browsing. More recently Callery (1996: para 2), writing about the Yahoo Search engine's tree-based classification system, noted the benefit of serendipitous findings from within the same classification branches, while Rice (1988) similarly attributes information organisation to serendipitous results.

In these cases, something more than mere chance is implied, as with Toms (1998), who talks of "serendipity-focused" research, and Roberts who discusses "pseudo-serendipity", in which serendipity arises not from random accidents but from circumstances brought about by unconscious motives which lead ultimately to the serendipitous event. These authors link serendipity to action and to important aspects of the retrieval process. Others, for example Hill et al (1997), consider ways to exploit serendipity amongst users of hypertext navigation systems. Jones and Rosenfeld (1992) suggest serendipity as an information retrieval strategy and moot it as an appropriate tool whereby information retrieval systems can retrieve inaccessible "invisible material". Similarly, Batley (1988) describes an experimental retrieval system that offers serendipitous browsing as an active search option.

Other researchers, as described in the section on Browsing (including Rice and McCreadie (2001) make much of the connection between browsing and serendipitous retrieval, indicating that "Serendipitous findings are one of the consequences of browsing in the library and through journals is finding something of interest or some things that are not originally

sought" (Rice and McCreadie, 2001:182). More significantly, Rice and McCreadie (2001: 179) link serendipity and browsing in a manner that tends to confirm the data presented in this chapter. Rice and McCreadie identified four dimensions to the process as the act of scanning; the presence or absence of purpose; the specificity of search outcomes or goals; and knowledge about the resource and object sought.

The most detailed recent studies by Erdelez describe a type of serendipity appearing in two contexts of activity: browsing and environmental scanning (Erdelez, 1996; 19997, 1999). Erdelez (1997: 418) called this "information encountering" and described it as an integral element of information seeking activities. In this view Information seekers could be classed as (a) super-encounterers, (b) encounterers, (c) occasional encounterers and (d) non-encounterers. Observations of information encountering and the resultant papers by Erdelez appear to accept a degree of passivity, but also allow the notion of serendipity occurring more often in the case of the "super encounterers".

The literature of information retrieval presents an underlying principle, complementing that found in the literature of other sciences that it is not only the prepared mind, but also the prepared retrieval system and appropriately developed information seeking skills that may have a role in engendering serendipitous information encounters. The literature therefore supports the basis of the results obtained in the present study and allows the beginning of a larger conceptualisation of serendipity and its role in a model of information seeking behaviour.

6   Core process: Orientation

6.1 Introduction

The processes associated with Orientation were described by interviews as "finding which way was up". Covering a diverse range of processes that were fed by, and in turn fed, the processes of the other core processes, Orientation was found to be a central event in the information seeking of the participants in the research.

> "[*By orientate yourself what do you mean?*] Well, trying to find what the landmarks are, and what the language is. So it might include identifying what key pieces of jargon mean, there might be some sorts of keywords that I wouldn't have thought of, or the concept that I am looking for might be talked about differently in a different discipline, and so it is orientating oneself in terms of language and what might be the key journals, or websites, and keywords indeed if you are looking at a database". P39: 39:28 (189:193)

The process was referred to metaphorically to learning a new language, an appropriate and descriptive summary of many of the activities connected with Orientation.

> "I think that the simplest model that I can use is when I've been learning a new language, that at first you are listening very closely to intonation and the physical context of the discussion, where you don't actually understand any of the words at all, but you can see the context of the situation, you can see if they angry or upset, or in a particular situation, and you hear words repeated again and again, and in time you start to formulate your own vocabulary, and in time you start to do something a little bit elegant, at least you think that it is, I think maybe it is a little bit like that in terms of interdisciplinary research. ... I try to imagine myself in the other discipline which the only thing that I can do is see how people in the other discipline can react to the situation at hand and see what excites them, or interests them, or what they react negatively to, or what they are worried about, so I may go and try to understand a particular detail and similarly other bits and maybe in time I'll start to make connections between them. It is a kind of model that at least for me it works". P15: 15:20 (190:206)
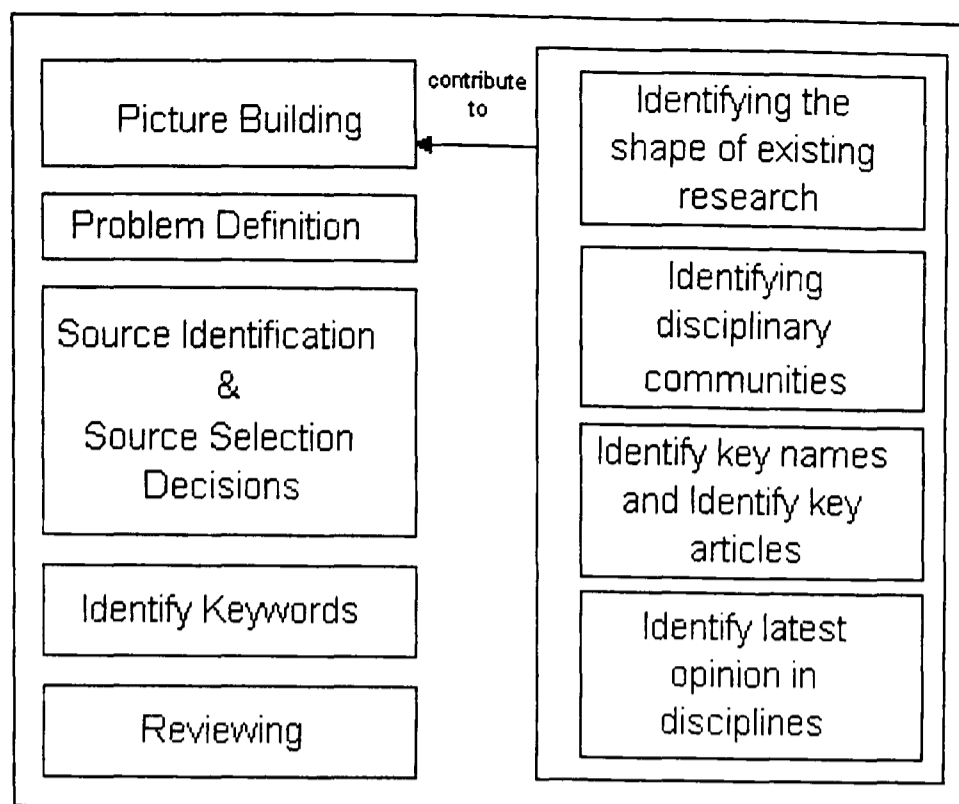
Figure 13. Orientation

The significance and place of Orientation within the larger view of Information Seeking Behaviour is discussed in Chapter 11. The individual components that of Orientation are detailed in the body of this Chapter, and illustrated in Figure 13.

6.2 Reviewing

A central theme of information seeking within the present study appeared as assessing current information. Analysis of interviewee transcripts suggested the process should be described as Reviewing. Reviewing occurs both before and after information searches.

6.2.1 Definition

Interviewees described patterns of reviewing their existing information and conceptualisation of their information problems. The process was found to have both "physical" and "intellectual" aspects.

In the "intellectual" form, Reviewing was identified as an entirely non-physical mental process and considered what was already known.

> "I first mentally review the literature that I have read, oral presentations that I have attended, and attempt to recall anything that I think could possibly be relevant... That is usually what I try to do first, I think is say 'is there anything about this that I know already', especially in these other disciplines that are outside of my core area of chemistry, is there something that seems familiar to me, that I have had experience with. That is probably the first thing that I do". P15: 15:9/15:11 (73:80)

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seems familiar to me, that I have had experience with. That is probably the first thing that I do". P15: 15:9/15:11 (73:80)

"I think I start off in a similar way, I start off with a brainstorm...". P7: 7:5 (41:42)

Reviewing also had a physical parallel in the construction of bibliographies from previously collected material and personal collections, for others the idea of drawing out the ideas, questions and pieces of information provided a similar effect.

> "...Well what I did was create a huge, enormous bibliography using the bibliographies of all the books that I think were relevant at that time to what I was studying and so if you like I had an immediate database to look at and then if you like from there I did in parallel to that I did the normal type of word search". P5: 5:19 (122:125)

The effect was suggested in graphic terms to be an agitation of ideas within known areas to allow further development into new areas.

> "Well, in a way, I can only talk about it from my own direct experience, I think interestingly enough this morning I was looking back at the bibliographies that I constructed at the start of the subject and I think to be honest you don't really have a clear idea of what it is you are doing, so what you do is agitate into the areas where you do know something about it, and you sort of try and look at those and exhaust those and that provides you with enough to go out into the field and even so you can go out into the field with wildly misconceived ideas but by virtue of actually talking to people and getting what is a more generally accepted version of events you are able to discard some of the things that you originally thought were relevant in your initial agitation of the 'washing machine' and that might well be replaced by new stuff or you concentrate on one or two things that you did fix on to a much greater degree". P5: 5:12 (75:85)

The focus throughout was on what was known or previously obtained and on preparation for a movement outwards on its foundations: It is noteworthy that much interdisciplinary research discussed by the interviewees was concurrent with other research, with teaching, and other interests. Information gathering and accumulation were often lengthy. The need for Reviewing was therefore a process of checking what had gone before.

> "Well, first of all I would look at the material that I had already got and had gathered together. That might be various formats and in various different places, it might be in one of the files in my filing cabinet, where I have some material arranged by modules that I teach - there is some subject material that I put in there, but also I have some additional subject material in files on previous interests or interests that I am building up, or on my shelf as my eyes move around the room, I have only a few filing cabinets, on my shelf there is an overflow and for example, [topic name] files are rather randomly stuffed with materials that I have gathered together, but there are also books and journals, so if I remembered something particular in a book or journal that I know or think that I have got, then I would root that out". P39: 39:3 (21:28)

Reviewing established a basis for knowing "what was known" and what should come next. Movement forwards was connected with information seeking to follow leads obtained from Reviewing. Identifying possible "seeds" of information that could be developed further with information seeking was one way of describing the transition.

> "...If it was writing a paper, then at the end it would be trying to chase references and validate references. It might also be reading through it, and thinking I ought to have referred to 'something or other' and then trying to find a paper that fitted. So it would be looking for quite specific things...". P39: 39:17 (110:118)

> "It is very seldom that one ever has a kind of blank sheet to begin with. Almost the fact that one has an interest in it means that has picked up background pieces of information along the way. So it largely a matter of developing those seeds...". P34: 34:5 (22:27)

Reviewing was associated primarily with assessing prior knowledge and was particularly connected with the use of Personal Collections, and in subsequent iterations, the information gathered itself.

Reviewing related to Orientation and particularly contributed to Picture Building, while suggesting Information Needs and development of Opening Strategies.

6.3 Picture Building

Whereas Reviewing considered the view of accomplishment to date, Picture Building placed this within a cumulative structure, a construct of the information seeker.

6.3.1 Definition

The concept "Picture Building" encompasses the processes or directions identified by respondents to be their way of grasping what a whole subject area is about, and where their own research will overlap, integrate or otherwise interact. Picture building is defined here as the way information seekers created an overview of a subject and constructed their "understanding" of what a subject was about, without an immediate need to go into any depth.

> "I am much more likely to do it that way than get stuck into the details and actually discover that it is not so relevant. So I tend to be mapping out and seeing how it all fits together as that predominates as I am building the picture and at a later stage I will then get down to the details and pull in all the articles and read them in greater detail". P9: 9:25 (93:97)

The process of Picture Building appeared in a direct relationship with the level of knowledge and understanding already held by the respondents. The process of "Picture Building" may be reduced by higher knowledge or other intervening factors such as existence of a social network or access to experts. Where there is low-level knowledge then respondent P6 summarised the process that occurred.

> "If I am starting off from no knowledge base or a little knowledge base then I probably do a lot more browsing and scanning than anything else because I then to think 'ooh there is a paper or chapter or web page or whatever' that is written about the subject, and I would speed read it just to get the feel of what it is about, and as I am going through that process I find that my knowledge and understanding increases a little bit, and then going from that I will then have some sort of map of the subject in my head that I can link into with the areas that I am interested in…". P6: 6:13 (150:166)

6.3.2 Processes

The process of Picture Building was deeply entwined with Knowledge and Previous Experience and Information gained through Opening. The research was not geared to a psychological investigation of the internal working of the mind, but the outward representation

of thought and in this the words and perceptions offered by interviewees provide an indicator of the processes as they relate to information seeking.

The clearest and most graphic form of mapping process included a paper component for some interviewees on which ideas and Reviewed material were sketched out containing words, concepts, notes of sources, boxes, notes, arrows and lines linking the various components.

> "What I did first was to think about how I could visualise time myself and I often draw papers before I start working on them and I take sheets of blank A3 paper and I put the question in the middle and then I draw around it and so I started by drawing ideas of 'time' so I drew crosswise lines and descending verticals that mean to mean generations, I thought about time going around in a circle – liturgically but also in the seasons, and I have now got another one because the anthropological material got me into the idea being like a swinging pendulum between opposites, e.g. night and day, winter and summer and a fantastic article which produced a variety of repeating – and an African word for this oscillating nature of time – to do with things in life that repeat, and I drew them and I suppose I have got this somewhere, there is this big sheet of paper about what I thought and then I drew and write down the subsidiary questions which arise out of each of the things that I have thought of". P30: 30:19 (195: 206)

In a similar way the creation of a taxonomy aided the development of an understanding of shape and function of disciplinary components. The interviewee showed examples of lists and tables drawn up to demonstrate the process.

> "...and then at some point and I am now, going to draw up something like a taxonomy of characteristic features that are said to belong to this so called new economy and I kind of throw in there all the words because writers don't all write under the same name of the new economy....so you read something about the way business organisation is changing into the virtual firm, and you read something about connectivity...[*multiple detailed examples edited*] .... So then you have this whole taxonomy so you see clearly that there are things like, if you talk about institutionalism mechanisms that this word Schumpeterian construction pops up and you sort of make a mental note to look it up.... and then you do get these more grooved passages into traditional orthodox disciplinary context because I do want to go beyond the journalists. A journalist will never go beyond a taxonomy, but ...what you actually want to do is eventually create a theoretical model or set them into a general principle relationship towards one another...". P2: 2:30 (223:243)

Orientation activities by their nature were throughout affected by the level of knowledge and understanding already held by the information seeker. Introductory guides and review articles figured prominently in boosting overviews of subject areas. Obtaining such material was one of the difficulties experienced by the interviewees.

> "The thing that I haven't found, I hope I could find some very easy text books that would give me a very easy basic understanding a sort of bluffers guide that you would give to first years. So far I haven't been able to find that, so maybe I haven't looked enough, may be I should just go into a bookshop or something....following leads to very academic, jargon laden academic texts, that is not necessarily what I want to get an overview of what the thinking is in that particular subject. So I haven't found that yet, its difficult to tell just from a library listing whether something is very basic or is at an advanced level. You know I think general magazines, not so academic texts, non refereed journals, have been the most useful....I have to use it to understand, you realise that there is a whole lot of History behind the terminology that they use that you haven't been trained in". P8: 8:13 (84:99)

However, the shallow depth of initial information required to begin Picture Building allowed interviewee's to gain much from other "superficial" sources such as abstracts, newspaper articles to gain an Opening to a subject.

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"Probably for my sort of approach it would be an abstract, so that you are getting, you are mapping in increasing layers of detail....You've got the overall area, the abstracts to give some indications, I then move fairly deeply in and look for sources that are going to give fairly detailed evidence. It wouldn't matter too much where I started at this stage because I would tend to get the full copies of the papers". P9: 9:35 (146:147-157:160)

6.3.3 Outcomes from Picture Building

With any process or activity the question moves from defining what is occurring to what it produces or what meaning it holds for those who are being studied. In considering the function of Picture Building the data formed around outcomes of the process.

In the first instance, the Picture Building was described by interviewees as allowing patterns to emerge that connected with their existing knowledge and that these patterns fed into their "map" of the subject to enhance further investigations as a framework upon which to fit concepts and literature together.

"...and it is now that the connections are happening and that I am beginning to see patterns in the research and I will start going back and restructuring, but I will have to go back to the methodical and the stuff that I would use when I am being methodical would probably be much more sort of book lists and like the British Library and searches on appropriate CDs and Internet". P7: 7:15 (111:117)

In the quote from respondent P7, above, and in the next quote from respondent P9 the framework or picture created by the respondents was viewed as an instrument of creative process and an enabler of successive information seeking episodes.

"It has got to be to sit down and think, before I go to the library, it has got to be to establish a framework so that whenever I am accessing printed material it has to fit into my tentative framework even though it might be jettisoned further down the line. I am unlikely to go charging down to the library and looking through all the past issues of a journal, I am more likely to map out my literature leads and broad conceptual map.... than to actually do searching". P9: 9:53 (139:141)

An extension of this description confirmed that the generation of Pictures set up a view in which reference point in new material could be mapped back against the information seekers own understanding.

"I think the main problems relate to the different focus of the different disciplines and finding a way to make them appropriate for the work that I am doing at that particular time. So, for example, most of the medical articles will be very scientifically biased even towards the sciences, so they won't take into account, things like Psychology, Sociology, the person as an individual, and then trying to make sense of those in terms of what I am trying to make sense about can be a little bit problematic at times. So, for example, most writing about deafness by medics is to do with assessment and cure, whereas most social writers will be looking at deafness as a social issue, and linguists will look at it from a language point of view, whether it be sign language or lip reading or whatever. In trying to make sense of all the different disciplines, in terms of looking at the whole, can be difficult at times". P 6: 6:18 (204:214)

The second outcome of Picture Building fell within the generation of broader knowledge and understanding and specifically affected understanding of language and terminology. Coping with differences in terminology (Section 9.3.4.3) relied upon mapping out a subject and

its associated specific language, and thereafter to seek information with a foothold in the terminology.

> "Well, I am a linguist, so words are my stock-in-trade, but I have got to write myself little glossaries at a very early stage, so that I am confident about what I do. So for example one of the collaborative projects is all about genetic markers in populations and how this might correlate with language family. The question that arises immediately there at the moment - because of work that is going on in genetics is well - which sorts of markers do we want to look at. Most people have looked at Y-chromosome and [technical description removed at request of interviewee] but they haven't looked at the X-chromosome in this way. I had to go off and look that up, but it is a question of trying to be absolutely confident if someone tackles me about this - am I going to be able to come up with a straight forward definition. So it is straightforward but it needs a certain amount of groundwork". P33: 33:22 (183:192)

> "I think there is a certain element of finding your way through the language in the first instance...in the early days I found that there was a certain style to particular disciplines and certain use of terms and language that takes some getting used to....So there is difference in commonly used terms.....It is only by tracking through some of these literatures that you can understand how people are viewing these concepts and therefore how you can view that ...literature". P28: 28:12 (129:142)

The consequences of Picture Building were recorded as increasing the ease with which information seeking could be carried out, as shown in the example from interviewee P9.

> "I suppose my own style is to work on a very broad front, it is the broad front that sparks off ideas. This is almost the problem definition stage and exploration. It gets a lot easier once you know where you are going, you have got your road map, you can use traditional techniques and interlibrary loans and back issues". P9: 9:47 (303:315)

6.3.4 Methods of Picture Building

Subsidiary and contributing to the Picture Building strategy, but nonetheless important components of Orientation in their own right, a group of codes were categorised as "Identifying the Shape of Existing Research". The processes involved in "Identifying" were elaborated upon in successive interviews and ultimately were found to exist in five focal forms with varying levels of breadth.

In elaborating upon Identification processes interviewees were found to use the same basic information seeking tools in pursuit of very different purposes. The association of activity and purpose gave multiple configurations to Information Seeking Behaviour within the emerging Model. In considering the information seeking behaviour of the interviewees discreet processes focused on fulfilment of particular aspects of Picture Building.

6.3.4.1 Identifying the Shape of Existing Research

The shape or form of existing research and meaning in that what constitutes research, data, methods, perspectives were suggested to be as important as other elements of Picture Building. Coded as 'Identifying the Shape of Existing Research' it carried forward elements of detail building from Picture Building.

"What I would be looking for would be the key conceptual tools that are at work in the field. I'd be looking for the questions that those conceptualisations generate, and the understandings that they provide and I would be looking as to whether there were a range of interesting but essentially ad hoc studies, or longitudinal build up of ideas on a particular issue, so I am trying to get at what is currently related to a particular issue". P19: 19:20 (246:253)

In the first part of identifying, relevant kernels of information were not always located within a discipline where information seekers expected. Identifying the place within a discipline for specific material was a separate problem in itself. Sometimes as in the case of participant P5 this meant looking in a related field to find the information in the target discipline.

"I suppose what I am trying to say is that the kernels didn't always, you find them in unexpected places, it just wasn't applied in the area. The other thing that I found was that there was much more awareness in different but related fields, for instance in the fields of Popular Music and Jazz what I was going on about was much more common than in classical music, and it was as though I was applying what was going on in those fields and applying it to classical music rather than the other way around. So, it is as much I have seen it in this field, but I could find it in another field. So things are in the air, but they are in the air in another part of the universe". P5: 5:28 (221:228)

"Yes, it is the concepts and I see a concept as very much a shorthand for opening a perspective, looking at a particular problem from a different perspective, and then from another perspective, and bringing it together, yes, and these perspectives, because these concepts are lodged and embedded within theoretical frameworks that are separate and each belonging to a different discipline it is sometimes a little bit inappropriate to dislodge them, to disembed them and to take them out of their context and lob them together". P2: 2:11 (64:69)

Building an understanding of the shape of existing research was found to involve the use of Opening activities.

"I would say search widely for one thing, which is an obvious thing to say, but I think looking widely, and read and write and try to get a grasp of the field really early on to try and get a grasp of who the main people are in the area and what is going on". P28: 28:16 (188:190)

Throughout the codes associated with Identifying Shape of Existing Research were the activities of Browsing, Keyword Searching and Networking were found to be the tools used to fulfil the task in hand, as in this quote from interviewee P23.

"Well, it seems obvious in a sense, I would say go out and one thing that I haven't talked about, I would go out and browse the library shelves at the beginning of a project and I would browse recent journals and I would browse the relevant shelves and I would look at the books that seemed to be newest, and I would look at journals, and what I would say to somebody starting a PhD or something would be do a number of searches in databases but also go down to the library and browse the recent periodical shelves in the various areas that might be relevant, see if just anything 'to get a sense of' where in each of the areas articles have been published and then continue to keep an eye on those journals. Join mailing lists, read publishers catalogues, that is something that I do that I haven't mentioned - I do that at least annually. There are publishers that publish in particular areas of interest. Probably bookmark a few online journals, and look for online journals in the areas of interest. Try to figure out what the key conferences in the areas are and keep an eye on the proceedings". P23: 23:47 (247:260)

Moving from an appreciation of the Shape of Existing Research in general terms to an Identification of Disciplinary Communities and more specific of all, the processes of Identifying Key Names, Key Articles and Latest Opinion in the Disciplines Identified.

6.3.4.2 Identifying Disciplinary Communities

Identifying Disciplinary Communities was of central importance for interviewees in their interdisciplinary peregrinations. Two situations were found to occur. First that the subject was sufficiently well known and its interdisciplinary connections were already defined, leading directly into other functions and the second in which the subject was unknown and the relevant disciplines as yet undetermined. In the second scenario, as described by interviewee P15, researchers moved to identify salient disciplinary areas: the process was described by the research as Identifying Disciplinary Communities.

> "[The resources required will be] ...be so far away from my research experience that I may not even know of the discipline in which that information lies, or even if I know the discipline there are other problems about where does the information reside within that discipline, you know is it journals, is it other people here that I can talk to in the first instance who know something about the subject, and things like that". P15: 15:1 (3:8)

The task of Identifying Disciplinary Communities was found to be the most difficult to achieve for each new interdisciplinary combination. Once established the role of Previous Knowledge and Experience made future connections comparably easier (See also Section 9.2.1 on Knowledge and Understanding).

> "One of the areas that I am working is the structure of species distribution. How their abundance is space and a whole bunch of related problems. Fundamental ecological problems, but there are large parts of literature which are ecologically invisible and they belong to fisheries, forestry, they don't get picked up by review papers in the subject area of ecology often because they're quite applied. ,They are highly relevant, they discuss relevant material and they are often some of the best case studies that are available, but they are couched in a very different language and with a very different set of motivations. Once you get into it the first time, it is that first contact which is the tough bit, it is crossing that 'between discipline' boundary which is the tough bit. Once you have got into the literature then you are into the same game as you would normally operate. But it is getting across and discovering those things in the first place". P34: 34:14 (61:71)

Knowledge and Experience was found to positively increase progress in many cases, though it could potentially negatively contribute by creating a false sense of knowledge. Two main methods of Identification were found within the data. These were deduction by "common sense" and "Opening" and shall be described in the next two sections..

6.3.4.2.1 Deduction by "common sense", logical emergence and literature links

'Common sense' deduction applied as a broad way of sifting out irrelevant disciplines. For others the nature of their project determined more precisely the disciplines that would be of use, some topics of research for example could discount Science, Technology, Medicine and Engineering as irrelevant leaving Social Sciences as the focus of general enquiry.

> "By common sense I think really, by thinking that that is something that I won't be able to find out by looking at Landscape documentation and also the sort of the research that I am doing there isn't much that is written by Landscape architects anyway, so a lot of my literature searching is leading me to articles that are written in different fields". P8: 8:18 (20:26)

For some interviewees the structuring of deduction and "common sense" took on the form of a self-reference interview as in the description of interviewee P28.

> "Okay, at the outset, even just writing a project proposal, that is when I would do the first major search to really see where this piece of early thinking about the work, where it might fit within other work and whether other work has been done and who are the main players in that area. So I would do a fairly traditional sort of reference interview with myself...". P28: 28:6 (72:80)

In a related theme ideas disciplines were identified by links implied within the research area itself, sometimes appearing as a natural progression from one discipline to another as in the descriptions given by interviewee P24.

> "I was sure first of all that it was dealing with education, because it was involving how people work in groups in educational settings. So education was one area, but because it was also dealing with IT and the implementation of IT into educational settings, then I had to expand it into this area as well. As soon as I was doing my literature review I realised I should probably use how collaborative learning and include working environments as well because the literature seemed to be mixed and involving both things. So, because I didn't want to miss anything I had to find articles that involved group interaction in working environments as well. So basically, yes it involved these two areas of research, it was education and IT". P24: 4:43 (227:237)

The inverse of logical emergence was found in the dismissal of disciplines that were identifiable as not relevant or entirely beyond what the information seeker could grasp. Dismissal implied a clear distinction of the topic and the purpose of the interviewees information seeking.

> "They would have to disciplines in which I felt reasonably comfortable myself, so I would not for example think there is a microbiological parallel - which would be completely outside my ken, and would mean that they would have to linguistic matters or artistic or something to do with art or Historical or something that I was familiar with". P45: 45:8 (86:90)

The idea of logical links was also applied in the Chaining of literatures (Section 5.2.7) from one discipline to another as in interviewee P40's example of moving through law, medicine, and living conditions within a Historical context.

> "...I remember looking at something that was left out of to do with conditions of people, and injuries, some would say that was History of medicine, and so you end up looking at some c19th medicine, and occasionally you come across something that mentions status of trade unions in C19th jurisprudence". P40: 40:8 (93:98)

6.3.4.2.2   The Role of Opening

Identification of Disciplines was strongly connected to the activities associated with the diverse information seeking activities that formed the Opening category. Interviewees described using Networking, Breadth Exploration, Browsing, Eclecticism and Chaining, as seen in Chapter 5, as collectively providing guidance on which disciplines should be considered.

> "I would say search widely for one thing, which is an obvious thing to say, but I think looking widely, and read and write and try to get a grasp of the field really early on to try and get a grasp of who the main people are in the area and what is going on". P28: 28:16 (188:190)

> "Initially what I have done is use book catalogues and library catalogues, and so I have done a lot of work in the British Library which obviously has a very good collection. Initially I just

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put in things like title searches or keyword searches, so I put in 'place' or 'space' and linked those with 'gender' or 'women' and it was just clear that the books that were coming out were being written by geographers or people in Geography departments. So that is primarily what I do and then of course once you have got those books in front of you, you can then look in their footnotes and chase up the History of their research and writing too. But primarily I just use keyword searches". P31: 31:6 (37:45)

Interviewees also acknowledged a sense of not knowing the disciplines that would contain information of relevance to their information problems and to relying on clues and serendipitous identification of parallel problems (As described in Section 5.2.8).

"...something about the problem that I think that I have, whether it is the same problem or a problem that I regard as a parallel. For example recycling is a funny thing – a recycling company can't buy its raw material, which is really quite a staggering idea when you think about it, there are hardly any other companies that have to rely on the goodwill of the British public for its raw materials, and there is nothing else that I can think of...". P11: 11:27 (232:237)

6.3.4.3 Identifying Key Names and Identifying Key Articles

At an increased level of detail respondents were found to focus information seeking on behaviour labelled as "Identifying Key Names" and "Identifying Key Articles" and "Identifying Latest Opinion in Disciplines". Each of these activities was found to be associated with the specific information seeking tools of Opening.

6.3.4.3.1 Definition

The literal interpretation of the codes Identifying Key Names and Identifying Key Articles apply in this case. The process of locating the main researchers and research within a field of enquiry preoccupied interviewees. Less significant in their descriptions than Identifying Disciplinary Communities the information seeking activities were more focused than those of Identifying Disciplines. However, the theme of applying Opening to these tasks was maintained.

"If it is a subject which is not entirely new, which I guess would be the case with most things that I would look at, I would go to what I would regard as up-to-date primary sources of information - review papers, to some extent books, but perhaps less so and use those as a starting point to follow up a number of key names through the various search engines that I could use...". P16: 16:14 (169:177)

"Again, if you can identify one or two good articles then often that person's area of interest, and other articles by that author, or good citations from that article. But it is just getting that one good article to begin with. And that is one thing that has been frustrating, you have got the article, you know something is referenced and you put it in and it comes up with nil, of course it's there I've got the reference!" P4: 4:44 (129:133)

Previous Experience and even general knowledge contributed to Identifying Key Names in disciplines, for example interview P36 spoke of awareness as follows.

"...there are towering names who have written commentaries from other disciplines that you are aware of so I'll go and look in the library for their commentaries. Then, thirdly I would talk

to people who work in that discipline and try to explain my problem and try to get their advice... That is certainly, like on my last project...". P36: 36:12 (54:62)

Identifying Key Names was matched with Identifying Key Articles. Key articles were journal papers, primary documents, books, indeed any substantial item of information from which Orientation could follow. Key Articles that would satisfy interviewees were reviews, course reading lists, or conference papers. Identification arose from use of Opening activities from Networking through to Keyword Searching. Once identified Chaining generated further connections (See also Chaining in Section 5.2.7).

"...I do lots of chaining, reading what I had identified as a key paper or something that struck me as a key paper and identifying what seemed to me to be the most significant citations in that ...and I might go into STAR (library catalogue) and look up books and I might even look up course reading lists to see what other academics in this university suggesting to their students for courses on topics of relevance to my research - that seems to be quite a good way of quickly finding out about what is considered to be core reading in another area". P23: 23:34 (121:135)

"At that point it is usually things which almost invariably no search engine is going to turn up. So cross citation, looking what people are citing and discovering obscure things that they know of, usually either because of one of three reasons:- one would be because from titles and keywords and things the relevance is not apparent so you have not picked them up although they might be quite relevant. Secondly, because they are in journals and outputs which just aren't getting picked up and related to that often because they are in bits of the world that aren't well published or are in other fields. A part of what I do and enjoy is extracting material from 'disciplines' which are relevant to ones own or the area that one is working in". P34: 34:13 (51:58)

6.3.4.4 Identifying Latest Opinion in Disciplines

As a distinct task Identifying the Latest Opinion from within disciplines formed a key aspect of the Picture Building and Orientation process. The data showed that current information was more valuable initially than some of the older material that might be available to researchers. Sources of this information were up-to-date reviews, current journals and current debate from each discipline adopted. A specific focus on identifying the current and accepted mode of thinking in an alien discipline was suggested by interviewees as essential to gauging what was important.

"So I am trying to get at what are currently some of the key themes that people are working on, and generating in the process of their explanations. Themes are very important for me, and the questions that are part of that theme based approach". P19: 19:20 (246:253)

"Where I have difficulty is in knowing once you get beyond the very famous Anthropologists, knowing who is still read, whose ideas are still listened to, what was in fact blown out of the water as complete nonsense by an incredibly important review in whatever, only I wouldn't know, that is where I always feel that I am at a huge disadvantage when I am working beyond my own discipline, because you don't have those feelers and you don't tend to have a sense of where an idea has been carried on... So I am also tending to try ... to move towards people that I have heard of and things that are offering review articles, and something that gives you some sense of the reception of an idea rather than having to rely on a single article". P30: 30:10 (88:98)

Once situated within an interdisciplinary context the problem was transferred to one of maintaining currency across the component fields. In this databases and interlibrary loans were thought to have improved the ease with which this was done.

> "So the days of laborious bibliographic searches are thankfully gone. The downside is that it is harder to keep up, which is perverse, because there is more information to sift through, whereas in the old days you could take your time, it had to come from Boston Spa through interlibrary loans, then you had a bit of peace to read it, whereas now you just start and I think it is difficult to keep up in a lot of fields, so business and the environment which was an earlier research area I wouldn't claim to be current because I have stepped out of that for 5 years, and focused on risk and crisis". P20: 20:9 (75:82)

6.4 Identifying Keywords

Interviewees discussed "Identifying Keywords" as a process that took multiple forms and was used in relation to Information Seeking activities as highlighted in Opening (Chapter 5). Keyword Searching may have been perceived as having variable levels of effectiveness, but Keywords formed the core of information seeking as a way of identifying relevant material by word occurrence, that is, as part of Relevance Judgements taking place in the process of reading. Sifting and Browsing. When faced with a new disciplinary area, interviewees suggested that they contemplated Identification of Keywords as one of their several early steps.

6.4.1 Definition

Identifying Keywords was defined very much as the coding label suggests. Keywords were any words that related to the language describing a topic of interest. The key to understanding Keywords in the context of interdisciplinary research was a representations of ideas bridging the intellectual gap between existing knowledge and the unknown. and also between the known and further detail. Identifying Keywords appeared strongly in all interviews. The identification of keywords appeared in the data to be separate from that of Picture Building, and Identifying the Shape of Existing Research. As a distinct activity Identifying Keywords was defined clearly in interviewees statements as 'finding', 'guessing', 'selecting', 'discovering', 'being inspired' and 'logically extrapolating'.

6.4.2 Methods

Three main methods of Keyword Identification were found within the data. Each contributed a different route to Identifying Keywords for the interviewees relating to Previous Knowledge and Experience, Opening activities and Problem Definition.

6.4.2.1 From thinking and experience

The first source of Keywords for interviewees was defined by them as "thinking". The process of "thinking" about Keywords drew on ideas arising from previous experience and knowledge of what the topic might be related or tangential to the topic that might be represented in language. Keywords were sometimes the first time a subject was fully recognised.

> "I think the first thing given a problem is go for a literature search around the problem, I think that would be kind of a second step. Hopefully at that point I would be able to somehow identify or perceive some common ground with the experience that I have from my discipline and if so then I might be trying to identify specific topics or perhaps a list of keywords and go directly to a database at that point...". P14: 14:3 (19:19)

> "Well, I tend to go the long way round. I have to satisfy myself that I haven't missed anything, so I tend to take the splatter gun approach and just look anywhere and try to think of things that are tangential and just work through keywords and try to come up with as many keywords as possible...". P11: 11:37 (305:325)

Prior experience contributed to the "thinking" attribute to Identifying Keywords.

> "Hopefully at that point I would be able to somehow identify or perceive some common ground with the experience that I have from my discipline and if so then I might be trying to identify specific topics or perhaps a list of keywords and go directly to a database at that point, like a science citation data or a library catalogue or a web search...". P15: 15:13 (86:99)

Experience gave interviewees an opportunity to work with Keywords drawn from their work, these were often referred to as "obvious keywords". A corollary of this was an increased perception of self efficacy.

> "...I found that there were very few things that fitted the obvious keywords and that I couldn't pull out that much. The other thing was really not knowing if you are fully exploiting the other disciplines that you are not so familiar with. So in my case the biological literature I can probably handle very well and I would know if I had got a reasonable coverage; but in an engineering context or economic context or whatever I would not necessarily know whether the coverage that I had would be adequate to give me a balance from that side. So I guess those are the most important things". P16: 16:21 (221:229)

> "...I used very obvious search terms just to see exactly what was about and what was fairly current. And I just used what resources were available at my library then and at that time not here at the university so it was a lot less, I didn't have access to BIDS, and I limited it to the 1990s really. I wasn't really looking for books particularly just journal articles and current attitudes really". P1: 1:10 (57:64)

The importance of some previous knowledge and experience was illustrated on those occasions where anxiety and uncertainty (Section 9.2.2) from a lack of knowledge to Identify Keywords.

> "a trial and we've shown that it works, and you put that - what you think are the right words in - and you come up with nothing or one and you think 'well this is a big area, there are thousands of people working in this area and I can't believe there are no articles'. So yes, a lot of anxiety, it is okay if you've had something where there has been quite a lot of literature, somehow that feels more comforting, because you have been sifting out, so you can feel well might be other things out there but I have refined it down just into the area that I'm interested in, but when you are not getting anything or just small bits, it is very unsettling....it is much easier in a single topic...". P4: 4:46 (190:211)

6.4.2.2 From Opening activities

In the process of Opening, as discussed in Chapter 5, Keywords were found by interviewees. Selection of Keywords relied upon initial ideas, but also on a degree of experimentation as in interviewee's P30 description.

Identification of Keywords took place via Opening activities and strategies, and was especially associated with Networking, Browsing and Previous Knowledge and Experience. Following Opening activities the scope for Identifying Keywords increased as material available increased.

> "Once I have done the initial search, I would then be looking to see if there were any other keywords, because sometimes in the articles you get, in the ones that I consider to be the good ones, you get keywords that would have found that article and that is just wonderful, because you can find that those keywords and this one and find keywords that you hadn't used in your original search and find other articles on the same area that you hadn't otherwise found. But it doesn't always work". P4: 4:16 (176:181)

Inspiration for keywords also came from Serendipity, and from the recurrence of words in the samples browsed in initial attempts.

> "If I am looking for something specific what I would tend to do is identify major keywords that are associated with both and then try doing a search which brought up both, or connected the two in some way. [*Interviewer asked 'How do you identify your keywords?'*] Usually it is a bit of serendipity, somebody might point out a particularly good author or book and sometimes when you are just browsing in a subject area you come across a keyword several times. It then begins to look like this is going to be an interesting lead to follow". P21: 21:5 (36:44)

Keywords followed from Browsing and Networking and Reviewing. Underlying the Identification of Keywords in Opening there was found to be a sub-text of identifying connections and links in other areas that are beyond existing knowledge.

> "There is always the nagging doubt that there is something that there is something that you have missed. Perhaps a connection that somebody else thought of that you didn't. [*Interviewer prompted for further detail: "Is that part of being interdisciplinary or something else?"*] Yes, I think it is, yes, because you are perhaps delving into an area that is less clearly defined, you don't always know whether somebody in education is really going into this area in depth, or somebody in the management school is going into this area in depth. They may be going into depth in their own areas but not making the crossover, but they may be and that is just something that is not always clear because when they are defining their articles and keywords for their journal articles they might not be thinking in educational terms if they come from the Management School, but they might be doing something that is really relevant to education". P21: 21:12 (79:95)

> "Browsing is almost like a lazy term in some ways but it gives me, if I am browsing through journals I can see other keywords that might be relevant and it actually under this heading and so I need to use that type of wording, so it makes me go back and recheck what I am doing. So it all relates, each method assists another method if you see what I mean". P1: 1:25 (194:202)

The outcome of Opening activities was often Keywords that would in turn allow further Information Seeking.

> "It started with a few articles about general stuff, and then I tried to figure out some keywords, and the keywords became more and more elaborated as soon as I was reading more and dealing more with the topic, then you cannot help it the keywords they will come up to the surface. I am not sure if you are really aware at the beginning of what you are doing, you just read and read and then you reach a certain point of time where it just pops up like that and comes to the surface and you think 'oh yeah' this is a thing that I have been seeing here and there all the

time so I guess this is a keyword lets use that. That is how I did it and you are basing your things on other things - articles - all the time, trying to figure out keywords from abstracts". P24: 24:41 (190:198)

6.4.2.3 From the question

Whereas Previous Knowledge and Experience and Opening were external to the topic and relied upon interaction with the Information Seeker or Opening activities, the Question. Topic or Subject area were often the underlying source of Keywords.

Interviewees with a question in mind, or with a question delivered from an external source - such as a funding body, supervisor or project head were able to look to the question itself for keywords. For example

> "Yes, if you wanted to know how children with phonological disorders, what were the nature of their difficulties, and what were the results of therapy intervention, then that straight away helps with keywords, so I suppose in population its who your subjects are which may be a client group or a professional group or it may be a strategy that you may be wanting to look at for example management issues, so things like one that I've been looking at recently, is benchmarking...". P4: 4:9 (86:97)

> "I look for my keywords - for my key subjects really, but those will change, by the sorts of results that I have, and develop some sort of understanding and then the random stuff will come through to give me new areas to look at in a more methodological stage, and that's probably a repeated cycle". P7: 7:28 (128:131)

Others would generate a title and work outwards from that, which fits very much into the idea of Orientation as a process of finding out what is required.

> "Well, initially, I would start off with a broad heading and just sit down and write a list of words that relate to my topic area, but sometimes I am led by the feedback I get from the databases, that gives you another areas that I have not included then I might decide to include that". P17: 17:20 (274:278)

> "If I am looking for something specific what I would tend to do is identify major keywords that are associated with both and then try doing a search which brought up both, or connected the two in some way". P21: 21:4 (36:38)

However, the generation of Keywords and question formation also grew with Problem Definition where the initial question supplied insufficient prompts.

> "...sometimes the keywords don't always appear straightaway, if for example like with dyslexia, if that is the only word that you know about, you start with that one and then you find all the others through reading, through literature, and then as my knowledge base increases I will start asking myself questions about the specific thing that I am interested in. So I need to know things like what is dyslexia, what are the causes, how is it assessed, how is it diagnosed, how do we support people, where does funding come from, so there are lots and lots of questions, and it is then back to the literature using those questions and looking for the answers. So I take a question approach to it". P6: 6:4 (37:47)

6.5 Source Identification and Source Selection Decisions

Within the information seeking behaviour of the interviewees one of the most significant activities undertaken involved identifying sources of information and making the decision to use them.

The material in this section follows the pattern of breaking down a complex problem into smaller subsections. At the first level Source Identifying and Selection becomes Source Identifying and Source Selection: Decisions. Themes emergent within the data gravitated around these two components that together represent the tasks leading to source use.

6.5.1 Source Identification

6.5.1.1 Source Identification as an output of Opening

The closest links within the data between Opening activities and Source Identification were found within the context of Networking as Information Seeking, Chaining, Serendipity and Browsing and Eclecticism. These formed the most significant tools from which Source Identification developed.

Of these routes for Source Identification, a recurrent theme, as with other elements of information seeking, was the influence of Serendipity throughout the Information Seeking described by the interviewees. Serendipity recurred as a useful input to the Source Identification process and one that could occasionally be very productive.

> "Within History I know the sources and places to look for a literature review, but I simply don't know where bibliographic aids of Sociology or Politics are so I am less systematic and driven more by serendipity". P36: 36:23 (205:207)

6.5.1.2 Knowledge and previous experience

The contribution of Knowledge and Previous Experience to the Source Identification process was found to important. At the simplest level it was clear from the responses of interviewees that experience and knowledge were valuable influences upon Source Selection. Many interviewees cited their experience as a factor in finding sources for interdisciplinary topics: experience provided ideas of where to look.

Interviewees expressed the phenomena as "having an idea beforehand" or making use of previous experience.

> "[*For the interdisciplinary work, how do you decide which sources to look at?*] Well, again I don't think that I tend to do this well, I tend to go for primary sources which are again more comprehensive than specialist journals, but which I know give the right general field, so I think that I have got some sort of idea beforehand of which might be important, I don't go back to the very beginning and look in journals which I don't normally read, I tend to go for the ones that I know a bit about their contents and so on. Then I probably only look at the ones that I can get easily". P16: 16:11 (135:142)

"Usually if it is social science I would look at social science citations index and see which ones are cited and most of it is just gut feeling and experience or you will talk to people and ask them what they consider to be the top rated journal". P20: 20:20 (169:171)

Each interviewee possessed a unique history of previous experiences and accumulated knowledge which contributed directly to their information seeking. Interviewees spoke of having a foundation of knowledge in their home disciplines that would provide each information seeker with a different, personal perspective.

"...so I am not logically running on project x and saying lets build on these foundations in my interdisciplinary areas, I am aware in single discipline areas you might build sequentially, logically, on previous results and see a chain of building brick by brick, I can imagine that happen more in a single discipline". P9: 9:25 (109:130)

"[How do you identify which disciplines are going to contain something that is relevant?] I don't do it systematically, is the short answer, I don't sit down and say 'right now I need to go off and look at organisational studies, Psychology, Sociology, Information Science, education in order to look at this', maybe my work would be better if I did, but really it is to do with, it is intimately connected with my own personal development as an academic researcher, so it is largely to do with what I have encountered in previous work". P23: 23:29 (75:81)

6.5.1.2.1 Valuable Personal Resource

Familiarity with available literatures tended towards a reduction of problems identifying information sources. In multiple examples experienced interdisciplinary researchers felt able to draw upon Sources with which they had either in-depth experience or a passing acquaintance with. As a method of Source Identification it was a valuable resource for experienced researchers.

"I think it depends on how long you have been in a discipline, if you have been in a discipline for a very long time, then you may have very good, powerful avenues for gathering information and networking that are extremely difficult to achieve in other areas quickly". P19: 19:19 (277:280)

Researchers with an established interdisciplinary interest tended to feel that an acquaintance with sources came from their previous experience and that experience allowed a context for new information seeking.

"There would be some ransacking of bibliographies of published books, roughly in the field, to see if there are any references that would be applicable. It is a bit difficult because it is such a cumulative business, that it would be hard to say after it had been done how many of the items consulted that I had at least a nodding acquaintance with to start with. There is probably quite a lot the first time...". P40: 40:7 (75:82)

Though the acquaintance with sources may be entwined with devising a project, somewhat influencing the required Information Seeking to begin with.

"Lets say I was starting in a new research project, now, it wouldn't be of nothing, obviously I would have some preliminary ideas of where and what was going to inform this research in order to shape the project in the first place". P28: 28:3 (43:45)

6.5.1.2.2 Changes within a project

Development of knowledge and experience means changes in sources and expectations throughout information seeking.

> "[Following comments in previous part of interview: *When you start off, you seem to have an idea of the keywords, how do you get a focus?*] Well, I need to go back a bit, because sometimes the keywords don't always appear straightaway, if for example like with dyslexia, if that is the only word that you know about, you start with that one and then you find all the others through reading, through literature, and then as my knowledge base increases I will start asking myself questions about the specific thing that I am interested in. So I need to know things like what is dyslexia, what are the causes, how is it assessed, how is it diagnosed, how do we support people, where does funding come from, so there are lots and lots of questions, and it is then back to the literature using those questions and looking for the answers. So I take a question approach to it". P6: 6:4 (37:47)

6.5.1.2.3 Familiarity with literature: Lack of Knowledge

For those with less interdisciplinary knowledge and experience the contrast with a single discipline was stark: At the lowest levels of knowledge and experience even physically locating material could provide extra hurdles, let alone identifying the materials to begin with.

> "I think having to go right back to the very beginning, in a single discipline I do know where the journals are kept, I can walk in and put my hand on the journals straight-away, but with interdisciplinary work I didn't have that information so I have had to be in touch with libraries about journals and where the information is kept, and on the internet as well I have been exploring new sites and again I have found it more difficult to assess them for quality, whereas in a single discipline I can judge for myself. But I have had to go back to applying all the rules, you know, whereas with experience that becomes second nature". P17: 17:30 (385:393)

A lack of knowledge was seen to limit the scope (or horizon) which allowed sources to emerge later in projects than a person with disciplinary knowledge and experience would find. The examples in interview transcripts cut across the Social Sciences and sciences with equal intensity.

> "There are issues because it is so full initially I think when you start the project you think you are looking at one thing and then you suddenly realise that something has been done in Psychology or educational Psychology that is not just basic. So when you actually start doing a literature review you realise that there is a lot more going on...". P1: 1:9 (42:49)

> "...I don't know and therefore don't use advertising sources and find it difficult to get into sources like that". P37: 37:32 (61:62)

Variations in the levels of experience were associated with familiarity with the literature. Interviewees indicated that Source Identification was related to the distance from original or 'home' discipline. Particular reference was provided by interviewees to indicate that Information Sources specific to disciplines could not always be identified by someone from another disciplinary origin. Aspects related to this are covered in Knowledge and Understanding, Section 9.2.1.

> "They [Information Sources] will be so far away from my research experience that I may not even know of the discipline in which that information lies, or even if I know the discipline there are other problems about where does the information reside within that discipline, you

know is it journals, is it other people here that I can talk to in the first instance who know something about the subject, and things like that". P15: 15:1 (3:8)

Interviewees saw their Source Identification as having an advantage in areas where they had some Previous Knowledge, but noted the difficulties of areas where Knowledge or Experience were insufficient.

"Yes, I think that is a definite drawback, I know when I am looking for things just in relation to reader response, that comes under literary criticism, well my degree was in that area, so immediately you are one step up when you are looking at that area, you know people, you know certain ways of thought, you know what they are talking about, you know I have had three years in which to develop that, whereas when I am looking at areas in which I am not familiar, yes, I am getting results, but its harder, you probably have to read around much more just to get some idea of what's happening". P1: 1:23 (179:185)

The contribution of Knowledge and Experience could be summarised as the Impact on Initial Orientation activity: without it, progress would be more difficult.

"...In terms of breaking into the business world on the world wide web I'm not really sure about how to do that. [*Why do you feel unsure how to get into the business side?*] Well, in searching this term [topic] on the internet I have come up with a few sites that are relevant. There is an article written on [topic] within this journal called VRW and in order to access their article and you have to join them for a free trial. Within this journal I have found one dead end after another, so within an academic network maybe we just don't have the links to business databases and I have got a friend in business and I suppose he would find it very much easier the archives". P37: 37:36 (88:108)

6.5.1.3   Source Identification led by problem

Interviewees were not entirely reliant upon Knowledge and Previous Experience, or upon Opening activities. The idea of Source Identification arising from the problem or topic itself occurred within the data as intuitively self-evident. The focus of the idea was proposed by interviewee P12 who suggested that good advice to beginners and newcomers in his interdisciplinary research field would be

"...Well the thing that I do with post grads which is to try and get them to literature type work to be aware of the field or fields that they are working in so that their work is driven not just by the literature but also by the subject that they are working on". P12: 12:31 (205:209)

That is, to look at the question and to seek sources of information that contained answers, rather than consider the available literature and be limited, to instead, look at what the subject was about and where it might have occurred in different fields, literatures, sources. The theme raised by interview P12 was extended in other examples of Source Identification activities.

Sources derived from topics appeared more frequently by virtue of sharing a similar name as one of the component areas, making them highly visible within a range of possible sources. For some topics the topic itself therefore implied a logical next step as in P24's example of discovering the INSPEC database as a suitable resource for an Education and Computing combination.

"Well, in a way some of them were easy, but for instance I had to go and look through databases that weren't educational ones for instance INSPEC which is not an educational

database it is more engineering but involves information technology, so I thought that I shouldn't miss that out". P24: 24:44 (242:245)

The links were in some cases immediately suggested by their names and coverage. as in P4's investigation of links into Medical Sources and working within the Social Sciences for interviewee P20.

> "...I'd go for Medline, or what is more user friendly is Pub Med with a nice user friendly interface. Some of the nursing professions now have their own web sites so the nursing, the nurses have their own literature database for producing nursing articles, the physiotherapists have also set up their own database and so you can actually know that looking at these particular professions that by looking at professional sites is quite good...". P4: 4:7 (60:69)

> "Usually if it is social science I would look at social science citations index and see which ones are cited and most of it is just gut feeling and experience or you will talk to people and ask them what they consider to be the top rated journal". P20: 20:20 (169:171)

At a more detailed level Sources were identified by their production by organisations involved in an aspect of the subject area, as in this example of referring to the Library Association for materials on an aspect of Reading.

> "Well, in terms of like keyword searching, and in terms of places library association and they are the obvious ones to flip through, and I think because they are done by information professionals you'd hope that indexes are all that they should be so that you can do quite a quick look through and find anything relevant. In terms of newspapers, just keyword searching, in terms of just looking through for the dates". P1: 1:29 (117:122)

A further dimension to problem led Source Identification used a combination of topic and Information Sources that were prominent due to their local provision and accessibility (See also External Context, Section 9) and was the suggestion of Sources by their provision and availability at a local level.

> "I tend to use the databases that are available to me through the university and I would look through the library web pages that list databases, and see what looked most appropriate, so healthcare and nursing would mean Medline, Cinahl, BIDs, but I am also very much into the internet for searching as well because you sometimes find useful sources on there. If it is a subject matter that I didn't know very much about I would probably look for a subject expert then I would go and ask them where to look. So, if I was going to do something in engineering, then I would go the library web pages and find out which librarian was in charge of that section in the library or email the engineering department saying what should I look at". P6: 6:7 (66:77)

6.5.2 Source Selection: Decisions

Source Identification formed merely the first part of Source Identification and Selection. The selection process, the decision to use a particular Source emerged within the data to have a number of particular parameters.

The first of these was generated from the topic itself and the second from the topic of interest and the Knowledge and Previous Experience of the information seeker. These are discussed as part of External Context and Internal Context respectively

The data emergent from interview transcripts highlighted a range of factors affecting the selection of an information source from a pool of identified sources. Subsequent analysis identified clusters of influences around three categories, these were Needs, Quality and Access.

6.5.2.1 Information Needs

The primary distinctions made in interviews were based upon Access and Quality. The information needed from information sources was subsidiary in the perceptions put forward by interviewees. However, what did emerge was a distinction based on scope of coverage as an element of need.

6.5.2.1.1 Strategies influence needs

The data illustrated an interaction between choice of Information Seeking strategy and Source Selection. Selection of a source implied certain activities, such as the connection between Keyword Searching and databases, however, the contribution of Strategy to Source Selection was equally valid in the experience of the interviewees. The Choice of Source and Choice of Strategy were inseparable features.

The manner in which Strategies affected Source Selection was illustrated most clearly in connection with Breadth Exploration. Here the BIDS database (now Web of Science) was used as a method to create a broad range of results to locate information on an interdisciplinary topic. Extracts from interviews P11 and P17 are illustrative of the connection between Strategy and Information Source.

> "But what I tend to do is use BIDS as a kind of splatter gun approach and see what is out there and I duplicate my searches in the sciences and Social Sciences because I am right on the border between them. But that distinction isn't any good for me – it might work fine for biologists but some of my journals can be either. But if I did find, say Psychology is the best example, Psychology has a bit of an argument going on here then I would focus on that, but I don't start off with a literature in mind, I am really searching for the literature to start with". P11: 11:32 (270:276)

> "I think I wouldn't focus on one particular area, I would use much broader strategies, talking about databases for example I would look at databases that covered all of the areas, so it would be BIDS, Medline, Cinahl, and the same if I was in the library I would look in all the sections". P17: 17:10 (175:178)

Other Strategies followed a similar pattern of Strategy influencing Source Selection. The influence of Source Selection on Strategy appeared at a lower level, by controlling the specific activities available.

> "[*By starting more broadly, what do you mean?*] Well, it would be in terms of the concepts that I would start with a broader term but it would depend on the source that I was looking at, if it had a hierarchy I might start with a broader term and then go down to a narrower term conceptually, if it was there on a search engine sometimes it would be that but more likely it would be that I would start out with a range of alternative words. Then I might get an idea of the recall that I got from that and then play around with the words and see what I got, I might

also start by using ' not' limiting it - but then search engines can limit by domain name or language, or year of publication...". P39: 39:20 (133:146)

6.5.2.1.2 Information Need

Throughout analysis data suggested a diverse approach to defining needs in the context of Source Selection. In one form needs were expressed in a grouping of similar scope, labelled in analysis as the categories "Information Need: General" and "Information Need: Specific".

6.5.2.1.2.1 Information need: General

At the most basic level Information Need: General was represented by interviewees as using Sources to obtain material that was broad in its coverage of both disciplines and Sources. Often compared with single discipline equivalents, Interdisciplinary needs were broader, often focused on identifying connections, parallels, and the key concepts or models. Some interviewees described this as a shallow level of information required. The search for concepts was closely related to Cognitive Approach (Chapter 8) and an integral part of understanding the information seeker's Context (Chapter 9).

Breadth formed the backbone of Information Need until a topic became established in the perception of the information seeker. Breadth was also driven by related needs that were focused on a need for coverage of multiple disciplines and a need for summary information, concepts, connections and metaphor to be revealed by information seeking. Such elements were considered by interviewees to arise only from breadth encounters described in Opening and by careful selection of sources.

The perception of requiring a shallow depth, and a desire for summary information, tended to influence the direction of interviewee's information seeking. Preference was given for sources that provided for the low level of detail and broad coverage.

> "Not really, I would say that it is less systematic in a way because it wouldn't really be possible for me to find all the information on all the subjects, so I would probably try and get an idea of the key texts from certain areas and not go into so much detail. Whereas in the previous subject, it would be essential that I got pretty much everything on that subject because it is a much narrower field". P7: 7:4 (32:36)

> "...we had a conference here...and we had chartered surveyors talking about the way in which you can demonstrate that public planting and public commitment to the environment around buildings can measurably add to the market value.... I would quite happily cite the person who had done that literature stuff without feeling that I had to get into the Journal of the Society of Surveyors and so on. [*So, it is a decision on how deep you go into the other disciplines?*] Yes, absolutely, because one of the things about interdisciplinarity is where do you stop?" P43: 43:20 (205:217)

6.5.2.1.2.2 Needs and information sources

In meeting a need for summary information or a shallow depth of information interviewees particularly found material came from information sources that allowed collections of "clips" and "crumbs" of information.

"But in a context where you don't get to the library for three weeks, four weeks, you just pick up crumbs where you can, so rather like a pigeon in Trafalgar square, I think I resent not having the time to do it more systematically, so I am just getting crumbs, and you've got to put yourself about a bit to make sure you get lots of crumbs, which is not the way that I would wish to do it". P9: 9:19 (79:84)

Interviewees talked of focusing upon shorter, summary information types of information, than they had wanted in single discipline research

"And then you just keep going and either you stop and think I have done enough now, or as in my case you find this other one (database) I got quite a lot out of it, I realise, and this is probably indicated by some of the work we did that what was written that was relevant to what I was doing was going to be basically in the popular press, I wasn't going to find it in the academic press, so almost by definition what there was in the academic press was very very limited, so what this American database helped me to do was select what appeared to be more relevant from the popular stuff and because it had very excellent summaries of lots of the stuff it was really good". P5: 5:21 (126:133)

A preference for material that was perceived as providing general introductions, or overviews, journalism provided a particularly prominent source of this type of material.

"Maybe looking at my own History of moving from single to multi-discipline I have to say that funnily enough single discipline work was much more related to the disciplines and journals and multidiscipline work you really have to rely on journalism and the business press and everything that passes your desk because it is basically what journalists do better, not that they do it well, because they lack a kind of single disciplinary depth and sounding board in their own heads, and because they are not so restricted, they are not restricted, they pick up anything that goes, so actually it makes for more lighter reading. ....I think that this is where interdisciplinary approaches we do find at the more superficial level of topics and issues as they crop up and you are more likely to find in the general press contributions by a variety of authors who could be professors of Sociology or Politics or economics and pick them up and say something about it, or in documentaries...". P2: 2:35 (287:312)

Review articles in journals offered the academic aspect to information seeking.

"...I would look for a recent review article, which was pretty focused in the topic area or near to it, and go to that and pick out from that a number of the primary references to pursue and then again look at those rather carefully to see if I would make any links myself with other bits of work that I would hope would be relevant. So a sort of feedback process starting with a good quality comprehensive review to primary sources and then to hunting from some of those to information that the reviewer hadn't drawn in". P16: 16:8 (100:119)

"I think I probably get some pretty good ideas for new research just by being familiar with abstracts and getting just sufficient information to latch onto new ideas". P9: 9:29 (147:149)

"Ideally a journal article, the full article, so I would look for full text abstracts, and the reference for it, as I am searching it". P17: 17:24 (331:337)

An introduction to key concepts and basic language were obtained through review literatures, text books, undergraduate level materials.

"Things like undergraduate readers in social Anthropology, or History and Anthropology, picking and looking for editorials in the journals...". P30: 30:6 (103:113)

"Well, I am not a trained geneticist, I only did Biology at 'O' level, ...and what that means is that I am constantly conscious of reading to make sure that I have got the ground work in place ....for the genetics stuff and for Archaeology stuff as well I feel that I have got to be up to speed on the basic terminology - for instance...because it is not based on years of studying and making sure that I know what the terms mean. So I tend to start right at the bottom of the ladder with undergraduate textbooks and then I'll move on to general overviews in the field and then when I am confident I will tackle the scholarly material and articles. So I suppose it is an insecurity thing, but a well founded one". P33: 33:21 (167:180)

Finally general information and broad coverage were derived from visits to Conferences within broadly related fields. If a conference could be identified, then going to a conference offered a similar opportunity to gain overview and introduction to an area as a good review of the literature. In this manner exposure at Conferences appeared as a useful Source.

"...and listening to some of the papers and seeing some of the evidence that they use it takes you beyond your own search for literature and you just see something else". P3: 3:11 (105:107)

6.5.2.1.2.3 Sources of concepts and connections

The need for summary information was complemented by a second aspect to information need, which was the identification of concepts and connections.

"...it is the concepts and I see a concept as very much a shorthand for opening a perspective, looking at a particular problem from a different perspective, and then from another perspective, and bringing it together, yes, and these perspectives, because these concepts are lodged and embedded within theoretical frameworks that are separate and each belonging to a different discipline it is sometimes a little bit inappropriate to dislodge them, to disembed them and to take them out of their context and lob them together". P2: 2:11 (64:69)

Similarly, interviewees described needing to identify models and frameworks that might provide understanding for current research.

"I was looking for theories and models, and frameworks to help me deal with this eighteenth century material, and I wanted frameworks to helps me, that I could then use in thinking about space, and History doesn't help because it talks about time, it doesn't talk about space. So I couldn't get those theories and models from the Historical discipline. So I think that is what I was looking for, fairly abstract models and approaches and theories that I could then use". P31: 31:9 (67:72)

An emphasis on the need for sources with a wide breadth of coverage, and particularly sources which particularly met the needs of identifying concepts and connections.

"...if you want to work in an interdisciplinary area then you have different routes that you can follow and actually you need to combine those routes and probably make them work in a further model or something like that....When you have to combine different things to make your topic, then one database, or even two is not going to be enough, and if you need to expand in other areas and think of your topic from different angles". P24: 24:31 (34:57)

"...I was looking for more interdisciplinary information I would go to more comprehensive journals which are more environmentally based than the specialist journals, for example there is a journal which is called the "Science of the Total Environment" which is a well thought of journal, but it has much wider information...". P16: 16:6 (90:98)

Breadth particularly produced the Concepts and Connections desired by interviewees, and these emerged from reading material within multiple disciplines and sources.

"I am trying to understand in a way, I am trying to marry concepts here from the computer world and bring it into an understanding of the Marxist economics concept of co-modification and so I see my work as very clearly interdisciplinary, I am doing that right now and what or why is that a problem is because of my lack of familiarity with each of these different literatures, I then come up against the limits of finding appropriate examples....So have I explained interdisciplinarity, so you come with different concepts and you are trying to bolt on to one another and you do gain new insights but you are forever struggling because you tend to operate at a fairly superficial level and sometimes it shows your lack of real knowledge". P2: 2:6 (46:60)

The breadth of coverage perceived in a Source was a valuable criterion in shaping Source selection. For example participant P39 found an encyclopaedia as a useful starting point, which contrasted in the experience of others who found library shelves to be a desirable, but inadequate, option.

"What is less helpful is relying solely upon what is on your library shelf, sometimes you have to go way way out and much more broadly to find what is relevant, because what the librarian in your particular area might think is important might have no particular significance to your particular search. You [as a researcher] mustn't limit where you are looking, or limit yourself to location is what I am trying to say". P21: 21:18 (147:151)

"[Browsing mentioned as something not used]. Not really, and the reason for that is because the library's holding are relatively weak in my area [assumption of library Browsing] and the order and classification system is not one that throws books together in a way that is particularly effective for my research...". P41: 41:29 (247:260)

6.5.2.1.2.4 Information need: Specific

The breadth of material and overviews provided a considerable, but not total picture of information need and source decisions. Interviewees described requiring progressively deeper information needs to focus on areas, fill gaps and follow leads. The sources used were narrower in focus and used more intensively.

"I think as I go deeper I would probably extend a much wider net, going into other sources of information like reports, theses, what I would call secondary sources as well as older references and things that would take me further back". P16: 16:22 (181:184)

Above all, information within the general interest area to build a knowledge on which to begin work appeared a key need. Interviewees indicated a proclivity for mixing different levels of specificity in their information seeking.

"I would certainly still do the literature search first, so I knew enough to be comfortable enough to contact people within that field and then you would identify a part of that field and home in on that and focus the literature search and identify specialists from thereon in that we could contact. So yes, that is it really in a nutshell". P14: 14:5 (21:24)

Sources to meet the desire for more detailed information were characterised in interviews as discipline specific, detailed, and often quite narrow, as in the case of P30. Indeed, they were described by interviewees in a similar way to that of disciplinary researchers: The Sources selected were to meet specific functions and provide for particular gaps in information.

"Okay, lets talk about the most recent thing that I did, it will be an article, it is called [Name Removed for Confidentiality], it relates widely to the Identity project, because central to the conception of identity it is the way that they constructed their identity......and I was looking at

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these genealogies and I couldn't see how they fitted into the narrative and so I started reading some secondary literature and I read something which talked about genealogical conceptions of time…". P30: 30:18 (180:193)

"…one would be involved in a range of different sources of information and approaches to try to understand an issue. Those may be Historical records, so one would be looking in the areas of historiography in various forms, official documentation of a contemporary nature - government reports, government consultative documents, LEA documents etc. One would be looking into the actual research studies of various sorts that have been undertaken in particular areas, so one would be looking at those studies. Autobiographies and biographical material, one would look at and try to explore and utilise some of the factors in there. So there are some example of the kinds of things that one would be looking for and thinking about in relation to a particular issue". P19: 19:4 (39:48)

Information Need was found to be an important factor seen to be linked with a use of media, textbooks, databases which provided abstracts and review articles as well as more specific information. Sources that were chosen tended to be perceived as providing information at each level of need.

6.5.2.2 Quality

Decisions on available information sources focused on judgements of quality. Quality was a measure of value given by interviewees to Sources.

6.5.2.2.1 Differentiated and undifferentiated

The first item of note in the interviews was a question of whether Sources really could be judged in an interdisciplinary context and whether this was a useful basis for decision making.

"I think it is probably true now, I don't think it is too much of a problem, but, of course you learn to recognise patterns of citations and what they mean, and so you are doing two things at once, you might do a search and come back with loads of stuff but at the same time you are starting to read and maybe starting to read undifferentiated stuff coming in from god knows what journal, from anywhere and from god knows what author, but you are reading and starting to get a feel for who the key names are, who gets cited and who the key names are so you get a sense of what is outlying and what is core in terms of both authors and the models and concepts that they are using". P23: 23:44 (206:212)

"It is improving, but from a very low base with the usual complaints about it being very hard to discriminate sources, especially for students, and there are some collections of primary documents and it is useful where people have translated text. Because translation can be a big issue. But again the problem is vetting the quality. Similarly I am conscious that although I do it a bit for my teaching I don't do it enough, but that is something else and a whole different area". P35: 35:21 (112:117)

Differentiation of quality was a combination of expectations, previous experience and recognition.

6.5.2.2.2 Level of knowledge and source quality judgements

Interviewees found particular difficulty with making judgements about Source Quality and Relevance in fields with which they were less familiar. Without a grounding in a field there were few clues as to what the originators of material within a discipline considered 'good

quality'. The product was a combination of extra work in "backtracking" and increased uncertainty (see also section 9.2.2.2).

> "I think the thing that I am most conscious, the thing that makes me most anxious, it relates to that thing about the canon, working in one discipline and having very close familiarity and mixing with people from that discipline, you know what is good and what people think are good works, the problem when you try to venture into other disciplines...you might find a couple of really good books that are written by geographers but which are very pertinent and they might appear to give you just what you want. But it is very hard to see how they are perceived in that discipline....I don't know how it has been received....So that has been the biggest difficulty, working out assessments of other disciplines". P31: 31:24 (259:270)

> "Whereas, when you don't know I still find I am looking at things, I am not a psychologist, you know I don't know how valuable research A has been or whether people have completely discredited it. So you are having to backtrack quite a lot really, and probably not always getting the best either". P1: 1:12 (71:78)

Outside of familiar areas, information sources were perceived by some interviewees as an indistinct mass of options and qualities.

> "You don't have to look very far away from ones core area to start struggling. It wasn't connected with this project, but I tried looking up a legal case in the law library and ended up wondering why there were so many different law reports and what is King's Bench Division, Court of Common Pleas, and things can appear in different volumes.... So I have had the odd hour wondering around shelves trying to find something and when I do find it - if I find it - I'm amazed. I don't even know if all legal cases are reported, are they more authoritative if they appear in book form written by legal experts than the snippets in newspaper columns by journalists....It is the same with medical History journals, I am never quite sure of all the statistics, and their applicability". P40: 40:10 (104:127)

The solution used by many interviewees was to use the material without differentiation, or to seek an external opinion via Networking (see also section 5.2.3) as in interview P33.

> "...that means something relevant that I don't know about. or because there are aspects of the abstract that don't ring the right bells for me - but immediately would for someone that I would collaborate with or know, so I guess my main issue is that I feel that I am to some extent working with second hand material more in those areas because I have got to rely on someone else to do that first stage of screening for me". P33: 33:23 (195:212)

Where past experience was higher within a field, then general knowledge of Sources contributed to decision to use sources. This was particularly the case with the use of personal collections.

> "[*Can you characterise your approach to solving an information problem?*] Totally muddled, I think I have got to a certain age now, and I have been in this game for far too long, and it is sometimes surprising to me, how much I know, and I have written some things recently more or less off the top of my head, with prompts from whatever is in my library at home...". P32: 32:3 (30:52)

Other examples of the contribution of experience included perceptions of the Internet as a low quality source of information, though retaining some value.

> "The biggest disadvantage is that whatever search engine you use you come back with more rubbish than useful stuff, another disadvantage is that sometimes the quality of the material on the net is isn't that good, but then some of the stuff that is in journals isn't that good either....Using the internet you are more likely to go through multidisciplinary units to find information ....so in terms of multidisciplinary approaches to looking for information I think it is very useful and because they post material on them as well, particularly university sites you can more or less trust them". P6: 6:8 (79:107)

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"It is improving, but from a very low base with the usual complaints about it being very hard to discriminate sources, especially for students, and there are some collections of primary documents and it is useful where people have translated text. Because translation can be a big issue. But again the problem is vetting the quality". P35: 35:21 (112:117)

The value of a Source was also perceived variable between different parts of topics as in this example from interviewee P46.

"I use the internet a lot actually because there is not much written academically on some pop forms and last week I was giving a paper on Bjork and so I went to loads of websites and found interviews and videos of recordings, but it is not a tool that I use for anything really to do with Psychology but it is useful on the Pop music area. But I would never bother doing it for the Psychology of Music because the stuff that is on the web is completely journalistic, but having said that there are other academic's web pages and they are useful. It is useful in different ways for different things. The British Library I use their Book Catalogue as another searching source for a particular area. There are other databases like Psychlit and Newspapers which have CD ROM or Web can be useful". P46: 46:7 (133:142)

This is indicated in a further delineation of Effectiveness as a measure Quality.

" ...looking at my own History of moving from single to multi-discipline I have to say that funnily enough single discipline work was much more related to the disciplines and journals and multidiscipline work you really have to rely on journalism and the business press and everything that passes your desk because it is basically what journalists do better, not that they do it well, because they lack a kind of single disciplinary depth and sounding board in their own heads, and because they are not so restricted, they are not restricted, they pick up anything that goes, so actually it makes for more lighter reading". P2: 2:40 (283:293)

"...what is less helpful is relying solely upon what is on your library shelf, sometimes you have to go way way out and much more broadly to find what is relevant, because what the librarian in your particular area might think is important might have no particular significance to your particular search...". P21: 21:18 (147:151)

"I imagine internet searching would work infinitely more effective because the horizontal multidisciplinary nature of the resource... if you can access multiple abstracting services across different disciplines, obviously if you only looking at a fairly shallow exposure level then it is easier to cover the ground rather than if you are at the stage of looking for evidence. I find it more effective in the single discipline context to go to recognised reviews, e.g. annual review of x or y, and even to look at back issues of particular journals...". P9: 9:43 (264:277)

Ultimately underlying Quality judgements, experience was a recurrent theme. Experience contributed to interviewee expectations of the quality of a particular source and of its applicability, or effectiveness for the nature of the topic being studied. Experience was gained through practice or through learning directly from others in the field.

"Well, at this stage, I think it is again something which I suppose changes over your career in some senses, but I suppose when I was doing my PhD and had my PhD supervisor who was very broadly read. So to some extent I used them to suggest areas, and things that I might read, and in a sense I am increasingly performing that function for my self in the sense that I am more familiar with some of the areas that I need. So it is partly experience and partly I'll go and have a chat with a colleague, talking to people if I'm stuck, so yes certainly thinking about the stuff on contemporary literature I would almost certainly go and talk to some of the people in the department who work on that area and ask them. I suppose for that very broad area it is best to ask somebody rather than try and head on in by yourself and not have a clue". P38: 38:35 (231:241)

A lack of experience was associated with interviewees inability to judge the quality and relevance of sources was common within the data.

"...which conceptually is a very hard task to do because you haven't got the first degree in that subject so you don't have that bedrock that allows you to be able to make decisions about what is important and what isn't important". P10: 10:29 (183:186)

"One of the difficulties is that you seem to have much more need for full text or long abstract information because previously when I worked in a single area anything which had the keywords would be useful, but whereas with the interdisciplinary stuff it is really difficult to tell". P7: 7:23 (174:177)

"Well, I suppose you feel quite unstable, there is certainly an image of being in a boat on rough water or something comes to mind, because you have lost the little networks that normally support you and so you don't know where to go, and you know that there is a lot of material out there that you have to sift through, so you start to worry that it is a needle in a haystack for how I am going to find the really relevant stuff without wasting a lot of time on the irrelevant". P41: 41:26 (220:226)

6.5.2.3 Access

In making a Source Selection Decision interviewees identified Access as a consideration of greater importance than many other factors including quality and need. Access is discussed in section 9.3.3 where two types of access issue, physical and resource emergent from the data elaborated.

6.6 Problem Definition

6.6.1 Definition

Problem Definition was described in interviews as the process of rationalising an area of interest and potentially broad information needs into a focus capable of consideration as an objective for information seeking. That is not to say that Problem Definition had to occur prior to information seeking. However, an "area of interest" was present in many of the descriptions given by interviewees and provided the stimulus for further enhancement and focus.

Interviewees expressed their Problem Definition process in a number of ways. Interviewee P27 likened Problem Definition to working on the chapters of a book. The key being an understanding of a topic based on a structuring of ideas from which information seeking tasks were developed.

"Well, it is like working out what chapters you are going to have for a book, what should it cover, I would start with the plant and concentrate on how the plant is affected - its growth and Physiology are affected by the galling organism....This is quite a big topic so I would try to find out from the literature. I can only work out one small part, so that would be a start, and then obviously that is related to lifecycle of beast causing gall, and leads into the different species. So I would have to go the literature to find out about the other species and details. Because it is a young science and not many species have been worked on, and then you go into genetics because it seems that some gall organisms at least program a plant and so even a change in genes in cells and hormones of plants. Again that is outside of my field, I can understand the results but I am no geneticist or microbiologist at any stretch. So the discipline of plant galls is stretching across a whole Biology department to understand the whole thing. I would understand the results but I wouldn't understand the methodology, because of the jargon

and the techniques and the machinery that would have been used that I have never come across. So I have to take that on trust. Some of it would be well over my head as well. and it wouldn't matter too much, because that sort of material isn't directly important for my present project". P27: 27:8 (68:86)

Others stressed that the process was one of setting parameters for their work, the creation of a border around the area of interest. Interviewees indicated that this occurred at multiple levels including quite specific cases such as P26's description.

"Well, at the beginning it is more a case of establishing parameters, finding out what there is, you might not be reading specific articles or books, you would be more compiling a list of articles and sort them and then decide which ones are worth getting hold of and which ones aren't. I suppose the middle bit is choosing which ones you are going to read, and finally, when you are just wrapping it up, you have a gap here, there is an article you never got around to reading but everyone else has referenced it. [*When you are having a look at what there is and you talk of sorting them out, and you decide what is worth having a look at, how are you deciding at that point?*] Probably on the basis of the journal, often I base it on the length of the article because quite often you get quite short one or two page pieces which aren't going to say a lot and especially if they are hard to get hold of aren't worth the effort. Also the author. if you know the author or if you have heard about him, or if they are someone who usually has something interesting to say". P26: 26:13 (154:167)

A particular attribute of Problem Definition was the variation in how fixed the initial ideas held by information seekers were. Interviewees could have a set of questions or agenda pre-formed as a basis of investigation. In this case Problem Definition was an elaboration of questions and frameworks upon which information seeking operated. In part this was explained by experience within the target research fields.

"I am going to impose more order on this than actually exists, but I think what I try to do is identify the key analytic questions and identify the kinds of information and sources that will help me answer those questions and that I think is the work that would normally identify me as an historian. But I also think about the interpretive difficulties of the sources, and the kinds of logical problems that will come up in an explanation and there I think other disciplines often have answers. So I am just starting a book on popular experience in the civil war, and one of the things that happened was that censorship broke down and there was an enormous amount of print on the market, but it is not clear who produced that - or who read it and what the people who read it thought about it, so as an historian I am interested in peoples' experience and I want to look at cheap print that ordinary people would have bought, but in order to understand how to use that I have had to go and look at other disciplines and particularly literary theory and how people respond to texts". P36: 36:11 (40:50)

"I usually have a strong agenda, not a clear sense of the answers, but of what the questions are that I want to write about, and I do produce relatively quickly for a historian and I think that is because I am more ruthless about excluding material that is not directly relevant or of use to me. Whereas I think a lot of historians might immerse themselves in a whole body of material and get a feel for a whole set of problems and what might emerge from that, whereas I will go in with a question and look at the things that will help me answer it, and so I have a relatively coherent agenda". P36: 36:14 (90:95)

Collectively the setting of questions, of creating a structure and boundaries to the area of interest defined Problem Definition. In considering the data a close link with Information Need was present and this interacted with Problem Definition such that Information Need represented Gaps in information which contributed to Problem Definition, which itself created an agenda of Information Needs. The data particularly suggested that the process was not independent and that the presence of many iterations of Problem Definition was a common feature of Behaviour.

6.6.2 Characterising Problem Definition

Problem Definition was a particularly clear example of the perception of time for interdisciplinary researchers. The definition and description of Problem Definition contained much that related to the perceived non-serial nature of interdisciplinarity. Problem Definition emerged as a combination of "constant redefinition" and "non-sequential" component processes (see also Chapter 10, Concepts of Time).

The quotation from interviewee P1, below, illustrated the theme that interviewees saw themselves as growing through projects and linked this to the processes categorised as "Opening".

> "...for me, looking at something from a multidiscipline. it is hard to define, because this current project could you surprise you in what it did actually come under and you have to stop having a blinkered and channelled way of looking at things, you have to be really open to anything and constantly redefining what you mean I think". P1: 1:7 (29:32)

In connection with successive searches P1:21 expressed the theme over time, and interviewees such as P7 expressed the feeling that "absolute definition" was inappropriate early in a project.

> "Well, I guess if it was a singular discipline, if you are looking in certain areas, e.g. reading of fiction, you would get some, probably a very good response rate, but because this goes across so much you can end up with doing one search with some things that are spot on but other things you could get high school curriculum from the United States of America doing the same search terms. Because it is a broad sort of area it means that often searching is really time consuming, because all the time you are having to redefine it and redefine it and lessen it and lesson it, and I don't think you get that problem so much in a single area, because you don't want to lesson it to such an extent that you rule out all the good areas. You know what I mean. if you are trying to get things on Sociology and Psychology, you have to be very careful on how you limit things". P1: 1:21 (164:173)

> "For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason, I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. Having read literature on education I realised it was part of a problem based learning exercise, then I realised it was part of a problem based learning exercise, and then I also realised that the live project was also relevant to anti-rationalist theory as well. But in a way I haven't absolutely defined it yet, I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it. In a sense I am ahead of myself as I'm doing my field research before I do the majority of my literature work, but I don't really expect any surprises, I think I know what people will tell me". P7: 7:12 (86:99)

Where preconceived ideas met with interdisciplinary topics the potential Problem Definition was redefined by the emergence of new themes. Interviewee P5 discussed examples of redefinition during a project.

> "[*So you have gone through quite a lot of redefinitions?*] Yes, what I thought was a continuum is a continuum but it is a disjointed continuum and the joints are technological change....Well, I think it is quite simple really, I think the reason that there wasn't very much about what I was looking for was because it wasn't actually reflect to a very high degree reality, in other words it

was a construction that I was putting on to it, which I don't think really absolutely stood up, it may have stood up for a short time on one leg, but having said that there was something there because when you got into there were other factors that were very influential that were driving change. The other thing I think was that during the 60s and 70s there was quite a lot of work on technology and culture but that had never been applied to the area I was working in, so in other words your standing point is going to be from that era, but your application of what does this mean is going to be entirely contemporary. It is like what is so familiar is invisible, people couldn't see it because it was absolutely standard day to day activity, so you had to stand back to see it". P5: 5:27 (150:154-209:219)

Interviewee P14 gave a similar account with regard to work involving an interdisciplinary combination of genetics, drug treatments, and clinical practice.

"It can be that you find something new and something that you don't know and that takes you out of the original search and that could be a technique that you don't understand or an associated problem, associated gene or drug treatment, and although it is related it makes for a very different search. Or it may be that what you are actually interested in is maybe limited to a particular gene and therefore you need to study that gene in particular. The interesting thing is that a gene is a good example. You can search for a gene in a very linear fashion going through the literature chasing an idea, but when you hit the gene you find a whole literature that surrounds it which will encompass the same gene from many different angles. So it may be a bit of both". P14: 14:9 (38:45)

Those interviewees who felt able to stand back from their topics, such as P9:25, described the process as non sequential and holistic.

"[We talked about how you started off, the idea you described of getting a broad picture, and then the detail. When you are faced with a new topic, how would you say that you come to a definition of what it is you are looking at?] I think it depends what you mean by a new topic, article or project. [Either, but preferably substantial.] It has got to be by a process, that Glaser and Strauss would describe as intuitive, perceptual thing. It is as much likely to come as you sleep or as you lay in bed worrying, it is much less likely to come from a focused intellectual activity, its more when you are really broadly thinking, because there are so many parameters to juggle, is there a good focus here, is it original, is it likely to receive funding, does it hang together, almost like a face, is it an attractive face that is worth going on to study, so it is very perceptual, holistic, fuzzy, even though it is based on, it is almost like digestion, even though what you eat may be very structured research reports, very scientific, the actual process of defining a new topic is very holistic, impressionistic, fuzzy, it is my own way of doing things, so I am not logically running on project x and saying lets build on these foundations in my interdisciplinary areas, I am aware in single discipline areas I aware you might build sequentially, logically, on previous results and see a chain of building brick by brick, I can imagine that happen more in a single discipline". P9: 9:25 (109:130)

These provide a context for description of the methods adopted in pursuit of Problem Definition.

6.6.2.1 Methods

6.6.2.1.1 Preconceived questions

Problem Definition was not always conceived in terms of a natural growth from an idea. Sometimes interviewees drew upon ideas that fitted within a tight framework, which thereafter provided a set of "preconceived questions" that needed to be addressed. These questions had the effect of setting a boundary and parameters from early in Information Seeking.

"Yes, when I started the space and landscape work I did have some very specific questions in mind and they certainly weren't about space, what I was doing was reacting to a History book,

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but it was a History of science and medicine book and I was using a set of material that I hadn't looked at before to test the hypothesis of this book. So that was about science and medicine and I have talked about that in research, but it is quite clear that the material is about other things and it became very clear that the way these writers are thinking is spatially rather than medically for example. So I did have some very specific questions to start with and I have answered them, but also new ones have emerged. .... I think this takes us back to preconceived questions. Although at the beginning of a research project I might have very clear questions those do evolve as I look at the material. But still when I am trying to find information from other disciplines there are still goal posts that I want this information to fall through – it is directed in a sense so there are, if not questions, then specific issues or themes, that I want to be equipped about in a context which I have already established - so that is gender inequality, and so I guess that I have gone deeply enough when I feel that I have competence to think about those themes or issues in the context in which I want to think about them. So if I am using a caricature and I go to art History to help me understand, not just caricatures, but masculinity in caricatures, what I don't want to be able to do is write a book on caricatures, I want to know how to think about masculinity in caricatures – so it is directed". P31: 31:14 (56:64-129:140)

"...I think particularly in my area you have to think about what you are looking for and try and think what the end product and to be clear that I am not steering too far away from Landscape, but equally it is quite interesting because I think it can be generally a lot more practical, you know life generally throws up problems that are not generally solved by one thing so I think it is a lot more realistic as well...". P8: 8:5 (31:41)

A predefined question was seen in connection with a need to break the topic down into smaller parts, each relating to components. For example interviewee P6 suggested "operationalise" the question, while interviewee suggested a similar practice.

"[*What would you recommend to someone starting in your area to improve their chances of finding information?*] Well, one of my colleague students, is actually looking at mental health and deafness issues, and I am going to joint supervise her thesis and I asked the student to forward to me a plan and we are meting next week and I have written back to here with some suggestions and it really cover where does one start when one is looking for information and what the student has started with is a title, and it is a very broad one, 'a literature review into the accessibility of mental health services for people who are deaf or have hearing difficulties', what I have suggested to her is as a starting point is to go back to the title and do what I call 'operationalise' it and to start to define what does she actually mean and what does she actually want. So in terms of the literature, do you know what type of literature you are going to review at the moment, do you know how far back you are going to go, would you look at medical, nursing, psychological, social, are you going broad, would you look at literature relating to other disciplines and other disabilities that may have some information or be able to information the debate. ...so I think it is very important that you define right at the beginning to some extent which areas that you are going to cover, and then thinking about the criteria of papers that you are going to include and exclude and be able to understand why you are going to do that". P6: 6:19 (216:241)

6.6.2.1.2 Emergent from 'Opening' an area of interest

Problem Definition was, as with the other components of Orientation, intimately interconnected with the process of Opening.

"...Other issues, are at the much more general level - of whether the kind of work that we are doing is relevant to linguistics, so inevitably at this level there is a kind of tiptoeing around in establishing why you are doing what you are doing, but I don't mind doing that". P33: 33:23 (195:212)

For example Browsing around an area of potential interest offered one route to towards Problem Definition.

"...but my first approach because I think I don't trust search engines and I don't trust my own ability to be able to hit the right words I tend to be a browser, so I tend to have a memory of going away for a weekend as a PhD student with the green printouts we used to get from printers and sitting in a mates garden with her reading a novel and me leafing through these BIDS titles looking for something to catch my eye, just browsing really. I think that is probably not very efficient, though I often don't know what question I am asking at the start, and that is probably why". P11: 11:40 (311:318)

Problem Definition often appeared to begin with an immensely broad interest area. Breadth Exploration (Section 5.2.1) around an area of interest led eventually to a focus closely reflecting a "Problem Definition" as suggested in the case of interviewee P7.

"For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at 'live projects'. I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason, I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. Having read literature on Education I realised it was part of a problem based learning exercise, then I realised it was part of a problem based learning exercise, and then I also realised that the 'live project' was also relevant to anti-rationalist theory as well. But in a way I haven't absolutely defined it yet, I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it. In a sense I am ahead of myself as I'm doing my field research before I do the majority of my literature work, but I don't really expect any surprises, I think I know what people will tell me". P7: 7:12 (86:99)

6.6.2.2 Informed by previous knowledge and experience

Problem Definition reiterated the influence of Previous Knowledge and Experience. The data suggested that Problem Definition was more difficult to achieve without a background experience in the disciplines required for a project. The process of Problem Definition was informed and enhanced by previous research experience.

"I think that would be kind of a second step. Hopefully at that point I would be able to somehow identify or perceive some common ground with the experience that I have from my discipline and if so then I might be trying to identify specific topics or perhaps a list of keywords and go directly to a database at that point, like a science citation data or a library catalogue or a web search. On the other hand, if I feel like this is really largely well beyond my experience then I will probably try to find an individual, probably first within the department and then within the university and then perhaps I may even look for organisations either in industry or universities where I could contact somebody and send a plea 'could you help me I'm looking for...' and try to just get to talk to somebody". P15: 15:13 (86:99)

"Yes, I think I could, but I think it is a process, if I thought of it as a process it would be largely as something that, I could describe processes that I have been through, but I don't think they could be prescriptive, and those processes tend to be of a different scale. One that I have noticed is that and one that tends to be quite puzzling is that for the last 5 to 7 years, and in general it has been the case in relation to 3 books that I have written and each book has been the culmination of the summary of the last 7 years". P18: 18:17 (250:266)

6.6.2.3 Links with Context

Problem Definition had the potential of continuous development and change for the interviewees. Resolution of an information problem was possible only where parameters were

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set, that is, criteria were drawn up after which information seeking would be deemed complete. A significant factor in the interviews was forced closure. Problems were given boundaries not by the topic, or by knowing all the possible avenues of investigation appropriate. but by external-outside influences on Problem Definition.

Funding bodies and the need to specify research as belonging to a particular funding opportunity appeared several times within the data. Interviewees felt that a funding link would force an early specification of boundaries. These are covered in Chapter 9.

6.6.2.3.1 Knowledge and familiarity

In considering Problem Definition the interviewees described a difficulty in creating boundaries for their topics. The level of Knowledge and Familiarity with literatures was attributable in part, but Internal Context (Section 9.2) need to find something that itself contained few definable elements were also identifiable.

Of most significance was the influence of the concept of Knowing Enough. This contains the centrally problematic nature of setting problem boundaries, simply that the interdisciplinary researchers interviewed felt that they could not discard areas and develop a focus before developing a conception of the disciplines and the topic equal to the task.

> "…I said I find it difficult to put boundaries around work….[*Do you envisage a time when you would know that the boundaries you have set include everything that you need*] No that would be absurd. It might be that I am not at all knowledgeable about science but I know that certain scientific theories and concepts are used to illuminate social phenomena, they are applied to the analysis of social phenomena, that is a whole area that I don't draw on, but I would be a fool to say that I would ever be competent to judge the boundaries… Hopefully there is some logic to my research and intellectual development, but at some level they are rather arbitrary in that I am not and have never been a scientist, so maybe there is a whole area that I am discounting". P23: 23:32 (93:108)

6.7 Discussion

Orientation represented the second core process of the emergent Model. Orientation, labelled "finding which way was up" during initial analysis, reflects a range of behaviours associated with defining current information held, identifying information gaps, creating mental models and identifying information landmarks. The primary components of Orientation were identified as Reviewing, Picture Building, Identifying Keywords, Source Identification and Source Selection, Problem Definition. Together these activities formed the basis of Information Seeker Orientation. In this section the literature relating to Orientation is discussed in relation to the findings.

6.7.1 Reviewing

Reviewing was a combination of physical and intellectual aspects focused on what information was already obtained or known by the information seeker. Reviewing was particularly identified in the patterns of using of existing knowledge in an area, reading or accessing a personal collection, considering material already gathered and from this review of "where I am now" to establish a base line of information from which ideas of "identifying which gaps need filling next" and "developing those seeds of information" followed.

In labelling the activity as Reviewing the analysis marks out an aspect that has been incorporated in a general sense into Krikelas's "memory" within a model (Krikelas, 1983: 17). In more central models of information seeking Kuhlthau's information search process contains an indication of a similar reviewing practice, identifiable under the description of initialisation, "brainstorming" and "relating prior experience and learning" (1993a: 237) is indicated which implies the use of previous knowledge or information to allow initialisation. The link is underdeveloped in Kuhlthau's model (1993). Elsewhere, Pitts (1994) indicated that prior knowledge was never used in isolation but was always informed by other learning and the subject matter.

In Ellis's Behavioural model the "Starting" category of activities includes on a close reading of Ellis (1987: 79) a reference to using previous knowledge and "files of useful references", which each imply the use of a reviewing activity.

However the concept has received little consideration as a significant component of understanding information seeking behaviour. It is particularly noteworthy that Reviewing was a key element in the balance between assessing the known and assessing what was not known, and therefore contributed to future directions for information seeking. As such the difference was in its iterative and detailed value as a central activity.

6.7.2 Picture Building

Picture Building was a composition of behaviours that respondents described aimed at mapping out in their minds and on paper the disciplines and concepts relevant to ultimately obtain an overview of the topic in the context of disciplines. Information seekers were found to be using reviews and information searching to add themes and items together to form a "map of the subject". The pictures created were held by information seekers in the study in either physical and mental form, and occasionally both. In constructing an understanding of a topic Picture Building developed and appeared to become more detailed through the course of projects.

The subsidiary components of Picture Building, were Identifying the Shape of Existing Research, the process of Identifying Key Names, Identifying Key Articles and Identifying Latest Opinion in Disciplines. These components filled in particular aspects of Orientation for

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information seekers and each offering new material for Opening activities and strategies to be enacted. Identifying Disciplinary Communities which was deciding on the basis of information, past experience, topic or general knowledge which disciplines might be appropriate places to look for information.

The literature has no direct bearing upon the approach described in this chapter and yet the concept is not entirely alien to the disciplines of Psychology, Education or Information Science. Within Information Science models have tended to include the subsidiary activities associated with Picture Building as part of Starting (Ellis, 1993: 369), and Topic Selection and Focus Formulation (Kuhlthau, 1993a: 238-239). Vakkari and Hakala (2000) talk particularly of the influence of "previous knowledge structures" in steering information need and information behaviour. The idea of a "previous knowledge structure" may indeed be a non-explicit indication of mental models.

However, the whole concept as represented by Picture Building is not expressed fully in existing models. A number of studies outside of the field of Information Science have considered mental models, which are the closest pre-existing construct to Picture Building if we take the descriptions of Jonassen (1995) as typical of the field. Mental models are what researchers such as Johnson-Laird believe to be the human way of understanding the world, that is, by constructing models of it in their minds (Johnson-Laird, 1983). Mental Models were defined by Marchionini and Shneiderman (1988: 72; 1995: 11-12) as "cognitive representations of a problem situation or system". Mental models as put forward in this definition are useful to help represent the information, the problem and the way to understand and organise information seeking.

A similar position was derived in the work of Ingwersen's in the presentation of a Cognitive Information Retrieval model (Ingwersen, 1996). Ingwersen's model (1996: 37-41) as introduced in chapter 2 describes a view of the information retrieval exercise driven by the user's own mental models of the world and each aspect of it that he/she comes into contact with. The cognitive viewpoint implies that action is mediated by the use of cognitive or mental models of the world (1996: 5). Ingwersen's position has much in common with Anderson's earlier (1980) description of cognitive maps which were used to highlight the use and value of cognitive representations of physical space, that is landmarks, routes and survey knowledge may be used to navigate the real world.

The literature of mental models shows a considerable overlap and parallel with the behaviours associated in this study with Picture Building, though in this study the concepts are developed around the information task and the information seeking environment. The results presented in this study found that information seekers were constructing their own models in a number of formats to accomplish successful interdisciplinary information seeking. If a mental model is a psychological representation that aids in understanding, explaining or predicting how

a system works (Johnson-Laird, 1983) then the application of this to information domains is a logical transfer of concepts. The concept of mental models does not directly reflect the whole process found here of building a picture of a topic and of the domain within which information may be found, hence the difference in name.

The findings presented in this chapter are supported by other studies of aspects of information seeking behaviour. Thus, Chen et al (1998: 583) noted that "Because browsing is frequently used in new or relatively unknown (unexplored) information spaces, users typically rely on pre-existing mental models of information organization as they explore". Work by Heidorn (1999) and Hirtle and Heidorn (1993) suggests that users have mental models of the image or information they wish to retrieve.

The present study takes this theme further and suggest that not only do mental models exist, which is proven by much previous research, but also that in information seeking in an interdisciplinary environment that the mental model is continually changing and developing and takes on new complexity when multiple mental models come together in a complex topic. The creation of a Picture of the information available and its relation to disciplines, resources, questions was found to be an incremental process reliant upon interaction with Opening and Consolidation.

The analogy in information seeking is the presence of Picture Building to achieve the same purpose for information. As this study was not able to consider in depth the psychological processes these are indicated in the processes and behaviours reported by information seekers and are noted for further research.

Other literature that develops themes of broader interest in this area include Slone (2002) whose study discusses the issues around the creation of mental models during web searching. Further literature includes Dahlback, Hook & Sjolinder (1996); Ferguson and Hagarty (1994); Thorndyke and Hayes-Roth (1982); Couclelis, Golledge, Gale & Tobler (1987) and Tversky, Franklin, Taylor & Bryant (1994) who expand the literature covered here to the field of Environmental Psychology which provides opportunity for further developments to inform the field of information science. Additional work of interest by Frost (2001) covered the use of mental models in image searching.

In developing ideas of Picture Building there are also possible connections with the teaching of information literacy which as a developing field has drawn on the use of "mind mapping" to represent the construction of basic mental models for information seeking in Brandt (2001); Callison (1997) and McGregor (1994).

The presence of Picture Building and its components in the findings of this study contribute a further insight into the relationship between concepts information seeking and cognitive psychology.

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6.7.3 Identifying Keywords

Identify Keywords consisted of the process of finding suitable terms for subsequent searching. Keywords were drawn from Opening activities such as browsing, from previous knowledge, from networking and from serendipitous encounters with information sources. Keyword searching was viewed successful or unsuccessful, depending on how much was known about a topic and how homogenous the terminology was.

Three main methods of Keyword Identification were found within the data. Each contributed a different route to Identifying Keywords for the interviewees relating to Previous Knowledge and Experience, Opening activities and Problem Definition.

Kuhlthau includes "listing descriptors" (1993a: 238) as one element of the Pre-focus Exploration Stage. Elsewhere studies have tended to focus on Keyword use rather than identifying keywords and originate largely in information retrieval. The available literature tends to concentrate on indexing and production of thesauri rather than user information behaviour aspects.

6.7.4 Source Identification and Source Selection

Source Identification and Source Selection Decisions covered the simplest level the identification and decision to use sources of information. At a lower level Source Identification was highly integrated with the Opening activities of Networking, Chaining. Serendipity, Browsing and Eclecticism. The contribution from previous experience or knowledge was high. Where no prior knowledge existed the data indicated the use of Opening to literally 'open' up ideas of what might be appropriate.

Decisions were based on evaluation of sources in three categories: need, quality and access. Information Need, discussed in relation to Source Selection Decisions, illustrated a staging point for gathering ideas of directions and information required. The study found a particular distinction coded as Information Need: General and Information Need: Specific to identify the variations present in needs expressed by information seekers. The differences were discussed and indicated multiple strategies co-existing for different components of an information seeking exercise with a variation in breadth and depth appropriately defined. A connection with Source Selection was noted.

Source Selection Decisions were related to the use of Differentiated and Undifferentiated material, that is on the basis of quality assessments, and discussed issues around the levels of knowledge required to enable intelligent judgements. These assessments were accompanied by further criteria formed from Access which itself is discussed in Chapter 10.

These elements are in broad terms common to studies of information seeking behaviour. Both Ellis and Kuhlthau included source identification in their models of information seeking. Kuhlthau as part of the "selection process" points to the selection of information sources within

Focus Formulation, (1993a: 339). While Ellis included sources identification and selection as part of both chaining, differentiation and browsing "In addition to its role in the identification of material, browsing, can also serve the purpose or be directed towards familiarising the researcher with sources" (1987: 94).

The present study places these within a different framework of understanding. Here the process of Orientation encompasses such activities not as a single stage or entity but as a representation of a palette of activities from which information seekers were observed taking only those aspects which fitted their perception and resources.

The process of source identification and selection was also subject to an interaction between the information seeker and contextual influences such as access. resources and time. These are confirmed in other studies, for example Pinelli et al (1993). Bystrom and Jarvelin (1995) and Bystrom (1996) found that source selection may be influenced by increased uncertainty and task complexity. Kuhlthau (1993) also acknowledged that different problems required different information types. Ocholla (1999: 129) clarified that source selection was also influenced by availability, while Julien and Michels (2000) found a correlation between gender, source characteristics and perceptions of usefulness of sources based on cognitive and affective aspects.

Bystrom continued the study of the relationship between sources and source use and presented five statements to summarise a view of source selection.

> "(1) As soon as information acquisition requires an effort people as sources become more popular than documentary sources; (2) The more information types are acquired, the greater the use of people as sources; (3) The more information types are acquired, the greater the share of general-purpose sources and the smaller the share of task-oriented sources; (4) The more information types are acquired, the more sources are used; (5) The more information types are acquired, the greater the use of people internal to the organization and the greater the use of external documentary sources." (Bystrom, 2002: 589)

The present study sought to identify processes, with a secondary identification of information sources. It was possible to identify a link between the work of Bystrom and to concur, within the boundaries of the present study, with the general findings of Bystrom (2002).

6.7.5 Problem Definition

Problem Definition, in the classic sense, was defining the focus and boundaries of the information problem. It was noteworthy that here the data indicated a process that was not clearly pinpointed in time, instead many iterations of definition appeared common to the interviewees throughout information seeking, such that problem re-definition occurred up to closure.

The contrast here with previous models is in the assumption present in Kuhlthau (1993), Wilson (1999), and implied in Ellis (1987) that Problem Definition is undertaken in a snapshot

of time at the beginning of information seeking, with the identification of an information need. and in this forms a stage within information seeking.

In a similar manner Information Retrieval traditionally followed a simple model based on the assumption of a fixed problem at the start of a search process. The model much demonstrated is shown in Robertson (1977) represents the retrieval pattern as "Document – Document representation - MATCH - Query - Information Need".

Problem Definition was identified particularly in Wilson's framework and in Kuhlthau's model as a key stage in information seeking behaviour. Such an understanding of this activity rested upon an underlying acceptance of Problem Solving theory. Specifically Problem Definition itself is linked to a definable Information Need and that subsequent information seeking aims to resolve that definable problem. Wilson (1999) describes four stages of a human problem solving process, these are problem identification, problem definition, problem resolution, and solution presentation, through each of which information seekers or problem solvers would work to reduce uncertainty and move towards problem solution. This is a linear definition of problem solving. Other models, albeit tempered by the idea of iterations of cycles through models, suggest that a problem, and hence problem definition, take place at a fixed point within the information seeking process. Neither problem solving, nor problem definition were found to reflect this position when explored in the findings of the present study.

Problem Definition took on the aspect of a developing and changing interaction with information seeking results and activities. Member checking interviews and comments and clarifications during initial interviews confirmed this evolution of Problem Definition. The research suggests a revision of Problem Definition from a central role to a subsidiary component of information seeking.

A more appropriate model in previous literature was found in the work of Bates. Bates considered the traditional information retrieval models and pointed out that

> "...throughout the process of information retrieval evaluation under the classic model, the query is treated as a single unitary, one-time conception of the problem. Though this assumption is useful for simplifying IR system research, real-life searches frequently do not work this way" (Bates, 1989: 409).

Bates's evaluation of searching suggested an evolving search as more fitting and accurately reflecting search processes.

The present study finds Problem Definition and Problem Solving more widely to be a continually evolving process within each core process, rather than the initiation of a series of stages. The present study finds Problem Definition to exist, but to exist within an alternative conception of Problem Solving, that Problems are not defined, they evolve and change throughout information seeking. They are no longer a fixed point. This tends to emphasise Bates's approach to an evolving information search, but places this within a larger framework of empirical research.

7 Core process: Consolidation

7.1 Introduction

Consolidation, a third core grouping was found to contribute to every interaction from an initial idea for a topic through to the end of information seeking. A key theme of Consolidation is that of consolidating and judging the work in progress and deciding whether further information seeking is necessary. Within the context of interdisciplinarity Consolidation looped and intertwined with Orientation and Opening. The primary components of Consolidation are shown in Figure 14.
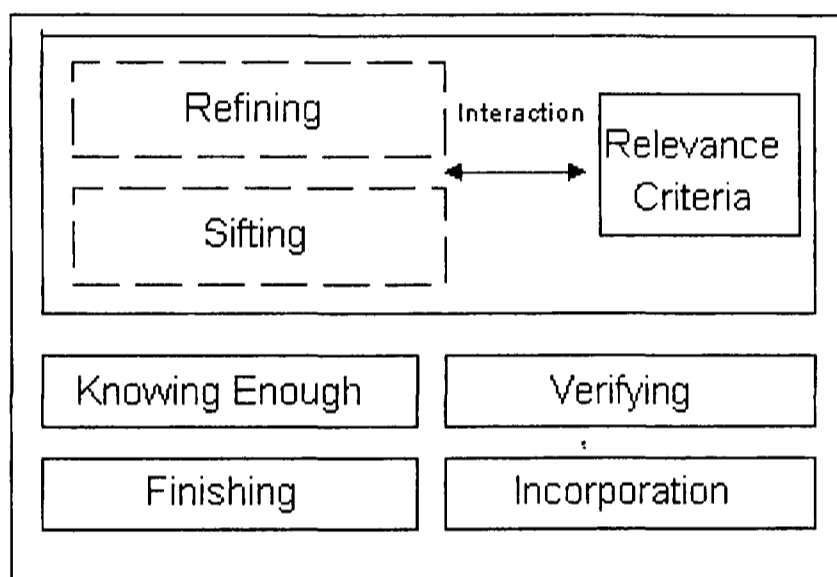
Figure 14. Consolidation

7.2 Refining and Sifting

Analysis of the data provided an indication in the first instance of processes connected with focusing information seeking activity and with judging the relevance of material retrieved. Two categories of event were identified matching these processes. Both processes relied upon an information seeker's concept of what "relevant" and "suitable" should consist of in any topic. The purpose of the study permitted an overview of Relevance, however, a more in depth study of this aspect was indicated as a possibility for further in-depth investigation.

7.2.1 Relevance and Criteria

The concept of Relevance was important for both Refining and Sifting activities. The following criteria were common to both activities and found to be in use among the participants

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of the study were identified as belonging to seven generic groupings. These were identified as Breadth Criteria, Direct Relevance, Negative, Gap - Specific Criteria, Duplication, Complexity and Quality. These were qualitative measures of relevance used by interviewees to explain their Relevance Judgements. The Criteria detailed in this section primarily occurred in relation to Refining and Sifting, other criteria specific to Source Selection are covered in section 6.5. The combination of Criteria were described by participants as being in use at different times with information seeking and to be developing and changing i.e. they were dynamic and multiple.

7.2.1.1 Breadth criteria

Breadth criteria as an element of relevance incorporated the recurrent theme that information could and should be broad to allow fulfilment of Opening and Orientation. Criteria were expressed in a number of ways. Interviewees expressed a general non specific, flexible criteria that was capable of including material that would ultimately be of interest, but not yet identified. Hence examples from P21 and P16 suggested such criteria and a match with Eclecticism.

> "What I would recommend is that you should take your time to think about the nature of the problem that you want to explore and whether or not there are indeed connections. Talk to people 'in the know', do some light reading in the area to see if there is actually something interesting to look at. And then, once you are sure that that is an area that really interests you, then go for it". P21: 21:23 (185:189)

> "I don't think so, I think it's the other way around, I think perhaps I would be a bit more prepared to look more flexibly at titles in an interdisciplinary area because you just wouldn't be too sure what was covered in that, whereas in a single area I would have thought that a title would be a very good indication of what was included within the topic. So I would be just a bit more lenient with references or titles which seemed marginally relevant in the case of an interdisciplinary topic". P16: 16:16 (199:204)

The breadth criterion was reiterated throughout interviews.

> "I would say search widely for one thing, which is an obvious thing to say, but I think looking widely, and read and write and try to get a grasp of the field really early on to try and get a grasp of who the main people are in the area and what is going on". P28: 28:16 (188:190)

7.2.1.2 Direct Relevance

In contrast with the breadth criterion, Direct Relevance set a narrow criterion of application to the topic.

> "Yes, definitely. Well, as you go through the process I think you become much more focussed on what you are really trying to concentrate on, probably by a process of elimination, and also getting into that stuff which is of direct relevance to what you are doing...". P5: 5:18 (109:118)

> "I think that probably, say I was writing a paper and I was building up the background, that I could get out of the way fairly quickly, but if I discovered some material – say a few other academic papers, that were very closely related to my project then I would have to look at them very closely and focus on those because I would be using them for the last stage of the literature review and the discussion and conclusions because I would need to link in what I had

done with what they had done. So it would be the closeness of material to what I was actually doing". P10: 10:57 (148:154)

Direct Relevance included specific criteria of publication date and inclusion of specific sub-topics of interest.

> "...I would probably consider if I needed to limit the set at all. The main ones that I am looking at, at the moment, I am searching from 1966 onwards. The obvious ones limit to human, and I might put some age limits in there, again that would depend on what I was looking at, and depending on the number of returns that I got as well I might consider language and local holdings". P17: 17:13 (198:218)

At the broadest fringe, yet still specific, were generic types of information that would be of interest.

> "I suppose I have got some research questions that I am working with in a broad sense - not formal ones - but there are certain kinds of things that I know that I am going to be interested in if I find them". P42: 42:19 (68:70)

7.2.1.3 Negative

Although many interviewees specified criteria based on pulling out the material that they did want, at the same time there were criteria applied based on what was definitely not wanted: Negative criteria, either well defined or as a broad technique for removing items.

> "...and I end up with some dreadful long list, but I start to look at the titles almost, and browse the titles, and I soon learn that there are things that I can get out of my list like – recycling in rat guts for example, so now I want all of these things but not these things, so I start to narrow it down that way". P11: 11:39 (308:311)

7.2.1.4 Gap Criteria

Specific criteria to fill Gaps were also in evidence in the form of criteria. Gap criteria appeared in interviewees work when there was a gap to be filled, either material within a particular focus, item of information or in obtaining final information items for Finishing and Verifying. Other themes attracting a specific criteria were whether the material added to that material already held.

> "...Having seen enough talks on Micro-Biology I started to recognise the 4 or 5 key journals that they continually referred to so I maybe started to check the contents of those online to see if there was anything in the titles or abstracts that looked important to me. At this stage I felt I knew enough to know where I should find information, I knew enough about the discipline and knew the door to use and start looking for specific pieces of information to fill in gaps in my knowledge". P15: 15:42 (175:189)

The links with previously obtained material are shown in this example from interviewee P31.

> "Well, I suppose because I already had evidence and now I was finding stuff that was a bit more abstract I suppose what I was doing constantly while reading the Geography was in my own mind setting up a dialog between that and my evidence. I wouldn't say that I was testing their theories necessarily. But all along I was thinking, does this apply, does it illuminate the material that I have? How useful is it? So I suppose I was using my evidence as an example to

help me understand these theories and illuminate these abstract approaches". P31: 31:10 (76:82)

7.2.1.5 Duplication

A less commonly spoken of criterion, interviewees included the idea of relevance based on whether they already had an item or not: that is duplication. Duplication also acted in connection with "Knowing Enough" as a measure of completeness based on re-occurrence and saturation.

> "...If anything is relevant to any my current interests or anything that I am going to be interested or I think that there is a fair degree of certainty that I'm going to be interested, also sometimes if I think it is interesting to some other people that I know, though not directly so interesting to me, so I suppose I go through a mental process of 'have I got this already?' and occasionally forget that I have got them already. So, I think about whether they plug a gap or contain some new idea, or I think that might be ideal to cite, or I think that might be ideal to teaching material. They don't even have to be ideal really, and I don't end up using everything that I collect, but I use a reasonable amount, I use enough of it to make it feel worthwhile. Although it is not something that I consciously started doing, but I find it to be a major method, and I collect information on the internet as well as anywhere that information happens to be and that I come across it". P39: 39:9 (55:69)

7.2.1.6 Complexity

In the interdisciplinary context interviewees were constantly assessing the depth of material and its complexity. Much depended upon personal background, but complexity of material tended to act as a prime criterion. Both from an Arts moving towards Science and a Science towards Arts direction complexity was an issue.

> "I think the way I did my research helped me a lot on that, after I identified the general area then I had to focus more specifically on very specific areas and then, even when you are there you realise that it is too technical for my topic, so you have to exclude that or you have to follow a smaller route and see if there is anything". P24: 24:67 (273:294)

7.2.1.7 Quality

Quality emerged in Source Selection aspect of Relevance but not important for Refining and Sifting. However, beyond the quality aspect indicated in Source Selection, quality played little part in the evidence to support Information Seeking as it relates to Refining and Sifting. In addition to these criteria Contextual aspects such as Access and Resources were also salient.

7.2.2 Refining

7.2.2.1 Definition

Refining appeared here as the process of deciding on boundaries for searches and of selecting a narrower search focus. Whereas Breadth Exploration was initiated to generate voluminous coverage, Refining fitted within the picture emergent from interviewees as the

opposite. Refining was a process of reduction. Refining reflected a change in relevance and also a response to Sifting where that showed that not enough relevant items or too many irrelevant items were retrieved. Evidence for Refining appeared in descriptions describing current information held and those describing what new information seeking was required, and how specific it should be.

7.2.2.2 Narrower

The process was characterised by movement towards a narrower focus. Interviewees spoke of a process of elimination and reduction. Beginning with a broad start and Breadth Exploration and moving towards finer detail and specificity. However, as Breadth Exploration indicated it was equally the case that smaller details led outwards to broad new areas of interest.

> "Yes, I guess, initially you are just going out for anything and everything, and working out from there, whereas when I have got my data I would imagine that it would be a lot more focussed in that I would be trying to search for certain things or evidence if I find something that doesn't fit the evidence that I have already got I would imagine that I would be searching particularly in one area for something very small". P1: 1:20 (145:149)

> "...Well, in my case it started with databases, big databases, as many as I could, and I went through all of the information they had got in a more general view. I identified certain books and articles and papers there and started like that and then I used more focused searches once I had got my feedback from my interviews - going probably back to the same databases and at the same time I was doing searches on the web all of the time. ...But over the process of the years I realise that my searches became more and more focused up to the point that I was looking for very very specific stuff". P24: 24:66 (131:148)

The activity of Refining applied to both ideas and to the quantity of material retrieved. Refining was a process of information reduction including variations of criteria applied.

> "...something that I like to do is keep a record of what I found and when, because of the nature of it you can have lean periods when nothing turns up and it is nice to have this sense of growing and you see where you have been, when I have got a reasonable amount of stuff then I will stop looking for awhile and do some analysis, work with it, read it, doing some writing about it to get some ideas crystallised and then there might be a second wave of research after that, but that process of trying to think about it and say something about it, will raise more specific issues and problems that then I might try and solve, I suppose that second wave of search might be slightly different in the sense that instead of it just being a question of feeding in the terms as wild cards and hoping something will come up it is much more a question of 'I need to know this precisely', so who can tell me about that, or which book should I use, although I must admit that I carry on looking for stuff until quite late, till probably I should have stopped in a sense while I am writing". P42: 42:27 (133:149)

7.2.2.3 Limitations of Refining

As transient visitors to a number of disciplines interviewees were found to express a range of limits on the extent of Refining. The primary limitation was a feeling that material would indeed be relevant once knowledge in an area increased. Refining continued as an activity but was indicated to be slower than comparable searching in a single discipline. Interviewees P1 and P17 encapsulated these aspects.

"Well, I guess if it was a singular discipline, if you are looking in certain areas, e.g. reading of fiction, you would get some, probably a very good response rate, but because this goes across so much you can end up with doing one search with some things that are spot on but other things you could get high school curriculum from the United States of America doing the same search terms. Because it is a broad sort of area it means that often searching is really time consuming, because all the time you are having to redefine it and redefine it and lessen it and lesson it, and I don't think you get that problem so much in a single area, because you don't want to lesson it to such an extent that you rule out all the good areas. You know what I mean, if you are trying to get things on Sociology and Psychology, you have to be very careful on how you limit things". P1: 1:68 (164:174)

"I think I just find it easier in a single area because I can focus quicker. I think in the multidisciplinary area I have kept things broader for longer, I haven't been as quick to focus down. That is, because I feel there is a possibility that I could miss things". P17: 17:29 (377:380)

Further intervening conditions emerged in from Knowledge and Understanding and particularly formed around language difficulties and size of research area.

"Oh, it is much easier in a single topic, it is much easier, you put in "speech therapy" and you get everything that has been written, but it is much harder if you put in something like "outcomes in therapy" you realise the word therapy is used by all doctors for the treatment that they give so there is drug therapy, insulin therapy etc. so you get 500,000 records. So multidisciplinary it is much harder to refine multidisciplinary into the area that you want because there are so many shared words when you are trying to look at just one particular area. So at the moment what I am trying to look at 'affective treatment' in the therapy professions and that is hard because again you put in therapy and get all these medical things and I don't want them!" P4: 4:52 (202:210)

7.2.2.4 Refining and activities

Refining and Keyword Searching, and Refining and Identifying Keywords and Refining and Source Selection and Refining and Problem Definition were revealed in the data to interact with Refining. Refining was seen to be a process of steering Opening and Orientation activities.

"...sometimes the keywords don't always appear straightaway, if for example like with dyslexia, if that is the only word that you know about, you start with that one and then you find all the others through reading, through literature, errm and then as my knowledge base increases I will start asking myself questions about the specific thing that I am interested in. So I need to know things like what is dyslexia, what are the causes, how is it assessed, how is it diagnosed, how do we support people, where does funding come from, so there are lots and lots of questions, and it is then back to the literature using those questions and looking for the answers. So I take a question approach to it". P6: 6:22 (37:48)

Refining was most clearly visible and closely associated and evident in connection with Keyword Searching. Keyword Searching offered interviewees an opportunity to demonstrate concrete examples of the process of Refining more so than did their descriptions of Browsing and thoughts.

"If I started with something like rehabilitation then I would introduce other keywords and combine them - probably using therapy or therapist first and then refine that down to speech or language therapist. I would consider as well perhaps using a condition e.g. stroke, with the rehabilitation as well and look at what I found". P17: 17:89 (206:210)

"... I end up with some dreadful long list, but I start to look at the titles almost, and browse the titles, and I soon learn that there are things that I can get out of my list like – recycling in rat guts for example, so now I want all of these things but not these things, so I start to narrow it down that way". P11: 11:39 (308:311)

Interviewees P33 and P39 described how Refining would progress in the course of their information seeking.

> "[*Summarising interviewees previous statement*] So you might focus on something that had arisen serendipitously?] Yes, that would be one of the things, or part of a conscious search strategy that I would start out more broadly and then if I discovered that that wasn't working I would find ways to work it down a bit until it did produce reasonable results". P39: 39:54 (128:131)

> "There are various things like linguistics abstracts that I had a good trawl through periodically, but that seems to fit into good old fashioned humanities research. I'd rather go to the library and sit on the floor and drag down things that look promising as a starting point and then follow up references from that. Also other journals that I subscribe to that I know cover part of the things that I am interested in. [*When you say trawl through, what does that mean?*] Well, just feeding in online, I usually search one subject at a time, and feed in a couple of appropriate search terms and my usual mistake is to go in at too general a level so that you end up so you end up with thousands of hits and then obviously have to go back and start again and put in something more specific and that can be frustrating when you are doing something that is interdisciplinary because you might be getting a large number of hits for one of the search terms and a much smaller number for another of them. Then you look through for unifying cases and there are precisely none, and I guess that happens with all databases but it seems to happen more with the humanities". P33: 33:7 (55:69)

Refining was not bound to a particular method, it was rather described by interviewees as an application of changed Relevance Criteria to information seeking and gathering activities.

7.2.3 Sifting

7.2.3.1 Definition

The process of applying judgements of relevance to information. Sifting was the process of applying Relevance Criteria described in a section earlier in this chapter.

> "It's different for me in effect because my objectives for this project I know at the end of the year that my project aims are already established, so I guess what it is a sifting out because there is no shortage of material in this area, but it is a matter of whether they help in this area or not'. P1: 1:67 (86:89)

> "...and you have to sift, because there is a whole army writing on my period and I also try to write in a way that is pretty accessible, I don't know if the students would agree, but I try to write for what used to be called the common reader, I am not interested in writing stuff that is going to have a readership of five, so that means that I don't want to get too complicated....All writing is creative it is not just sticking down the facts, it is the thinking as well as the finding and terror is a great impulse to thought". P32: 32:26 (126:134)

Sifting was shown in interview transcripts to be the application of relevance judgements. An intellectual process identifiable primarily by the effect of its existence and in the descriptions of information seekers, in coding the concept was a little more recalcitrant than some other concepts. The application of judgement was described by P31 as an interaction between information and information seeker.

> "Well, I suppose because I already had evidence and now I was finding stuff that was a bit more abstract I suppose what I was doing constantly while reading the Geography was in my own mind setting up a dialog between that and my evidence. I wouldn't say that I was testing their theories necessarily. But all along I was thinking, does this apply, does it illuminate the material that I have? How useful is it? So I suppose I was using my evidence as an example to

help me understand these theories and illuminate these abstract approaches". P31: 31:10 (76:82)

7.2.3.2 Difficulties and Context

The recurrent theme of interviews was the interaction between activity and context and between activity and further activities. Sifting was particularly demonstrative of the integral relationship between activity and information seeking context, for example interview P4 highlighted the feedback of Sifting into improvements to Identification of Keywords and effectiveness of Opening activities, while also suggesting the prevalence of difficulties with Resources and Relevance Judgements.

> "Well, that is the hardest part of the literature search, because some of the abstracts are really well written and they have got a very structured abstract and you can see from looking at the abstract whether it is covering the area that you wanted to look at and you think that is a good one, but the majority of the abstracts are very woolly and don't really tell you if it is the one you want, and one of the problems in my area is that many of the things in my area are not things the university holds, and that means you have got to get the articles, wait while you get it, and then if it not what you wanted you have wasted money for something that wasn't any good. So you can't say I'll get these fifty references because that is an awful lot of money, so you have to think not only about what is useful, but also about how many I can afford. I much prefer an online text, which allows you to scan through quickly and then if there is one that has all the right keywords and looked good in the abstract, but when you read it isn't your area at all but had all the right keywords in the abstract as you scan through you realise it isn't the right one at all, but that was good because you've read it and you don't need it, but if it is a good one you can print it off and you've got it". P4: 4:15 (111:124)

7.2.3.3 Method

The methods associated with Sifting were in themselves basic. Sifting was demonstrated to rely upon interpreting available information and applying a relevance judgment to it. In a simple form Sifting was equated with checking material against criteria. Criteria which it should be noted were treated flexibly as in interviewee P16 above, and which were multiple in their combination and application.

Interview questions refrained from mentioning relevance to allow interviewees to develop their thoughts without artificial terminology confusing their own interpretations. Hence questions gave a general focus, for example having some results to look at, and then a plain English question to find out what happened next, as in this quote from interview P30 which also illustrates the Sifting process and its relationship to information gathering. It was interesting to note that precision of search results was not considered desirable. Breadth Exploration was considered more valuable and fully compatible with Sifting.

> "[When you have looked at the results of a search, or a list of items, how do you decide which results are going to be worth following up?] Usually because it is clear from the short title or the expanded title and the bulletin in which it appeared that it discussed a period or set of conditions that I can just tell from the way it has been framed are alien and therefore unhelpful to the question that I want to explore. For example I didn't pursue anything that turned out to be about church clocks in thirteenth century Germany, I try whatever I am doing to frame the

question, if I am not searching for keywords in the title – if I am looking for something conceptual I try to frame it widely enough with the intention of being offered a lot of things that are no use, if everything is specific then I wonder if the question was good enough and then I try to broaden it out. [So databases and search engines that try to tailor themselves to you are exactly what you don't want?] Precisely, what I don't want and I choose to keep on the list of things that I will pursue articles that at first sight will look at most tangentially relevant but I would still want to have been offered them. The other thing of course is that I might think that an article that came up in a collection of essays doesn't look incredibly helpful, but the essay collection as a title that might be quite promising and so I might find the volume and look what else was in it and the volume might be so arranged that it wouldn't otherwise be indexed. You can have just one or two papers in a volume that deals with something that is conceptually extremely interesting to me and then I might find I would choose the volume and I might read the ones that were about other centuries because they might conceptualise the problems in a different way that I had not thought of and that might led me into some methodological literature which is also what I want". P30: 30:33 (347:372)

"...where there has been quite a lot of literature, somehow that feels more comforting, because you have been sifting out, so you can feel well might be other things out there but I have refined it down just into the area that I'm interested in, but when you are not getting anything or just small bits, it is very unsettling.... but it is much harder if you put in something like 'outcomes in therapy' you realise the word therapy is used by all doctors for the treatment that they give so there is drug therapy, insulin therapy etc. so you get 500,000 records. ....Then it is back to sifting out and that is where the abstracts come in, and that is where on some of the databases quite often don't make an abstract available you get a title and no abstract and so unless it is good - that the title itself is fascinating then if they are not going to give me an abstract then I'm not going to bother with it...". P4: 4:41 (192:218)

In applying specific and negative criteria the Sifting process aimed to eliminate all papers there weren't "relevant". Relevance as already indicated was multiple in its form and perceived as ever changing throughout information seeking.

"[*If there is enough literature there?*] Then what I would start filtering it out, and so from my search I would eliminate all those papers that don't talk about the subject or only have little bits of it or are much broader in terms of the questions that I am asking. At that point I would be hoping that I would be able to find specific citations or web references specific to the thing that I want to learn or discuss myself". P6: 6:14 (168:174)

"...and I kind of filter out stuff that looks odd or that doesn't look as if it is going to be relevant and try and if it seems to be coming from the right sort of angle then I will go further with it and try and find it". P42: 2:21 (81:84)

It was of particular note that leniency in the application of judgements allowed variation to the Relevance Criteria applied to Sifting. If material was considered borderline the criteria were reshaped to allow borderline material to remain within the remit of information seeking goal.

"I don't think so, I think it's the other way around, I think perhaps I would be a bit more prepared to look more flexibly at titles in an interdisciplinary area because you just wouldn't be too sure what was covered in that, whereas in a single area I would have thought that a title would be a very good indication of what was included within the topic. So I would be just a bit more lenient with references or titles which seemed marginally relevant in the case of an interdisciplinary topic". P16: 16:16 (199:204)

The Context of information seeking was also brought into the Sifting process.

"If I am just looking at abstracts say from bids or a website it would be whether the abstract helps me, what keywords there are and whether I could some sort of relationship to some sort of environmental design or it is answering a specific question that I have. Then the second criteria is whether I can get hold of it. So I would go straight to the library files and find out if it is in Sheffield and then basically it depends on where my research is at the moment, for the months I haven't really done much literature searching, I have been working on case studies,

but I have a list of things that I want to get hold of when I have the time. I will sometimes just try if something comes into my head I'll punch it in somewhere. I got too bored with just doing a literature search on its own". P8: 8:9 (70:79)

Interviewees preferred the opportunity to Sift based on full texts, however the focus of attention for Sifting worked down from full-text, through access to introductions and conclusions, which imply full text access and downwards to brief Abstracts and Bibliographical details as in these examples from P1 and P27.

"Well, titles, with written stuff I am a great fan of directed reading, so I read the introduction and the conclusion and I will often decide on that basis if it is valuable or not and sometimes if I am not sure then I will skim read very quickly or parts of it". P31: 31:12 (220:224)

"Sometimes it can be a bit hit and miss, so that sometimes when I have used bibliographies of other authors, I have looked at how they used it at the time, but also if the title looks particularly appealing and you can't always tell a lot from a title then you will probably go for that and if the title doesn't seem to be very appealing then you'd probably miss that". P1: 1:27 (122:126)

"Well their titles, but also more important where they are referred to in the paper, so you are reading a bit of information, and a fact is thrown out by the author who refers to another paper which I want to know more about that fact, so I will get hold of that paper". P27: 27:14 (41:46)

7.2.3.4 Sifting, Full Text and information overload

One side effect of the preference for full text of documents for Sifting was an effect that bordered on Information Overload.

"One of the difficulties is that you seem to have much more need for full text or long abstract information because previously when I worked in a single area anything which had the keywords would be useful, but whereas with the multidisciplinary stuff it is really difficult to tell". P7: 7:23 (174:177)

"Which conceptually is a very hard task to do because you haven't got the first degree in that subject so you don't have that bedrock that allows you to be able to make decisions about what is important and what isn't important". P10: 10:29 (183:186)

The Sifting task was in this way analogous, at least perceptually, to searching for a needle in a haystack.

"...I suppose you feel quite unstable, there is certainly an image of being in a boat on rough water or something comes to mind, because you have lost the little networks that normally support you and so you don't know where to go, and you know that there is a lot of material out there that you have to sift through, so you start to worry that it is a needle in a haystack for how I am going to find the really relevant stuff without wasting a lot of time on the irrelevant". P41: 41:26 (220:226)

7.3 Incorporation

7.3.1 Definition

Interviewees described the incorporation of material into their understanding as "taking on board", "trying to tie them all in", "bringing it together". Incorporation was recurrent throughout information seeking as a process associated with drawing together. Essentially

represented in the descriptions of intellectual activity than in the physical action of information seekers, Incorporation was most evident as a process of merging new material into the body of material and knowledge already held. Interviewees gave descriptions, such as this from interviewee P1.

> "...you are trying to tie them all in and there is almost no end to what you can look at really it is much broader really and there is almost no end to what you could look at really, it is much much broader". P1: 1:30 (20:22)

7.3.2 Incorporation as a periodic process

As a periodic process incorporation was something that occurred most often during and after exposure to information, that is via Opening or more generally in thinking about a topic of inquiry and was indicated to continue to develop throughout the course of information seeking. In this Incorporation was specified as building knowledge, or an interpretation of information, from the many opportunities presented during information seeking.

> "I think I don't do it in the most economical way, but I like to think that I am quite thorough. It tends to be, and this is probably the case for a lot of people, you find something interesting, you go and look for that, you look at the references on that, you go and look. You do that and it branches off all over the place. Every so often you have to stop and gather it all back in and work out if you have missed anything". P26: 26:6 (53:66)

> "Okay, at the outset, even just writing a project proposal, that is when I would do the first major search to really see where this piece of early thinking about the work, where it might fit within other work and whether other work has been done and who are the main players in that area. So I would do a fairly traditional sort of reference interview with myself - what are the keywords, where do I think the resources are, where would I expect to look, what would I want, and put that together and go through that literature probably quite carefully, or the results of those searches and do a literature review at that point, and then I do it all again when the project gets underway and build onto it. And then it is an ongoing process, it never really stops..." P28: 28:21 (72:91)

The material incorporated tended to be an understanding based on specific functional information such as publications of interest and the acquisition of concepts and ideas. The Incorporation process merged new information with existing information as in interview P2.

> "...it is the concepts and I see a concept as very much a shorthand for opening a perspective, looking at a particular problem from a different perspective, and then from another perspective, and bringing it together, yes, and these perspectives, because these concepts are lodged and embedded within theoretical frameworks that are separate and each belonging to a different discipline it is sometimes a little bit inappropriate to dislodge them, to disembed them and to take them out of their context and lob them together....I am trying to understand in a way, I am trying to marry concepts here from the computer world and bring it into an understanding of the Marxist economics concept of co-modification". P2: 2:11/2:22 (46:48/46:69)

> "I think the first thing is actually being able to recognise the keywords and the terminology in the other, across the boundary. The people will be looking at essentially the same phenomena but they will use a different description of it, and once you have understood that you can try to track that back in the other field and realise that perhaps 80 per cent of the papers you have found in a different perspective is actually irrelevant to your needs or incomprehensible to you, but actually there is something in it that just gives you that spark to say yes, I can see that yes we wouldn't have thought of it that way, we wouldn't call it that, but I can see what it means. So part of it must be recognising the constructs and which constructs are in parallel despite the fact that they may appear to be different". P3: 3:8 (71:80)

7.3.3 Incorporation methods

The process of Incorporation was visible most clearly in writing, development of arguments, and organisation of information. Many interviewees saw the Incorporation as taking place when thoughts were put onto paper, either as notes, ideas, sketch outlines of concepts and emergent relationship to the developing topic. In this the link with Picture Building and Orientation was important (See Chapter 6).

The central activity was organising a synthesis of new material and old material, be that knowledge, information, understanding or intuition.

> "What tends to happen is that things tend to acquire a momentum, and I tend to write early, I think people write at different times, some people do the research methodically first, but for better or worse I start writing at a very early stage and it is likely that I am going to be researching on things that I have already formulated and created a set of ideas about, which is very dangerous but nonetheless I do it". P32: 32:10 (72:77)

Interviewees used the analogy of building to express Incorporation.

> "It is like building something using bricks, you have to put one brick next to another to make your wall, and sometimes you might miss a few things and you have certain holes here and there". P24: 24:68 (181:183)

Understanding was one possible outcome of the Incorporation process, while further routes for information seeking were drawn out from Incorporation, as in the example from interview P21.

> "Initial activities, which start me on my search I suppose, I actually like to start writing fairly soon in the process and I start by creating headings, subject or sub-headings for the interdisciplinary subjects that I am trying to look at, and then I do a little bit of reading about in the different subjects or subheadings that I have identified and as I am reading I see things that are applicable to the other subheadings and that is where I am starting to pull threads together, so I actually do an active process of taking my thoughts and putting them onto a screen and that makes it really easy for me to keep going in and filling in and making it more interesting. And as I start coming across connections the keywords start to spring out of the page as you move the text around". P21: 21:32 (63:72)

7.4 Verifying

Verifying was a less common aspect of interdisciplinary information behaviour. In part interviewees reported feeling uncertain of their ability to judge the accuracy of material from other disciplines, but a feeling of information overload prevented much of the desire to do additional searching to verify the contents of papers. Where it did occur the verifying tended to be limited to the accuracy of quotations and references.

7.4.1 Definition

Defined as checking the accuracy and completeness of information be that references, statistics, statements and quotations. Within the data the definition was drawn from two main streams: checking for completeness and checking for accuracy.

7.4.1.1 Checking for completeness

Information seekers expressed a process of limited seeking with the particular purpose of checking that their previous information seeking included all of the aspects of relevance to them. Checking was associated with end of project writing-up and with change of focus and emphasis within projects. This aspect of checking acted to fill in missing items, confirm that material was up-to-date.

> "...I will always check with somebody else, I would always do that I think, I would certainly scrutinise all of the literature that I have used to make sure that all the sources that I have used are correct. I would in the best of circumstances check obvious literature sources again to make sure that I hadn't missed anything that is current and up-to-date, and is critical, because you have started something two years and now everyone else has also discovered it as well. I would always check those sorts of things". P10: 10:18 (131:143)

> "...towards the end it is just mopping up the odd reference where you might have missed something and someone helps you to find it, e.g. someone is reading a draft for you and says have you read X, but it is not systematic search for material by that late stage, it is more a responsive mode - responding to suggestions by colleagues". P33: 33:27 (123:139)

The Verifying process was associated with the Feelings and Thoughts of the information seekers and acted to satisfy feelings of uncertainty.

> "...at some point in the project to reassure yourself that you haven't missed anything through all your informal networks you will go to Athens or Historical Abstracts and type in the keywords to see if there is anything else out there that you have missed". P41: 41:19 (165:175)

7.4.1.2 Checking for accuracy

Accuracy was a difficult concept for the interviewees. At the simplest level accuracy involved checking that bibliographic details and footnotes were correct and that facts were verifiable.

> "Normally it would mean getting out the photocopies, looking up in most cases references and also at that stage to check and say is there anything else that I need to include here at this point. Almost like a trawl to say can I find anything else and also to add support. That kind of search often results in nothing. That is all I guess verifying the accuracy of the sources and verifying the accuracy of what you are saying. You are not looking for new ideas at all. You are trying to find supporting evidence to reinforce what you have said". P9: 9:50 (213:222)

> "...I also try to check my footnotes and make sure items say what I think they do, and I try to check myself too as a final stage". P36: 36:44 (150:156)

> "...There is also the nitty-gritty of checking that the chronology is right...". P42: 42:38 (295:303)

"Yes, the links trigger ideas for other possible sources, some of which you draw a blank and some of which are good. Lots of links into biography are important to check dates and facts. Sometimes reading suggests possible links". P40: 40:28 (227:229)

Interviewees as interdisciplinary visitors to disciplines did not consider themselves generally to be competent to verify the accuracy of information and concepts in all of the fields they were interested in. In limiting the part of Verification both Internal and External Context contributed to this pattern.

7.5 Finishing

7.5.1 Definition

Interviewees described one other process identified as Finishing, composed of activities as diverse as browsing, keyword searching and networking, this process was described by one respondent as "sweeping up" the loose ends before closure.

> "Sweeping up, [explain], sweeping up the bits and bobs at the end with a final trawl through and maybe a final literature review from a key database, it would be at that stage updating. Maybe going back through my own list of bibliographic references and checking that I haven't missed anything out and that there is nothing that looks to me like 'oh my god I noted that down but I never looked at it', yes that is about it really". P23: 23:41 (176:180)

> "Well, the library is such an unpleasant place to work that I would tend to visit it for short visits when I need to. Like the other day I came across some slips for books that I want for the British Library in the hope of chasing up some loose ends. There is some sense that I am finishing something and ought to look at that before finishing just on the off chance that there is something there". P40: 40:30 (249:253)

Finishing included final information seeking to update earlier searches and to ensure a measure of completeness was achieved. In this there was an overlap with Verifying (Section 7.4).

> "No, I did early on to help me get started, a literature review on deaf people's access to healthcare and I am now updating it, so I don't actually stop, but what I do is look for up-to-date literature, but because I have already done a lot of the work I have already got to know the keywords and the databases and how to search them so I can be fairly specific. But once I have got the chapter written it will be written, there has to be a point of closure". P6: 6:16 (190:198)

> "...Then towards the end it is just mopping up the odd reference where you might have missed something and someone helps you to find it, e.g. someone is reading a draft for you and says have you read X, but it is not systematic search for material by that late stage, it is more a responsive mode - responding to suggestions by colleagues". P33: 33:27 (123:139)

In these actions activities of Opening and Orientation, and activity of Verifying contributed.

7.5.2 Difficulties and perceptions

Finishing, in one sense was a move towards closure of information seeking. However, as a concept it presented a number of difficulties for interviewees in organising, limiting and completion.

> "Organising it, I suppose it must be organised somehow, I have often wondered about this myself, when you are writing an article you hope that you have got all the relevant information that you need, and you hope that you haven't missed anything out that is vital and you hope that you are up-to-date with what everyone else is doing, but you can never be sure about that. So it is always a bit uncertain, there is no closure when you are writing an article or whatever either". P22: 22:27 (247:252)

> "Yes, I think it is harder really, because when it is just one discipline you can see a pattern of thought across History and different ways of looking at things come into being. Whereas with a cross discipline you are trying to tie them all in and there is almost no end to what you could look at really, it is much much broader". P1: 1:5 (18:22)

> "Yes, it's strange but even when I have got papers published I don't always consider them complete. If you go back to it then you suddenly realise that if I had known this before I wrote it then that bit of information would have gone in". P6: 6:11 (126:132)

7.5.3 Finishing and External Context

Despite issues around the concept of closure, projects are completed and Finishing does occur. Interviewees explained the process of closure in relation to Knowing Enough and External Context. Interviewees pointed out that the context in which they worked set deadlines and practical limits. These gave more impulse to completion than a sense of reaching a point of completion to terminate information seeking. In moving towards an end point interviewees described filling in final gaps.

> "Yes, I was going to say, I think so, I think as you get towards the end there is some element of necessary gap filling and so on, there is a creative phase where one is really trying to look around a whole lot of areas and finishing up with looking around and making sure that no one else has done this before or whatever, or checking out doing much more conventional citation search or something like that, and saying 'this looks really profound but it is a 1998 date on it, and I didn't know they had done anything else', so it is almost looking for a gap through association of ideas". P43: 43:29 (350:355)

A final component relied upon conception of Knowing Enough and External Context which is covered in the next section.

7.6 Knowing Enough

Knowing enough emerged as a process of self-questioning of whether sufficient material to meet present information need had been acquired. This was closely connected with Refining, which appeared here as the process of deciding on boundaries for searches and of selecting a narrower search focus.

7.6.1 Definition

The conceptualisation of having gained or identified sufficient material was a highly variable process. For each interviewee the amount of material deemed sufficient on any component of their information seeking was an individual matter.

> "No, I think in fact I can't think of many things where I have actually started by searching, it tends to go in waves of learning more about something and then thinking and then searching. Yes I think it certainly would tend to build, it certainly wouldn't start with lots of searching, it would tend to go in spasms, that I get to a point where I feel that I have enough material to get through and then there might come a point where I realise there is a gap and have to go back and think oh I need something here. So I might well go back and do more searching". P39: 39:15 (91:95)

> "I try to do methodical searches on small sections of it, and I will find that on the small sections I will get key texts, so that is like multidisciplinary on each section, I don't worry too much about getting all of the texts, but once I feel that I have got all of the key ones and the most up-to-date ones as well". P7:7:21 (143:146)

Nonetheless, the conception of "Knowing Enough" was important to interviewees, it was not something that they considered as achievable, but they recognised Knowing Enough as a compromise position to allow exit from the information seeking process. Interviewee P22 summed up a clear position on the concept of Enough.

> "You never have enough". P22: 22:26 (240:241)

Others similarly suggested, though in a little more detail, that Knowing Enough was potentially open ended.

> "It is really hard to know, you could just carry one and carry on, but for me there has to be a time when you have to say enough is enough and that point for me will be my main emphasis is libraries and so the other areas that I am looking at has to be applicable to libraries or looked at or tested within the library environment. When I think I have got enough other areas that I think that I can test those out in libraries, if it holds true for borrowers in libraries as well, then I will be satisfied that I have got enough really". P1: 1:14 (106:112)

> "On one level, the reason that that is a nasty question is because you never think that you have got enough. You could go on no doubt adding things, but you have to be willing to stop at some point and put what you have into the public domain. I think to some extent that is more straight-forward if you are doing something that involves working with data - because either you have done your experiment and you have validated the evidence and have something concrete to work from, or you have collected your data from whatever source. You have figured out what sorts of correlations you can get to, if you are doing something much more theoretical I think it is harder to know when to stop and even when you have made a decision, that I can't find any more literature, it is still difficult to know when to stop...". P33: 33:20 (141:155)

7.6.2 Knowing Enough, Uncertainty and Knowledge

Determining the level of information that would allow a judgement of Knowing Enough was bound to both Uncertainty and to Previous Knowledge and Experience. These elements were represented in interviews as an aspect of the decision process. Uncertainty and doubt were high amongst interviewees and interviewees felt these were higher where background or previous knowledge were low or absent.

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"Well, I suppose that idea I was talking about earlier, about not being sure, and I think that applies more to interdisciplinary research than to single, that you are not sure that you are getting all the information that is out there, not that you possibly want all of it, but you want a big chunk of the main things. So perhaps that uncertainty about you're not quite sure what is going on in other areas, because you have to keep an eye on lots of other areas unless you have got people to do that for you. You have to collaborate then as well, work with people, which is a good thing, though not so good in this university, because the RAE always wants single authored articles as well as multi-authored articles so you can do both". P22: 22:30 (279:287)

"There is always the worry that you have missed something, I think literature searches often peter out rather then finish. I don't think there is a point when I can say I know everything that is relevant in this area". P25: 25:26 (170:177)

7.6.2.1   Judgements of Enough

As a process of self-questioning Knowing Enough encompassed criteria for judging how much was Enough. In the context of interdisciplinarity complete knowledge of a subject was perceived to be low among interviewees. Within the data categories of ways in which Judgements were made emerged.

7.6.2.2   Knowing Enough and Context

Finding sufficient material was balanced by the external context of the information seeker. Knowing enough was deemed to be a compromise that permitted assessment of information gained and development of information problem and to measure this against Context. In this aspect deadlines and time limits were the first and foremost example of interaction between information seeking and context.

"I always think that I haven't got enough material, but with deadlines looming, or I have reached the word limit, or something like that will put a stop, probably deadlines really, it is never finished, but then it is never going to be because there is always something more to find out....So it is always open ended even though it is addressed as far as I have been able. So I think I accept and expect to leave it open. You just make a little strive forward". P27: 27:12 (109:123)

"Oh, when I've run out of time, there is never enough, there is always more that you could read, no question is closed, I can always come back to it at another time and I suppose one I have an argument that I think will stand up and isn't arbitrary – in other words I can set the reverse case and demonstrate it not to be so, if I have difficulty with the reverse then I might do more, but usually it is simply time that often I have to give in to". P30: 30:42 (415:420)

7.6.2.3   Shape of project settled: Post Problem Definition

For others Knowing Enough meant that the problem could be defined, and that itself relates to the type and size of the problem.

"Again it depends largely on the scale of the problem, if I am looking at something very specific then one can pretty much systematic and go through everything that is out there, if it is a big issue, then one tends to sample across the range of the topic - one can't do everything, get hold of everything or see everything, so that tends to have more of a shotgun approach". P34: 34:12 (36:39)

"I feel its a bit intimidating sometimes, the kind of map of subjects that I have to try and juggle with, but I am the kind of person who doesn't mind stopping when I feel that I'm good enough on a subject, I don't like wasted work so I wouldn't probably produce too much material on an area...". P7: 7:20 (148:152)

"So as soon as I feel that I have the shape of the article, and the way I am going to approach it, then I won't do any more searching, I'll say that's enough, unless I suddenly think that I could do with a quotation in which case I will go and search for something as well". P39: 39:25 (172:178)

7.6.2.4 Judgement of Enough: Saturation diminishing returns

A primary criterion discussed by interviewees was named "diminishing returns". Much as the economic principle of input level versus output level, in information seeking a decision to end active information seeking was based upon a similar estimation of returns.

"Well, I suspect that you never ever do, you never are going to be scraping the bottom of the barrel, for a reasonably large type of question - obviously it's not true for a focused question. I guess it is the diminishing returns - at which point do you find the point where cross citations and new material is only really telling you about things that you already know or material that you have already encountered. So you can effectively graft the returns against papers read and new books encountered. I guess experience is what at some point kicks in and the returns have diminished too far". P34: 34:21 (117:122)

"I think that is one of the dark secrets, it is not very accurate - it is a question of diminishing returns, the reading no longer changes my mind. e.g. Asylum seekers, you could read 85 pamphlets and the 86th won't make any difference...". P36: 36:45 (158:163)

The concept of Knowing Enough was measured most clearly by interviewees who recorded a sense of saturation as represented by duplication.

"...then I feel that I have enough after that, it is very much akin to the idea of qualitative research – if you start seeing the same references again and again then you can start to think that this is a self referential community and I have scoped it and I know what they are saying now and I feel comfortable with them now". P11: 11:28 (215:219)

"I don't know, I tend to just go on looking, probably when you feel everything you have come across is just repeating everything you've already read, when it starts to get repetitive I'd say you've started to cover the main points. Obviously there could still be stuff out there, but then again it could be more of the same...". P26: 26:12 (146:150)

"Well, I think when something becomes interesting enough to write about and you have some examples and you feel that you have a representative view of the subject and you do get a general sense of what the subject is and what is important, what the important books to read are and what the cultural and social issues concerning it are, and once the general picture starts to emerge and your own response to it starts to emerge then anything else becomes surplus". P37: 37:47 (192:197)

To summarise, interviewees felt that a combination of factors led them to a judgment of "Knowing Enough", as in these examples from interviews P36 and P27.

But I think a lot of humanities writing the difference between people is when they are willing to say that they have finished a project, they just can let go of a project, and I think that I am a relatively good finisher. I am relatively good at saying there isn't any better return from doing this longer, and if you don't someone else will come along and do a better job. P36: 36:47 (174:177)

I think I always think that I haven't got enough material, but with deadlines looming, or I have reached the word limit, or something like that will put a stop, probably deadlines really, it is never finished, but then it is never going to be because there is always something more to find out. There are so many species you see, we are a young discipline and we are nowhere near

finished. So I always think I'll never get there. [*Is there a particular way you have to think about a topic to be able to accept that there are limits to what you can do?*] I think if you are writing a paper, or reporting on a particular piece of work it is focused on to the work, but always in the discussion it will broaden things out and there will be 'ifs', 'buts', 'maybes', and information required that will not be available or that I haven't found. So it is always open ended even though it is addressed as far as I have been able. So I think I accept and expect to leave it open. You just make a little strive forward. P27: 27:12 (109:123)

7.7 Discussion

As a category Consolidation went through several iterations of labelling until it properly reflected the activities that formed its contribution to information seeking. As information seekers experienced information each activity led them to judge, to inquire as to the relevance, to establish new relevance criteria, and to incorporate findings within their existing framework of knowledge.

7.7.1 Refining and Sifting

The chapter details Refining and Sifting in the first instance and primes the reader with the essential factor underpinning both of these concepts, Relevance Criteria. Relevance Criteria were found in this study to belong to seven groupings. Breadth Criteria, Direct Relevance, Negative, Gap-Specific Criteria, Duplication, Complexity and Quality. These criteria collectively representing represent the basis of decisions made by participants. It is noteworthy that Breadth Criteria took on the role of a flexible judgement such that participants could utilise their discretion based on an idea that a given item might be useful at some unidentifiable point in the future. Other criteria, and particularly Direct Relevance, Negative, Gap-Specific, and Duplication were each fully associated with a definite objective. Complexity and Quality criteria were present as interdisciplinary information seekers indicated decisions based not on traditional relevance, but based upon Evaluation criteria: Complexity and Quality. Quality judgements have some prominence in evaluation with Olaisen (1990) Cool, Belkin, Frieder and Kantor (1993), Park (1993), and more recently Rieh (2002) suggesting that quality covers at least five factors, these being goodness, usefulness, currency, accuracy, and trustworthiness.

In assembling the criteria it was found that they were flexible, generic guides to interest, and were described as lenient, flexible, non specific in application. Additionally the combination of Criteria were described as being in use at different times with information seeking and to be developing and changing, dynamic and multiple. The conceptualisation of Relevance Criteria being multiple and varied leads to a possible explanation of why users consider different items relevant and not relevant at different times. In considering the variation, of partial relevance and the framework within which the model presented here exists,

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it would be possible to consider Dynamic Relevance Judgements an appropriate label for the phenomena.

The literature on relevance criteria traditionally puts forward a binary division or relevant and non-relevant. More recent developments in the literature have considered multiple levels of relevance, based largely on the identification of multiple relevance criteria. A good example of this is Barry and Schamber (1998:11) who created a list of some eighty relevance criteria from a detailed review of the literature. These when grouped fall within the headings adopted in the present study.

Elsewhere the work of Spink, Greisdof and Bateman (1998, 1999). Spink and Greisdorf, (1997; 2001) and Greisdorf and Spink (2000) consider the conception of Partial Relevance within Spink's framework. Other research by Vakkari and Hakala (2000) has considered the relationship between relevance criteria and problem stages, again emphasising a framework of time and changing criteria.

JUDGES	REQUESTS	DOCUMENTS	INFORMATION SYSTEM	JUDGMENT CONDITIONS	CHOICE OF SCALE
Biases	Diversity of content	Aboutness	Access (item identification)	Breadth of document set	Availability of anchors
Cognitive style	Difficulty level	Accuracy (truth)	Access (subject description)	Definition of relevance	Ease of use
Concept of relevance	Functional ambiguity	Aesthetic value	Access (subject summary)	Order of presentation	Kind of response required
Error preference	Specificity/amount of information	Authorship	Accuracy (data transfer)	Size of document set	Number of rating categories
Expectations regarding distribution	Subject matter	Credibility	Browsability	Social pressure toward convergence	Type of scale
Formal education	Textual attributes	Difficulty level	Comprehensiveness (coverage)	Specification of the task	
Intelligence	Weighting of components	Diversity of content	Convenience of location	Time for judging	
Judging experience		Importance	Convenience of hours	Use of control judgments	
Knowledge/experience		Informativeness	Cost saving		
Professional involvement		Interesting content	Currency (updating)		
Research stage		Level of condensation	Ease of detection of relevance		
Use orientation		Logical relevance	Effort expended		
Vigilance level		Novelty	Flexibility (dynamic interaction)		
		Pertinence	Formatting (scanability)		
		Publication source	Interfacing (help, orientation		
		Recency	Links to external sources		
		Scientific "hardness"	ordering (subject matter)		
		Style	Physical accessibility		
		Subject Matter	Precision of subject output		
		Textual attributes	Reliability (consistency)		
			Response speed		
			Selectivity (input choices)		
			Simplicity (clarity)		
			Time spent		

Table 11. Relevance Criteria (Barry and Schamber 1998)

The results are particularly interesting as a development of the concept of partial relevance as put forward in Spink (1999) and Spink and Greisdorf (2000). This work talks of a Plane of Time and a Plane of Judgement within which relevance is conceptualised as containing a degree of relevance that is neither wholly relevant, nor wholly non-relevant: Partial Relevance. Conceptually the Spink model highlights a valuable conceptualisation of relevance as non-static and existing within the context of time. Spink incorporates Saracevic's earlier

work and Schamber's contributions to understanding relevance judgements and relevance criteria. Spink rejects the static view of relevance and defines relevance as belonging instead to a Plane of Judgement.

A weakness in the Spink approach is in accepting Kuhlthau's information search process as an acceptable indicator of time. However, the Spink framework remains useful in emphasising the passage of time. The Spink framework in particular is related to the frame of time; and uses the structured, linear process, of Kuhlthau's model. This appears as a weakness of the Spink framework, but one that the present study may improve. The findings presented here allow an adaptation of Spink's framework to include a nonlinear conception of time. Such an adaptation of Spink's framework has the potential to extend our understanding of partial relevance. Indeed the present study indicates that within the context studied multiple relevance criteria exist, along with refining and sifting, within a dynamic framework. The combination of non-linearity and the multiple criteria offer a useful potential development of the work by Spink. Further research will be required to explore this potential. The themes of Partial Relevance and multiple relevance criteria are positive indicators that the findings of the present study are more widely confirmed in the literature, albeit within other frameworks of understanding. The findings on relevance criteria have value in enabling a view of what could be referred to as dynamic relevance existing within a non-linear conceptualisation of information seeking behaviour.

Where significant differences in Relevance Judgements were found was in their connection to Refining and Sifting. Refining was defined in the data as the process of deciding "boundaries for searches and selecting a narrower focus". Refining appeared at the junction between current information seeking and a renewed or refreshed focus at a more detailed or specific target. In this it was characterised in movement to narrower interests, as compared with Breadth Exploration which stressed the generation of wide coverage.

Applied both to ideas and quantity of information, Refining was associated with particular limitations that included doubts about ability to judge relevance where fore knowledge of what would ultimately be desirable and relevant which had an impact in producing slower searching. Integrated with Keyword Searching, Identifying Keywords, Source Selection and Problem Definition, Refining was an integral part of the information seeking process.

In contrast, Sifting applied Relevance Criteria to the product of information seeking, the search results, that is, it was the process of deciding which items retrieved would be acceptable. Sifting demonstrates the relationship between activity, context and the feedback of one activity into another. Sifting particularly highlighted the value of Breadth Exploration and the desire for other criteria for judgements than Precision of recall.

As processes Refining and Sifting are found in indirectly in Ellis et al (1997: 388) as Distinguishing, Filtering and Extracting and in earlier work under Differentiating and Extracting (1993: 359). These take on the form of identifying material and sources that are useful and contribute to the satisfaction of an information need. Kuhlthau's (1993) model specifies the Collection stage as incorporating the process of "gather information pertinent to the focussed problem. Users have a clearer sense of direction, and can specify the need for particular information". The processes are identifiable in each of these but are placed in a different relationship in the models presented by these authors.

The approach taken by Marchionini (1995: 55-57) specifies Examine Results and Extract Information as a stage in his model most closely relates to the function of Refining and Sifting. Examine Results in Marchionini specified that an information seeker must judge the relevance of individual retrieved units with respect to the information-seeking task, he goes on to link the process of Examining Results with Extraction. Marchionini wrote "there is an inextricable relationship between judging information to be relevant and extracting it for all or part of the problem's solution" (1995: 55-57). Marchionini suggested that full text documents may be retrieved for further examination and hence deeper consideration before applying relevance criteria.

Collectively the findings related to Refining, Sifting and Relevance Criteria in this study are confirmed by existing literature and some aspects pertaining to relevance criteria suggest further investigations in the future to develop further the concept of partial relevance within the framework presented in this thesis, rather than the stage theory adopted by Spink's (1999) study.

7.7.2 Incorporation

As an activity Incorporation was described as a process of knitting together new information into existing knowledge. As such the process had much in common with learning. Incorporation was not a continual process, it was considered by participants to be periodic and to occur after exposure to new material.

The Kuhlthau model of the information search process contains the most significant view of an equivalent to the Incorporation process described here. Kuhlthau includes this as part of Stage four, Focus Formulation (1993: 239) and the sixth stage, Search Closure (1993: 240). There was no single activity associated with the function.

Beyond information science Incorporation would have most in common with theories of learning. Particularly relevant would be the perception of a reflective observation stage in Kolb (1984). As an avenue of future research the combination of learning and the Incorporation process may be fruitful.

These limited examples the literature generates few contributions of value to further understanding the process of Incorporation.

7.7.3 Verifying

Verifying was less prominent within participant's descriptions and focused on checking for completeness, updating and accuracy. Affected by context in the form of self-efficacy checking and rechecking were linked with doubts about personal information seeking skills and disciplinary knowledge.

In previous models Verifying plays a supporting role. For example in Kuhlthau's stage model the sixth and final stage, Search Closure, includes "rechecking information" (1993: 240) which may clearly be taken to mean Verifying.

In Ellis (1993) Verifying was added into the behavioural model as the result of a study of physical scientists, this same aspect was considered to be a sub-aspect of Chaining in a later variation

> "Verifying can be treated as a sub-aspect of Chaining. Often the researchers make use of review articles in their own internal reports to give an overview of a topic. In such cases the original sources are rarely consulted. However, when they publish their own articles or papers in international journals or conference proceedings, then the original sources are consulted to verify that the information is correct" (Ellis and Haugan, 1997: 396).

For Ellis Verifying therefore contributed a relatively small part in information behaviour and one in which the purpose was checking of accuracy of information rather than checking for completeness of coverage.

The role of Verifying was however an important part of Consolidation in the behaviour of the interdisciplinary researchers in the present study. It is feasible that the differences between Ellis's early (1987; 1989) results and later (1993; 1997) patterns were derived from the differences in the participant groups, scientists, engineers and social scientists. It is also feasible to consider that the information behaviours observed among interdisciplinary researchers would suggest a distinctive pattern of their own.

7.7.4 Finishing

Finishing was characterised by interviewees as "sweeping up" and emerged prior to closure, while offering a point leading to further information seeking. In this it was closely linked with the idea of Knowing Enough. it was however particularly problematic and linked to concepts of Knowing Enough, organising, limiting and completion. Finishing Off itself was consistent with recurrent activity.

Finishing Off presented difficulties for participants in determining whether information seeking had fulfilled its purpose and in accepting the influence of External Context factors such as Time in forcing an end to information seeking.

Kuhlthau's sixth stage encompasses the idea of Search Closure, in which rechecking, Confirming, Returning books, and exhausting resources all take place. The process presented

by Kuhlthau contained a considerable crossover with that found in the present study. Ellis also added an Ending function to the earlier version of the model (1993: 365) which extended the model to include preparation and presentation of results. In a similar sense of requiring a terminal point Marchionini's model similarly included a Reflect Stop function as an end point.

In each case including the present study. Finishing, Ending, Reflect Stop or Search Closure was presented as an opportunity to exit from information seeking following an assessment of the success and completion of information seeking or an indicator of a need for further information seeking.

7.7.5 Knowing Enough.

Closely related to Finishing and Refining, Knowing Enough was a self questioning process that began and continued iteratively throughout projects. The data put forward in this chapter indicated the concept to be a highly subjective decision making process as each participant saw their judgements of enough as relating to their previous knowledge, their context, and their conception of diminishing returns.

Judgements of Knowing Enough were difficult for participants and was complicated by the cumulative constantly evolving definition of an information problem. A connection with participants feeling uncertainty and low self-efficacy were also identifiable at this time.

It is interesting that the literature covering this area is rather vague. Where it is covered it is as a component of closure, solution, resources and context, as in Kuhlthau (1993). However, beyond the conception of enough it is possible to view Kuhlthau's Search Closure stage as containing diminishing relevancy, increasing redundancy or retrieved items and exhaustion of resources. Kuhlthau (1999) in the Keynote of 1998's Information Seeking in Context conference suggested that 'enough' is determined only through reference to the information seeker, their context and their information task. Beyond this knowing enough has little meaning.

The present study confirms the existence of the 'enough' concept. This study also provides an empirical definition of Knowing Enough, a definition which states that it is a personal process that exists for each information seeker and one that exists separately within each moment in time.

8 Contextual interactions: Cognitive Approach

8.1 Introduction

Cognitive Approach identifies the patterns of thought or ways of thinking found in interdisciplinary researchers and was highlighted throughout the interviews as crucial to understanding their information seeking behaviour. Working with the activities described in the core processes of Orientation, Opening and Consolidation, Cognitive Approach suggested a style of thinking about an information problem that indicated a willingness to identify and use information that might be relevant to an interdisciplinary problem.

The category consisted of the components "Flexibility and Adaptability", "Open and Opening", "Nomadic Thought" and "Holistic". Aspects of Internal Context were directly relevant to understanding the Context within which Cognitive Approach was found. The features of Cognitive Approach emerged from interviews as of significant importance for the interdisciplinary researchers in the study.

8.2 Flexible and Adaptable

8.2.1 Definition

Interviewees showed a considerable degree of flexibility and adaptability in their approach to thinking about their interdisciplinary subjects. In terms of information seeking this was reflected in a willingness to work with information sources, concepts, and disciplines, to look wider than the 'obvious' sources, and to adopt sources, disciplines and concepts as they progressed in their information seeking. Participants summarised their position as a resolve to accept whatever ideas, information sources or directions emerged.

> "....within the sociological approach it may be a much more narrow and restrictive form, whereas with an interdisciplinary approach you may be attempting to be much more flexible, much more open". P19: 19:5 (53:58)

> "...this current project could you surprise you in what it did actually come under and you have to stop having a blinkered and channelled way of looking at things, you have to be really open to anything and constantly redefining what you mean". P1: 1:7 (29:32)

Descriptions by interviewees of Flexibility and Adaptability as they experienced information seeking were coded together. In member checking commentary on the importance of Flexibility and Adaptability were prominent.

8.2.2 Expression in Opening, Orientation and Consolidation

The ultimate purpose of interdisciplinary research for many respondents was to increase knowledge within a field by applying the greatest possible range of access to information. Flexibility was applied to more than locations for searching, but was applied also to the application of Relevance Criteria, where the determination of an acceptable threshold of relevance was lowered to allow more possibilities to be highlighted in searches. Flexibility was expressed in relation to specific information seeking and Relevance Criteria, and Flexibility and Adaptability tended to shift the Criteria towards Breadth and inclusiveness.

> "...I think perhaps I would be a bit more prepared to look more flexibly at titles in an interdisciplinary area because you just wouldn't be too sure what was covered in that, whereas in a single area I would have thought that a title would be a very good indication of what was included within the topic. So I would be just a bit more lenient with references or titles which seemed marginally relevant in the case of an interdisciplinary topic". P16: 16:16 (199:204)

Flexible and Adaptable behaviour applied to the focus of information seeking as influence on adoption of information and concepts from a variety of sources and disciplines.

> "...I have no idea where the answer is going to come from or if the answer will come in terms of metaphors or parallels to the subject that I am looking for. So I just have to be really open minded and look...". P11: 11:41 (318:321)

> "I think it is because it is apparent that the area that I work in is also an area that Computer Scientists, Psychologists, Sociologists and all sorts of disciplines work in this area and that they clearly have a different spin on things to me and the information systems side of things. But I think it is crucial to see what they do think, and to get that different viewpoint and also not to re-invent things that have already been done. Also, general interest as well, it is not just an obligation it is inquisitiveness as well that drives me. I would say that although I say I start off in quite an organised way, it is driven by a sort of inquisitiveness and also a desire to not look at an area or issue in a narrow way. But to see it in broad terms and how other people see it, digital libraries is a good example of this: Computer Scientists are looking at the area in one way and librarians look at it in another way and Organisational Behaviour people look at it in another way and work practice people in yet another way". P28: 28:11 (111:125)

The context of interdisciplinary information seeking was particularly described by interviewees as interacting with their Cognitive Approach. Operating in a situation of many possible target disciplines, sources and imperfect knowledge Flexibility and Adaptability was cited by interviewees as a way of succeeding in interdisciplinary information seeking.

> "Well, it is easier to think of things that are more appropriate to cross discipline than the ones that are less appropriate. I suppose some of the more appropriate ones, the internet, these days can be awfully time consuming, but can equally be quite powerful because of the absurd links that get thrown up, but many times you find centres that you did not know exist that you would not have thought of, so it can be quite powerful in that sense, it is quite flexible in that sense...". P3: 3:18 (162:174)

> "I suppose in some senses, kind of what I tend to do is look at the question and try to think about how it could be approached, so in a sense the area comes first and then I try to be flexible about thinking about what kinds of things would fit around it, rather than thinking about the area and try to come up with a question, that never really works. An example recently was my PhD in which I ended up looking at a lot of grammar books of the 1790s and I got particularly interested in women writing grammar books - who tended to write children's grammar books very much and I kind of have an interest, but then that goes out all over the place, because then you are into ideas about women and language and there are various people that you know work

in those sorts of areas, so you might look at all that kind of research, and they'll be dotted all over the library. And then when I started to look at it, it came about tangentially that although I couldn't find anything specifically on children's grammar that there is quite a lot on children's literature that looks at text books and things like that. So, as long as you don't get too focused in on grammars you find that there has actually been done theorising this. That is more about the text and then finding something out about it rather than trying to find the subject area first". P38: 38:6 (42:62)

The influence of this code on Orientation activities such as Identification of Keywords and Source Identification and Source Selection was important. Flexibility and Adaptability was also associated with Reviewing in reacting to new concepts and possible avenues to be followed up.

"...it never really stops throughout the project, and usually as time moves on I kind of leave that early literature search and seize on the 'new side' or 'other views' of the work, I am always really eager to hear about that. So, it is the systematic search, then there is the prep pre-the project and then an even more comprehensive search later on and then when I am talking to other people about the work, always people will come up with things - like 'that is like such and such' and my network of close people who I talk with cover a range of disciplines and they might led me on to think that I should explore an area and sometimes it is not of interest, and sometimes it is, all the work practice literature was just opened up to me just by a conversation with a colleague and then all the work articulation work led on from that, so I am always keen to follow leads". P28: 28:7 (71:91)

8.3 Open and Opening

8.3.1 Definition

"Open and opening" appeared as the ability to be open to finding, and in this also recognising salient information, parallel problems or metaphorical similarities within information identified in 'alien' disciplines and to apply this, via "Flexibility and Adaptability" to the information seeking activities.

"I think I am unfocused in that I am open to finding all kinds of things, I am very happy to stumble upon things that I didn't know about or come upon things that I haven't anticipated, I am not the sort of person that begins by saying 'there is this archive and I will systematically analyse it', on the other hand it is difficult to begin without there being some kind of concrete thing at the centre of it. I can give an example, I research the History of Linguistic Ideas and I am particularly interested in grammars as a type of text, and at the moment I have become interested because Byron published a 'Grammar of Armenian' in 1816 and I think it is very interesting that somebody who is well known for writing poetry was also involved in this sort of activity and at the centre of that is that grammar, and a certain group of texts that it belongs to, but on the other hand there are all kinds of things that I probably don't know about that are relevant, and so there is this kind of woolly edge if you like. I am very kind of willing to find and I don't have a clear sense of where it would go necessarily. I think that answers your question". P42: 42:18 (46:62)

A further example was suggested in interviewee P11 whose research required identification of parallel problems from several other areas.

"Whether or not they are the only communities that I need to know about – that's the hard thing to find, but once I have got into a community in terms of terminology and got one pivotal or important paper then it is not a problem it is just interlibrary loans – they must think that I am mad because I get stuff from all over, but once I can get into that its just finding those communities I have to think to myself who would have a similar problem to this, because it is a

new discipline, it can't be a brand new problem there must be problems like this, who would have problems like this, where would I find out how they have solved them and see if that helps me, once I get into them and hit on the terminology – usually by accident or by asking somebody who knows something about something else". P11: 11:50 (219:244)

Others illustrated a ready acceptance of new information, forms of information and variety of solutions, sources as a central part of being interdisciplinary. Nonetheless the underlying approach fell within the pattern identified as Open and Opening.

> "...for me, looking at something from a multidiscipline, it is hard to define, because this current project could you surprise you in what it did actually come under and you have to stop having a blinkered and channelled way of looking at things, you have to be really open to anything and constantly redefining what you mean". P1:1:7 (29:32)

> I think it comes down to two things, feeling free when you go to the literature and going outside to other sources, totally traditional sources of literature, because there is a hell of a lot of expertise out there that we ignore at our peril I think, it is not just because we are going to back and apply it to them, but they have done an awful lot of the leg work for us. P43: 43:31 (422:425)

In the broadest pattern Open and Opening was associated with an acceptance unlimited or at the very least undefined potentially valuable information types, sources and outcomes.

> "I would say it is the randomness really, I think it happens in all research, but I think it is essential in a multidisciplinary area, any event that you go to, anything you read, any conversation, can suddenly provide a link and I don't think that happens quite so much in a single discipline where you know where you are heading. A magazine was one thing I knew I should get, I went to a lecture, and that provided further ideas and links which tied in. So the method for multidiscipline in my mind is more of a lack of method". P7: 7:33 (164:170)

8.3.2 Expression in Opening, Orientation and Consolidation

The data showed that serendipity was more readily accepted as a part of a researcher's portfolio of resources when they were intellectually open to accepting information from a wide range of locations and types of resource. "Being open" to information allowed serendipity to occur in many ways and at different times often when away from the information problem that benefits from the serendipity. Illustrations of "being open" were present in many interviews with a general theme of underlying "preparedness" throughout.

> "Well, I think, I am always on the look out for new avenues, and I think that has always been the way that I work, I don't expect to find things, I am always looking for new viewpoints anyway so I might actually search within an area. For instance I don't normally search the Sociology literature, but I might get a sense that I should just have a look in that literature and see what it brings up. I don't know that I consciously do anything to stimulate it, but I do seize opportunities that arise in mention of something, a reference in a newsgroup, or mention of some author or personal communications, but I don't know that I do anything to stimulate that condition". P28: 28:5 (60:67)

Preparedness was matched in interviewees by a determination to utilise information seeking and avenues of investigation opened up. Open and Opening was not merely allowing information to become visible it was about recognising and embracing it.

> "...you have to be really open to anything and constantly redefining what you mean". P1: 1:7 (29:32)

"...one has got to be open to possibilities and ready to fix into something very quickly should it come your way". P19: 19:11 (140:172)

Particular examples arising from activities associated with Breadth Exploration, were Browsing and Serendipity. In Browsing interviews linked activities outcomes.

"[*Do you ever browse?*] Yes, usually with one particular goal in mind but open to the possibilities of things turning up". P34: 34:18 (93:95)

While Serendipity was recurrent as an example of experience connected with an Open approach.

"...Then there are women writing on women's rights and there was this one person ...I looked up what else she had done and I found something that might have something on grammar in it and then I got the modern edition [*and*] this was the thing that gave me the whole idea of looking at children's' literature and recognised that there is quite a good body of work that has been done on children's' literature in that period....at that point I had a very clear feeling of serendipity....I think it must happen in everybody's research, if you are a bit more interdisciplinary...so serendipity, total random chance can lead to interesting things. That is one of the things about being interdisciplinary, particularly when you have got time to do it properly, you can be open to things in some ways". P38: 38:46 (339:364)

8.4 Nomadic Thought

8.4.1 Definition

The third component, Nomadic Thought appeared at first to be the same behaviour as Open and Opening to Possibilities. It does, however, move onwards in such a way that it embraces the process of thinking about a topic in many diverse ways to find the information needed in locations and ways remote from the original idea. Key elements include the idea of abandoning well-known and favoured disciplines and sources in search of new material. This tends to contradict the traditional idea of staying within known disciplines and having well-trodden resources. As an element of Cognitive Approach, Nomadic Thought encompasses a different aspect than the Flexibility and Adaptability, Open and Opening of the two previous sections.

8.4.1.1 A perception of value

Among the interviews a number of instances arose in which identification with any discipline was seen as a negative impulse and damaging to interdisciplinary problem solving. Nomadic Thought emerged from the data as conveying a deliberately rootless, nomadic, conception of information and disciplines. The ideas represented in P18 again suggest the cross-linking of themes with Knowledge and Understanding.

"That is coming at it with the wrong discipline. Actually coming at it without any discipline, a good scientist couldn't approach the problem like that because they would immediately see that this particular problem isn't open to that kind of scientific investigation....There is nothing

radical there, it is the sort of old fashioned idea that until you know what it is you want you are not going to find it". P18: 18:13 (181:191)

"I suppose originally, yes, which was Psychology, work Psychology, that was my original training, and errm and it was a when I moved to a management school that I first became rootless but originally I came from Psychology". P3: 3:4 (37:39)

In explaining their experience of interdisciplinary information seeking, and by way of passing that experience on to others, respondents explained that working without a fixed idea of which discipline had the answers, or where the work might fit in with other disciplines to enable answers to interdisciplinary questions to emerge.

"I would also encourage people not to conceive of themselves as being part of a discipline because you won't get anywhere with that, you might start coming to recycling as an economist, well you can forget that for a start, you have to open to what psychologists and sociologists and civil engineers and geographers are saying – so to be open minded". P11: 11:45 (341:345)

"Well, I think one difference is that these days most problems and most situations there are five different answers to and there is greater recognition that that is the case. So I suppose that very few situations can actually be solved just because of the complexity of the problems that we face, so, that is one sort of difference, so a single discipline is more limited and therefore it tends to work on a contingency basis, there may be a particular facet to a problem that you can say that this discipline has got the best way of looking at it. But no one actually has these days got ownership". P3: 3:51 (44:50)

Though encouraging the principle of "forgetting your discipline", was noted that the Context of interdisciplinarity was prevalent throughout descriptions of information seeking practices. In coming to an information seeking exercise from a fresh angle the respondents were keen to actively discard their disciplinary baggage and seek out possible alternative disciplines:

"I think I would have to say forget your discipline, just don't worry about your academic or your academic career, but that is part of the difficulties...So it is hard to tell someone to do this, say a PhD student, don't worry about what you thought the problem was, read everything and anything and come to your structure". P3: 3:23 (215:219)

The other side of this Approach was a perception of no discipline owning the "right" answer to a topic of investigation.

"... I think there are strong disciplines like Science and Economics which would almost reject forms of knowledge and information that didn't come from within that particular disciplinary tradition. In my case there is a whole group of people who do work in Economic Geography who are always exercised by the extent to which economists don't regard what they are doing as quite proper or even relevant to their own concerns. So I think there are characteristics of disciplines, Anthropology might do that too in terms of particular methods – so Anthropologists would claim Ethnography as a field based method of research and something that only proper anthropologists can do correctly and would be sceptical of Geographers employing similar qualitative approaches, so yes I would think there are some hard disciplines that have a rather territorial view of their own knowledge or methods or sources of data". P12: 12:6 (53:64)

That same non-territorial aspect also reduced the potential for like-minded local peer groups.

So again, I see myself as a pragmatist, sadly it means that you don't have a field in a traditional sense which is quite, you know you don't have an annual conference to go to and you don't have a group of people around the country that you can feel as though that is your peer group. P11: 11:3 (74:78)

8.4.2 Holistic approach

Interviewees indicated a tendency towards viewing their interdisciplinary information seeking as an holistic experience. Interviewees returned to a view of their work as holistic and based around gaining and keeping a "big picture". Not all interviewees provided descriptions of their approach, but tacitly indicated its existence in their description of Picture Building, Problem Definition, and their combination of Opening and Orientation exercises.

8.4.2.1 Definition

Definitions revolve around the idea of holding back from a focus for much of information seeking and to gain in this the general, "big" picture of a subject. Interviewees described this as a way of thinking and structuring their approach.

> "Well, I think I probably try to take a step back from the specifics and ask myself what are the issues, what are the real issues of the whole situation and try to be as objective as I can about the importance of the different facets of it. So I would try to think of the different compartments in a model which would make up a system. So in other words a systems approach to things. I try to do that". P16: 16:9 (121:127)

> "It has got to come back to this thing that I mentioned earlier, this impressionistic, holistic, almost take your mind off it sort of thinking about the state that you have got to....I suppose subconsciously what you are doing is going over the entire pattern, and perhaps you are finding some error and are unable to formalise it just yet, but it just registers as 'problem' something doesn't 'gel', very impressionistic words". P 9: 9:51 (229:243)

Some interviewees suggested that they aim to gain a holistic understanding through information seeking from which they could develop their own research themes.

> "I wouldn't necessarily characterise the work that I do as problem solving, and with my action research I am quite clearly trying to solve problems, but I think the thing that I am interested in, in my work, is this thing about really gaining an holistic understanding of a context because that will be valuable in developing practice or models and new understanding. So it may be that the thing that I am focusing on at the moment is very specifically in an educational setting, what I might be focusing on in the future might be an organisational setting. But there I would hope to draw on concepts from organisational theory, Information Science, user behaviour, maybe some stuff that I know about learning, it might all come together in order to illuminate that context. So it is looking into a particular setting or context and being informed by multiple constructs. I don't know, I think it is useful to be interdisciplinary when you are looking at qualitative research". P23: 23:28 (60:69)

While others developed a view from a generalised thinking around a topic.

> "It has got to be by a process, that Glaser and Strauss would describe as intuitive, perceptual thing. It is as much likely to come as you sleep or as you lay in bed worrying, it is much less likely to come from a focused intellectual activity, its more when you are really broadly thinking, because there are so many parameters to juggle, is there a good focus here, is it original, is it likely to receive funding, does it hang together, almost like a face, is it an attractive face that is worth going on to study, so it is very perceptual, holistic, fuzzy, even though it is based on, it is almost like digestion, even though what you eat may be very structured research reports, very scientific, the actual process of defining a new topic is very holistic, impressionistic, fuzzy, it is my own way of doing things, so I am not logically running on project x and saying lets build on these foundations in my interdisciplinary areas, I am aware in single discipline areas I aware you might build sequentially, logically, on previous results and see a chain of building brick by brick, I can imagine that happen more in a single discipline". P9: 9:96 (117:130)

8.4.2.2 Associated methods

The conceptualisation of information seeking as holistic was also connected with interviewees perceptions of appropriate methods to achieve an holistic approach.

Interviewees described taking a view of a topic and all of the component disciplines within which their information topic developed and was answered. Connected with the aspect of Picture Building, discussed in section 6.3. Thus interview P14 suggested an "interdisciplinary look" at a research or teaching topic within medicine.

> "[*When you tell your students to take an "interdisciplinary look" at a topic, what do you mean?*] Yes, well, maybe an example of that is an approach we use for teaching medical students, which is called Systems Based Teaching. In a very classical way one would teach Biochemistry followed by Physiology followed by Pharmacology followed by....all of the disciplines one by one. Systems Based approach means that we throw all of that out of the window and start with Cardiovascular System and we actually mix in everything so we talk about Pharmacology, the Physiology, the Anatomy all in one go as applied to the Cardiovascular System. That is my view of interdisciplinary teaching anyway. So we are looking at a problem from all angles rather than a subject and then when you are in real life you have to put all of that together. People would argue whether it is a good way or a bad way. But that is the approach. The other thing is exam questions which is where I will particularly stress an interdisciplinary approach, because I feel that if you have topic and you know you are writing a Pharmacology exam and you say cardiovascular system and you just purely respond in terms of Pharmacology I think you have missed the whole picture. I think as an examiner I like to see the whole picture, put some realism into it. So maybe interdisciplinary is a realistic approach to science, but don't quote me". P14: 14:20 (128:146)

While interview P24 illustrated a social science example of an holistic approach.

> "I think unless you don't have somebody to help you, to give you some guidance, what you do is you start rather than trying a general picture you try to start with a big thing and then you try to concentrate and focus and try to find where you are in this area, but then again that will involve you actually following other people's assumptions in a way, it is not good, but it is not bad, but other people's assumptions might be wrong. So I think it is pretty important for me, it depends on what you are doing whether you are dealing with a small topic and you want to create a ten page item on something, then it is okay, but if you are dealing with a PhD, you are doing something which is quite big then you need to be able to draw the big picture and so you have to be able, so you have to start by trying to find as much information as you can, try to draw different areas that would be included in your bigger area of research and probably try to step back and see the picture from a distance and probably make an effort to identify yourself in there. So in my case for example what I started doing was I collected lots of data - for a long period of time I was just collecting data, actually I started first in my first year by identifying theories and models and group processing and traditional collaborative learning, so that would give me some sort of background, and then I start making it more focused and became even more focused once I did my interviews and then people I interviewed they gave me feedback and then I would try to follow the little routes instead of the main road, I tried to follow little route and find articles in very specific areas. For me I would rather have the big picture and try to draw that and be rather holistic and then try to narrow down and focus on certain areas of interest". P24: 24:70 (106:129)

In looking holistically interviewees saw themselves as looking across disciplines and minor distinctions to be able to view whole problems as they appeared in the real world.

> "Well, I think I probably try to take a step back from the specifics and ask myself what are the issues. What are the real issues of the whole situation? And try to be as objective as I can about the importance of the different facets of it. So I would try to think of the different

compartments in a model which would make up a systems. So in other words a systems approach to things. I try to do that". P16: 16:9 (121:127)

8.5 Combinations of Cognitive Approach

The combination of the Cognitive Approaches, "Flexibility" and "Open and Opening" and "Holism", saw recognition of information, acceptance and application of that information to interdisciplinary problem solving.

> "....within the sociological approach it may be a much more narrow and restrictive form, whereas with an interdisciplinary approach you may be attempting to be much more flexible, much more open ....you hear something on the wireless, and you hear someone say something and it is something that you haven't come across and you recognise it as important, and so you have got another avenue to pursue, or you meet somebody at a conference, and you start talking to them and they say - well have you seen so and so.... one has got to be open to possibilities and ready to fix into something very quickly should it come your way...". P19: 19:5 (53:58)/P19: 19:13 (140:172)

In specific case of interdisciplinary research serendipity the need to be open and flexible about information that might be helpful also appeared.

> "I don't think so, I think it's the other way around, I think perhaps I would be a bit more prepared to look more flexibly at titles in an interdisciplinary area because you just wouldn't be too sure what was covered in that, whereas in a single area I would have thought that a title would be a very good indication of what was included within the topic. So I would be just a bit more lenient with references or titles which seemed marginally relevant in the case of an interdisciplinary topic". P16: 16:16 (199:204)

In those participants who spoke of purposive serendipity "being open" was considered more important as a way of increasing the chance of obtaining serendipitous results, though fell short of being considered a strategy, rather it appears here as a pre-requisite for serendipity.

8.6 Discussion

Cognitive Approach presents data relating to the descriptions given by participants of the way they think when they are information seeking. The limitations of the study place a boundary preventing the detailed psychological study that Cognitive Approach as a concept suggests. As a study from an information science the study incorporates Cognitive Approach as a perceptual phenomenon, recorded by Naturalistic Inquiry as being of importance to the participants of this study. The terminology reflects the use of in-vivo coding to reflect as much of the participants' self-portrayal as possible. Cognitive Approach contributed to understanding information seekers both as an independent element and as part of the Context of information seekers.

The results presented in this chapter suggest that the "ways of thinking" could be grouped into four Cognitive Approaches.

The first element, Flexible and Adaptable, emphasises the mental agility and willingness to adapt to the different information and disciplinary cultures that are a basic component of working in an interdisciplinary field.

Second, Open and Opening to Possibilities, which was at its simplest an open-minded approach in which no prior framework for judging relevance was implemented. In this all sources, disciplines and ideas were viewed as viable until proven otherwise. The data suggested that interdisciplinary researchers used Flexibility and Adaptability in their information seeking and when they found a potential information source are "open" in their approach as to how this might fit in with their information needs.

The third component, Nomadic Thought appeared at first to be the same behaviour as Open and Opening to Possibilities. It does, however, move onwards such that it embraces the process of thinking about a topic in many diverse ways to find the information needed in locations and ways remote from the original idea. Key elements include the idea of abandoning well-known and favoured disciplines and sources in search of new material. This tends to contradict the traditional idea of staying within known disciplines and having well-trodden resources.

The fourth and final aspect of Cognitive Approach, an Holistic Approach, was highlighted in the earliest interviews, as important to grasping and incorporating concepts from across diverse areas and bringing them together either as an answer or to generate new questions and information searching directions.

Each of these Cognitive Approaches are indicated to be associated with the information seeking defined in the core categories of Opening, Orientation, and Consolidation.

A review of previous research indicates a paucity of research on information seeking that addresses the issues raised here as Cognitive Approach. The well established models of Ellis (1987) and Kuhlthau (1993) are particularly lacking in this respect. Similarly, Ingwersen's Cognitive Information Retrieval model (1996) raised issues of Cognition but did not relate these to the elements highlighted here. Similarly other models by Marchionini (1995) and Wilson's model (1997; 1999) places cognitive style within psychological factors.

One may also consider potential links between Cognitive Approach and work on Learning Style, Cognitive Style, and Individual Difference which are indicated in the literature to affect information seeking (Ford, 1985; 1995) and more recently Cognitive Styles were considered as part of work by Ford et al (2002).

The findings presented here tend to indicate many of the more general thematic comments made in Bates (1996) Library Quarterly special issue, rather than more substantive theoretical information seeking literatures. The contributions of Bates, Klein and Palmer to the 1996 special issue Library Quarterly raise in passing the comments on flexibility and requirements that might be associated with information seeking. In particular Klein (1990: 183)

pointed to reliability, flexibility, patience, resilience, sensitivity, risk taking, a preference for diversity. These are supported by the findings of the present study.

In the present study there was no intention to cover cognitive styles. The findings do however lead to some interesting interpretations and insights.

As illustrated in the chapter, a tendency for holist, open and flexible ways of approaching information seeking were identifiable. It would be beyond the evidence to suggest something more precise than a general theme. However, the findings tend to point in the direction of the cognitive styles identified by Pask (1976a; 1976b; 1976c; 1979; 1988) and Pask and Scott (1972; 1973). Pask's work indicates that people use one or two basic approaches to tackle problems, serialists and holists. Holists tackle problems in a global way with an overview of the whole problem uppermost in their activities. Serialists work on a small part of a problem at a time, forming a global view only when approaching the completion of their tasks. Further work by Witkin et al (1977), and Riding and Cheema (1991) adds the dimension of field dependence and field independence and connects with the holist-serialist dimension. These may usefully be simplified to relate to structuring and ordering abilities. Field independent individuals have the most self-structuring ability and hence appear as flexible thinkers.

A number of instruments are available for the measurement of cognitive styles, including Riding's (1991) Cognitive Styles Analysis measure used in Wilson et al (1999) to examine information seeking themes. Cognitive styles have a wide background in the literature and many applications as detailed in Ford et al (2002).

The findings of this study are indicative therefore of patterns highlighted in the literature as cognitive styles. Particularly holistic and flexible, open and opening in this study all suggest a degree of field independent cognitive styles. A number of hypotheses may arise from considering the implications of the connection between the interdisciplinary researchers who participated in this study and the apparent dominance of actions with a highly developed field independent component. Further research would offer an opportunity to examine more fully the area of cognitive styles and interdisciplinary researchers.

In the broader literature some reference to Nomadic Thought is made under the area of postmodernism by Guatton (1987:104). However, though the label contains the same elements the concept intended is particularly different from that emergent from the results of this study. The label adopted here was derived from consideration of the data and the patterns exhibited by participants. Elsewhere in the work of Durkheim (1982 reprint) there is a similarity in the discussion of anomie, a sense of not belonging. In this case Nomadic Thought indicated a sense of embracing "not belonging" to any discipline when information seeking.

9 Contextual interactions: Internal and External Context

9.1 Introduction

Influences on the operation of information seeking within the model are identified as internal influences and external influences. As will be noted from reading of earlier chapters Context has a considerable role to play in developing our understanding of information seeking behaviour. The primary components of Context are illustrated in Figure 15.
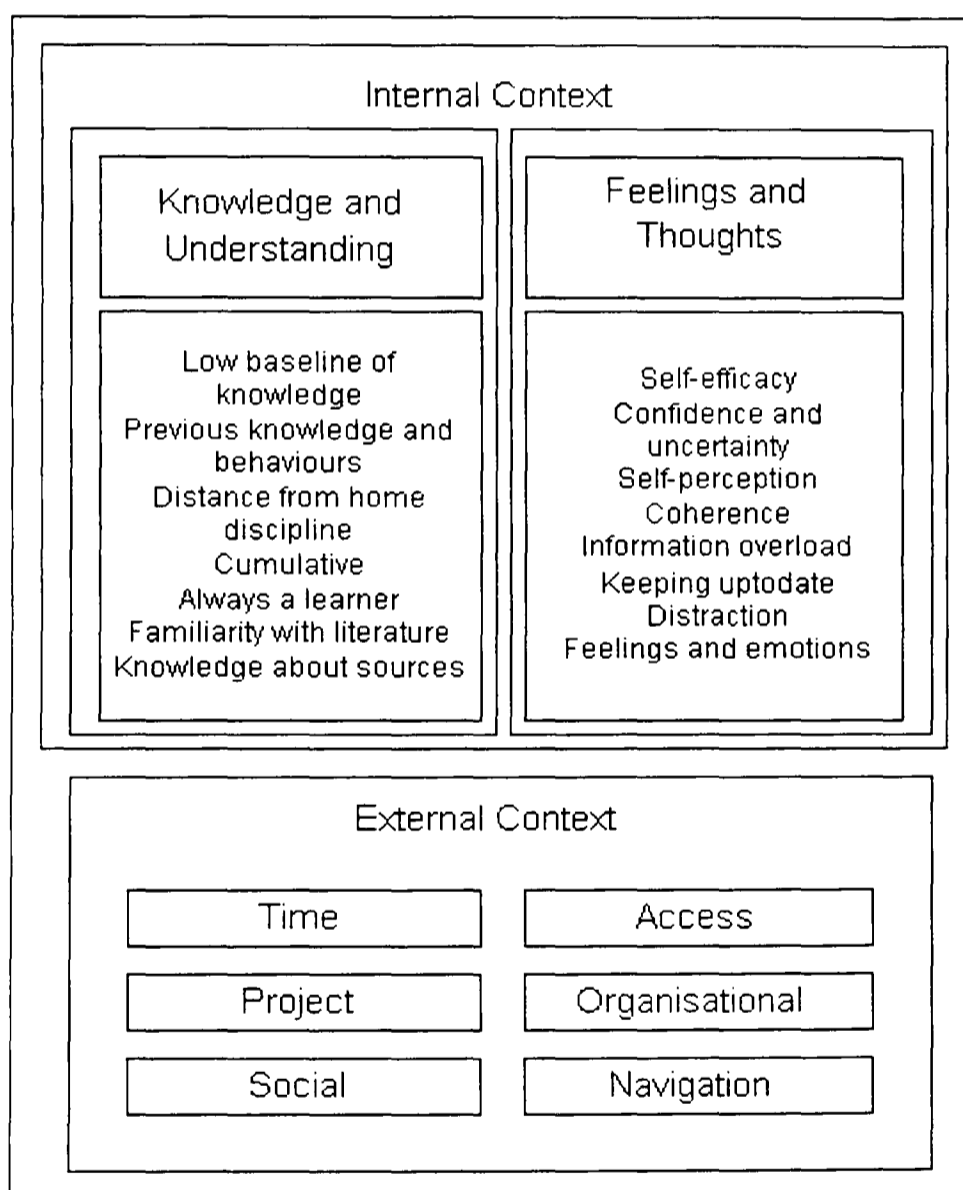
Figure 15. Context, Internal and External Aspects

As the focus of the study was on the behaviours and activities, contextual data were allowed to emerge in a less formal sense and indicate a number of directions for further research. They nonetheless contribute to the emerging model.

9.2 Internal Context

Analysis of interviews as information seekers drew into their world picture their background, experience, knowledge, feelings, thoughts and linked this directly as an attribute of the information seeking behaviour they described. Labelled 'Internal Context' the category developed around three major groups: Coherence, Knowledge and Understanding and Feelings and Thoughts. Interviewee P28 summed up the context of many interdisciplinary researchers in the study.

> "I have worked in different departments, and different literatures and I have a matrix meshing together the literatures, and I have a kind of ideas and things linked together for the different disciplines, so there is the experience side which is quite important, knowing where to look and also a commitment to myself, I have to be learning and I love to start pursuing new areas - and I was reading a lot of Cyber Culture stuff about 5 years ago and getting into that whole area of how people use technology and that was just a kind of interest that influenced the way I wanted to look at research and my approach to qualitative research, action research etc., which has informed the way I look at problems, it is critical to the sort of informed research that I would do. It is interesting to think about it, because I don't think I have ever thought about what I do or where it comes from, but I am very very conscious that I have a unique little pathway through my research career that probably no one else shares and I will work with somebody else who comes from a different background and overlap in our work. So I start to learn other things through sharing". P28: 28:20 (192:205)

9.2.1 Knowledge and Understanding

In studying the information seeking behaviours and perceptions of interdisciplinary researchers the researcher indicated a constant interaction with information but with the Knowledge and Previous Experience.

As a Naturalistic Inquiry the conception of an individual coming to information seeking with a background of knowledge and previous experience, a context appeared feasible. From feasibility came awareness that the data contained a strong element of Knowledge and Understanding as one element of the internal context of information seekers.

At the general level Knowledge and Previous Experience were gained through education, previous projects and previous search episodes for the same topic. Throughout the previous chapters element of Knowledge and Experience have been discussed, this general conception was highlighted as containing further sub-categories. These sub-categories are presented in the following sub-sections.

9.2.1.1 A low baseline of knowledge

Accepting the proposition that most of the time there is a baseline of knowledge, interviewees put forward an extended view in which the baseline might be very low. In this scenario P7 gave the familiar analogy of a needle in a haystack to represent the situation.

"I guess partly because you don't know the subject areas as well, and partly because you don't know the subject areas as well, but it is more difficult because you don't know what is going to be relevant until you find it, you are searching for something that you don't know what it is until you find it, you are searching for a something in the haystack but you don't know whether it is a needle or a pair of socks. Whereas in a specific subject at least you know you are looking for that, you just don't know you've got it until you've found it". P7: 7:24 (177:182)

While P24 likened the low knowledge level at the beginning to a movement from blindness to seeing.

"But to speak about good things as well, it is an enormous satisfaction when you get stuff in your area and you are trying to figure out what is going on. It is like you haven't got a clue at the beginning what is going on, you think you know, but you are absolutely blind and then it is like step by step you are using the medicine that will allow you to view things in a clearer view and be able to spot things quite easily. For instance at the beginning I had to read all of the articles from the beginning to the end and think about them, make comments about them, and at the end I became so selective it was bang bang bang I need this and this and this and I could read an article in like 20 minutes - like scan through it and my eye would become really easy to pick up only the things that I wanted. So it is a learning process for yourself apart from anything else". P24: 24:49 (322:332)

The low knowledge level was seen in trying to identify disciplines that would contain interesting material, but was clearest in the contrast between perceptions of Knowledge and Understanding between having an educational background in a discipline and not having such a background.

"...I think that is a definite drawback, I know when I am looking for things just in relation to reader response, that comes under literary criticism, well my degree was in that area, so immediately you are one step up when you are looking at that area, you know people, you know certain ways of thought, you know what they are talking about, you know I have had three years in which to develop that, whereas when I am looking at areas in which I am not familiar, yes, I am getting results, but its harder, you probably have to read around much more just to get some idea of what's happening". P1: 1:23 (179:185)

"[Early in our conversation, you mentioned some textbook material, is that an indication of the depth of material that you need to find?] Well, I am not a trained geneticist, I only did Biology at 'O' level, so I have picked up a lot of my knowledge of Genetics on the job as it were, and what that means is that I am constantly conscious of reading to make sure that I have got the ground work in place, in contrast to the way that I take for granted that in Linguistics I will know the background material or go to the journals or state of the art scholarly review rather than a textbook. But for the Genetics stuff and for Archaeology stuff as well I feel that I have got to be up to speed on the basic terminology, for instance, first and even if that has been something that I have worked on before I find that my knowledge in that area is more precarious because it is not based on years of studying and making sure that I know what the terms mean. So I tend to start right at the bottom of the ladder with undergraduate textbooks and then I'll move on to general overviews in the field and then when I am confident I will tackle the scholarly material and articles. So I suppose it is an insecurity thing, but a well founded one". P33: 33:21 (167:180)

However, a low base of knowledge was not the same as no knowledge, and many interdisciplinary researchers within the study saw their experience and knowledge gained over time as important. Interviewees considered themselves to hold a body of transferable knowledge or skill that enabled them to work across disciplines.

"It is very seldom that one ever has a kind of blank sheet to begin with. Almost the fact that one has an interest in it means that has picked up background pieces of information along the way. So it largely a matter of developing those seeds. So my standard route would be reading pretty widely so chaining things through the library, web of science and search engines of that

description, bibliographies, references etc etc. If I am desperate, it tends only to be as a desperate measure when I have come to a full stop, emailing colleagues". P34: 34:5 (22:27)

Background knowledge was particularly beneficial in provided links to keywords, researchers and disciplines.

> "...Now I picking up more experience from talking to people in the different disciplines my searches are coming much more easily for me because I can actually pick those words out". P14: 14:14 (93:96)

> "If we take an example of consumption issues in India, I start from a pretty low level of knowledge but I have a sense of some of the people who are working in that area, so I would start with some of their work, for example I came across a really good book called 'clothing matters' but which happens to be about India, I got that through Interlibrary loans, followed some footnotes and citations, but simultaneously contacted the author who suggested other contacts in that field". P12: 12:18 (150:155)

> "Well, this idea wouldn't have come from nothing...so there will always be that body of prior knowledge that I am aware of on which I will be building". P23: 23:33 (118:120)

9.2.1.1.1 Extra training and individual pathways

One interviewee was particularly noteworthy and unusual in seeking training in multiple disciplines to fulfil future research goals.

> "I think where I did have a problem was when I was doing my PhD and a lot of the major hazards stuff was chemical engineering and my maths couldn't cope with it - to the point that as recently as this week thought maybe I should maybe retrain and take a conversion in maths - and a little voice said 'oh behave', but I do feel that that is a potential weakness. It is hard but you just can't do it, I think you get a base line of entry for certain things and you have to work around that". P20: 20:12 (100:106)

However, it was more common amongst interviewees for information seeking to rely upon ways of applying their previously collected knowledge and experience.

> "Usually if it is social science I would look at social science citations index and see which ones are cited and most of it is just gut feeling and experience or you will talk to people and ask them what they consider to be the top rated journal". P20: 20:20 (169:171)

Each interviewee had their own path through their research and History. In this they illustrated a consciousness of having an individual, if not unique, pathway through disciplines based on prior experience and knowledge gained from education and research.

> "[When you have a particular interdisciplinary area, or a particular context that you want to investigate, how do you identify which disciplines are going to contain something that is relevant?] I don't do it systematically, is the short answer, I don't sit down and say "right now I need to go off and look at organisational studies, Psychology, Sociology, Information Science, education in order to look at this", maybe my work would be better if I did, but really it is to do with, it is intimately connected with my own personal development as an academic researcher, so it is largely to do with what I have encountered in previous work". P23: 23:29 (75:81)

9.2.1.2 Previous knowledge and behaviours

The position of having a low baseline was addressed by interviewees through their choice of information seeking activities. Clearly in terms of the impact of previous knowledge and experience in judging the level of "Knowing Enough".

"[*How do you decide when you have enough, that you have gathered enough information?*] There is always the worry that you have missed something, I think literature searches often peter out rather then finish. I don't think there is a point when I can say I know everything that is relevant in this area. There is a point when you feel that you do know the major parts of an area. Sometimes it is easier than others - sometimes there are high quality reviews which you find fairly early and then that is okay. Often research is a progression, research projects build on another one - even if it is not directly in that area there will be aspects, so once you have got going you are never actually starting from scratch. As I said before you can use the accumulated heuristics". P25: 25:26 (170:177)

While the data also suggested a tendency towards more Orientation .

"If I am starting off from no knowledge base or a little knowledge base then I probably do a lot more browsing and scanning than anything else because I then to think 'ooh there is a paper or chapter or web page or whatever' that is written about the subject, and I would speed read it just to get the feel of what it is about, and as I am going through that process I find that my knowledge and understanding increases a little bit, and then going from that I will then have some sort of map of the subject in my head that I can link into with the areas that I am interested in, because I sometimes find that although I have an interest in something fairly specific, that there is no literature about it, or there is not enough to make a worthwhile investigation, and the best example I have of that is when deaf people who have mental health problems describe seeing a vision in front of them and this vision is telling them to kill kids because kids are the devil's children. What I want to know is are they having an auditory hallucination or a visual hallucination, so I go to the literature and start looking for hallucination and deaf people and I start reading through it and what I find is that there is no work done on a neuro-physical basis of hallucinations and their presentation in deaf people, so I come to a dead stop. So even though I take a broad brush approach I sometimes hit a brick wall". P6: 6:13 (150:166)

Additionally the data pointed to a strong relationship between Opening and an information seeker holding a low level of starting knowledge. For example, Networking, as in examples from interviewee P12 and P33, application of Opening, as in the example of interviewee P31. In this way Opening provided a basis for information seeking, and in this knowledge development.

"If we take an example of consumption issues in India, I start from a pretty low level of knowledge but I have a sense of some of the people who are working in that area, so I would start with some of their work, for example I came across a really good book called 'clothing matters' but which happens to be about India, I got that through Interlibrary loans, followed some footnotes and citations, but simultaneously contacted the author who suggested other contacts in that field". P12: 12:18 (150:155)

"With information gathering it is not necessarily a problem, but I do find that I am more reliant on colleagues or collaborators in other areas when it comes to information gathering. Whereas in Linguistics I can look in a database and look at the titles or at worst the abstract and be quite confident and make an instant judgement just based on intuition or whatever else you might call it - but it's possible to say that's in and that's out. I am on much shakier ground with Genetics and Archaeology and Biological Anthropology and various other literatures that I would need to look at. I am happy to read, learn and inwardly digest but I can't always be trusted to go and find it all on my own because I may miss things because there is a term in it that means something relevant that I don't know about, or because there are aspects of the abstract that don't ring the right bells for me - but immediately would for someone that I would collaborate with or know, so I guess my main issue is that I feel that I am to some extent working with second hand material more in those areas because I have got to rely on someone else to do that first stage of screening for me...". P33:33:23 (195:212)

9.2.1.3 Distance from home discipline

The data suggests that the level of similarity between an information seeker's 'home' discipline and the disciplines used in a research topic influence the application of information seeking behaviours. Further research would be required to investigate the variable of 'Distance from home discipline' in more depth. The present study merely confirms that there is a shift in ability and confidence levels as information seekers move from similar disciplines to non-similar disciplines.

> "About information seeking interdisciplinary....what he is looking for... They'll be so far away from my research experience that I may not even know of the discipline in which that information lies, or even if I know the discipline there are other problems about where does the information reside within that discipline, you know is it journals, is it other people here that I can talk to in the first instance who know something about the subject, and things like that". P15: 15:1 (3:8)

> "I am not so sure that there are such great disjunctions at the level of interdisciplinarity I actually operate under. The difficulty comes when one makes huge jumps from Biology to History. At that point in my experience one does find one's self to be somewhat floundering because there is virtually no overlap in the sources and one has not got the N of years experience of that particular set of sources. So people start talking about standard references that you just do not have a clue about and you are back then to the undergraduate feeling. But across science I don't think the sources are really that different". P34: 34:19 (98:103)

The data indicated that the greater the distance in conceptual frameworks and knowledge types, the greater the practical distance from home discipline.

> "Well, I suppose that I see it in two ways, one is coming from different academic traditions and education, sort of set-ups in a way, so that you have been schooled in different functions and secondly I suppose it is also crossing different mind sets as well, the two can go hand in hand but not necessarily. [By mind sets what do you mean?] Different ways in structuring a problem, different assumptions I suppose, I suppose, a reliance on different sort so evidence, and different techniques you know like even within Psychology you would find a big difference between those who would follow a quantitative view of the world and those who would follow a more quantitative perspective and the two are totally different traditions, different data sources, different journals and so on. That is one example from within Psychology, I mean there are many different functions, people would actually use that as a divider. Within Work Psychology for example you would find those two different very clear schools of thought, it is incredible that even within a discipline, I am sure it is true of most disciplines, that you can find ways of looking at the world that there is almost warfare between the two views, with no attempt understand across them, and that is even within a discipline and if you take cross-discipline then those boundaries really become writ large". P3: 3:25 (11:33)

A further aspect was that of joining a discipline that already contained themes and developing arguments that to an outside observer were not obvious, contributed to the perception of difference and alienness of disciplines.

> "Frequently when I find I read things from another period of History or another discipline then I find that they are following an argument - the tramlines of an argument - which if you are coming from outside are not at all obvious, and so I think that is the fruit of interdisciplinary work - it is that I have an eccentric view of what they are doing and respond to it eccentrically, but the risk is that you are taking their ideas so far out of context that you are not actually doing what they were doing, you might feel that you are doing the same thing but you are not. I think that partly it is a matter of terminology but it is also a certain way that academic debates get carried off and assume a coherence that doesn't really exist. There is quite frequently a sense that I haven't really understood what they are doing...". P36: 36:13 (66:82)

As an aspect of context links to Confidence and Uncertainty were made and seen to illustrate another influence of "distance".

9.2.1.3.1 Knowledge and previous experience as cumulative

Knowledge and Previous Experience were perceived by interviewees as developing through experience. Information Seeking was not a static process, it interacted with previous knowledge and experience and knowledge and experience grew through the act of information seeking. The relationship again reiterated the dynamic interactivity of components.

> "Well, in a way, I can only talk about it from my own direct experience, I think interestingly enough this morning I was looking back at the bibliographies that I constructed at the start of the subject and I think to be honest you don't really have a clear idea of what it is you are doing, so what you do is agitate into the areas where you do know something about it, and you sort of try and look at those and exhaust those and that provides you with enough to go out into the field and even so you can go out into the field with wildly misconceived ideas but by virtue of actually talking to people and getting what is a more generally accepted version of events you are able to discard some of the things that you originally thought were relevant in your initial agitation of the 'washing machine' and that might well be replaced by new stuff and that might well be replaced by new stuff or you concentrate on one or two things that you did fix on to a much greater degree". P5: 5:12 (75:85)

Previous experience also accumulated from previous information seeking on the same topic.

> "I suppose I tried to think about who might have written about time that would be helpful, so as ever I did what I always do, which is run keywords through the Cambridge University Library Catalogue and there is a method on the catalogue which they call 'concise searching' which enables you to do conceptual searches, you don't necessarily have to search for words in titles and I ran that, and I came up with thousands of possible entries and then I did it over a period of time I worked through lots of them until I couldn't stand it anymore and then I did it another time. You get obviously lots of stuff on Newtonian Physics and lots of stuff about teaching children to tell the time, it's a copyright library so it's got lots of things, and then I began to realise where I might find things. That exercise didn't give me a single book title that was any use. What it gave me, was a sense of who works on time and then I think I probably started with Anthropologists that I had heard of, then the bibliographies and footnotes and just sidestepping between the ancillary materials offered until I came across work that was actually specifically going to answer my questions". P30: 30:8 (72:86)

> "There would be some ransacking of bibliographies of published books, roughly in the field, to see if there are any references that would be applicable. It is a bit difficult because it is such a cumulative business, that it would be hard to say after it had been done how many of the items consulted that I had at least a nodding acquaintance with to start with. There is probably quite a lot the first time, but in History there is no particular moment that you can say 'yes, that is it that is the book or article I have waited for', I might come across something that is marginally useful and then think I need to rethink that". P40: 40:7 (75:82)

Other elements suggested a long-term view in which the length of time working on a subject or as interdisciplinary research lead to the growth of avenues of investigation.

> "I think it depends on how long you have been in a discipline, if you have been in a discipline for a very long time, then you may have very good, powerful avenues for gathering information and networking that are extremely difficult to achieve in other areas quickly". P19: 19:19 (277:280)

> "Well, at this stage, I think it is again something which I suppose changes over your career in some senses, but I suppose when I was doing my PhD and had my PhD supervisor who was very broadly read. So to some extent I used them to suggest areas, and things that I might kind

of red, and in a sense I am increasingly performing that function for my self in the sense that I am more familiar with some of the areas that I need. So it is partly experience and partly I'll go and have a chat with a colleague, talking to people if I'm stuck, so yes certainly thinking about the stuff on contemporary literature I would almost certainly go and talk to some of the people in the department who work on that area and ask them. I suppose for that very broad area it is best to ask somebody rather than try and head on in by yourself and not have a clue". P38: 38:35 (231:241)

9.2.1.4   Always a learner

The position with regard to Knowledge and Understanding was taken by many including those selected for Member Checking to be represented by the phrase "always a learner", to be interdisciplinary is to accept the need to learn and continue to learn. A key attribute of Knowledge and Understanding this coding placed learning at the centre of interdisciplinary information seeking. Working in a interdisciplinary field suggests not only a usually low starting knowledge and cumulative growth of knowledge and experience as a background to the information seeker, it also necessarily points to a link with learning. Interviewees, and member check interviews, tended to highlight that they are most productive when they accept a view of themselves as learners. The coding "Always a Learner, Never an Expert" highlighted precisely this theme.

> "I mean also there is a third thing is that you end up that you are never the expert because you are always asking for advice....I am always going 'excuse me I am a learner, an apprentice, will you advise me', and that position doesn't change really. I can go across to Psychology and ask Social Psychologists for advice but my role, my status within this department counts for nothing because I have to go over there and say I'm sorry I don't know the sources for 'test for depression' and so on. I think that can be a barrier to doing this type of work". P10: 10:32 (189:196)

> "Finally I would say that the raison d'etre of your work is that you will always, forever and never anything but a learner, thus there is no room for arrogance and there is no room for complacency". P19: 19:28 (348:350)

Even with some experience the process was indicated to continue to be one of a learning scenario.

> "So I think I do that anyway, I would never claim to be an expert in those disciplines, but I think I am always interested from that perspective. Now technically I can understand these disciplines, I can see where they are coming from, but I will never have a very good perspective on that other discipline because I am not an expert in that discipline. So, we are getting to the point now where maybe we can anticipate what the experts might say, but still need that reassurance". P14:14:12 (74:79)

9.2.1.5   Familiarity with literature

Within the sphere of Knowledge and Experience, Familiarity with the literature was prominent. When considered in greater depth the descriptions of literature and information seeking given by interviewees were addressable by two "Knowledge" elements: Knowledge about Sources: Source Identification and Selection, and Knowledge about Disciplines and

Disciplinary Literatures. Interviewee P2 was a good example of how this theme emerged in interviewees.

> "I am doing that right now and what or why is that a problem is because of my lack of familiarity with each of these different literatures, I then come up against the limits of finding appropriate examples". P2: 2:7 (49:51)

9.2.1.5.1 Knowledge about Sources

In the first element, knowing about sources emerged. Previous experience was a great part of Source Identification. Many examples, as in this example from P16 and P20, illustrate the value of having some relationship with a discipline or source to enable its future use.

> "...again I don't think that I tend to do this well, I tend to go for primary sources which are again more comprehensive than specialist journals, but which I know give the right general field, so I think that I have got some sort of idea beforehand of which might be important, I don't go back to the very beginning and look in journals which I don't normally read, I tend to go for the ones that I know a bit about their contents and so on. Then I probably only look at the ones that I can get easily". P16: 16:11 (135:142)

> "God yes, well, I think there are inherent difficulties in initially knowing which are the major journals, it is easier now because I get a lot of electronic alerts, so the journals that I am interested in send me their details of what is published, BMJ does that, some do abstracts of papers as well, so that is a bonus, so you can download that and follow stuff through". P20: 20:18 (154:159)

Movement through topics and disciplinary areas allowed multiple levels of familiarity to co-exist within a single information seeking exercise.

> "If you have one area and you are competent in that area and you already have a good knowledge ...Yes, I think that is a definite drawback, I know when I am looking for things just in relation to reader response, that comes under literary criticism, well my degree was in that area, so immediately you are one step up when you are looking at that area, you know people, you know certain ways of thought, you know what they are talking about, you know I have had three years in which to develop that, whereas when I am looking at areas in which I am not familiar, yes, I am getting results, but its harder, you probably have to read around much more just to get some idea of what's happening". P1: 1:32 (71:72)/ P1: 1:23 (179:185)

For those who were not familiar with sources, Familiarity with the literature came to the fore as an issue for information seekers.

> "I think I identify what are going to be the key sources for me in answering a question. I do that partly by knowledge of what the question is and what the available sources are, and I do that partly by knowledge of what the question is, but also by what sources have been treated by other people. So, one of dimensions of war for the current project, is what burdens of administration placed on people to raise troops and soldiers - and I have done some stuff on that but I know of another historian who has done as much you can really do on the sources, so I'll not start there, but instead on all the 'cheap printed sources' which hasn't been used. So it is a question of knowing what is available and then there are other sources that won't help directly to find answers of my questions". P36: 36:15 (99:106)

> "Conceptually (it) is a very hard task to do because you haven't got the first degree in that subject so you don't have that bedrock that allows you to be able to make decisions about what is important and what isn't important". P10: 10:29 (183:186)

Sources become apparent to information seekers through Orientation, but familiarity with location of possible material or previous identification, gave some information seekers an advantage.

"About information seeking interdisciplinary...what he is looking for... They'll be so far away from my research experience that I may not even know of the discipline in which that information lies, or even if I know the discipline there are other problems about where does the information reside within that discipline, you know is it journals, is it other people here that I can talk to in the first instance who know something about the subject, and things like that". P15: 15:1 (3:8)

"...The other thing that I found was that there was much more awareness in different but related fields, for instance in the fields of Popular Music and Jazz what I was going on about was much more common than in classical music, and it was as though I was applying what was going on in those fields and applying it to classical music rather than the other way around. So, it is as much I have seen it in this field, but I could find it in another field. So things are in the air, but they are in the air in another part of the universe". P5: 5:28 (221:228)

The issue of Familiarity with the literature may be further reviewed in relation to Judgment and Organisation elements.

9.2.1.5.1.1 Familiarity and judging relevance and quality

In the first, where information sources were identified the interviewees described multiple aspects of judging relevance and quality of sources/literatures. Experience with, or knowledge of, sources was found to contribute a great deal to the ease with which sources were adopted for use.

"I think having to go right back to the very beginning, in a single discipline I do know where the journals are kept, I can walk in and put my hand on the journals straight-away, but with a multidisciplinary work I didn't have that information so I have had to be in touch with libraries about journals and where the information is kept. And on the internet as well I have been exploring new sites and again I have found it more difficult to assess them for quality, whereas in a single discipline I can judge for myself. But I have had to go back to applying all the rules, you know, whereas with experience that becomes second nature". P17: 17:30 (385:393)

"I think the main problems relate to the different focus of the different disciplines and finding a way to make them appropriate for the work that I am doing at that particular time. So, for example, most of the medical articles will be very scientifically biased even towards the sciences, so they won't take into account, things like Psychology, Sociology, the person as an individual, and then trying to make sense of those in terms of what I am trying to make sense about can be a little bit problematic at times....In trying to make sense of all the different disciplines, in terms of looking at the whole, can be difficult at times". P6: 6:18 (204:214)

In considering the quality of sources, familiarity was of great importance in speed of decisions. Source Identification and Relevance Judgements were central parts of Orientation and the contribution of familiarity to this was as an enabler of decisions on quality to take place, where this was low, Orientation and Opening processes were suggested to be more prolonged.

"I think having to go right back to the very beginning, in a single discipline I do know where the journals are kept, I can walk in and put my hand on the journals straight-away, but with a multidisciplinary work I didn't have that information so I have had to be in touch with libraries about journals and where the information is kept. And on the internet as well I have been exploring new sites and again I have found it more difficult to assess them for quality, whereas in a single discipline I can judge for myself. But I have had to back to applying all the rules, you know, whereas with experience that becomes second nature". P17: 17:30 (385:393)

"if you have one area and you are competent in that area and you already have a good knowledge of it then when you are doing searches or anything else then it is picking out names and journal articles then you have an idea of how worthy they are already or how maybe a certain name or research they did is worth anything. Whereas when you don't know I still find

I am looking at things, I am not a psychologist, you know I don't know how valuable research 'A' has been or whether people have completely discredited it. So you are having to backtrack quite a lot really, and probably not always getting the best either". P1: 1:12 (71:78)

Aspects of familiarity were directly interrelated with Information Behaviours.

Particularly in Relevance Judgements, Source Identification, and Problem Definition.

Interviews perceived a risk of following a "wrong focus" or making "misjudgements" about their sources of information and saw their knowledge level as one of the contextual elements with which their information seeking interacted.

"The interdisciplinary approach means, and I have always found it to be so, by using other disciplines what one is actually wanting is a surface knowledge of the whole area which gives you enough information to come down to a very specific area which conceptually is a very hard task to do because you haven't got the first degree in that subject so you don't have that bedrock that allows you to be able to make decisions about what is important and what isn't important and you can go wrong in a number of ways. Either you will totally miss a subject area completely and you end up with a misjudgement because of that or you focus down on only part of a subject area without seeing the whole picture and then you mess up it up because of that. I mean also there is a third thing is that you end up that you are never the expert because you are always asking for advice.". P10: 10:30 (181:197)

"With information gathering it is not necessarily a problem, but I do find that I am more reliant on colleagues or collaborators in other areas when it comes to information gathering....I am happy to read, learn and inwardly digest but I can't always be trusted to go and find it all on my own because I may miss things because there is a term in it that means something relevant that I don't know about, or because there are aspects of the abstract that don't ring the right bells for me - but immediately would for someone that I would collaborate with or know, so I guess my main issue is that I feel that I am to some extent working with second hand material more in those areas because I have got to rely on someone else to do that first stage of screening for me....". P33: 33:23 (195:212)

Beyond this the ability to make judgements of boundaries around information seeking were limited by knowledge, though they were as much influenced by External Context as well.

"...and what I encounter during the course of that particular project through talking to other people, through chaining, and what I think is the difficulty for me and what may be a problem for a lot of interdisciplinary researchers – is putting a boundary around a project and so I am always thinking that there may be other concepts, theories, models, which might be of use in illuminating the subject, but which might be somewhere out there that I don't know about in a discipline - wherever, and you just have to say that I am using the tools that I know about and I think that you depend on the feedback mechanisms - peer review, colleagues, you know it might be that I do a piece of work and give it to somebody to read and they say 'why haven't you used X', and then I might think 'oh ****, that you would have been useful I better go and find that', or I might think that what I have done is sufficient enough to be 'fit for the purpose', you hope that what you choose is fit for the purpose, you can't know everything'....I find it difficult to put boundaries around work, but in the end external factors force pragmatic considerations and place boundaries any way. P23: 23:30 (81:93)

9.2.1.5.1.2 Information organisation

Once a potential body of literature was identified interviewees described the next aspects of familiarity as relating to the way in which information was organised for a discipline and also the way in which disciplines valued some concepts and frameworks over others. These could be described as "cultures of information control" as in interview P9, below, or more commonly in learning how a discipline and a related disciplinary literature organised information.

"...different literatures, the linguistic differences and the cultures of information control. lack of knowledge of specific bibliographic control tools, need to scan simply more journals and sources. At the moment I do a search say in LISA and I know I also have to look in Psychological Abstracts, I probably also have go to looking in computing. education. I probably look in Social Sciences, you are never quite sure when you are going to find stuff....there are titles of abstracting journals, the titles of journals or knowledge of which journals give systematic reviews is less known across disciplines. The equivalent of knowing that in Information Science you can go to ARIST and get a certain type of review. I am not sure in Psychology what the equivalent type of journals would be". P9: 9:11 (43:64)

"...when I was simply looking at History writing I had a sense that there was a corpus of material - an Historical canon - and if you wanted to know about family there were some very obvious books that you would go and look at and they would be your staple. But there is no canon when you are searching through other disciplines, or I don't have a sense of that". P31: 31:23 (247:257)

Each discipline had the potential to be substantially foreign in its information organisation, leading to a complex interaction between interdisciplinary scholar and resources.

"Well, I think what it really boils down to is that each discipline has its own way of acquiring information or handling information, they may be rooted in the same ideas, but you know different sets of behaviour, different procedures will have been set up, so what I find is that you tend to be working along two parallel paths - you've discipline (a) where they do things like that here, and path (b) is where I've got to do this, but I've got to use this sort of approach because that is the way they do it in path (b). Where I think that is useful I think is that you tend to have more options open to you, you've got more a selection of choices. rather than this is the way you do it and that is that". P5: 5:5 (30:37)

"In this particular area that we are talking about there was a fairly formal way of looking up references and so on and everyone did that, but in the music side there wasn't any system at all that I could see, well actually there was but it was a very very different system". P5: 5:6 (41:43)

Websites and Law libraries were particularly clear examples of the potential for difference and apparent incomprehensibility, for interdisciplinary information seekers. In this quote from interview P40, the interviewee was describing a lack of familiarity in organisation and prioritisation of different materials and could not judge credibility, value or purpose accurately.

"You don't have to look very far away from ones core area to start struggling. It wasn't connected with this project, but I tried looking up a legal case in the law library and ended up wondering why there were so many different law reports and what is King's Bench Division, Court of Common Pleas, and things can appear in different volumes and it was an important in the legal profession in the 1860s. So I have had the odd hour wondering around shelves trying to find something and when I do find it - if I find it - I'm amazed. I don't even know if all legal cases are reported, are they more authoritative if they appear in book form written by legal experts than the snippets in newspaper columns by journalists. Presumably the accuracy of the Times reports depends on the ability of the Times reporter to make sense and coherence of the case report. It is the same with Medical History journals. I am never quite sure of all the statistics, and their applicability". P40: 40:10 (104:127)

"...websites, it tends to depend on how they are organised. if I am not familiar with it and I am looking for something specific then I would try to search it. but searching is so dreadful on so many websites. I would also try looking for a site map. I find sometimes if it is something that I have just come across, then I will just browse through it, so it will depend a bit on whether I have been there before, whether I am looking for something specific". P39: 39:14 (81:88)

9.2.1.5.1.3 Differences of conceptual frameworks: Disciplinary knowledge and familiarity

Disciplinary literatures were perceived as containing many different ways of presenting material related particularly to the different underlying conceptual frameworks for disciplines which shape the relative importance of materials, sources, and themselves relate materials that an outsider would not recognise. Where interviewees drew a comparison with single discipline research it was focused on the impression that single discipline researchers build an "expertise" and in-depth knowledge of the literature, whereas interdisciplinary researchers tend to miss this depth of knowledge.

> "...Well, I am not a trained geneticist, I only did Biology at 'O' level, so I have picked up a lot of my knowledge of genetics on the job as it were, and what that means is that I am constantly conscious of reading to make sure that I have got the ground work in place...". P33: 33:21 (167:180)

> "With information gathering it is not necessarily a problem, but I do find that I am more reliant on colleagues or collaborators in other areas when it comes to information gathering. Whereas in linguistics I can look in a database and look at the titles or at worst the abstract and be quite confident and make an instant judgement just based on intuition or whatever else you might call it - but it's possible to say that's in and that's out. I am on much shakier ground with genetics and Archaeology and biological Anthropology and various other literatures that I would need to look at....so inevitably at this level there is a kind of tiptoeing around in establishing why you are doing what you are doing, but I don't mind doing that". P33: 33:23 (195:212)

Familiarity with conceptual frameworks and disciplinary material went beyond literature and into learning about disciplines and the information contained within them. Where an interdisciplinary researcher did not understand the significance of information presented then the potential for finding the way the information was organised and linked could be lost or only partial.

> "...so you come with different concepts and you are trying to bolt on to one another and you do gain new insights but you are forever struggling because you tend to operate at a fairly superficial level and sometimes it shows your lack of real knowledge". P2: 2:8 (57:60)

> "I suppose the greatest difficulty is anachronism. Both the application and the concepts, but also lack of understand and misuse of somebody else's results if you read them with the wrong set of genre rules. Archaeologists always say that we make a mess of their results because of course we ask very different questions of them...". P30: 30:43 (423:446)

9.2.1.6 Information need

Information need was considered worthy of separate study, here it appears as belonging to Internal Context and is defined as an outline for further study. Defined earlier as relating to and shaping Orientation, Information Need was a significant part of Internal Context. Definable as both General and Specific levels, Information Need was discussed earlier in more depth. Here it acts to remind the reader of Information Need as an element of Context that develops with information seeking and growing knowledge.

9.2.2 Feelings and Thoughts

Information seeking context was found to include the feelings and thoughts, the affective element, of the information seeker. The expression of emotion and personal thoughts were associated with the information seeking process.

Defined through interpretation of quotations in the study as a measure of self-belief related to ability within the coding of this study, it was found to be composed of belief, confidence and uncertainty.

9.2.2.1 Self-efficacy

The first instance of personal thoughts was expressed through Self-efficacy. Self-efficacy was defined as an information seeker's belief in his/her ability to complete an information seeking task. Many of the descriptions of self-efficacy were related to confidence and a sense that existence within an interdisciplinary environment was precarious.

Interview data illustrated two ways in which Self-efficacy was identifiable among interdisciplinary information seekers, these related to domain knowledge and to domain technologies.

9.2.2.1.1 Domain knowledge

The first identifiable source of self-efficacy was seen to be connected with domain knowledge. Information seekers were challenged by their interdisciplinary information seeking and linked this with low self-efficacy when information seeking.

> "I suppose there are other thoughts, am I missing some really vital source because of the interdisciplinary nature of it. Another very interesting case study I recently did a paper for Information Retrieval I was drawing on a bit of brain research and one of the reviewers was a guy from Cambridge who was heavily into brain research and he gave me some sources that I would never have come across. He also shattered confidence, oh the brain stuff here has a quaint slightly out of date air, this reinforces the point earlier about uncertainty, this guy was obviously a top researcher directly in this area, he was able to bring materials and perspective that I couldn't have done and for which I was grateful". P9: 9:24 (99:107)

A view of self-efficacy was difficult to achieve, however, where domain knowledge was low enough to offer no basis for measurement of success.

> "Well yes I did that, but it was a bit time consuming to be honest with you, but I did it just to ease my mind I guess, because I thought I should follow that route too, so I did that with certain journals too. I identified, and it is much easier now with the web, you can do that because most of the journals even if they don't have articles online they do have abstracts and stuff, so if you have identified like 20 or 30 key journals in your area it is not very difficult to go through that and do searches on that, but I did that really just to make sure that I had covered lots of things. But I am not sure if it is helpful. [*What makes you not sure that it is helpful?*] Because it takes such a long time to go through the articles and read the abstracts and stuff and at the end of the day you might end up with one or two interesting ones. The thing that worries me is like I said before is am I ever going to be able to say that I am happy I

covered quite a big part of what is supposed to be my topic. To my mind it is all about interpretation and it is all about how you perceive a certain area and I am sure you are going to miss things out everybody does, you cover things to a certain degree but I am sure you are missing things out as well and nobody is able to say – It would be silly - for a person to say that they are really aware of what is going on in an area, we are all aware of what is going on but only up to a certain degree". P24: 24:40 (160:179)

In doubting success levels, interviewees pointed back to their intellectual skills, and more particularly to a perceived lack of ability in this.

"So I have been literary and linguistic in my past and now I generally try to be both. Generally leading to a faint sense of inadequacy in both. [*Why inadequacy?*] Well, I think it is because you have to work in more than one area and you only spend half your time working in one area and half of your time in the other, or you do a slightly borderline area of it in some ways. I mean the literature people look at linguistics and think that you are putting poems through computers and doing terrible horrible things to poems and being much too hard about it and not allowing for certain factors and all the linguists think that you are terribly soft and fluffy and not doing proper linguistics and yet you need to know about both areas, and so by definition you are spread a bit more thinly and perceived a bit more borderline by the centre of disciplines". P38: 38:4 (20:34)

"[You wouldn't generally describe yourself as systematic, you said "you are not as systematic as you should be", why do you feel systematic would be a better thing?] Because I don't believe that informal networks are perfect, they are extremely imperfect, and although it is a small world of eighteenth century History and I hang out pretty close to the centre of it - I go to seminars and conferences and I know people close to the centre of things going on, I still think there are probably some interesting people beavering away on this outside the loop whose work could be quite important. So I do not have the confidence that I know or that I can find out about everything that is important that is happening in the field, it is almost a political point about not liking these informal networks because it means those who are in are in, and those who are excluded are excluded by where they are and who they know". P41: 41:23 (177:186)

9.2.2.1.2 Domain technologies and information seeking skills

Domain knowledge was matched by low self-efficacy as this related to particular technologies and information seeking skills. The variation in skill was particularly apparent in descriptions of using databases and websites unfamiliar to the visiting information seeker.

"Well, one would be conventional information sources like going to the library, finding appropriate journals, getting people to recommend references to me, you know obviously more and more web sites and databases if I could make them work, those sorts of things I would do, again because of my subject area there also tends" P10: 10:13 (91:95)

"I have made attempts at using Citation Indexes, but I find that I haven't got sufficient expertise, I usually have got too few hits or too many". P40: 40:16 (158:161)

9.2.2.1.3 Coping and Self-efficacy

Low self-efficacy was also seen to result in a number of behaviours to "cope" with the perception of inadequacy. These centred on Networking and on extra iterations of activities described in the chapter on the Core Category. Consolidation as in this example from interview P10.

"Final things, oh dear, well using other people, not really different things than I have done so far, 'please will you read what I have done so far, is that the right kind of thing' and so on. I will always check with somebody else, I would always do that I think. I would certainly

scrutinise all of the literature that I have used to make sure that all the sources that I have used are correct. I would in the best of circumstances check obvious literature sources again to make sure that I hadn't missed anything that is current and up-to-date, and is critical, because you have started something two years and now everyone else has also discovered it as well. I would always check those sorts of things". P10: 10:18 (131:143)

9.2.2.2 Confidence and Uncertainty

9.2.2.2.1 Uncertainty

The expression of feelings and thoughts was most prominent in the concept of Uncertainty. Identified in previous research the concept emerged in the present study notably without direct questioning from the interviewer.

9.2.2.2.2 Familiarity with topic areas

A factor of central relevance to interdisciplinary information seekers was found to be familiarity with the topics or areas of investigation.

> "...I would feel less uncertainty if I were doing a mono-disciplinary, if I knew all the researchers, and relevant researchers, it would be much easier to know what to think at this stage". P9: 9:34 (169:174)

> "Well, I suppose that idea I was talking about earlier, about not being sure, and I think that applies more to interdisciplinary research than to single, that you are not sure that you are getting all the information that is out there, not that you possibly want all of it, but you want a big chunk of the main things. So perhaps that uncertainty about you're not quite sure what is going on in other areas, because you have to keep an eye on lots of other areas unless you have got people to do that for you". P22: 22:30 (279:287)

While learning more about a topic was also a source of uncertainty as more information become visible and identifiable as potentially relevant.

> "It is the more I learn the more ignorant I feel, well Medicine is like that, medicine is a very humbling experience and science should be the same and imparting that is very important". P13: 13:13 (266:267)

Uncertainty was found to be related to "the distance from home discipline" with perception of confidence rising with relatedness of disciplines to home discipline.

> "Some more than others, obviously some of the scientific disciplines are closer to my own and therefore in those I feel that I can actually do pretty well, others that are further away, my confidence is not so great and I will make mistakes, but sometimes that is fun. So we are not afraid to make mistakes but we do have to narrow them down, throw them out. That is quite a good issue actually, because Mike and I particularly have a History of going and giving joint presentations. There has been occasion where one of us couldn't turn up and then you are in the position that you are giving this dual presentation and you are carrying the can for both sides of the fence. That is when the confidence disappears because suddenly you realise that you are talking about somebody else's subject who isn't there anymore. So you really have to be careful. Actually working in somebody else's field is very hard to do". P14: 14:19 (117:126)

9.2.2.2.3 Coverage of materials

Confidence was further expressed by information seekers in relation to the level of coverage they were achieving. In this the perception of incompleteness was a source of low confidence and increased uncertainty.

> "At the moment I do a search say in LISA and I know I also have to look in Psychological Abstracts, I probably also have go to looking in computing, education, I probably look in Social Sciences, you are never quite sure when you are going to find stuff...So I think I feel greater uncertainty as to whether I have found, not only everything, but the key stuff that I need". P9: 9:4 (35:35)/P 9: 9:12 (45:48)/P 9: 9:13 (48:49)

> "I am always quite concerned that I might have missed things. I am never confident that I have found everything. [*Do you think that is the same for single disciplines?*] No, I am more confident with a single discipline, particularly if it was my sort of area, particularly if it was my area, then I would be more confident with the results, because of my own experience I would probably know the area really well. So from my own experiences in that area, I would be aware if you know that I felt that I had missed areas, whereas in other disciplines I don't have that sort of background knowledge". P17: 17:21 (283:293)

To this level of uncertainty were added serendipitous discoveries that further added to insecurity by their revelation

> "But you know so much of it is around inspiration, the spin off of ideas from something that you read, what is particularly worrying is when you can actually pull connections up into another body of literature. An example, the work on crisis incubation started with [name removed] and had been worked upon in a Psychology department and had been worked up by others in a Management context so there is one example". P20: 20:22 (178:183)

Also related to Knowing Enough (Section 7.6), low confidence tended to be linked with continued information seeking and was linked to behaviours apparent throughout interviews.

> "I think I just find it easier in a single area because I can focus quicker. I think in the multidisciplinary area I have kept things broader for longer, I haven't been as quick to focus down. That is, because I feel there is a possibility that I could miss things". P17: 17:29 (377:380)

> "I don't know if you ever know if you have got enough information. There is always the nagging doubt that there is something that there is something that you have missed. Perhaps a connection that somebody else thought of that you didn't. [*Is that part of being interdisciplinary or something else?*] Yes, I think it is, yes, because you are perhaps delving into an area that is less clearly defined, you don't always know whether somebody in education is really going into this area in depth, or somebody in the Management School is going into this area in depth. They may be going into depth in their own areas but not making the crossover, but they may be and that is just something that is not always clear because when they are defining their articles and keywords for their journal articles they might not be thinking in educational terms if they come from the Management School, but they might be doing something that is really relevant to Education". P21: 21:11 (79:95)

Part of the prolongation of information seeking involved Verifying and Browsing which had a direct relationship with confidence in ability and personal knowledge.

> "Well, I tend to go the long way round. I have to satisfy myself that I haven't missed anything, so I tend to take the splatter gun approach....my first approach because I think I don't trust search engines and I don't trust my own ability to be able to hit the right words I tend to be a browse....I think that is probably though not very efficient, though I often don't know what question I am asking at the start, and that is probably why, and I have no idea where the answer is going to come from or if the answer will come in terms of metaphors or parallels to the subject that I am looking for...". P11: 11:37 (305:325)

> "Well yes I did [Browsing], but it was a bit time consuming to be honest with you, but I did it just to ease my mind I guess, because I thought I should follow that route too, so I did that with certain journals too. I identified, and it is much easier now with the web, you can do that because most of the journals even if they don't have articles online they do have abstracts and stuff, so if you have identified like 20 or 30 key journals in your area it is not very difficult to go through that and do searches on that, but I did that really just to make sure that I had covered lots of things. But I am not sure if it is helpful". P24: 24:39 (159:168)

Paradoxically uncertainty itself was deemed to be a liberating experience because it implied the impossibility of completeness.

> "I think you have to incorporate uncertainty into any argument that you make and that is true about any argument you make I suppose, but there is a sense that anything that you say is provisional and that someone else might read one article that you left alone which turns out to be the crucial article. So the downside is that kind of uncertainty, but on the other hand that can be liberating in feeling that you are not writing something - that you can't ever - write something that is definitive - it is all a personal view. But I think a lot of humanities writing the difference between people is when they are willing to say that they have finished a project, they just can let go of a project, and I think that I am a relatively good finisher. I am relatively good at saying there isn't any better return from doing this longer, and if you don't someone else will come along and do a better job". P36: 36:46 (168:177)

9.2.2.3 Self-perception

The aspect of Self-efficacy also showed up in a negative or weak Self-Perception. Interviewees put forward their self perception, or image of themselves as information seekers largely in a poor light. Their experience led them to believe that they were both on the periphery of disciplines and their information seeking lacking in some sense when compared with others.

> "You probably feel a bit more central to an area, I tend feel that I belong to the outskirts of several different disciplines". P38: 38:40 (266:268)

The perception of relying upon Serendipity was strongest amongst these perceptions. Interviewees saw Serendipity as immensely useful, as discussed in an earlier chapter (Chapter 5), yet felt this weakened their information seeking, this despite clearly identifiable successes in their chosen fields.

> "Disturbingly to a great extent serendipitous....I am sure that I could do this more systematically, but in a context when you've got time...". P9: 9:15 (67:85)

> "...coming across by chance, rather than by tracking down, then yes I think in a way that that is the way I get material, though I'd like to be more methodical....for example on the kidult fiction my paper took the form of a reading of six essays which had nothing to do with kidult but hit me broadside that these two things were the same... [Why would you like to become more methodical?] Because I feel that the research that I do is almost anecdotal or chance, whereas I would really like to have a sense of a factual bed of information out of which my research comes and so I could feel more confident". P37: 37:43 (141:154)

Given the variety of information seeking behaviours observed in use among interdisciplinary scholars the Self Perception as low ability information seekers was surprising. In part an explanation was offered where interviewees indicated that they perceived other methods or patterns to be "what they should do", typically this was related to discussion about Serendipity and to their the timing or ordering of behaviours and thoughts.

Self-Perception extended into the previously discussed concept of Self-Efficacy. Feelings of Self-Efficacy were not necessarily a reflection of the true position, it was a perception, a belief, hence repeatedly information seeking using the internet and databases was viewed as unstructured (suggested to be a bad thing by interviewees) and disorganised. This occurred despite successes.

> "Disorganised and inefficient. I am actually really bad at it. I rely on talking to people, following up my own expertise which is limited and surfing the internet in a very vague unstructured way". P37: 37:29 (30:32)

The perception of a wrong way of information seeking was expressed repeatedly, as in these examples from interviewees P35 and P10.

> "I suppose I would suggest that they do what I do, but I realise that is not the right answer. Well, it works for me. I might suggest a textbook and 2 or 3 primary sources and see what suggested itself". 35:33 (209:213)

> "This sounds terribly weak and feeble, but I mean I would go and find human beings to help me, that would be my first line of attack. I realise that I have got an example here, and this is something that happened after I had the original contact with you, I have an ex-student who is a Palestine-Israeli, who did some interviews for me, we are going to write a paper, the interviews are in Israel, in order to write the paper we need a substantial literature review and I had no idea where to source that information so I actually contacted the Scharr Medical Library and they did a search for me". P10: 10:7 (50:57)

Self Perceptions such as these tended to perpetuate feelings Self-efficacy and Uncertainty.

9.2.2.4 Coherence

The Coherence of a topic was a subject of much discussion with interviewees. The data illustrates multiple ways in which the structure of a topic as it falls across disciplines and concepts may produce variable levels of apparent coherence which directly interact with the information seeking behaviours. Coherence referred particularly to how dispersed the disciplines and resources were that related to the information seeker's topic. In the first instance the data suggested that the multiplicity of possible disciplines holding relevant answers contributed to the lack of perceived coherence of information seeking.

Hence interviewees such as P1 and P3 recognised the availability of possible unlimited directions of investigation and possible answers to a given problem.

> "Yes, I think it is harder really, because when it is just one discipline you can see a pattern of thought across History and different ways of looking at things come into being. Whereas with a cross discipline you are trying to tie them all in and there is almost no end to what you can look at really it is much broader really". P1: 1:5 (18:22)

> "Well, I think one difference is that these days most problems and most situations there are five different answers to and there is greater recognition that that is the case. So I suppose that very few situations can actually be solved just because of the complexity of the problems that we face, so, that is one sort of difference, so a single discipline is more limited and therefore it tends to work on a contingency basis, there may be a particular facet to a problem that you can say that this discipline has got the best way of looking at it. But no one actually has these days got ownership". P3: 3:5 (43:50)

Further investigation suggested Coherence contained further related concepts. The description of several perceptions of interdisciplinary information seeking described different attributes of a sense of Coherence. Information seekers' grasp of the topic and its relationship to multiple literatures as containing interpretation problems.

9.2.2.4.1 "A lot of things are relevant" and Information Overload

The theme of unlimited directions was carried over directly into two attributes of Coherence, recorded in the coding of data as 'feeling that lots of different things are relevant' and 'information overload'.

Interviewees recounted feelings of many things being apparently relevant to their topics. This appeared in the number of places to find information, in the number of types of information and in the number of items possible to retrieve. In part linked with problems of topic definition and Orientation. The feeling was not necessarily a negative occurrence and was equally viewed as enjoyable and challenging, a key part of interdisciplinary research. In this aspect the clarity of a single minded purpose was lost, giving an appearance of low coherence.

> "'thousands of people working in this area and I can't believe there are no articles'. So yes, a lot of anxiety, it is okay if you've had something where there has been quite a lot of literature, somehow that feels more comforting, because you have been sifting out, so you can feel well might be other things out there but I have refined it down just into the area that I'm interested in, but when you are not getting anything or just small bits, it is very unsettling...". P4: 4:41 (192:218)

> "...and you have to sift, because there is a whole army writing on my period and I also try to write in a way that is pretty accessible, I don't know if the students would agree, but I try to write for what used to be called the common reader, I am not interested in writing stuff that is going to have a readership of five, so that means that I don't want to get too complicated and what often happens I rashly, as in a couple of weeks, I accept invitations to talk here or abroad. I usually give them something that isn't yet written, so it is a good impetus to finish the thing even if it is done the night before, but that is not a bad way of working because you do need adrenalin. All writing is creative it is not just sticking down the facts, it is the thinking as well as the finding and terror is a great impulse to thought". P32: 32:26 (126:134)

The more negative side Information Overload led to much comment from interviewees and led into discussion of the difficulty of Achieving and Maintaining an Overview of the Whole.

9.2.2.4.2 Achieving and Maintaining an Overview

Coherence equally related to the concern of interviewees for achieving an overview of their topics and the relationship of different elements to one another.

> "My perception would be a mono-discipline, it would be easier or more likely that you would be able to develop a cursory overview of that discipline and the range of knowledge that is contained within it. I think that is part of the answer, whereas my perception of interdisciplinarity it is much more difficult, you are spread much more thinly, so it is more difficult to have an overview of a single discipline, perhaps even difficult to be aware of disciplines that may be important". P15: 15:7 (60:66)

The theme was particularly prominent in a perception of increased Complexity for interdisciplinary information seeking compared with single discipline counterparts.

> "No, I think it is really that the more that you do, and in some respects the harder it is to do work because I think you realise the limitations of your own knowledge, you realise the limitations of your core discipline or your abilities at that point in time to work within a problem space and I think that it can actually take you longer to bring material to paper. It certainly is a function of that. I can see the links, but for every link you realise that you have a lot of gaps. So most of it is about filling the gaps, and trying to fill the gaps, and I think interdisciplinary research is hard, probably harder than dealing with a very narrow path. Also as well, I think if you are concerned with trying to deal with a problem then the problem invariably spins off questions and issues from other disciplines and that adds to the complexity". P20: 20:23 (187:198)

> "...I think in a single discipline I think although it can still be complex and within the single discipline when you are looking at it people may have used multidiscipline methods to reach what they have decided and when I look at it, it is just a single discipline..." P1: 1:6 (26:29)

9.2.2.4.2.1 *Keeping up-to-date across fields*

Coherence and the dispersal of materials was also considered in relation to maintaining an awareness of the current and up-to-date materials across disciplinary boundaries. One of the particular issues was the difficulty of keeping up with many growing literatures and a feeling of being overwhelmed by it at the same time.

> "...there is certainly an image of being in a boat on rough water or something comes to mind, because you have lost the little networks that normally support you and so you don't know where to go, and you know that there is a lot of material out there that you have to sift through, so you start to worry that it is a needle in a haystack for how I am going to find the really relevant stuff without wasting a lot of time on the irrelevant....When I started I would gather lots of information and then try to make sense of it, but I think one of the things I learned as I gained experience is that when you do that you gather lots of information that ultimately you end up not using, it is not a very efficient way of doing research, and as you start to make sense of it lots of new questions arise which of course means that you realise your research isn't finished...". P41: 41:27 (220:240)

Bibliographic tools made things easier and paradoxically more difficult at the same time, as in for example participants P20 and P24.

> "The days of laborious bibliographic searches are thankfully gone. The downside is that it is harder to keep up, which is perverse, because there is more information to sift through, whereas in the old days you could take your time, it had to come from Boston Spa through interlibrary loans, then you had a bit of peace to read it, whereas now you just start and I think it is difficult to keep up in a lot of fields, so business and the environment which was an earlier research area I wouldn't claim to be current because I have stepped out of that for 5 years, and focused on risk and crisis". P20: 20:9 (75:82)

> "...first of all though you have got to understand that you start with a vast amount of information, you get articles and articles and books and everything and you reach a point where you are really lost, and you say what is going on here and you need to start grouping things and if somebody hasn't done that before you , for instance creating a bibliography on your topic and grouping things then you are the one who has to do it and in a way it is your personal interpretation, because it is all about interpretation actually, people have seen a topic from different points of view". P24: 24:34 (94:104)

Interviewees considered maintaining any degree of expertise in areas was difficult when put in the context of interdisciplinary interests.

"Although for a more interdisciplinary area you could build up the same level of expertise [as for a single discipline] but it is harder because you have a lot more areas to pull in to find out what is going on, different areas of research, different publications, different areas of publication, different people to coordinate you, just simple things like knowing where to publish things - if you have a single area you know the journals and you probably know the people who edit the journals as well, so it would be a lot easier from that point of view as well". P22: 22:7 (57:77)

The by-product for interviewees was a sense of only superficial "keeping up" with developments in non-central fields of interest.

"I am conscious that I am not as au fait with Archaeology as I am with History, in a general sense, but I think that is more a function of the way in which this university is organised and the fact that I spend most of my time teaching in a History department. I used to be a bit more up-to-date, but not I have a feeling that I am keeping up in just a superficial way, but as I am not interested in keeping up with the technological side of things that I really not the problem and I am not overtly theoretical, but as to new excavations and new material - the problems are the same for History - because it takes time". P35: 35:36 (228:234)

9.2.2.4.3 Distraction

In traditional approaches the retrieval of off topic materials is viewed as problematic. Distraction would be thought of in a negative sense in a traditional sense. Distraction could detract from the success of information seeking. Interviewees in the present study took a different perspective on Distraction. Distraction was perceived as a difficulty in remaining focused. As in, for example, interview P45.

"...and one necessary constraint really is whether you pursue each individual item as it occurs at that stage or you say to yourself 'No, I'm going to get lost' I can come back to it I've got it written down. I keep trying to define the field as it were at individual blades of grass. [*So it would be a matter of resisting?*] Yes, but sometimes something might be irresistible and intellectually exciting and I would be scurrying round pulling books off shelves and looking in dictionaries and things but even then I would not be writing things formally down I would just be jotting down some notes". P45: 45:6 (41:52)

Instead of being viewed as a negative occurrence, Distractions were often seen as a revelation of connections (See also aspects relating to Serendipity in Section 5.2.8 and Needs in Section 6.5.2.1) and in this a positive part of information seeking.

"So I would tend to go into finding small subjects at a time and concentrating on one area, but I find my mind does flip halfway through [*What do you mean 'flip?*] Well, probably seeing a connection really, rather than flipping, and there would be a tendency to go and look at that other area". P7: 7:8 (48:54)

"I read masses that doesn't really help and I would expect to do so and I am often looking for the incidentals in the other literature rather than the main argument and that I can, if I was doing this work in Cambridge I wouldn't Xerox I would read it first before I decided if I wanted to keep it or make notes on it, but if I can only go for the day you have to make a snap decision on the basis really of the first couple of paragraphs, does this look as if it will be worth enough use to be worth taking a copy of in which case I can then read it, or does it look as if it isn't going to answer any of my questions in which case I can just abandon it". P30: 30:30 (284:295)

In producing distraction, the divergence from expected paths linked in with the perception of interdisciplinarity as a creative, inspirational, connection building mode of research.

"I wish I could say that I did it systematically, I think in a way I am far more inspirational in the way that I do things in a way than systematic. Basically once I have hit a gold seam I follow it rather than getting deflected. If I find something useful then I follow up references from that and hope that way that I tend to cover most things that I need to cover. So I don't progressively refine the sieving process. I tend to go for a few key references and spread out from those. [*When you say "inspirational", what do you mean?*] I probably make links myself between things that I think are probably going to become relevant, I think probably I would look for a recent review article, which was pretty focused in the topic area or near to it, and go to that and pick out from that a number of the primary references to pursue and then again look at those rather carefully to see if I would make any links myself with other bits of work that I would hope would be relevant. So a sort of feedback process starting with a good quality comprehensive review to primary sources and then to hunting from some of those to information that the reviewer hadn't drawn in". P16: 16:8 (100:119)

9.2.2.5 Feelings and emotions

A range of other feelings were recorded. These included a low satisfaction level with information seeking. Interviewees never felt that they had completed an information seeking exercise to its fullest extent, instead they were driven by External Context. In seeking, other feelings expressed included finding misery (Participant P9), intimidation in the scale of the task and most widely, frustration.

"I feel its a bit intimidating sometimes, the kind of map of subjects that I have to try and juggle with, but I am the kind of person who doesn't mind stopping when I feel that I'm good enough on a subject, I don't like wasted work so I wouldn't probably produce too much material on an area, though in a way I feel that I should, it would help with the randomness and provide links that I hadn't thought of". P7:7:32 (148:152)

"It can be a bit frustrating sometimes because you can find something that you like from a literary perspective but they just don't say the kinds of things or show interest in the kinds of things that you would like them to be writing about. It is just very different, the sets of expectations, really there are two sets of expectations, one for reading from a literary and one for linguistics, although you do then get stuff like the History of linguistics for example which I also draw upon which is in its nature interdisciplinary because it is linguistics and it is History". P38: 38:28 (176:183)

"I feel frustrated, I just want my information to be on there". P4: 4:43 (137:163)

Collectively these tend to add more to the general understanding of the Internal Context than to specific issues of information seeking. They do however illuminate the non-tangible human aspect of information seeking rather clearly.

9.3 External Context

Whereas internal context reflected individual experience and background, External Context was much more concerned with the existence of information seeking within the context of individual and organisational interactions. Four major areas were identified: Time, The Project, Access and Navigation.

9.3.1 Time

Many aspects of External Context could be simply described as Resources. That would however oversimplify the nature of the issues involved. Time was identified as a significant element within the study as it gave the overall parameters within which information seeking could occur and presented an end point to information seeking. In the first instance Time gave meaning to the way information seeking fitted into academic life, as suggested in this quote from interviewee P9.

> "It's the same with systematic searches, it is really when the students come along, that it is a chance for somebody to do a better search for me. I can go literally for months without systematically searching...I am sure that I could do this more systematically, but in a context when you've got time. But in a context where you don't get to the library for three weeks, four weeks, you just pick up crumbs where you can, so rather like a pigeon in Trafalgar square. I think I resent not having the time to do it more systematically...". P9: 9:17 (78:84) / P9: 9:37 (186:188)

Time created limits by imposing deadlines, other commitments, that curtailed the amount of time available for information seeking.

> "Time, time constraints, definitely impinges on how widely you can explore, you usually have deadlines that you have to meet, and whilst it might be nice to go to the nth degree in a particular connection, sometimes you just have to let that go in favour of your main lead, that is a question of personal discipline in saying 'no although that is interesting I am going to put that on one side and explore that at another time". There is so much in life that is interesting, but if you tried to explore it all at once you would get so confused, that you wouldn't be able to come out with one single thing that made any sense". P21: 21:21 (167:174)

> "Not as often as I should, the intention is there but I never get the time". P27: 27:30 (88:94)

> "I would say deadlines, I always work to some sort of deadline, e.g. students coming back, got to do this book by a certain date, RAE breathing down the neck. Get it finished. So I can't say that searching literature and considering it all never happens I have always done it in a rush, so I have always been fairly pragmatic, I have had to move on and hope for the best". P10: 10:20 (159:163)

Browsing covered on page (page 97-) was also illustrative of the problems of time. These issues were also associated with Knowing Enough in the form of satisfaction with coverage.

Limits on the amount of time available were compounded by the perception of information seeking as particularly time intensive. In great part the perception connected the diversity and breadth of interdisciplinarity as part of the increased time consumption, while also reflecting the perception of working within an organisational framework that limited "free" time.

> "Well, I guess if it was a singular discipline, if you are looking in certain areas, e.g. reading of fiction, you would get some, probably a very good response rate, but because this goes across so much you can end up with doing one search with some things that are spot on but other things you could get high school curriculum from the United States of America doing the same search terms. Because it is a broad sort of area it means that often searching is really time consuming, because all the time you are having to redefine it and redefine it and lessen it and lesson it, and I don't think you get that problem so much in a single area, because you don't want to lesson it to such an extent that you rule out all the good areas. You know what I mean, if you are trying to get things on Sociology and Psychology, you have to be very careful on how you limit things". P1: 1:21 (164:174)

Time devoted to information seeking was also limited and characterised by frequent breaks and interruptions. These were thought by interviewees to be a part of academic work and typically meant complete uninterrupted information seeking episodes were punctuated by staccato-like interruptions of information seeking episodes and information seeking squeezed into free time and opportunities as schedules permitted.

> "I think I start off generally with an idea or a problem in a field and something that interests me and then I tend to read everything that I possibly can about it, at which point I generally lose track of my original idea and then start a teaching term and forget about it for a while and then have to focus for a conference paper. I think it is important to mention that this kind of project goes on with loads of interruptions and asides. It is part of the nature of the project, in other words you can't pursue something with your full attention. You almost have to spread out and look at things more diffusely". P37: 37:38 (115:121)

9.3.2 The project

Time presented one aspect, the Project and its nature presented the second significant element of Context. The project, or work for which information seeking was undertaken provided a background canvas for information seeking.

The project type was identifiable as big as for example in a funded project, small as in a journal article or conference paper and by the intended audience for the research output. Essentially the simplest relationship was implied: the larger the project the more resources that could be devoted to information seeking.

> "Again it depends largely on the scale of the problem, if I am looking at something very specific then one can pretty much systematic and go through everything that is out there, if it is a big issue, then one tends to sample across the range of the topic - one can't do everything, get hold of everything or see everything, so that tends to have more of a shotgun approach". P34: 34:12 (36:39)

Complexity was added where the number working in the field was higher. Interviewees were able to know everyone interested in a field and hence know much of the resource available, to face the inverse situations.

> "And also probably realising that it is too big for me to know everybody in the field. Particularly in this sort of area it is highly likely to find some sort of research group working bang in this area with some interesting results and for this to emerge late in the process by serendipity". P9: 9:35 (176:180)

> "I would almost never go to an electronic database because it is actually quite a small field, and I tend to know what people are doing, I am on editorial boards and that kind of thing so I tend to feel that I have a perception of what is coming out next, what I do use for phonology work is a big archive of papers in a particular theory, I think it is dreadful, but you need to know what the enemy are up to, and that is maintained online and I have tended to go on to that archive and see what has been posted since last week. But, not really searching, yes combing through journals that I don't subscribe to, and every couple of months going up to the library and just checking, but apart from that it is more knowing who is doing what from conferences and from email contact with colleagues". P33: 33:8 (71:80)

The project's variables included length of project. As a parameter this placed stringent limits on the proportion of time available for information seeking.

"Yes, I think I could, but I think it is a process, if I thought of it as a process it would be largely as something that, I could describe processes that I have been through. but I don't think they could be prescriptive, and those processes tend to be of a different scale. One that I have noticed is that and one that tends to be quite puzzling is that for the last 5 to 7 years. and in general it has been the case in relation to 3 books that I have written and each book has been the culmination of the summary of the last 7 years. And I can describe that process. in terms of me going through different states and experiences or I could make comment about a project that might last a year. suppose on the whole the ones that have been one year. have been ones where is clearly a well formed problem that has a well formed empirical base. not in the sense of my findings based on that because again I think that relationship is very problematic. but at least it is clear that I want some data. Planning for that I would think of the problem. I think in general I would want to get those ideas before I necessarily start moving around the subject. I want to come at them fairly open and come at them based on questions that came out of my own prior research". P18: 18:16 (250:266)

"You should make a distinction between scientists who write books and those who don't. The average breadth and scale of problem are very different for each type of writing". P34: 34:26 (138:139)

Finally, a project was often linked into a larger research plan over time. a continuation of interests or a development with some intellectual or practical context. This was identifiable as the Project's Context and included both research background and other developments in the field while research was undertaken.

"Lets say I was starting in a new research project, now, it wouldn't be of nothing, obviously I would have some preliminary ideas of where and what was going to inform this research in order to shape the project in the first place". P28: 28:3 (43:45)

"Well, you rarely start out with a completely new area, the best example now is probably. I just started working on a paper on duelling, and this is actually new for me in that I have never done any History of elites which is what it is, so it is a bit of a departure but then on the other hand it deal with violence, and it is a crime and so on so it does have to do with things that I have been involved in....". P41: 41:7 (62:82)

Such adjustments included taking account of other projects results published in course of research.

"As we have gone through the objectives have changed slightly and the emphasis is changed slightly because some other research has happened which was published in November which alters our objectives and they will be publishing more next year. Otherwise there would be two pieces of research coming out at exactly the same time looking at very similar areas to we have had to slightly change the objectives, we have to abide by those because that is what the money was given for, but there will be more emphasis on some areas than others". P1: 1:22 (89:95)

9.3.3 Access to sources

Two types of Access issue arose within the data, these were Physical access and Resource access. Together they presented a substantial contribution to understanding Source Selection Decisions and the Context of Source Selection, which as discussed earlier was found to be a major component of Orientation.

9.3.3.1.1.1 Physical aspects

Access was in the first instance determined by physical location which was found in transcripts to be linked to decisions to adopt a source. or find an alternative. Physical location

appeared in a continuum from a source that was available with some exertion of effort locally through to something being entirely inaccessible or unobtainable.

Physical Access was defined by interviewees as being able to look at, and use, a Source, in this sense it is very much a matter of geographical location relative to the information seeker. This encompassed the location of materials within University Libraries. Hence on a dispersed University site if an item was identified to be of potential interest, but was located in a collection on the other side of the campus then Access became a factor.

Local availability, but at a remote branch library was one factor in Access. For strategies such as Browsing, ease of access was vital to use of Sources. Resources that were not easily available, unless they were proven to be very valuable, were ranked lower by interviewees. Where access was judged very important then interlibrary loans with an implied delay and travel across cities, or to other cities were identified in interviews as necessary. In these cases, libraries fell short of meeting the needs of interdisciplinary researchers

"I suppose access is quite important, in other words I am highly likely to find the journals I need are not taken by the library, I guess you can find this in the single disciplinary as well, I am highly likely to have to charge over to Hallam [another university's library] to look at the Computing and Education literature, having said that on a micro scale I am hardly likely to find anything I want at the local branch library even on Psychology. So accessibility is a bit of a problem, and thinking about it the others are that I mentioned and are to do with being sure of covering the ground, lack of familiarity with the literature". P9: 9:45 (284:291)

"[*When you describe going to the management school library was that the best source?*] Yes, unfortunately I have many arguments spanning many years, the collection of books and documentation that is relevant for me, i.e. these International Annual Reports of international organisations, some of which we do have such as IMF, they used to be in the main library and then the library decided to take them to the Management School, and it became obvious that I was always going there to where all the Economics books were. At some point we managed to persuade the library that it was unfair to have the whole series there so they split it so that the old volumes were and still are kept at the main library, and all the national statistics and all these things are still in the main library. But the latest current issues are kept in the management school. So I find myself walking in between from one to the other". P2: 2:20 (147:157)

The description of dispersed Sources and the issues surrounding Access resulting from this were prominent in interviews. Particularly access difficulties could reduce usage.

"I think having to go right back to the very beginning, in a single discipline I do know where the journals are kept, I can walk in and put my hand on the journals straight-away, but with a multidisciplinary work I didn't have that information so I have had to be in-touch with libraries about journals and where the information is kept and on the internet as well I have been exploring new sites and again I have found it more difficult to assess them for quality, whereas in a single discipline I can judge for myself. But I have had to back to applying all the rules, you know, whereas with experience that becomes second nature". P17:17:30 (385:393)

Beyond material held by an institution, interviewees made decisions of Source Selection by Access locally versus material that though valuable would have to be ordered through interlibrary loans and therefore take time and expense to obtain.

"I don't know, I think accessibility is probably one of the things that would determine how I would make the decision, there could be five or six interesting sources, does getting access to those sources involve just a walk down the road to the library, or is it a few attempts on here

[indicating the computer] and getting it, it is how easy it is to get. It is not a terribly intellectual rationale but it would be ease of access". P10: 10:17 (126:130)

"Access, getting hold of things, getting hold of journal articles is a particular problem, particularly when you know there is an article and it is really important but it is out of print and your library doesn't have a copy and the lord alone knows where you are going to one". P21: 21:20 (162:165)

If availability for a particular source was not easy then information seekers would tend not to pursue that source. Where material was crucial, as with P20's example of Grey Literature, then considerable effort was expended by participants to obtain the material.

"Well, it depends on what you mean by information, if you are talking about data, or knowledge, if you think in terms of data access, skills, then the single biggest problem for a researcher is getting access to data or information. Even information in the public domain can be quite hard to get hold of. Also, you pick up obscure papers that might actually be quite interested that aren't published formally, but appear in that grey literature, and that is the sort of thing that is hard to get. I remember once struggling to get an article that was published in a journal called 'Chemosphere', I had the devils own job of trying to track it down - it was an obscure American Journal. I also remember trying, I came across a reference to a PhD done in Natural Hazards looking at how humans cope with earthquake. I even eventually phoned the university in Hawaii and found out that it wasn't submitted. So the person had referenced a PhD thinking that they were going to submit. Obviously, certainly at that point in time hadn't done. That was frustrating, it took a lot of time, effort and money to try and trace". P20: 20:25 (201:215)

Interviewees saw an improvement in the value of the Internet in recent years, though their comments on quality and the Internet balance out the ease of access gained.

"One of the biggest things is that even if you find information, then you need to access it, this is much easier nowadays with the internet because some of the things you can find them online, for instance, I found lots of PhD theses online, people who did a PhD put things there and I didn't have to order them away for six months. So access to information is one thing, even if you find something, then you have to get hold of it, which is the next step and sometimes even the abstract is not enough to led you to see if the article is going to be good or bad, sometimes it is, but sometimes, you think 'oh yeah I really want this article it is so essential that I can't live without it' and you get hold of it and you think 'oh yeah it wasn't essential as I thought initially'". P24: 24:48 (301:311)

9.3.3.1.1.2 Resources and Access

A range of variables identifiable as "resources" also influenced access. Interviewees cited diversity of the Information Sources and the spread across disciplines as making demands upon the resources that they could put forth on any interdisciplinary information seeking. As a factor of access one interviewee considered resources to be the deciding factor.

"...and in my case access was the ultimate thing because I had very limited resources anyway". P1: 1:11 (67:68)

The resource of time was most important.

"I think there are the practical issues that everything is all over the place, for example they might have moved most of the leisure books down St. Georges but they haven't moved them all, and all of the statistics information is up at the main library. So there is the practical aspect that you have to go all over the place to get information which is more time consuming and it can end up making you put off looking something up until you really have to which can mean

that you don't get around to checking something up and finished as soon as you should. I think those are the main things". P26: 26:15 (179:184)

"Not as often as I should, the intention is there but I never get the time. But keeping up with journals is difficult and we get some at home, but I only look at one or two journals". P27:27:9 (92:94)

Instantly accessible items were more attractive given limits on the amount of time that could be given to waiting for requested items. or to a particular aspect of a project.

"If it is a subject which is not entirely new, which I guess would be the case with most things that I would look at, I would go to what I would regard as up-to-date primary sources of information - review papers. to some extent books, but perhaps less so, and use those as a starting point to follow up a number of key names through the various search engines that I could use - BIDS in particular and anything that I would think intuitive at that point which would be again looking along the current periodicals in the library, and just acquiring things more or less that were available immediately. So starting with up-to-date reviews, and then working my way through spin-offs from those and then on to searches for the last five years". P16: 16:14 (169:177)

Limitations on the amount of material that could be ordered, purchased, travelled to see, were all presented as a factor of resources influencing Source Selection Decision making.

Access to Sources also emerged when Sources were in the form of experts in a discipline. On one level a minor problem, but more significant in view of the weight given to Networking as Information Seeking by interviewees and is discussed further within Chapter 9 as part of Context. Access also crossed into issues of self-efficacy and confidence where access to experts was concerned as in the following quotations. In these the full context of the interdisciplinary researcher as an individual working within a disciplinary framework was evident.

"...I think problem-wise it is often a problem of access and getting the confidence to talk to say – 'I don't know much about the ethnology world, what are the current issues' and who I would contact". P8: 8:15 (111:119

"Yes, well, in the Social Psychology thing there would be several academic members of staff who I know would have the answer, but I also have a friend who has just got her doctorate in Social Psychology and I would ask here instead because of the problem of status. It is easier to ask here than people who might use my lack of knowledge as a way of 'bad mouthing' my subject area". P10: 10:34 (213:217)

"Of course I have seen it in some instances that it will depend upon the position of the people involved in the process, what position they have within the institution and therefore what positions they are vis a vis one another, e.g. lecturers and professors and also women in relation to men". P19: 19:23 (303:306)

9.3.4 Navigation

A cluster of elements relating to navigation of disciplines as an outsider led initial coding to group these around the working title "Navigating Alien Disciplines". In considering the full scope, the heading Navigation Issues appeared more appropriate and was hence forward adopted. Related elements included Familiarity with the literature. The main issues were information organisation and terminology.

9.3.4.1 Information organisation causes problems and difficulties

Accepting that Familiarity with literature forms a basis for using literatures. the physical organisation of information was found to be significant in supporting interdisciplinary information seeking.

Interdisciplinary research will tend to group and utilise information from different disciplines. The Dewey decimal system of organising materials tends to the needs of disciplinary research. The comparison made by interdisciplinary researchers with their past work in single discipline research topics was again of value.

> "Well yes, it was relatively simple in those days funnily enough, and I can very vividly demonstrate this that when I wrote the first book Sociology of developing societies there was an enormous literature on modernisation theory and so on and I remember the convenience that in those days in the library all the books to do with social change, and societal evolution and modernisation were conveniently classed as 324.481 and I knew the shelves and I used to work through them and the referencing to other works there were very clear journals, there was one called the Journal of Economic Development and Social Change, the point is the that the pointers to the literature all seemed relatively straightforward and it was fairly clearly classed". P2: 2:43 (81:89)

> "Well in the single discipline everything was in text books and all very neat and tidy and all the techniques had existed forever. So you are basically learning how to use tools, so I was learning how to do linear programming, and then trying to programme linear programming into a case study. So everything that you needed was in text books and you could basically do everything that you needed by dumping everything into the computer and hacking about with it until you had worked it out. Actually learning to use things". P11: 11:11 (140:146)

The suggestion made in these examples was of an inadequacy of information organisation to enable relevant information within existing information systems for interdisciplinary researchers. This perception appeared where disciplines were to be identified (Identifying Disciplinary Communities, page 144) as in interviewee P15's case.

> "My perception would be a mono-discipline, it would be easier or more likely that you would be able to develop a cursory overview of that discipline and the range of knowledge that is contained within it. I think that is part of the answer, whereas my perception of interdisciplinarity it is much more difficult, you are spread much more thinly. so it is more difficult to have an overview of a single discipline. perhaps even difficult to be aware of disciplines that may be important". P15: 15:8 (61:66)

Interviewees indicated that their research interests were so unusual as to be uncharted and to fall between categories and coverage of materials. Potentially this would explain the perceived inadequacy of index and catalogue systems for much interdisciplinary research.

> "Well, I suppose possibly if you are working in a multidisciplinary area, the likelihood is that you are working at the interstices of the subject, you know where the two disciplines touch, and quite often that's uncharted or not very well charted, it won't be as well charted as the territory in the middle of each central area, and so it is more open. I think what I would say, you can have a go and see what happens. There is, I don't know if it is being a bit too flippant, but, in uncharted territory, there is quite a lot to discover….There is something else, that I don't know if it unique to me, that there isn't actually a great deal, sometimes the subject is too big or too arcane or its not been dealt with or its too volatile for much work to have been done on it anyway". P5: 5:10 (60:65)/ P5: 5:17 (100:103)

> "I am not sure whether these would be the same for single discipline, but I perceive the need to use a lot of interlibrary loans, you are getting at material that is not part of a main stream collection. An example might be the Journal of Educational Hypermedia and Multimedia, we

don't take it because it is not a mainstream Psychology or Information Science journal. There are quite a few journals like that aren't taken, whether that is because they are multidisciplinary, or just a lack of money to fund new journals. I am not sure about that". P9: 9:46 (292:301)

Where information organisation failed, looking at the texts rather than their bibliographic profiles was one of the few courses of action available.

"Library catalogues and book searches for information on those areas. but from there I think I found it actually really difficult to find the relevant information, from there, most of the time you have to see the text to see whether it is going to be of any use to you". P7: 7:6 (43:45)

9.3.4.2 Language and terminology

Language may be equally appropriate as an attribute of Knowledge and Understanding. in the Internal Context of Information Seekers. The decision to view Language related issues as External Context comes from the number of ways in which disciplines use language and terminology and the number of ways that this may vary external to the information seeker's own knowledge.

The most important guide was the view of interviewees that language and terminological differences were part of the accepted landscape of moving around disciplines.

I suppose the different disciplines have different terminology to describe the same concepts. but that is endemic in the settings that I am in, I don't know whether that is the same in mono-disciplinary research so much, that people are using terminology in different ways or to mean different things using the same terminology. That is just something that you accept that is just part of coming to understand the field that you are working in, it is part of the conceptual landscape. I don't see it as an information problem, it poses problems. but I accept them and am aware of them and they don't worry me greatly. P23: 23:39 (158:164)

The understanding of language as part of the landscape of interdisciplinary External Context becomes clearest in its most extreme form, when we consider the parallels with barriers to communication, and hence information seeking.

"The difficulty comes when, as Bernstein[4] would have put it, an elaborated code, where the language they use and I include Mathematics in that label of language, is one which you are not fluent in. Medicine is very much like that, I wouldn't begin to say that you can get into some of those medical issues, on the occasions when I have done that I think I have collaborated with someone trained in medicine. Clearly I don't have that background of concepts and training". P20: 20:15 (121:127)

"Language issues are fun. Science has it's own peculiarities as any major broad band does. thankfully we are all scientists so thankfully a lot of that is minimised. But yes different disciplines still have their own language and that certainly you need to see through. Interpretation of that can come from reading papers in the different disciplines and we do do this. but also from actually having the courage to say 'what are you talking about?', 'what was that word?', 'what was that technique?' and luckily (in our group) none of us are shy to say that". P14: 14:13 (83:88)

[4] Referring to the work of Bernstein, B. (1971). Class, Codes and Control (Volume 1). London: Routledge & Kegan Paul.

9.3.4.2.1 Two language barriers

Two primary situations prevailed in language terms. The first was a null vocabulary. As a part of the analysis this data could easily have belonged to Internal Context as an element of Knowledge and Understanding. In this information seekers were placed in a context for which they had no language relationship in place. The disciplines were built around terminology, abbreviations and descriptors specific to that area.

> "There were two types of problems that I personally had, one was when I didn't know the words that were being used, I didn't even know these words existed, so completely new words. I had no idea what their meaning was in other disciplines. So, I knew that a word might refer to a property of groundwater flow, but I didn't know if it had to do with the temperature, the direction, or something else, I had no idea. A null vocabulary. The second type is where we had the same vocabulary where we might have a similar word or the same word and I would naively assume that this must have a very similar meaning to the one that I understood from my own discipline. Sometimes it was and sometimes it wasn't. So these were particular problems". P15: 15:17 (152:161)

> "New things that I probably didn't know at the beginning, for instance, abbreviations and stuff that they use, for instance we use the word CMC, for computer mediated communication, but we can use online as well, or other things as well, or terms that are not used in other disciplines, for instance synchronous or asynchronous communication, and stuff like that. This is what I mean by terminology, things that if a person is new to an area that they are not going to know what certain things mean". P24: 24:51 (342:351)

The second part of language and terminology appeared in the form of words that were known from other disciplines, but applied to very different concepts in another discipline. To use the correct descriptor, these are homographs. As a source of navigation problems it appeared frequently, yet occasionally would benefit the interdisciplinary research by opening up new areas of interest and interpretation, as in case P12.

> "Sometimes the meanings change and that can sometimes be quite helpful for us because we are saying that in this project 'trans-nationalism' in Sociology is very narrowly defined but that it doesn't apply just to some very narrow groups. I think different ways of conceptualising things can be constructive rather than it being obstruction to understanding". P12: 12:23 (189:193)

More often the data suggested the need for adaptation and learning the new variations of language for each discipline, and hence methods of coping.

9.3.4.3 Coping with language barriers

Language and terminology difficulties were a major force in directing Orientation and Opening behaviours. Interviewees described use of introductory texts and general reading as one way in which they obtained the means to overcome language barriers.

> "I think there is a certain element of finding your way through the language in the first instance, I feel that I am perhaps that I am more familiar with a wider range of disciplines now, but in the early days I found that there was a certain style to particular disciplines and certain use of terms and language that takes some getting used to and delving your way through there are certainly synonyms and things that you might need to be aware of and there are cases where terms are used in slightly different ways, well even the term 'usability' from a computer science point of view is about testing performance in a fairly positivist view point, but whereas

from a work practice is about the people side of things, whereas in computers it is the system as focus. So there is difference in commonly used terms. There was also something in the education literature about 'affordances' which is very different from the original psychological use of the term. It is only by tracking through some of these literatures that you can understand how people are viewing these concepts and therefore how you can view that point of departure for that literature. Sometimes I expect it to be happening, but sometimes I just blunder on in the literature until I realise what they are actually meaning. It is just a matter of time and understanding. I am quite open to change and I don't see it as a failure if something that I started to work on turns out to be unworkable or needs change, but I guess I just read on through and try to make sense of what I am doing and I write a lot and write a lot about what I have read and I guess gradually it just then dawns on me. I'd like to be able to say I was smarter than that but I can't". P28: 28:12 (129:142) / P28: 28:13 (146:152)

"The thing that I haven't found, I hope I could find some very easy text books that would give me a very easy basic understanding say ethnography – a sort of bluffers guide that you would give to first years. So far I haven't been able to find that, so maybe I haven't looked enough, may be I should just go into a bookshop or something, but if you are following leads to very academic, jargon laden, academic texts, but that is not necessarily what I want to get an overview of what the thinking is in that particular subject. So I haven't found that yet, its difficult to tell just from a library listing whether something is very basic or is at an advanced level. You know I think general magazines, not so academic texts, non refereed journals, have been the most useful, but I haven't followed them up too much as yet. They're more useful because they are easier to understand from someone who is not within those fields. A lot of the work that I have been looking at is work by leisure scientists and cultural geographers and things and it still comes at things from a different angle, but it's the only information that I have to go on, so I have to use it to understand, you realise that there is a whole lot of History behind the terminology that they use that you haven't been trained in". P8: 8:13 (84:99)

Some described the process as "ploughing through", suggesting a feeling of unavoidable obstacle to be overcome.

"Well, the quickest way entry is to actually understand the language in which that other disciplines is actually operating and then that gets you the keywords and the way around that literature. [If the discipline is remote from your core disciplines, how would you gain entry, to understand the language?] I think by just encountering papers that you then sit down and plough through to discover that they are actually doing something that is relevant". P34: 34:15 (74:80)

"Sometimes I expect it to be happening, but sometimes I just blunder on in the literature until I realise what they are actually meaning. It is just a matter of time and understanding. I am quite open to change and I don't see it as a failure if something that I started to work on turns out to be unworkable or needs change, but I guess I just read on through and try to make sense of what I am doing and I write a lot and write a lot about what I have read and I guess gradually it just then dawns on me. I'd like to be able to say I was smarter than that but I can't". P28: 28:13 (146:152)

Others wrote glossaries and participated in what has been described as Picture Building activity.

"Well, I am a linguist, so words are my stock-in-trade, but I have got to write myself little glossaries at the very early stage, so that I am confident about what I do. So for example one of the collaborative projects is all about genetic markers in populations and how this might correlate with language family. And the question that arises immediately there at the moment - because of work that is going on in genetics is well - which sorts of markers do we want to look at. Most people have looked at Y-chromosome and Mitochondrial but they haven't looked at the [technical term removed by request of interviewee] another chromosome. I had to go off and look that up, but it is a question of trying to be absolutely confident if someone tackles me about this - am I going to be able to come up with a straight forward definition. So it is straightforward but it needs a certain amount of groundwork". P33: 33:22 (183:192)

Interpersonal Networks and Orientation completed the links to activities and behaviours for managing language and terminology issues.

"...even more knowing where to look for it. I happen to have a friend who is a pathologist so he would work with Medline, but I would never go to Medline and just have a hack about, until I had some idea of what the terminology was, otherwise you would be just looking forever. I am often looking for needles in haystacks and sometimes the needles that I think exist...". P11: 11:18 (187:193)

"Well, trying to find what the landmarks are, and what the language is, so it might include identifying what key pieces of jargon mean, there might be some sorts of keywords that I wouldn't have thought of, or the concept that I am looking for might be talked about differently in a different discipline, and so it is orientating oneself in terms of language and what might be the key journals, or websites, and keywords indeed if you are looking at a database". P39: 39:28 (189:193)

9.3.5 Social and Organisational

Information seeking behaviour occurs in a social and organisational context. Both theory and the Naturalistic Inquiry methodological approach suggest this to be the case. The present study set out to identify the social and organisational context of interdisciplinary researchers. The results presented in the following sections illustrate findings related to the appearance of Social Barriers and Organisational Barriers

9.3.5.1 Social barriers

Social interactions for information seekers appear to cover contact with professionals, such as librarians, and colleagues in both the same and different departments.

> "Incidentally on the topic of vested interests for many years when I have gone to the Management School, to the library there, every single time I bump into a colleague who will say 'What! What are you doing here' it is most irritating, there was a time when I felt, obviously I had other difficulties with the Management School long before your time, [names omitted] but take for example a colleague wanted to start a course some twenty years ago on political economy in Britain, and an economics professor objected that he wasn't allowed to use the word Political Economy. Don't underestimate the way that passions reign. At the moment I know that another writer in the area of Globalisation [name removed] an Economist who wrote a big book on Global Transformation, but has great difficulty with whether his books are submitable to the RAE. It works itself out with great venom. What he writes is what I would regard as Economics but it doesn't actually, it is not regarded as Economics for economics research rating discipline or subject. These are real and concrete fights. So at the end of the day in real life anything that approaches multidisciplinarity doesn't actually stand a chance, it just doesn't have whatever Historical, social forces, exist to support the discipline, the discipline is simply a cacophony of people talking with one another and not wanting to listen to somebody else". P2: 2:17 (120:137)

9.3.5.1.1 Power relationships

Interviewees with prolonged experience of Interdisciplinarity indicated that the relationship between individuals had an impact on information seeking. Personal and disciplinary status were difficult obstacles to overcome.

> "I mean also there is a third thing is that you end up that you are never the expert because you are always asking for advice....I am always going 'excuse me I am a learner, an apprentice, will you advise me', and that position doesn't change really, I can go across to Psychology and ask social psychologists for advice but my role, my status within this department counts for

nothing because I have to go over there and say I'm sorry I don't know the sources for 'test for depression' and so on. I think that can be a barrier to doing this type of work. [*In what way?*] It is a barrier in the sense that if you as an individual are very concerned about protecting your status, subject identity etc you don't want to reveal your lack of knowledge and there would be some individuals that I wouldn't want to reveal my lack of knowledge to, I would say that there would be some individuals who I feel I could say I feel okay asking advice from and others who I wouldn't. And those people would use my lack of knowledge as a way of point scoring. You know academic point scoring and 'she's a woman' sort of thing. So I think there can be barriers to doing that. Also potentially I think it wouldn't be just a point scoring competition I could have a germ of an idea they could say oh yeah that's quite an interesting idea, we could get a research grant for that why don't we just do that". P10: 10:32 (189:196) / P10: 10:33 (198:209)

Attempts to overcome power relationships were indicated by interviewees who had gained significant academic status within the university.

"I am not sure that I would take that position now, I may have taken that position in an earlier time when I was working in this way. Now, I think I might want to start right at the beginning and ask them what do you think about this, and how do you see this as being something of importance or significant, what sorts of things can you offer me with. So I would want to get something right at the base without there being too much of an established frame there, because the moment you have an established set of frames you already have some power relationships involved, now I am not romantic or naive to believe that you are going to remove the power relations anyhow, but one wants to be as possible and get the real participation of all people". P19: 19:24 (312:320)

9.3.5.1.2 Defensive

A component of the Social schema was the protection of knowledge by disciplinarians against interdisciplinary interlopers. This was in part linked in the minds of the interviewees with their "pillaging" of other disciplines for information that fitted their own particular needs.

"I think the problems arise when people are a bit protective of their particular knowledge area, where developments are being made but they are not releasing them - except to a chosen few - and that can have a real impact on what you are trying to discover. I think if you are not in the know of who's who in the field and looking at the right authors". P21: 21:19 (156:160)

"Well, when I worked here at Sheffield and where I am now, I always see myself on the margins of whatever department that I have been in, not marginalised, but in the main core established research core, but when you think about it, it is a mythical core and it is obviously depends on the people in the department who say 'this is our department's work', but I've never fitted into that. So, in terms of how that has been, sometimes it has meant a lot of work to both justify the work that I have done and perhaps to establish research funding to support that work in the early days. Once it is up and running it has actually been quite easy to continue it. I think I often have to make extra effort to explain where this work is situated and how it goes, whereas people who see themselves in the core take it for granted that we will all know what they are doing and what I found was that I had to spend a lot more time on that. It is often a requirement to work with people from other departments, so there is the overhead of coordinating and establishing those networks in the first place. Also, getting funding is often seen as slightly less fieldwork, not mainstream, and doesn't always fit into one research council or grant awarding body's domain, although that is getting to be less of an issue, so whether I am getting better at positioning myself or whether these things are more flexible now, I don't know". P28: 28:15 (165:181)

Interviewees saw themselves as need to be careful who and how they approached people and resources in other disciplines.

"Other issues, are at the much more general level – of whether the kind of work that we are doing is relevant to Linguistics, so inevitably at this level there is a kind of tiptoeing around in

establishing why you are doing what you are doing, but I don't mind doing that". P33: 33:24 (209:212)

9.3.5.1.3 Reliance on Networking as a weakness

The interaction of information seeking and Social Barriers and the preferred modes of information seeking created problems. Primarily, where Networking was a primary tool of information seeking, which for many interdisciplinary researchers in this study it was, that reliance clashed with the social relationships to impoverish information seeking.

> "Given a reliance on personal knowledge and networking, if you go to a discipline with which you not familiar then clearly that doesn't work very well you have got to build up contacts so for example our knowledge of Indian social science is very slight at the moment but our knowledge of British Social Science research on India is much stronger and there is literally no substitute for field work and networking in India. But you see some of the topics which are interesting cut across disciplines – which make you conscious of a topic rather than a discipline". P12: 12:24 (197:203)

> "Yes, well, in the Social Psychology thing there would be several academic members of staff who I know would have the answer, but I also have a friend who has just got her doctorate in Social Psychology and I would ask here instead because of the problem of status. It is easier to ask here than people who might use my lack of knowledge as a way of 'bad mouthing' my subject area". P10: 10:34 (213:217)

The alternative to social barriers, a supportive, non-threatening environment, was deemed to be the best for interdisciplinary research.

> "[*Are those communication issues are present in your searching?*] Yes, you would use and you would still find that you bring to the party your own bits, we would say something this way, and so you need to have a fairly high trust environment in which people will drop boundaries, share insights, they won't worry about academic qualifications, name order on papers, but of course everyone is and so it makes it hard. But you need a positive research climate". P3: 3:21 (202:209)

> "Yes, the most important facilitator of communication, I don't think is the different disciplines, but it is the freedom to communicate not worried about what one is saying, now there is the – I don't know what the full term for it is – but in most communications we have boundaries around ourselves and guard them with fences that limit the information that we pass out, so for example an extreme example of that is a brainstorming where on is supposed to say the first word that comes into mind. Again, that is generally the opposite of what most people do, but we try to do that sort of thing as a general part of conversation, we call it synapsing, we try to combine our brains and let all the thoughts come out and see what comes out of it. I think we do this most effectively on train journeys when no one can disturb us and we even come up with ideas for patents from them. In fact this is one of them, this was on a train journey from London. We combine different bits of information which on their own would have little value they would just be interesting, but combined together had great value potentially; because there is a complete and free exchange everything we just pass out on the chance that an interaction might develop that would then produce something of greater value". P13: 13:14 (62:74)

9.3.5.1.4 Organisational barriers

Beyond the social context, interviewees pointed to the organisational context as a further issues. These issues were raised in resource provision for interdisciplinary research in the first instance.

"I want to be fair to my department because they have always been much more open than any other department about the issue of developing countries, globalisation and so on but the problem with these annual international reports and particularly the ones that I am after is that they cost an awful lot of money and the way to solve this is to say 'try and find a friendly colleague in another department' and make joint application and the cost can be split between departments". P2: 2:25 (159:166)

"The host department doesn't always like you doing work with other departments, because they have this perception that if you are out there with other departments you are not in here. It is kind of bizarre". P20: 20:26 (224:226)

Whereas some had experience of other ways of organising interdisciplinary research that were more supportive the contrast was strongest in the minds of the interviewees.

"I also think one has to ask questions about the extent to which the institutionalisation of this topic is a means of enabling its development or restricting or denying it. It is just the way in which the academics, the institution, actually the social relations of intellectual life can be extremely restrictive, they can also be enriching, but one has to bear that in mind is that what happens through the process of institutionalisation that either creates an exciting and challenging climate becomes almost moribund and lacking in development. I remember once hearing a renowned intellectual Marxist scholar once saying in a lecture that the best way to remove the potential of Marxism as a revolutionary force is to set it as a subject within university life. In some ways that is a crude caricature, it has all sorts of problems, but nevertheless it is raising the question that we cannot afford to underestimate a careful examination of the context in which interdisciplinarity is attempting to take place and what is it within that context that will be enabling and what is it that will be inhibiting. Another is the problems particularly where any type of relationship starts to develop funded projects about where that funding should be located and who gets what. Who administers it, about where should where begin to find outlets for disseminating some of this work. There can be points of very serious division between participants in an interdisciplinary engagement". P19: 19:20 (281:293) / P19: 19:22 (299:303)

The practicalities of interdisciplinary research were also subject to institutional frameworks from department and university and wider to include funding agencies.

"[In a single field] I think practically it is easier and from an academic point of view we are always being told by our department to build up an area of expertise that you can be recognised in, that you can gain a name for yourself in and not to spread your research net too widely, but to focus on a particular area, I think that is seen as a good thing, though I am not necessarily sure that it is a good thing, though the university seems to think that it is good to be focused on one particular area.". P22: 22:7 (57:77)

"Well, I am working up a research proposal at the moment, it depends really on what it is, if it is in response to something that I have read, or thought about independently, then my thoughts tend to be quite focused because it is quite an individual point that you want to pursue, but in the present situation, and I guess this is something that is becoming more common for humanities research, it is a direct response to a call for proposals from a funding agency...". P33: 33:11 (95:107)

Finally, boundaries around interdisciplinary research were constructed not entirely from research interest, but as the result of an interaction with external context.

"I said I find it difficult to put boundaries around work, but in the end external factors force pragmatic considerations and place boundaries any way. You know PhDs have boundaries, funded research has imperatives that you have to work to, so there are external constraints which is a good thing, because I think that otherwise I would probably spend a lifetime on one project because there would always be something different, another angle, another resource. I am still learning what it means to be a researcher". P23: 23:31 (93:99)

9.4 Discussion

Context within information science has been a difficult area to define. Essentially the definition of Context has multiple variations and is the subject of extended discussion. The present study developed a view of Context directly from analysis of interviews and took Context to be a group of factors affecting and affected by information seeking, both internal and external context were identified. Elsewhere Dervin (1997:14) expressed the view that anything which is not the phenomena being studied is the context. Leckie and Pettigrew (1997) also suggested that Context is composed of the background social, cultural, individual, and organisational factors surrounding the phenomenon being studied. Vakkari, Savolainen and Dervin (1997: 9) do however come to the conclusion that "context constitutes necessary conditions for sufficient understanding...". Indeed, this echoes an earlier view that emphasised the importance of context as "the pattern that connects...all communications necessitates context...without context there is no meaning" (Bateson, 1978: 13).

Marchionini represents the broad consensus: "Each person is situation in a context that at any given instant influences all actions, including information seeking" (Marchionini, 1995: 34). Context was indeed also the subject of an Information Processing and Management special issue covering an overview of the cognitive, social and situational aspects of context. The editorial confirms that there is no single definition of the scope or meaning of context (Cole and Spink, 2002) as does the work of (Talja, Keso and Pietilainen, 1999).

In models of information seeking Kuhlthau is especially context conscious in detailing the influences upon the concept of Uncertainty (1993a) while omitting this from explicit inclusion in the Information Search Process model. Ingwersen's information retrieval model (1996) places an emphasis on the interaction of different parts of context, the user, the system, the query and so forth. Wilson (1981; 1997; 1999) also includes Context as a key component within his overarching framework of Information Behaviour and suggests that a range of factors could give rise to barriers to information seeking. These covered personal characteristics, social and interpersonal, environmental and situational, and source credibility. Where others talk of context it is often to focus attention on a particular user group. Many of the studies presented in the Information Seeking in Context, particularly highlighted in the first (Vakkari, Savolainen, and Dervin, 1997) and the second (Wilson and Allen, 1999) conferences.

In the findings presented here Context takes on a range of attributes and highlights their significance to interdisciplinary information seeking behaviour. Context was found to consist of the internal and the external experience and position of an information seeker. Internal Context consisted of Knowledge and Understanding and Feelings and Thoughts; while External Context consisted of Time, The Project, Access, Navigation and Social aspects.

The significance of how much knowledge and previous experience was high in the study. A low baseline of knowledge was identified as a possible starting point or introduction to information seeking. Caused by education and experience in disciplines it had specific effects on Orientation. Specifically the issues of creating Orientation from a position of little or no knowledge were identified. Extra training was mentioned in one case as a way of tackling information seeking from a position of low knowledge. Knowledge and Understanding also had an impact on behaviours from judging how much information was enough, to choice of sources, identification of keywords and suggested a connection with extended iterations of Orientation along with some perception of increased Opening activities. Further evidence suggested that interdisciplinary researchers were likely to experience Knowledge and Understanding in terms of distance from their home discipline. The implication of this is to suggest that the more similar or related a new information seeking project was, the more knowledge and experience could contribute.

As interdisciplinary researchers move around disciplines they expressed themselves as conscious of being forever in an "always a learner" situation in their interdisciplinary activity. Such descriptions highlight the situation for interdisciplinary information seeking but are potentially echoed in those areas that are identifiable as "fast moving" fields and in the area of distance learning\continuing professional development where parallels may emerge.

The factor of knowledge was highlighted in familiarity with literature, knowledge about sources and disciplinary concepts and conceptual frameworks. Each presented the information seeker with a learning challenge. A challenge which it appears varied with experience distance from a 'home' discipline. The knowledge element crossed over into Information Organisation. The issue of information organisation was significant as a factor in movement around information resources. The library profession are familiar with the idea of different frameworks for information categorisation – each catalogue geared to a specialist area that has a different citation order. This chapter raised the idea of 'cultures of information control' and this indicates a link with disciplines. The findings also indicate variation across disciplines as an issue of interdisciplinary information seekers who do not have the basic knowledge about what are the important landmarks for navigating disciplinary literatures.

In reflecting upon the findings related to knowledge it becomes "common sense" that knowledge and previous experience should be important and indeed be cumulative across time and from project to project. In this Vakkari and Hakala (2000: 544) offer explanation by suggesting the significance of previous knowledge structures on setting information need and information seeking behaviour. Kuhlthau's work (1999) also indicated the importance of previous knowledge in the information seeking process.

A limitation and boundary to the study is the identification of Information Need as a large area that offered a distraction from the focus of the study, information seeking behaviour.

Information need was not the focus of this study and is indicated in this chapter as an area for further development. Case (2002) considers information need as a key ingredient of models of information seeking, whereas here it is acknowledged as one element of a wider context.

The second major component of internal context, Feelings and Thoughts highlighted the complex interactions between information seekers' self-efficacy, confidence and self-perception. Feelings and thoughts were a contrast to the analytical emphasis placed on Knowledge and Understanding. The findings show that Self-efficacy. Confidence and Uncertainty, along with Self-perception and a sense of Coherence each contributed to the shaping of information behaviour: Particularly these led to coping through extensive Opening. Orientation and Consolidation with a side effect identifiable as Information Overload.

Previously identified and examined by Kuhlthau (1993), Wilson et al (2000) and Wilson et al (2002) the principle of uncertainty was confirmed in the case of interdisciplinary researchers by the present research. Familiarity with information sources was indicated by and linked to distance from home discipline; coverage of materials and the perception of incompleteness; and of not being able to assess the level of success in finding information was a further source of uncertainty. Uncertainty contributed to further Opening. Orientation and Consolidation, and particularly within these to Browsing and Verifying.

The identification of feelings continued as domain knowledge was linked to a poor self perception and low self-efficacy, which was linked in the data to the idea of perception generated from knowledge. Additionally these points were related to specific domain technologies and the familiarity of information seekers with specific types of database or website. Low self-efficacy was indicated to trigger coping strategies that were in this case an extension to Opening, Orientation and Consolidation processes. Work by Bandura (1977) identified self-efficacy in the form of a doubt about personal capacity. This definition fits precisely the experience recorded in the present study, though in the present study it contributes only one of several feelings and thoughts applicable to the participants. Brown. Ganesan and Challagalla (2001) offer further commentary that would be of interest as further reading.

Coherence was raised as an important aspect of interdisciplinary information seeking and offered a further dimension to understanding the progress of information seeking and the adoption of particular activities and strategies. Variable levels of apparent coherence were illustrated throughout interviews. This chapter highlighted particularly how dispersed material caused issues for keeping up-to-date, which tend to confirm the views expressed in Klein (1996). It was interesting that participants pointed out that bibliographic tools had allowed both ease and on the other hand the problem of expectations and volume to co-exist for the participants.

From uncertainty and self-perception, a further concept was identifiable: Information overload. Information overload was defined in this study as a difficulty of achieving and

maintaining a view of the whole due to the vast amounts of material available. The concept of information overload is confirmed in the literature, and highlighted in both interdisciplinary and other contexts.

In an excellent review of the literature Bawden (2000) identified early origins for the concept, citing Wurman (1991:143) who found it at the beginning of the twentieth century. Though Tildine (1999) cast doubt upon the existence of the concept the evidence suggests otherwise. Information overload is put forward as a huge organisation and personal problem (Shenk, 1997) and a significance management and practice issue as well (Schott and Westerinen, 2002). Associated in many works with complexity and interdisciplinarity, for example Wilson (1996: 193) stressed that overabundance was a severe problem for interdisciplinary researchers and indicated that the biggest hurdle was gaining the initial grasp of material rather than the simpler task of updating (1996:195). Bawden (2000) took this further and suggested that information overload was caused by the diversity of information and the problems arising from trying to hold a mental framework of materials together. Other contributions to the study of information overload include Olsen. Sochats and Williams (1998) and Blair and Maron (1985) who highlight information overload in full text retrieval, which it was noted in the findings presented here that interdisciplinary researchers are often drawn to.

Waddington (1997) usefully emphasises that information comes in all forms of communication, and collectively creates an overwhelming volume. Examples include email as a source of information load is covered by Goldschmidt, Folk, Callahan and Shapiro (no date) and in a report by Knowledge Ability Ltd (2000). Further contributions relate to information systems, business, and communication (Farace, Monge and Russell, 1977; Davis and Olson, 1985; Marchand, Kettinger and Rollins, 2001).

Distraction was highlighted in a combination of roles. Traditionally information retrieval would consider non-relevant items as superfluous and as such a problem to be eradicated by improved retrieval mechanisms. The data presented in this chapter indicates a different view, that distraction had a potential value in steering participants to inspiration linked to serendipity but here experienced as an affective element of information seeking.

Other feelings that were highlighted in the course of interviews were more difficult to explore within the bounds of the present study and covered a range from misery to frustration, the latter of which was indicated in Kuhlthau's work in more depth and detail. The details of the present study tend to confirm and expand the work of previous researchers on the presence of affective aspects of information seeking.

Kuhlthau (1993) indicates that feelings and thoughts are integral to understanding information seeking behaviour. The context of the present study allowed perception and personal feelings to emerge as part of the description of activities given by participants.

The implication of these findings tends to indicate the value of previous contributions by Kuhlthau (1993) in emphasising the role of affective aspects of information seeking. Uncertainty is confirmed as a factor shaping the amount and duration of information seeking. This is in accordance with previous examinations of Uncertainty have also confirmed the role and nature of the uncertainty theory (Kuhlthau, 1993; Wilson et al, 2000; Wilson et al, 2002). The findings allow a picture of low knowledge and low self-efficacy with associated higher uncertainty and relative incoherence leading to increased and diverse application of the core processes, Opening, Orientation and Consolidation. It would be reasonable to extrapolate an hypothesis from this position that higher levels of knowledge and high levels of self-efficacy would be associated with relatively less information seeking, measured either by duration or intensity.

External Context presented interdisciplinary information seeking behaviour within a larger framework of factors generally outside the control of the information seeker.

The first of these, Time, suggested that information seeking had an ultimate boundary placed by external deadlines, or available opportunities for information seeking activities to take place with the pattern of academic life described by participants. The second, the Project, brings in factors such as the size and type of project which were identified as defining the parameters for information seeking resources and time. These first two influences were in form extremely simple, both in identification and description. Their impact does however underpin the whole information seeking experience.

The third and fourth influences identified, Access to Sources and Navigation were closely related to each other. These aspects indicated that physical access and access limited by resources were significant aspects of interdisciplinary information seeking. Access took on a more complicated role when the issue of Navigation was added. Navigation problems could limit the extent to which Access was feasible. A key element of Navigation was the reliance upon Language and terminology. Interdisciplinary information seekers were found to be particularly vulnerable to two types of language obstacle. In the first type, a null vocabulary where neither the words nor the concepts were known to the information seeker. In the second type the words used may appear familiar to the information seeker but their underlying meaning and the concepts they were used to represent were different from the established meaning. Previous studies of interdisciplinarity, and particularly Palmer (2002) have derived a similar judgment about the position of language within information seeking, including null vocabulary and the situation of same words different meaning. Both the present study and Palmer's (2002: 90-102) suggest that social networks were drawn upon as a coping mechanism in these scenarios. Rice and McCreadie (2001) discuss at length the issues surrounding Access to Information and add further weight to the importance of Access in information seeking. Earlier

articles by Line link access to materials and serendipity. These literatures serve to confirm the findings of the present study.

The fifth, Social and Organisational, places the information seeker as an actor within the human social environment. The social networking, human, component of interdisciplinary experience was one of the most significant problems for interdisciplinary information seekers. Social networking was identified in Opening as an important information source, that dependence could also have the effect of reducing access to information resources or of significantly bolstering them. Socially, interdisciplinary information seeking was dependent upon "goodwill" networks between individuals from a variety of backgrounds, status and disciplinary origin collaborating to share information. Sheen (1982) particularly pointed to barriers caused by experts collecting information but not distributing information, similar in many ways to the experience of interdisciplinary researchers approaching unwilling experts from other fields. The Psychology of personality could potentially offer further insight into the position of individual information seekers. However, it proves difficult to consider measuring the human personality. Work covering interdisciplinary issues has touched on personality in various ways. For example Bromme found traits unstable, and possibly invalid, and that specific traits of patience and tolerance are less important than the situation and the context (2000:116). Bromme did however comment on hints of personal traits influencing interdisciplinary work, specifically that interdisciplinary work means moving about in foreign territory; participants must have a sufficiently strong identity of their own to face challenges to their legitimacy. The personality issue suggests a submissive stance for interdisciplinarians. Bromme points to Immelmann (1987: 86; in German) on the "necessity of abandoning imposing behaviour" for interdisciplinary research. The findings presented here suggest that an interaction takes place and it is one in which personality would legitimately be considered to have an effect.

The surrounding organisational climate also affected funding, access to resources such as interdisciplinary journals: a wide difference was found between a positive and encouraging culture and a negative and restrictive culture. Where disciplines effectively denied access to communication or cast doubt upon the effectiveness of interdisciplinary research information seekers felt reticent about approaching or found it impossible to obtain information from those sources.

Dependence upon social networking for interdisciplinary information seeking was indicated in an earlier chapter of this study and also by previous researchers (Sonnenwald & Iivonen, 1999). Where an information seeker's social network was absent or inhibited this reduced access to information resources. Departments varied in their support of interdisciplinary researchers. At its simplest level this might mean resources for

interdisciplinary journals were not provided. or that Research Assessment Exercise results were restraining influences.

In the broadest terms the findings of the present study add credence and detail to the factors suggested by Wilson's earlier summary of factors could give rise to barriers to information seeking. These were Personal Characteristics, Social and Interpersonal; Environmental or Situational; and Source Credibility (1981; 1986: 42). The more recent work of Sonnenwald and Iivonen suggest that information behaviour may be influenced by social networks in the degree to which access to information, knowledge sources and expectations or norms of information behaviour are experienced (1999: 435).

Within the study of interdisciplinarity, Spanner (2001) independently confirms the themes of context and barriers suggested in the findings presented here. Particularly he points to "cultural difficulties expressed were not restricted solely to intellectual differences. Technical barriers were also encountered and imposed by various disciplines..." (2001: 351). Collectively the findings presented in this chapter and the literature tend to confirm the complex nature of context.

10 The evolution of a nonlinear perspective

10.1 Introduction

Initial coding aimed to cover all aspects of the behaviour and experience of interdisciplinary researchers present in the interview transcripts. The results of these aspects were discussed in more depth in earlier chapters.

Concepts related to stages and time were identified early in the analysis. Subsequent re-coding and consolidation of these codes was combined with detailed consideration of their inter-relationships. The product points to areas of interest to the structure of information seeking behaviour particularly as it relates to stage theory.

This chapter details the process of initial analysis of codes relating to information seeking and the passage of time through to the presentation of mature categories and their implications for a model of interdisciplinary information seeking behaviour.

10.1.1 Coding related to time

Broad categories of concepts relating activities and behaviours to concepts of "time, order or chronological sequence", that is the order in which activities and behaviours were reported to take place within information seeking contexts, emerged early in the analysis. In the earliest part of the analysis themes and relationship of codes were not fully developed, but illustrated general concepts and contexts.

Further coding extended coding to identify relationships between codes and their parameters, for example when and in what order events, activities or behaviours were occurring within each individual's information seeking. Hence code 'A' might occur before code 'B' and be noted as such. In this way the coding developed into a substantial number of specific chronologically and function related points. Secondary analysis using network diagrams and the "co-occurrence" search tool of Atlas-ti allowed grouping of individual codes around emergent code categories. Each code relating to activities and behaviours from the initial analysis was considered separately as it related to chronological sequence.

10.2 A stage view

From the coding and grouping of concepts related at the simplest level to time a simple picture of "stages" emerged from interviews, that picture consisted of three stages: an "first", "second" and "third". Membership of categories was illustrated in a sequence of Atlas-ti

network view diagrams. The visual method of organising emergent categories initially focused the categories on separate "corners" of an on-screen layout.

Diagrammatically, the progression from showing "first" as shown in Figure 16 and superimposing second, as shown in Figure 17, and a third, as shown in Figure 18. Individually the identification of a "first", "second", "third", as shown in diagrams these diagrams suggested the possibility of a basic stage model.
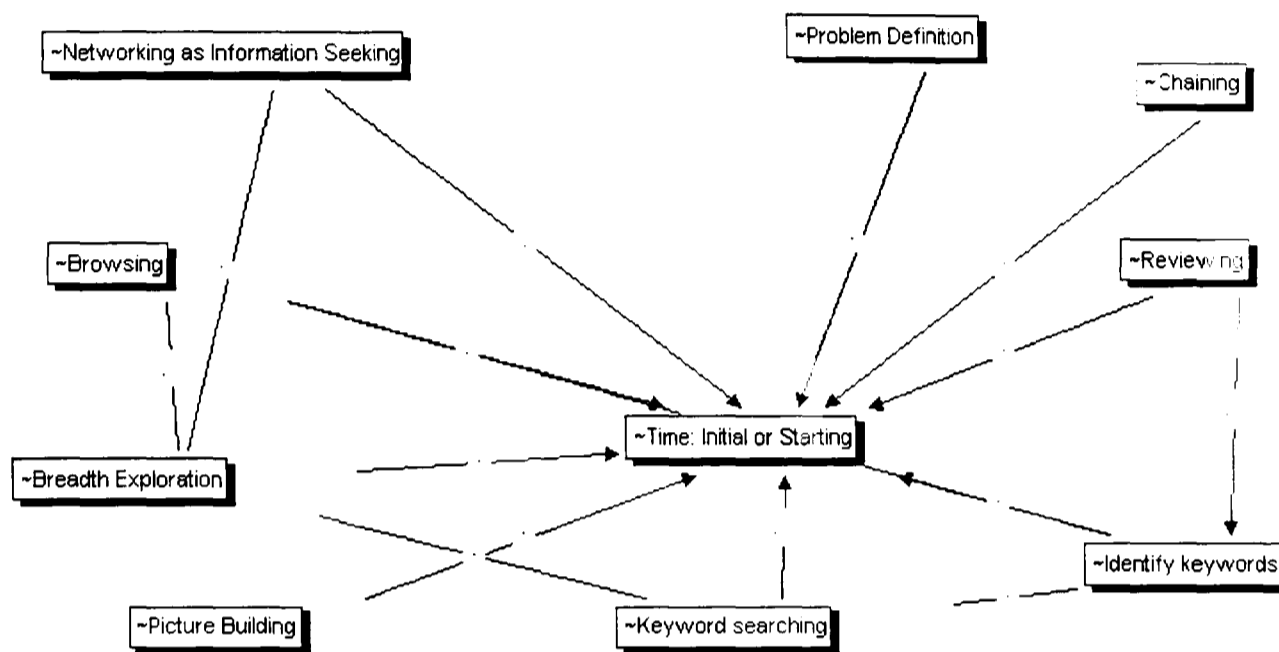
Figure 16. Initial analysis: The emergence of a first stage
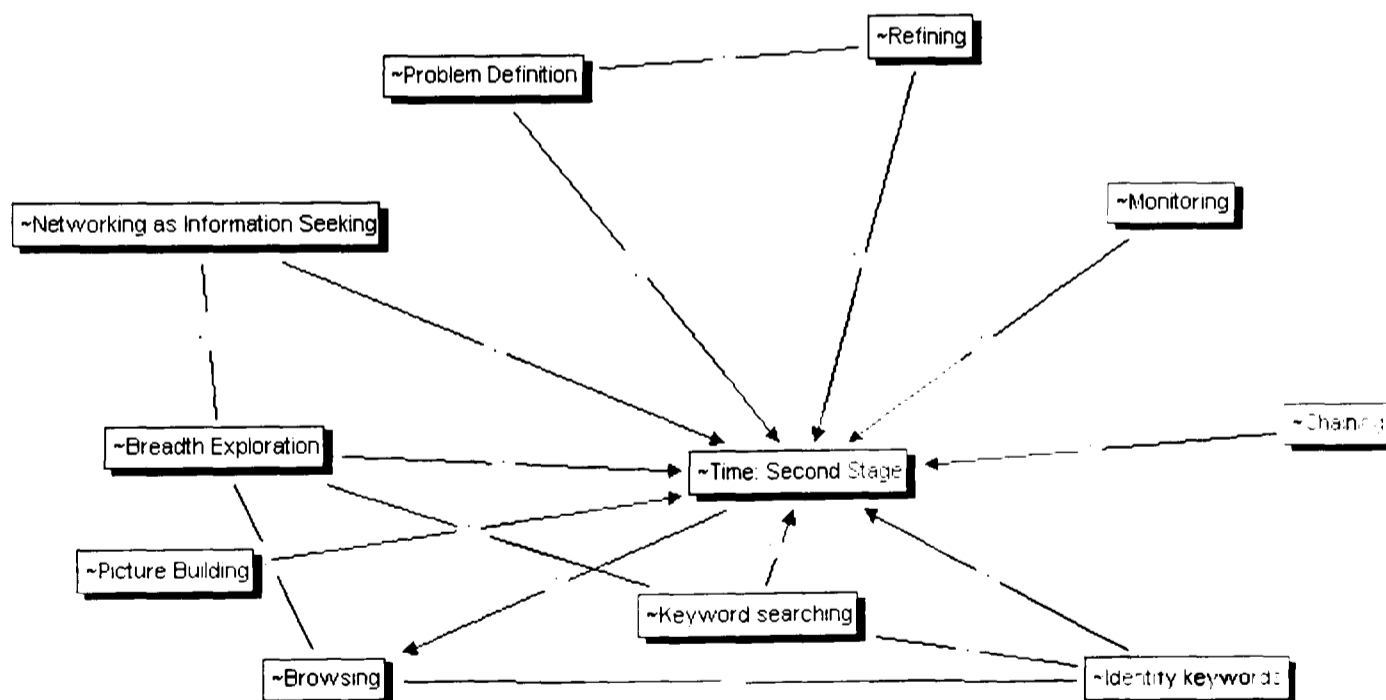
Figure 17. Initial analysis: The emergence of a second stage
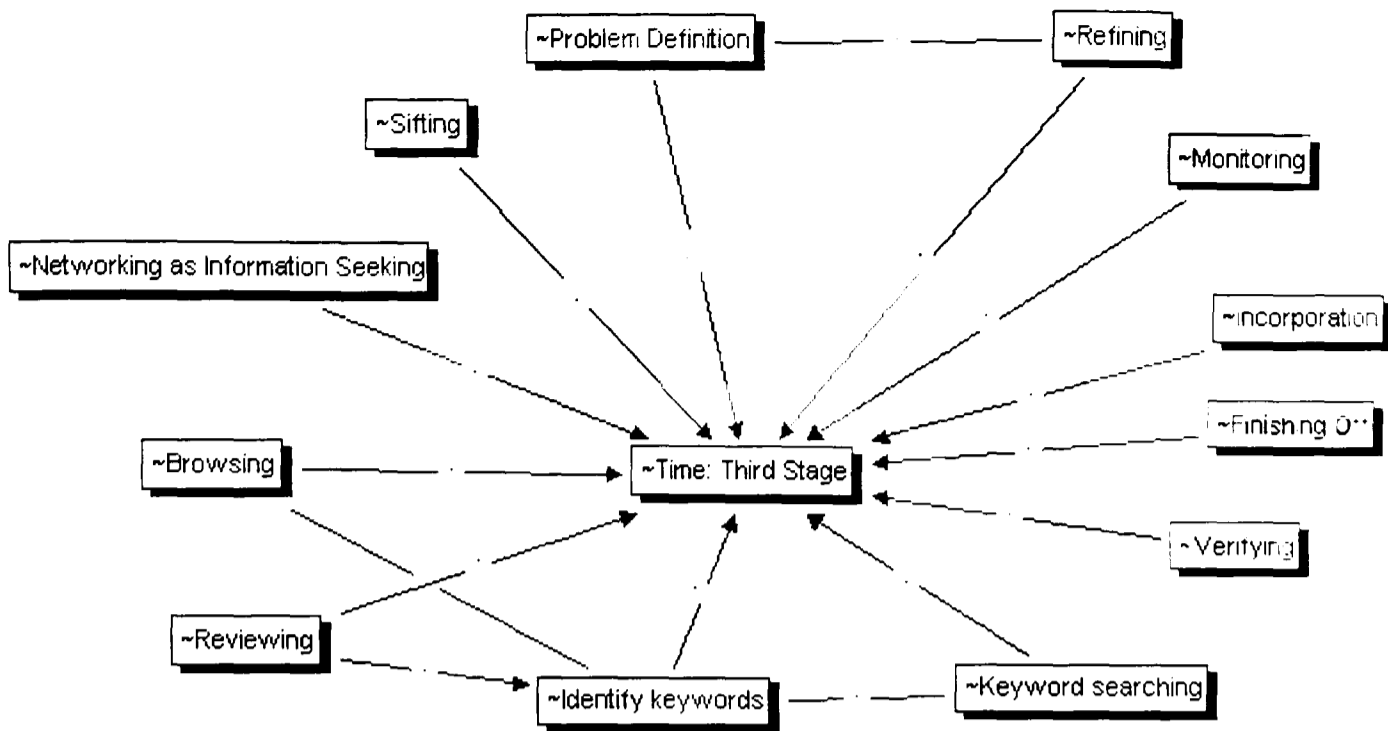
Figure 18. Initial analysis: The emergence of a third stage

Support for this view came in the form of codes attributable to particular "times" within projects even though they are attributable to other "times" as well, and to the identification of activities that are specific to particular points, that is they were grouped in the order they were described as occurring within the course of a research project, and the particular search episodes when different strategies would be used.

Once the relationships of codes to categories was established a second sequence of diagrams was created and used to visually compare the code membership "stages" and to identify commonalities. Used in this manner code occurrence and code relationships were visible and directly comparable.

10.3 First stage, second stage and third stage

The aim of this section is to provide a brief overview of the data which lead to a view of stages. It is not a complete exposition of the data related to particular activates and strategies, rather the aim is to provide an overview of the occurrence of activities and how the activities came to be categorised in the stages described in the previous section. The data contains pointers, both explicitly and implicitly through language and description of the place and role of activities.

10.3.1.1 Timing: Problem Definition

Problem Definition was identified in the work of interviewees as existing throughout the course of projects. Descriptions placed Problem Definition primarily in the first two thirds of a project, with some further Problem Definition at a third stage.

"Well, at the beginning it is more a case of establishing parameters, finding out what there is, you might not be reading specific articles or books, you would be more compiling a list of articles and sort them and then decide which ones are worth getting hold of and which ones aren't. I suppose the middle bit is choosing which ones you are going to read, and finally, when you are just wrapping it up, you have a gap here, there is an article you never got around to reading but everyone else has referenced it. [*When you are having a look at what there is and you talk of sorting them out, and you decide what is worth having a look at, how are you deciding at that point?*] Probably on the basis of the journal, often I base it on the length of the article because quite often you get quite short one or two page pieces which aren't going to say a lot and especially if they are hard to get hold of aren't worth the effort. Also the author, if you know the author or if you have heard about him, or if they are someone who usually has something interesting to say". P26: 26:13 (154:167)

"...When I started the space and landscape work I did have some very specific questions in mind and they certainly weren't about space, what I was doing was reacting to a History book, but it was a History of science and medicine book and I was using a set of material that I hadn't looked at before to test the hypothesis of this book. So that was about science and medicine and I have talked about that in research, but it is quite clear that the material is about other things and it became very clear that the way these writers are thinking is spatially rather than medically for example. So I did have some very specific questions to start with and I have answered them, but also new ones have emerged". P31: 31:8 (56:64)

The data suggested that as a second stage, Problem Definition was described as following other activities that were strongly identified with the first stage.

"We started to look at how you start to find information, you have the questions, the keywords and knowledge base and I suppose generally speaking what I would be doing would be focusing down from the general to the specific, I'm trying to think of an example, in dyslexia one of the issues that has come up several times from talking to people, but not from the literature, is that people with dyslexia, or some people with dyslexia may be a danger to patients because of their inability to read drug charts properly, that is the perception. So doing the broad brush thing, I need to know if there is anything in the literature about it, so what I would do would be go back to the literature that I have already got and reread it and look for the little segments and try and draw them out and then I would go through a process of collating all the bits of information that I could find and bringing them together and then trying to come up with a narrow focus as to what the literature says about that specific issue. So that is going from general down to the specific". P6: 6:10 (109:124)

Elsewhere interviewees suggested Problem Definition as part formed but developing in a second and potentially third stage of activity.

"For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason, I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. Having read literature on education I realised it was part of a problem based learning exercise, then I realised it was part of a problem based learning exercise, and then I also realised that the live project was also relevant to anti-rationalist theory as well. But in a way I haven't absolutely defined it yet, I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it. In a sense I am ahead of myself as I'm doing my field research before I do the majority of my

literature work, but I don't really expect any surprises. I think I know what people will tell me". P7: 7:12 (86:99)

Ultimately Problem Definition was found in a third and final stage for some interviewees.

"[Having described two steps Interviewee went on to describe Problem Definition] Hopefully at that point I would be able to somehow identify or perceive some common ground with the experience that I have from my discipline and if so then I might be trying to identify specific topics or perhaps a list of keywords and go directly to a database at that point, like a science citation data or a library catalogue or a web search. On the other hand, if I feel like this is really largely well beyond my experience then I will probably try to find an individual, probably first within the department and then within the university and then perhaps I may even look for organisations either in industry or universities where I could contact somebody and send a plea 'could you help me I'm looking for...' and try to just get to talk to somebody. At that point if I am really out of my depth then I need something very interactive and preferably something personal that I can find somebody that I can really talk to and give them a picture of my level of ignorance and hope that they can point me in some direction that would kind of bring me back into that previous level of understanding". P15: 15:13 (86:99)

Further data suggested that Problem Definition was found at all stages of Information Seeking.

10.3.1.2 Timing: Networking

The data illustrated Networking to be important and integral throughout the research process. For the interviewees Networking was described as an essential initial activity as shown here by Interviewee P10.

"This sounds terribly weak and feeble, but I mean I would go and find human beings to help me, that would be my first line of attack....I would say an hour chatting time with somebody would give you a slant on a subject area that will be of more use in the early stages than trying to read a huge amount". P10: 10:7 (50:57) / P10: 10:38 (233:237)

The usage pattern continued such that following initial search activities Networking continued to play a key role. The pattern for second stage networking suggested some prior preparation or knowledge upon which Networking could develop.

"I would certainly still do the literature search first, so I knew enough to be comfortable enough to contact people within that field and then you would identify a part of that field and home in on that and focus the literature search and identify specialists from thereon in that we could contact. So yes, that is it really in a nutshell". P14: 14:5 (21:24)

"So I guess the next stage is going to back for another look. That to a lesser extent happens with other projects as well, I'll start with my own fund of knowledge, and form a question and then I'll start asking people if they know any other materials". P37: 37:40 (130:132)

The third point at which networking was identified suggested Networking was present through to the completion of research projects. Thus, the example participant P10 described the last part of research as Verifying and Checking with a colleague.

"Final things, oh dear, well using other people, not really different things than I have done so far, 'please will you read what I have done so far, is that the right kind of thing' and so on, I will always check with somebody else". P10: 10:18 (131:143)

10.3.1.3 Timing: Browsing

Descriptions of Browsing were closely found associated most often with information sources, and the usage of information sources at different points through browsing.

> "Well, it seems obvious in a sense, I would say go out and one thing that I haven't talked about, I would go out and browse the library shelves at the beginning of a project and I would browse recent journals and I would browse the relevant shelves". P23: 23:47 (249:251)

The use of Browsing continued throughout the later stages of projects. In the later second and third stages it was particularly associated with the use of current journal shelves and bookstores

> "Yes, I think I do quite a lot of browsing initially, but I do become more systematic as I go along, but I do still browse though...". P17: 17:26 (356:360)

Browsing also operated on the basis of foundations built from earlier information seeking, thus identifying its role chronologically and blended with descriptions of a third stage for some researchers.

> "I would be looking for much more specific information. It is at the start partly where you are exploring the topic in general, whereas I would be looking much more specifically. I still use the tourism and leisure abstracts, but I do that to try to keep up-to-date. I am subscribed to several Mailbase groups which send out information, Elsevier Science send out an index to their journals when they come out, so I get those for three of the journals I look at. If I am in the library then I browse through just the current journals in the index. It is much easier once you have got that basis [of information sources], and also I get publisher's catalogues come in so you can, and the University of Leicester bookshop publish a regular Museum Studies Catalogue which they send out so you can look through and check what is new". (P26 26:7)

> "I think I browse right at the beginning of a research project, I said that often what I am looking for is approaches and theories and concepts which I can then shape and choose from but use ultimately, and so at the very beginning - [for example] with History I'll have already looked at some of my sources and then I am going out to secondary material and yes it is at that point I'll be browsing, because it is at that point that there is creativity comes in. When you are trying to work out how you are going to bring this material alive and choosing which direction you are going to come from. It is then that you try to be as wide as possible in your searches as possible". (P31:31:18)

Browsing was of least significance to interviewees at the third stage, where it was connected almost incidentally with other activities such as Sifting through results using a browsing method.

> "[Following descriptions of earlier activities] Then it is back to sifting out and that is where the abstracts come in, and that is where on some of the databases quite often don't make an abstract available you get a title and no abstract and so unless it is good - that the title itself is fascinating then if they are not going to give me an abstract then I'm not going to bother with it, because again it takes so much time to get it, things like the BMJ are online now so you can actually go and get it but it tends to be the smaller journals that want their money I suppose, [that don't put electronic texts online]". (P4: 4:41)

10.3.1.4 Timing: Breadth Exploration

Breadth Exploration, identified as a strategy for information seeking also forms a major part of the information behaviour identified within the data. In coding the data and subsequent

analysis breadth exploration was shown to belong to the first two chronological stages identified by Interviewees.

Breadth Exploration was discussed in terms of initial information seeking. Interviewee P7 and P14 were illustrative of the description of initial moves based around Breadth Exploration.

> "I tend to go in with very simple questions to begin with and then from those questions I will start refining until I get to the pieces of information that I want". P14: 14:51 (150:157)

> "For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything...". P 7: 7:12 (86:99)

> "I have really kept things very broad at the moment. A lot of it was done by my predecessor as well, but sort of looked at therapy, physical therapy, occupational therapy, and then the client groups - stroke, fractured neck of femur, age as well, clinical competence, multidisciplinary care, team work, task performance and analysis. That's it at the moment, I haven't looked on Cochrane (a specialist www site) which is the other one that I wanted to look at". P17: 17:3 (53:60)

Interviewee P8 expressed the need to obtain information from an open ended and informal range of possible sources and activities at the earliest stages of information seeking.

> "Well, I suppose the first stages are, trying to pick up informally what I can from what I read, and trying to be quite open minded about where information has come from". P8: 8:7 (59:63)

Breadth Exploration was found again in the second stage for the interviewees as something that could be a follow up to other information seeking.

> "...and then to some extent look at it more broadly and look at socio-linguistics and dialectology and some political and critical theory and things". P38: 38:32 (218:220)

Breadth Exploration was restricted to the first two stages, those stages linked in the descriptions of interviewees with finding new information and increasing range of sources. The third stage indication was of refining rather than breadth exploration.

10.3.1.5 Timing: Picture Building

Picture Building was found in first and second stages, though the data describing this area tended to be briefer than on some other activities. Nonetheless it appeared initially as in this quotation.

> "I have got to get the broad picture, in other words I am very unlikely to dive in and start reading in great detail, particularly looking at new aspects. I have got to be assured of the overall – where does this fit in – I am very unlikely to commit effort and time to something that won't subsequently be useful". P 9: 9:55 (89:95)

Explained as part of a list of events "mapping" formed a part of second stage activities.

> "So I tend to be mapping out and seeing how it all fits together as – that predominates as I am building the picture and at a later stage I will then get down to the details and pull in all the articles and read them in greater detail". P9: (93:97)

Chronologically third stage was indicated to be a time of consolidation rather than mapping of new areas and therefore the absence of Picture Building after the Second Stage would be credible.

10.3.1.6 Timing: Identify Keywords

Identification of suitable keywords continued throughout the first two stages, with identification of new keywords still present, but less common in the third stage.

> "I think the first thing is actually being able to recognise the keywords and the terminology in the other, across the boundary. The people will be looking at essentially the same phenomena but they will use a different description of it, and once you have understood that you can try to track that back in the other field and realise that perhaps 80 per cent of the papers you have found in a different perspective is actually irrelevant to your needs or incomprehensible to you...". P3: 3:8 (71:80)

Following initial information seeking the initial results were used to identify further keywords. In this way the effectiveness of each method was increased by contribution to and from other methods.

> "Once I have done the initial search, I would then be looking to see if there were any other keywords, because sometimes in the articles you get, in the ones that I consider to be the good ones, you get keywords that would have found that article and that is just wonderful, because you can find that those keywords and this one and find keywords that you hadn't used in your original search and find other articles on the same area that you hadn't otherwise found. But it doesn't always work". P4: 4:16 (176:181)

> "It started with a few articles about general stuff, and then I tried to figure out some keywords, and the keywords became more and more elaborated as soon as I was reading more and dealing more with the topic, then you cannot help it the keywords they will come up to the surface. I am not sure if you are really aware at the beginning of what you are doing, you just read and read and then you reach a certain point of time where it just pops up like that and comes to the surface and you think 'oh yeah' this is a thing that I have been seeing here and there all the time so I guess this is a keyword lets use that. That is how I did it and you are basing your things on other things - articles - all the time, trying to figure out keywords from abstracts". (P24 24:41)

Interviewees indicated that keywords continued to be drawn into the process of information seeking after initial searching and following reading of retrieved items. Identification of keywords continued as product of other activities too, hence networking and serendipity produced new keywords along with other information through to closure.

> "[Following a second step] Hopefully at that point I would be able to somehow identify or perceive some common ground with the experience that I have from my discipline and if so then I might be trying to identify specific topics or perhaps a list of keywords and go directly to a database at that point, like a science citation data or a library catalogue or a web search". (P15: 15:13)

> "Once I have done the initial search, I would then be looking to see if there were any other keywords, because sometimes in the articles you get, in the ones that I consider to be the good ones, you get keywords that would have found that article and that is just wonderful, because you can find that those keywords and this one and find keywords that you hadn't used in your original search and find other articles on the same area that you hadn't otherwise found. But it doesn't always work". (P4: 4:16)

Ultimately the suggestion for some, such as interviewee P4, was that keywords would appear from the information retrieved or develop with exposure to materials as in interviewee P31.

> "...They come out of the ether, those keywords just come from the meeting of me and my sources, in the case of landscapes it is really that I wanted to think abstractly about these sources, up to a point where things like 'place' and 'space' seemed like things that people might put in their book titles, so where do they come from, it is really the collision between me and the materials really". (P31: 31:58)

10.3.1.7 Timing: Keyword Searching

Although keywords obviously have to be generated, this did not preclude the appearance of tentative Keyword Searching as a popular first information seeking activity. The tendency was to indicate some prior grounding as a basis from which Keyword Searching could progress.

> "I think I take a broad brush approach, so I do things like going to the journal databases and do keyword searches on things like dyslexia, I would also go to national institutions associated with the subject that I am interested in, if they exist, like British Dyslexia Association, and I would also probably look into other areas and fields". P6: 6:3 (28:35)

> "Well, what I did was create a huge, enormous bibliography using the bibliographies of all the books that I think were relevant at that time to what I was studying and so if you like I had an immediate database to look at and then if you like from there I did in parallel to that I did the normal type of word search". P5:5:19 (122:125)

Choice of initial source also pushed towards Keyword Searching was associated in interviews with particular sources that themselves were found in the first two stages of information seeking described by interviewees.

> "First of all I would start with the University of Sheffield through a search engine with basic keywords. Then I'd also look at the Guardian online and I also did web searching to find home pages of people and this is where I did most of my searching". P37: 37:31 (36:39)

While Keyword Searching was found to exist and continue throughout a third and final stage, for example as found in interview P23.

> "...With a final trawl through and maybe a final literature review from a key database, it would be at that stage updating". P23: 23:41 (176:180)

10.3.1.8 Timing: Reviewing

Information seeking was found to occur very rarely without some link to previous experience or knowledge, however tenuous.

> "Well, this idea wouldn't have come from nothing, I don't think so, so there will always be that body of prior knowledge that I am aware of on which I will be building". P23: 23:36 (118:145)

The activity of Reviewing was found to be an important initial step for the academics interviewed. The process took on different characteristics, from a thought process, as in interview P15.

> "I first mentally review the literature that I have read, oral presentations that I have attended, and attempt to recall anything that I think could possibly be relevant...". P15: 15:9 (73:74)

Reviewing was present in activities such as writing and planning on paper to provide a structure.

> "Well, initially, I would start off with a broad heading and just sit down and write a list of words that relate to my topic area...". P17: 17:20 (274:278)

Initial knowledge reviewed in these ways provided for a variety of subsequent moves. as illustrated by interviewee P16

> "If it is a subject which is not entirely new, which I guess would be the case with most things that I would look at, I would go to what I would regard as up to date primary sources of information - review papers, to some extent books, but perhaps less so, and use those as a starting point to follow up a number of key names through the various search engines that I could use - BIDS in particular and anything that I would think intuitive at that point which would be again looking along the current periodicals in the library, and just acquiring things more or less that were available immediately. So starting with up to date reviews. and then working my way through spin offs from those and then on to searches for the last five years". P16: 16:14 (169:177)

Reviewing was not present at the middle stage, when other activities appear more prominent, however it reappeared in the third stage alongside discussion by interviewees of the parallel tasks of Finishing and Verifying.

> "...I get to a point where I feel that I have enough material to get through and then there might come a point where I realise there is a gap and have to go back and think oh I need something here. So I might well go back and do more searching". (P39 39:15)

10.3.1.9 Timing: Refining

No evidence for Refining activities was found chronologically at the earliest stages of information seeking. However, interviewees indicated that Refining was possible soon after initial information seeking. Interviewees spoke of moving from the general to the specific. of focusing on smaller parts of the whole and defining boundaries for searches. Interviewee P6 described how Refining fitted into the information seeking pattern.

> "I suppose generally speaking what I would be doing would be focusing down from the general to the specific, I'm trying to think of an example, in dyslexia one of the issues that has come up several times from talking to people, but not from the literature, is that people with dyslexia. or some people with dyslexia may be a danger to patients because of their inability to read drug charts properly, that is the perception. So doing the broad brush thing. I need to know if there is anything in the literature about it. so what I would do would be go back to the literature that I have already got and reread it and look for the little segments and try and draw them out and then I would go through a process of collating all the bits of information that I could find and bringing them together and then trying to come up with a narrow focus as to what the literature says about that specific issue. So that is going from general down to the specific". P6: 6:10 (109:124)

Refining was present in interviews as discussion moved to contemplation of finalising searches and of finishing information seeking.

> "...Whereas when I have got my data I would be a lot more focussed in that I would be trying to search for certain things or evidence if I find something that doesn't fit the evidence that I have already got I would be searching particularly in one area for something very small". P1: 1:20 (145:149)

"...Then you would identify a part of that field and home in on that and focus the literature search and identify specialists from thereon in that we could contact. So yes, that is it really in a nutshell". P14: 14:5 (21:24)

"...I think really focusing down on relevant stuff". P17: 17:19 (254:256)

10.3.1.10   Timing: Chaining

Chaining appeared here as a possible starting action, that interviewees saw as happening less often at the beginning of a project. Chaining in the beginning stages relied on receiving a stimulus – either the original stimulus for the research project or receiving an early piece of information from which chaining could progress.

"I think of the keywords, you can do sort of exploding an area where you put in one big umbrella area and then narrow it down, or you can start off more restricted and widen it out. or if you know that somebody has written a lot on an area and then look for citations. So if I find its quite narrow, then if you have a good reference then you can find other articles that cite their articles and be honing in on that area. But if you are new to the area, then you probably haven't got that and you probably have to start wide and work down". P4: 4:5 (49:54)

"If we take an example of consumption issues in India, I start from a pretty low level of knowledge but I have a sense of some of the people who are working in that area, so I would start with some of their work, for example I came across a really good book called 'clothing matters' but which happens to be about India, I got that through Interlibrary loans, followed some footnotes and citations, but simultaneously contacted the author who suggested other contacts in that field. P12: 12:18 (150:155)

Chaining was found in a second stage. but was not evident in the third stage.

"So starting with up-to-date reviews, and then working my way through spin-offs from those and then on to searches for items from the last five years". P16: 16:14 (169:177)

The second stage highlighted citation searching as a gap filling exercise to check information.

"...There is a creative phase where one is really trying to look around a whole lot of areas and finishing up with looking around and making sure that no one else has done this before or whatever, or checking out doing much more conventional citation search or something like that...". P43: 43:29 (350:355)

10.3.1.11   Timing: Monitoring

Monitoring was a less common activity, justified by interviewees as a consequence of an ever changing and developing knowledge, information need, focus. Interviewees who specifically cited such behaviour saw it occurring after initial searching through to completion of the project.

In the second stage it appeared as in this quote from P23.

"I would not be particularly proactive, it would be just more a monitoring kind of effect. so yes, just hanging in there on the mailing list, checking stuff as it goes past, picking up on chance encounters with what might sound like relevant references - maybe through conversations with people, going to conferences, so it is a kind of state of alertness but it is not really information gathering as a principle activity". (P23: 23:40)

It also appeared in the third stage as in this quotation from P22.

"I suppose once I have found a good site, either a journal or a web site or a consumer site or whatever then I'll bookmark that - either on the website, or make a note of the journal or I might even subscribe to the journal or make sure that I check it when I wander in the library. Often they will feed off each other, when you find a good article in a journal then I will chase up those references in it and it will go on from there". P22: 22:17 (157:162)

10.4 Multipoint coding

Once established the First, Second and Third stages were available for direct comparison and wider consideration. The most significant factor to arise from this comparison of stages was the pervasiveness of activities and strategies throughout the entirety of research projects.

The largest proportion of codes indicated a picture of events in which an overlapping core of activities and behaviours were found. A new code "C: Multipoint" was established to highlight those codes that appeared in multiple stages, shown in Figure 19 and further emphasised by the superimposed Atlas-ti Network view diagrams from each identified "stage" and Multipoint, as shown in diagram Figure 20 showing stages one to three and the Multipoint coding group superimposed in one diagram, one line for each connection to a stage category.
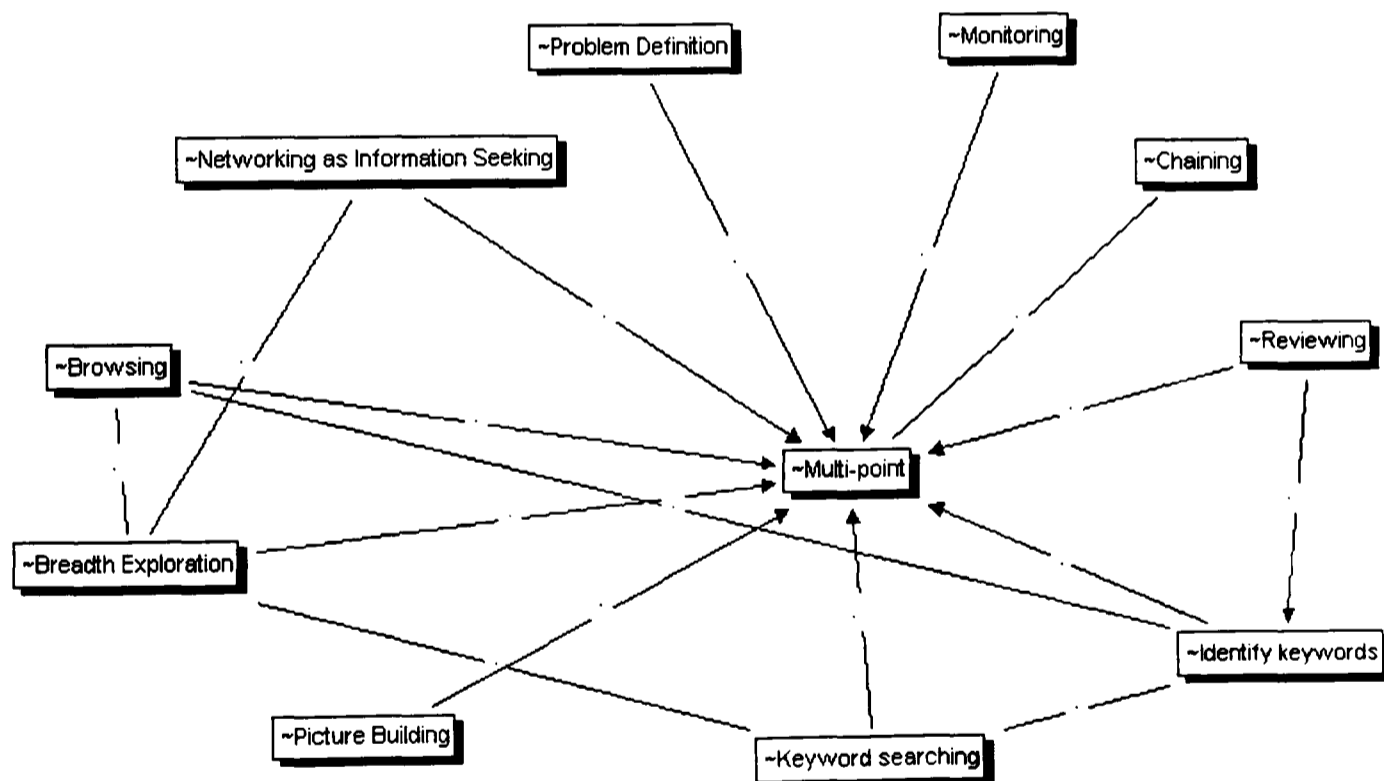
Figure 19. Multipoint Codes
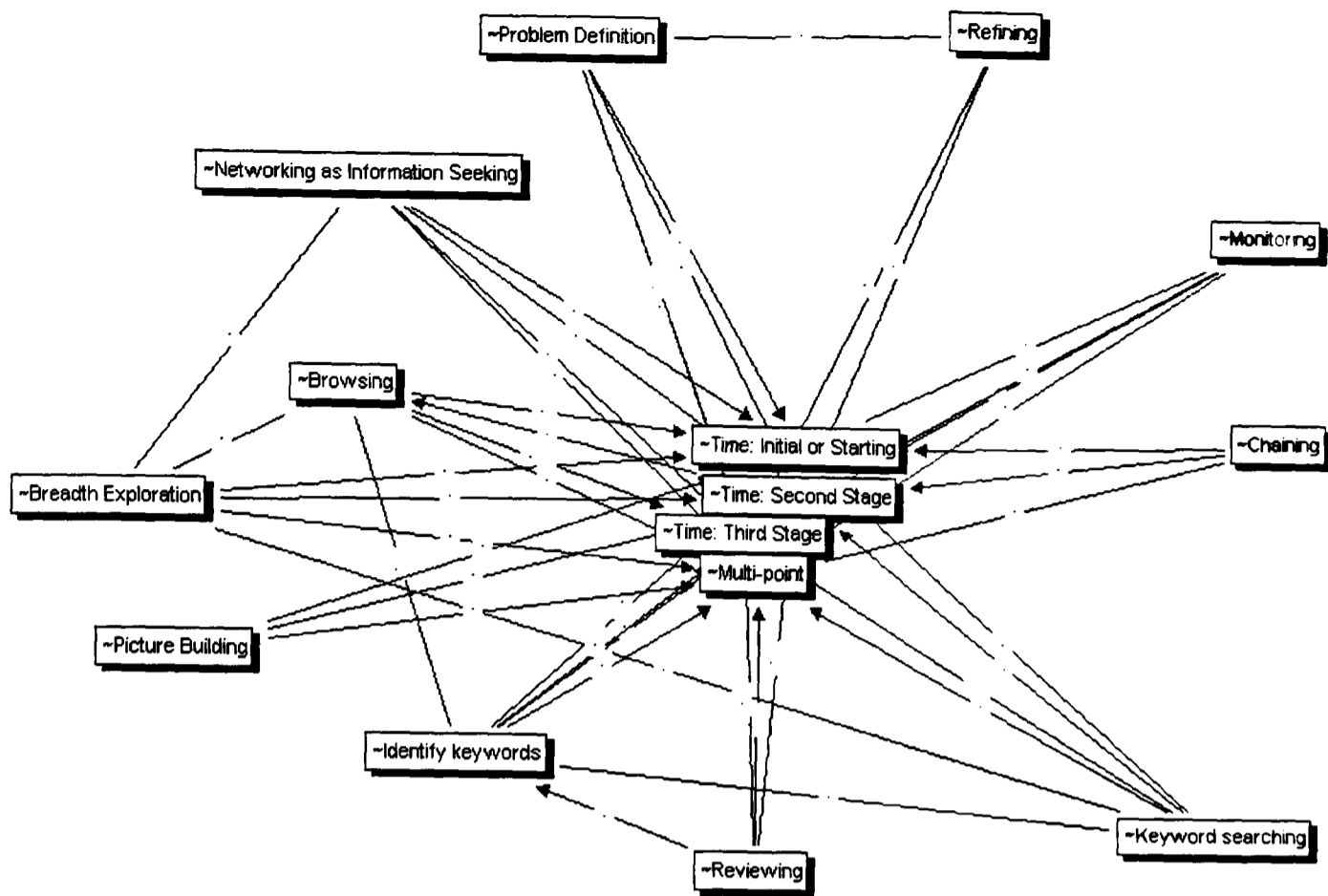
Figure 20. Stages Superimposed

Time (1)	Time (2)	Time (3)
	Monitoring	Monitoring
Problem Definition	Problem Definition	Problem Definition
Networking	Networking	Networking
Browsing	Browsing	Browsing
Breadth Exploration	Breadth Exploration	
Picture Building	Picture Building	
Identify Keywords	Identify Keywords	Identify Keywords
Reviewing		Reviewing
Keyword Searching	Keyword Searching	Keyword Searching
		Verifying or Checking
	Refining	Refining
Chaining	Chaining	
		Finishing
		Incorporation
		Sifting

Table 12. Summary of Time: Activities

Collectively these elements provide a compelling picture of the data: that the dominant concepts associated with interdisciplinary information seeking can be associated with more than one "stage" of information seeking. That is to say the concept of time related to descriptions of activities was of limited value.

Evidence for the presence of stages was therefore undermined once individual ideas of a passage of time and occurrence of activities were seen side by side with the resultant stages: The largest proportion of information events indicated an overlapping core of activities and behaviours.

The information generating activities and behaviours of interdisciplinary researchers were potentially concurrent and indicated to be influenced by contextual factors including social framework, pre-existing knowledge and resources. Activities coded as specifically falling exclusively within particular stages were as follows: Finishing, Incorporation, Verifying and Sifting. For example Verifying and Finishing as in these quotes from P10 and P23.

> 'Final things, oh dear, well using other people, not really different things than I have done so far, 'please will you read what I have done so far, is that the right kind of thing' and so on, I will always check with somebody else, I would always do that I think, I would certainly scrutinise all of the literature that I have used to make sure that all the sources that I have used are correct. I would in the best of circumstances check obvious literature sources again to make sure that I hadn't missed anything that is current and up-to-date, and is critical, because you have started something two years and now everyone else has also discovered it as well. I would always check those sorts of things". P10: 10:18 (131:143)

> "Sweeping up, [*Explain*], sweeping up the bits and bobs at the end with a final trawl through and maybe a final literature review from a key database, it would be at that stage updating. Maybe going back through my own list of bibliographic references and checking that I haven't missed anything out and that there is nothing that looks to me like 'oh my god I noted that down but I never looked at it', yes that is about it really". P23: 23:41 (176:180)

The evidence suggested that the other activities existed in two or more time-stages, while further activities such covering Eclecticism, Source identification and Selection, Serendipity and linked processes which used activities aimed at "Identifying", and coded as Identify the Shape of Existing Research, Identifying Key Names, Identifying Key Articles and Identifying Latest Opinion in Disciplines, Identifying Disciplinary Communities were connected with data suggesting a non-stage pattern.

10.4.1.1 A pivotal review

The presence of some stages, that subsequently proved to be very weak and overlapping was confirmed by the number of activities and behaviours that fell outside this framework. Additional data unaccounted for in this first approach suggested a different framework was present to explain the relationship of activities and behaviours.

Further analysis and testing looked firstly for any evidence to suggest that stages were better defined in the data than had hitherto emerged: that is to ask if miscoding taken place or

that some concept had been overlooked to explain the results; and secondly, to look for an explanation of the behaviours highlighted in the data that offered something more substantial than the view of "stages" initially considered and accounted for all of the data found.

Later interviews emphasised this with specific questions about the perception of stages. In addition coding practices and coding notes were checked for possible errors. None emerged and so attention was directed at the second option, to find an alternative explanation of the amorphous "stage-less" results.

In seeking to understand and interpret the data particular attention was given to understanding more of the position of identified and coded activities such as Serendipity and Eclecticism which were visible in the data as existing across all stages but without a firm link to any conclusive place in the first, second or third stage: The codes were present but not tied to any particular landmark. As part of this extended process further analysis looked beyond coding of activities and their place in time or sequence, and embraced variables that appeared as explanations of action, of ways of thinking and perception of results. The codes for these produced a considerable body of evidence to suggest that activities were mis-interpreted when viewed solely in terms of their sequencing, the context and needs addressed began to produce a very different model.

10.5 An alternative view

The simple stage explanation accounted for only partial quantities of data, not the full, or even the majority of the data. The unaccounted data could have been "forced" into the stages. It was more important and within the Naturalistic Inquiry approach, methodologically acceptable, to seek an understanding of the whole data.

10.5.1 The beginnings of an alternative explanation

Though the data could be interpreted in the form of broad stages, further characteristics of the data indicated other attributes of information behaviour which suggested an alternative framework. Grouped for ease of processing under the heading "time loop", the specific codes consisted of "T: Looping", "T: Cumulative", "T: Variations throughout", "T: Simultaneous actions", "T: Waves of Searching", "Constant Redefinition", "Cumulative", and "Perception of Stages". Together these codes and the data attached to them formed the core of a new line of inquiry.

For these alternative descriptions, all but a minority of interviewees described their behaviours and perceptions of their behaviours. For this data negative case analysis was considered, a brief summary is provided in Table 13. Of those few cases that did not clearly point to alternative explanations analysis found a reliance on a view expressed in the initial

analysis of duplicated stages, one inexperienced information seeker for whom conceptualisation was limited and an absence of conclusive data in three cases. That is to say the strength of opinion expressed by interviewees was in favour of an alternative view of the timing of information seeking.

Participant Number	Explanation of Negative Case Result
8	Inexperience and relatively inarticulate
11	Relies upon initial analysis
19	Relies upon initial analysis
25	Inconclusive
27	Relies upon initial analysis
32	Inconclusive
44	Inconclusive

Table 13. A summary of negative cases

These conceptualisations of time were attributable to particular aspects of the emergent core processes. Each core process, its associated connection with alternative explanations of timing was identified using the Query Tools of Atlas-Ti version 4.2. Each Core Category was composed of activities, behaviours and strategies that were individually identified as related to the Time Loop data set.

10.5.1.1 The perception of stages

Interviewees described a complex mixture of activities and strategies with one common factor running through them, that is, stages were not appropriate to describe their perception of information behaviour.

"...on the one hand what appeared to be a sequence, was a sequence, but a disconnected sequence". P5: 5:55 (144:149)

"I suppose not correlating so much with the stages, I tend to use whatever strategies that I can at the time, in other words if I am at home I have internet access and I have got a bit of time. If I have got access to Athens then I will also do some systematic searching there, and if I am around here and a typical day here and I get a chance to go to the library then I will browse around the current journals. It tends to be more opportunity led rather than stage led. In other words no matter what stage that I am at I need to get to the library, I need to browse the current journals, I need to look at BIDS and things like that. It really is opportunity led. Besides the more obvious differences, such as when you have written a paper and are checking the references and checking the accuracy of your findings. But maybe more than in other disciplines I am just as likely as I am finishing off one research idea to be also generating the next one, I suppose you could think of stages for an individual project, but they tend to blend into each other, in other words its almost like working on a continuous research project. It is the same theme around which I am generating ideas. The notion of stages is then less relevant to me". P9: 9:90 (197:212)

"Yes, I think I could, but I think it is a process, if I thought of it as a process it would be largely as something that, errm I could describe processes that I have been through, but I don't think they could be prescriptive, and those processes tend to be of a different scale. One that I have

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noticed is that and one that tends to be quite puzzling is that for the last 5 to 7 years. and in general it has been the case in relation to 3 books that I have written and each book has been the culmination of the summary of the last 7 years.... I suppose on the whole the ones that have been one year, have been ones where is clearly a well formed problem that has a well formed empirical base, not in the sense of my findings based on that because again I think that relationship is very problematic, but at least it is clear that I want some data. Planning for that I would think of the problem, I think in general I would want to get those ideas before I necessarily start moving around the subject. I want to come at them fairly open and come at them based on questions that came out of my own prior research". P18: 18:16 (250:266)

While indicating that information seeking could not be taken away from its context the quotation P18:16, above, also points to the longevity of some "stages" of information seeking.

Interviewee P16 spoke of being 'inspirational', meaning in this context that rather than clearly defined pathways if something gave an idea then all attention would shift to that, in this example Chaining was stimulated from finding a reference.

"I wish I could say that I did it systematically, I think in a way I am far more inspirational in the way that I do things in a way than systematic. Basically once I have hit a gold seam I follow it rather than getting deflected. If I find something useful then I follow up references from that and hope that way that I tend to cover most things that I need to cover. So I don't progressively refine the sieving process. I tend to go for a few key references and spread out from those". P16: 16:54 (103:108)

Of all interviewees P23 was the only one who could conceive of three stages matching a beginning, a middle and an end, yet also, and more strongly, indicated elsewhere a duplication, repetition and periodic 'Looping' behaviour.

"Well, I think three sounds reasonably plausible to me, there is certainly a difference in what you do at the beginning and what you do thereafter, whether there is a really clear progression from stage two to stage three. I think there is sweeping up, for instance at the end of a project I did do a couple of literature searches of LISA and Anbar right at the very end which probably duplicated exactly searches that I had done two years previously. So there is some method to the madness, so I guess three phases sounds intuitively reasonable. I suppose as I say, there may be keywords or something that have become apparent during the process that need to be used, but I wouldn't be looking in entirely new directions at that stage". P23: 23:42 (184:191)

These statements were supported by a variety of data indicating the nature of this alternative framework of information seeking.

10.5.2 Looping

Interviewees considered their behaviours to contain perceptible loops on one level and a lack of sequence, or linear pattern on another. As a description of information behaviour 'Looping' at first implies a cycle, a cycle that could imply a series of stages or processes. However, the usage of the term 'Looping' here therefore goes beyond the simplest conception and defines Loops as iterations, or re-occurrence of one or more activities or behaviours throughout the course of information seeking and includes Non-Linear patterns. The data presented here establishes first the concept of Looping and second the linked concept of Non-Linearity as described by interviewees.

Looping appeared within the data in connection first with the individual components of information seeking and was echoed in the attributes of core processes emergent from the analysis. The data suggested a definition of Looping as "tracking back", feedback into further information seeking, as layers and repeated activities. The following are indicative of the theme. Each interviewee described a similar experience, understandable as part of the same concept. For example in developing a conceptualisation of relevance interviewee P3 discussed tracking iteratively to accomplish information seeking.

> "I think the first thing is actually being able to recognise the keywords and the terminology in the other, across the boundary. The people will be looking at essentially the same phenomena but they will use a different description of it, and once you have understood that you can try to track that back in the other field and realise that perhaps 80 per cent of the papers you have found in a different perspective is actually irrelevant to your needs or incomprehensible to you, but actually there is something in it that just gives you that spark to say yes. I can see that yes we wouldn't have thought of it that way...". P3: 3:8 (71:80)

Further examples suggested that one action or iteration fed back into other activities over time.

> "I'll try to summarise. You began with bibliographies of books you knew, you moved into databases, you started to develop an idea of relevant and irrelevant. I think it is a little more subtle than that, I think it only came out in the field work, I started the fieldwork with what I thought were relevant ideas, but subsequently found to be quite irrelevant. So I suppose the continuum would in my case be bibliographies, databases, all that being subsumed in discrete literature reviews for each of the subjects, then that gives me certain ideas, and I go out into the field and find that the ideas are complete baloney, but there is something else and it is this. So the baloney acts as the trigger to find reveal something else....so it is a constant process, you are knowing what to look further for, what you might have looked for initially and think you'd better do a bit more work on that, and in my case a certain function kept coming up at interview and I went away and read about that and it was very revealing...". P5: 5:25 (168:186)

The simple repetition of activities also formed part of the participants perception of layers and loops.

> "Well, in my case it started with databases, big databases, as many as I could, and I went through all of the information they had got in a more general view. I identified certain books and articles and papers there and started like that and then I used more focused searches once I had got my feedback from my interviews - going probably back to the same databases and at the same time I was doing searches on the web all of the time. Plus I was able to identify bibliographies on for instance [subject area removed] and people have already made some sort of interpretation of the bibliography and the different areas and up to the last minute I was doing searches on the web - because over the years I realised it was becoming more and more sophisticated, probably it was me that couldn't find relevant information because my topic was still really vast. But over the process of the years I realise that my searches became more and more focused up to the point that I was looking for very very specific stuff". P24: 24:66 (131:148)

> "Probably for my sort of approach it would be an abstract, so that you are getting, you are mapping in increasing layers of detail". P9: 9:28 (146:147)

> "I look for my keywords - for my key subjects really, but those will change, by the sorts of results that I have, and develop some sort of understanding and then the random stuff will come through to give me new areas to look at in a more methodological stage, and that's probably a repeated cycle....Just to give me an idea of what was available and a starting point and then I will expand next time around". P7: 7:53 (128:131)/P17: 17:102 (221:272)

These perceptions provide the beginning of a definition of Looping, iterative, behaviour. Further clarification was developed through consideration of the data as it referred to individual categories. Data referring to Opening, Orientation and Consolidation were considered in relation to the developing theme.

10.5.2.1 Looping and core processes

Orientation processes were perceived by interviewees as being integrated with other processes and was in this looping and characterised as waves

> "No, I think in fact I can't think of many things where I have actually started by searching, it tends to go in waves of learning more about something and then thinking and then searching. Yes I think it certainly would tend to build, it certainly wouldn't start with lots of searching, it would tend to go in spasms, that I get to a point where I feel that I have enough material to get through and then there might come a point where I realise there is a gap and have to go back and think oh I need something here. So I might well go back and do more searching". P39: 39:15 (91:95)

Hence the Identification of Keywords took place in iterations, each of which was a development of the other previous iterations with interviewees suggesting that at least two iterations would be part of the behaviour.

> "Once I have done the initial search, I would then be looking to see if there were any other keywords, because sometimes in the articles you get, in the ones that I consider to be the good ones, you get keywords that would have found that article and that is just wonderful, because you can find that those keywords and this one and find keywords that you hadn't used in your original search and find other articles on the same area that you hadn't otherwise found. But it doesn't always work". P4: 4:16 (176:181)

> "[We started off with the idea that you would have prior knowledge, and ideas of what you would like to look at, is that where the ideas for keywords to search would come from?] Yes, probably, I have never really thought about this, presumably if I do another search later on I might have new keywords, and terminology changes anyway in the field that I work in. So virtual communities, network communities, knowledge management, etc. there is new terminology developing all the time and you have to put that into your search strategy as it does develop". P23: 23:38 (149:154)

Similarly, Identifying Sources and Identifying the Shape of Disciplines and Problem Definition also reflected the iterative, developmental approach.

> "For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason, I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. Having read literature on education I realised it was part of a problem based learning exercise, then I realised it was part of a problem based learning exercise, and then I also realised that the live project was also relevant to anti-rationalist theory as well. But in a way I haven't absolutely defined it yet. I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it. In a sense I am ahead of myself as I'm doing my field research before I do the majority of my literature work, but I don't really expect any surprises, I think I know what people will tell me". P7: 7:12 (86:99)

The iterative state was further characterised by features connected with Opening and Consolidation categories which were in addition to looping, concerned with the idea of an 'ongoing', 'constant', 'periodic' behaviour that only when taken as a part of the totality of information seeking could be perceived as iterations.

"....But it is an area where there hasn't been much published academic research specifically on the area that I am doing, but a lot of it is also grey literature. It is also changing quite a lot and I need to do a thorough trawl over both disciplines and as I go along I collect information of all kinds. I think there will come a point when I write the literature review up in full specifically for the PhD - that I will need to do another catch-up formal search, but because the area is moving fast you couldn't do just one search on this area. Also I think there is interaction between the disciplines which might send one back and forward following ideas from one database to another following slightly different angles". P39: 39:29 (196:204)

"I first mentally review the literature that I have read, oral presentations that I have attended, and attempt to recall anything that I think could possibly be relevant and then pursue either the written source or my notes of the oral presentation, or in some cases where I know the presenter of the oral presentation I may contact that source directly and query him. That is usually what I try to do first, I think I say 'is there anything about this that I know already', especially in these other disciplines that are outside of my core area of chemistry, is there something that seems familiar to me, that I have had experience with. That is probably the first thing that I do and if I am going to written sources then I may be looking and skimming through say a book chapter, I may check the bibliography, to see if there is any written information that I could easily retrieve, that might even be in my office, in the library or a colleague and the same if I am talking to somebody I might just say, it might be important, could you recommend or could you refer me to an overview of the subject that I could glance through? I think that would be kind of a second step". P15: 15:24 (73:86)

The presence of iterations was indicated throughout interviews at the level of individual searching activity.

"Well, this idea wouldn't have come from nothing, I don't think so, so there will always be that body of prior knowledge that I am aware of on which I will be building. I do some literature searches in a fairly structured way. There will be a little search strategy, probably not as rigorously as one might hope, but reasonably, and I would update that from time to time". P23: 23:10 (118:146)

Again seen in discussion of interviewees Browsing habits.

"There are various things like linguistics abstracts that I had a good trawl through periodically, but that seems to fit into good old fashioned humanities research. I'd rather go to the library and sit on the floor and drag down things that look promising as a starting point and then follow up references from that. Also other journals that I subscribe to that I know cover part of the things that I am interested in. [When you say trawl through, what does that mean?] Well, just feeding in online, I usually search one subject at a time, and feed in a couple of appropriate search terms and my usual mistake is to go in at too general a level so that you end up so you end up with thousands of hits and then obviously have to go back and start again and put in something more specific and that can be frustrating when you are doing something that is interdisciplinary because you might be getting a large number of hits for one of the search terms and a much smaller number for another of them. Then you look through for unifying cases and there are precisely none, and I guess that happens with all databases but it seems to happen more with the humanities". P33: 33:6 (55:69)

"I think I browse right at the beginning of a research project. I said that often what I am looking for is approaches and theories and concepts which I can then shape and choose from but use ultimately, and so at the very beginning - with History I'll have already looked at some of my sources and then I am going out to secondary material and yes it is at that point I'll be browsing, because it is at that point that there is creativity comes in. When you are trying to work out how you are going to bring this material alive and choosing which direction you are going to come from. It is then that you try to be as wide as possible in your searches as possible. I also browse when I am tired and bored. I have an afternoon when I know that I

should be working and I am not in a frame of mind to do that sort of intensive writing or researching and then I often go off to the library and wander around in a very non-directed way - but it has brought results. I am not scientific". P31: 31:18 (179:192)

While at a more abstract level interviewees explained the existence of something other than stages in terms of periodic, unstructured, recurrent behaviour. Stages were acknowledged as possibility, but were not considered by interviewees to be a significant part of their experience.

> "I suppose not correlating so much with the stages, I tend to use whatever strategies that I can at the time, in other words if I am at home I have internet access and I have got a bit of time. If I have got access to Athens then I will also do some systematic searching there, and if I am around here and a typical day here and I get a chance to go to the library then I will browse around the current journals. It tends to be more opportunity led rather than stage led. In other words no matter what stage that I am at I need to get to the library, I need to browse the current journals, I need to look at BIDS and things like that. It really is opportunity led. Besides the more obvious differences, such as when you have written a paper and are checking the references and checking the accuracy of your findings. But maybe more than in other disciplines I am just as likely as I am finishing off one research idea to be also generating the next one, I suppose you could think of stages for an individual project, but they tend to blend into each other, in other words its almost like working on a continuous research project. It is the same theme around which I am generating ideas. The notion of stages is then less relevant to me". P9: 9:90 (197:212)

Underlying the theme of periodicity was a sense of continuity and constancy in interviewee conceptions of how activities related to their information seeking.

> "Well, still gathering actually, whether or not they fit into the final project, but its not finished so I can't tell, but I have written five books and I've got a shelf full of nearly 200 items so I am constantly gathering new examples, newspaper clippings, ideas that I come across in other people's work". P37: 37:41 (134:139)

> "It is quite different in some ways because the projects run for years. But one that I am working on at the moment, is trying to write a grant proposal. I have got my research question and because the kind of work that I am doing is empirical – it is about doing experiments with people – a lot of my thinking is about what types of experiments that I can do to kind of investigate this issue, so I want to know what people do when they are listening to music, what kind of similarity relationships they are hearing. So I suppose I would kind of start off with a pretty general information gathering which is to use any references that I have got to generate new ones – so it is reading the articles and picking out any bits that are relevant to what I am thinking about and picking up the references at the end of the article in a continual process, using BIDS as I said which follows on from that, talking to other people about what I am doing, it kind of depends on whether there is a conference on or that there happen to be people around that are doing that sort of topic, so I had a person around yesterday from Keele to talk to about it who is from a Psychology department and so they have more of a background in that literature than I do, so she was a useful contact. Then it is reading articles. [*Do you do all of your gathering in the first part of your research?*] No, it is not systematic, I tend to do a lot of reading and gathering initially and then I start writing, but I always find that as I start to write I discover what I don't know and what questions I need answered. So I am continually going backwards and forwards and finding particular things that I don't know about and I suppose I do that with the general books first and then go through the STAR and BIDS, or Web of Science as it is called now". P46: 46:14 (80:104)

In connection with Consolidation activities, interviewees indicated a cumulative pattern resulting from repeated loops reflecting a growth of focus and knowledge.

> "I suppose generally speaking what I would be doing would be focusing down from the general to the specific. I'm trying to think of an example, errm in dyslexia one of the issues that has come up several times from talking to people, but not from the literature, is that people with dyslexia, or some people with dyslexia may be a danger to patients because of their inability to

read drug charts properly, that is the perception. So doing the broad brush thing. I need to know if there is anything in the literature about it, so what I would do would be go back to the literature that I have already got and reread it and look for the little segments and try and draw them out and then I would go through a process of collating all the bits of information that I could find and bringing them together and then trying to come up with a narrow focus as to what the literature says about that specific issue. So that is going from general down to the specific". P6: 6:52 (109:125)

Similarly Incorporation, Recognition and Understanding were described as occurring in cumulative loops.

"Sweeping up, [explain], sweeping up the bits and bobs at the end with a final trawl through and maybe a final literature review from a key database, it would be at that stage updating. Maybe going back through my own list of bibliographic references and checking that I haven't missed anything out and that there is nothing that looks to me like 'oh my god I noted that down but I never looked at it', yes that is about it really". P23: 23:41 (175:181)

"I think the first thing is actually being able to recognise the keywords and the terminology in the other, across the boundary. The people will be looking at essentially the same phenomena but they will use a different description of it, and once you have understood that you can try to track that back in the other field and realise that perhaps 80 per cent of the papers you have found in a different perspective is actually irrelevant to your needs or incomprehensible to you, but actually there is something in it that just gives you that spark to say yes, I can see that yes we wouldn't have thought of it that way, we wouldn't call it that, but I can see what it means. So part of it must be recognising the constructs and which constructs are in parallel despite the fact that they may appear to be different". P3: 3:8 (71:80)

The Looping theme was particularly strong in the descriptions of Refining and Sifting where iterations were fundamental to the activity.

"...something that I like to do is keep a record of what I found and when, because of the nature of it you can have lean periods when nothing turns up and it is nice to have this sense of growing and you see where you have been, when I have got a reasonable amount of stuff then I will stop looking for awhile and do some analysis, work with it, read it, doing some writing about it to get some ideas crystallised and then there might be a second wave of research after that, but that process of trying to think about it and say something about it, will raise more specific issues and problems that then I might try and solve, I suppose that second wave of search might be slightly different in the sense that instead of it just being a question of feeding in the terms as wild cards and hoping something will come up it is much more a question of 'I need to know this precisely', so who can tell me about that, or which book should I use, although I must admit that I carry on looking for stuff until quite late, till probably I should have stopped in a sense while I am writing". P42: 42:27 (133:149)

"...sometimes the keywords don't always appear straightaway, if for example like with dyslexia, if that is the only word that you know about, you start with that one and then you find all the others through reading, through literature, errm and then as my knowledge base increases I will start asking myself questions about the specific thing that I am interested in. So I need to know things like what is dyslexia, what are the causes, how is it assessed, how is it diagnosed, how do we support people, where does funding come from, so there are lots and lots of questions, and it is then back to the literature using those questions and looking for the answers. So I take a question approach to it". P6: 6:22 (37:48)

Verifying and Finishing were also suggested by the data to be composed of several iterations, with Verifying a particular subject of iterative behaviours.

"No, I did early on to help me get started, a literature review on deaf people's access to healthcare and I am now updating it, so I don't actually stop, but what I do is look for up-to-date literature, but because I have already done a lot of the work I have already got to know the keywords and the databases and how to search them so I can be fairly specific. But once I have got the chapter written it will be written, there has to be a point of closure". P6: 6:16 (190:198)

"I suppose not correlating so much with the stages, I tend to use whatever strategies that I can at the time, in other words if I am at home I have internet access and I have got a bit of time. If I have got access to Athens then I will also do some systematic searching there, and if I am around here and a typical day here and I get a chance to go to the library then I will browse around the current journals. It tends to be more opportunity led rather than stage led. In other words no matter what stage that I am at I need to get to the library, I need to browse the current journals, I need to look at BIDS and things like that. It really is opportunity led. Besides the more obvious differences, such as when you have written a paper and are checking the references and checking the accuracy of your findings. But maybe more than in other disciplines I am just as likely as I am finishing off one research idea to be also generating the next one, I suppose you could think of stages for an individual project, but they tend to blend into each other, in other words its almost like working on a continuous research project. It is the same theme around which I am generating ideas. The notion of stages is then less relevant to me". P9: 9:90 (197:212)

Looping occurred for tangible reasons such as in section 10.5.2.1, where for example information overlooked during initial information seeking is gathered. Others cited new sources, networking and development as redirecting them into further activity. One variation was suggested to be not in the activity but in the focus and intensity of information behaviour.

"...Sometimes as you are finding information that is relevant it is clear that perhaps the direction that you thought you were taking has already been explored or that there are leads to follow. One or the other. So you might perhaps deviate slightly either to follow up a lead or to avoid duplicating somebody else's work, unless you are actually setting out to verify somebody else's work then there is very little point in doing exactly what somebody else has done....What I tend to do I think, when I have discovered a title in an abstract that interests me then I will go in depth and I like to read and really see what is in the whole context. I like to get the context of that whole piece of information. Which is why I have read four books, I didn't need to read them cover to cover, but I did because, having identified some interesting bits there would be other interesting bits that would also be interesting along with all the not so interesting stuff". P21: 21:13 (104:121)

"...I tend to start right at the bottom of the ladder with undergraduate textbooks and then I'll move on to general overviews in the field and then when I am confident I will tackle the scholarly material and articles. So I suppose it is an insecurity thing, but a well founded one". P33: 33:21 (167:180)

"[Activities] ...change in as a much as a project develops the things that one is looking for, you never stop discovering potentially new material, it gets obscure and typically harder to get hold of and I guess that a stronger element of judgement of the likely returns has to come into it. Otherwise you would never submit a paper.... as time goes on and the things that one is looking for get more specific, e.g. particular phenomenon or examples, and diminishing returns, and involved in that lags get into the system – the more obscure the material the longer it can take to get it e.g. by interlibrary loan, a trip to some other library or whatever. P34: 34:22 (44:48) / P34: 34:25 (132:135)

10.5.2.2 Loops and non-linearity

Throughout the many descriptions in previous sections Looping suggests iteration and some variation. A further specification of Loops was characterised in the data. Interviewees thought of their information seeking not as loops of the same activities in a fixed order, but in terms of a perception of an analogy to waves. The data suggests that each loop or iteration was, as with different waves on a sea shore constituted of different activities (droplets of water) that collectively formed the wave, but were in a different order each time. Waves of varying information seeking occurring repeatedly (the looping phenomena) provides one dimension.

Along with the initial analysis in demonstrating the high degree of overlap between activities and timing the data confirms the continued prevalence of many activities throughout information seeking.

Waves were intimately associated with data coded under the labels Non-linearity, Non-sequential and Cumulative behaviour. These add further support to the conception of a dynamic, flowing, information behaviour pattern. Particular aspects of Non-Sequential behaviour were strong in the indication of Constant Redefinition in the Problem Definition aspect of Orientation. Interviewees perceived themselves as working in a non-linear manner. Hence when interviewee P35 spoke about their work no stages were defined.

> "Yes and no, there is a pattern, but there is no stage method with me, that it is think of a problem, read the stuff, start writing, realise what I don't know, read some more stuff, then sit down and write often without using my notes at all, it is more or less a saturation in my head that I have to write it down to convince myself that it exists. So I have written whole articles in the past virtually without reference to my notes. But in the end I will put the footnotes in and check my notes. The writing is my distillation of what I have read, but usually it is again more intuitive than cumulative and sometimes it doesn't work. I don't have, and it is one of the reasons that I struggle with project proposals, is that I don't think in terms of what I would be doing in 3 months and I would distrust those who did use those methods instinctively. [*So really, the same things are going on right the way through to finishing an article?*] Yes, there is a point where I tend not to allow myself to go to the library anymore because I would always prefer to go to the library, so there has to be a point where I tell myself that I don't need any more information and then vary that by rummaging about in books and photocopies of things that I have got. But the physical act of going to the library is banned". P35: 35:26 (140:157)

The idea of Non-linearity could be linked with movement through a topic and with each core category Opening, Orientation and Consolidation. Interviewees suggested that frequently activities and strategies followed the needs of purpose and project rather than any repeatable information seeking path.

> "Some things I would do only at the start, they would tend to be Web of Science, searches under keyword combinations for the project and I try to do that as thoroughly as possible and try to use whatever combination of words that I could possibly think would be relevant to it. But things like following up articles, talking to people and finding out if they know anything about the subject they carry on the whole time. But the topic of what I am doing can also change as a function of me having found information and so yes I suppose I never go back and do a general information search, I do tend to be looking at increasingly specific questions that have to be answered". P46: 46:26 (156:163)

> "I gear it to what I am writing, really, and I start with what I have got to write, and that resolves into duplication of problem - I'll read for a purpose and then reread for another purpose". P36: 36:43 (147:148)

Hence the pattern on Non-Linearity was also visible in relation to Problem Definition and "Problem Solving".

> "It has got to be by a process that Glaser and Strauss would describe as intuitive, perceptual thing. It is as much likely to come as you sleep or as you lay in bed worrying. it is much less likely to come from a focused intellectual activity, its more when you are really broadly thinking, because there are so many parameters to juggle, is there a good focus here, is it original, is it likely to receive funding, does it hang together, almost like a face, is it an attractive face that is worth going on to study, so it is very perceptual, holistic, fuzzy, even though it is based on, it is almost like digestion, even though what you eat may be very structured research reports, very scientific, the actual process of defining a new topic is very holistic, impressionistic, fuzzy, it is my own way of doing things, so I am not logically running

on project x and saying lets build on these foundations in my interdisciplinary areas. I am aware in single discipline areas I aware you might build sequentially, logically, on previous results and see a chain of building brick by brick, I can imagine that happen more in a single discipline". P9: 9:26 (117:130)

"For me it was, I realise now, it was like a shallow but broad thing. I knew the reality of what I was studying, I knew I was looking at live projects, I knew that they existed, but I needed to find out everything before them, you know the theory behind why anyone would do them, not that they would do them for that reason, I have to develop a theoretical argument, I have to find out the Historical questions, I had to find out writings actually on the live project, it was by the practical event really, I didn't know how to define it at first. Having read literature on education I realised it was part of a problem based learning exercise, then I realised it was part of a problem based learning exercise, and then I also realised that the live project was also relevant to anti-rationalist theory as well. But in a way I haven't absolutely defined it yet, I am basically waiting to see what other people define the live project as, I let them tell about it. So I guess after I have finished collecting that information I will hope to be able to define it. In a sense I am ahead of myself as I'm doing my field research before I do the majority of my literature work, but I don't really expect any surprises, I think I know what people will tell me". P7: 7:12 (86:99)

Interviewees took this to the extreme of describing their work as a disjointed continuum and a process of constant redefinition.

"[So you have gone through quite a lot of redefinitions?] Yes, what I thought was a continuum is a continuum but it is a disjointed continuum and the joints are technological change". P5: 5:23 (150:154)

In this line of thought Participant P46 was particularly suggestive.

"Well, the project that I am working on at the moment is on the question of similarity and how people understand them and so it is Music Theory Analysis and Psychology and so my research question was very clear in that it I knew what was going on in the music and I wanted to know whether this related to what people heard and what the reasons for music being made in this way might be. So the research questions are clear. In that case I know that there is a large literature on the perception of similarity and categorisation and so having that I then do all the normal things – use BIDS and databases and find out if anyone has done anything on the focal area that I am looking at and then from that kind of go backwards into the more general understanding of how similarity and categorisation operate. It is quite difficult to think of when I am away from it, I have to think back in my mind to what happens. Within that larger research question you kind of find more and more smaller and specific questions, maybe, and for example thinking about similarity and categorisation when I started off I might have thought there was no difference between the two but as I read one thing it suggested a whole literature that said these two don't agree at all. That is when I think I need to get that sorted first and then come back to the main issue. It is quite random in a way, it is generating the question as you are doing it. But, if you don't start out with a fixed vocabulary and ideas, rather I have a research question and it generates things that you need to know". P46: 46:23 (57:75)

The final component explaining the information behaviour of the participants placed information seeking within a long term Context and pattern of gathering information.

"No, but this is true, for example I do actually browse in libraries and I don't really search, and I ask colleagues and I keep it sort of filed away in my head for a while and then as a sort of constant signal to pick up things that I come across, like this current one. I will have it in the back of my mind for a very long time, months, maybe as much as a year, I am sort of thinking that will fit in there with my book I really must mention this, I mustn't omit this, and from that moment on and I read masses of journals, not so much journals as journalistic magazines more, but a huge amount passes my desk and then I read books because I come across a review and I sometimes think that sounds like it might be interesting. So it is a bit like maybe not a cooking pot, but perhaps the analogy should be perhaps like the old fruit and errm rum pot, like they have in Germany, where they start in the summer with the dirty old fruit and they just dump it in a barrel in the corner and add some brandy or rum or something and every time you come

across something you just throw it in and by Christmas it has all fermented and beautifully melted together and kind of well it is there. So this is how it goes. and I do it with another topics, so this is why I have a lot of clippings and then I lose all the clippings because I can't control the paper world". P2: 2:33 (266:282)

"Yes, I think I could, but I think it is a process, if I thought of it as a process it would be largely as something that, errm I could describe processes that I have been through. but I don't think they could be prescriptive, and those processes tend to be of a different scale. One that I have noticed is that and one that tends to be quite puzzling is that for the last 5 to 7 years. and in general it has been the case in relation to 3 books that I have written and each book has been the culmination of the summary of the last 7 years and I can describe that process. in terms of me going through different states and experiences or I could make comment about a project that might last a year. [*Describe a year project.*] I suppose on the whole the ones that have been one year, have been ones where is clearly a well formed problem that has a well formed empirical base, not in the sense of my findings based on that because again I think that relationship is very problematic, but at least it is clear that I want some data. Planning for that I would think of the problem, I think in general I would want to get those ideas before I necessarily start moving around the subject. I want to come at them fairly open and come at them based on questions that came out of my own prior research". P18: 18:16 (250:266)

The perception of stages was also contributed to with indirect data taken from interviewees comments on the characterisation of their approach to information seeking. As a Naturalistic Study it was appropriate to take data from across the aspects of perception to form a composite opinion on the nature of information seeking. Primary examples of this with regard to Eclecticism and the examples of the "Happy Bees" provided by interviewee P35 illuminate much that was described as characterising the information seeking behaviour of interdisciplinary researchers.

"I do what I tell students to do, which is read other people's footnotes and when you stop seeing things in the footnotes that you don't know about you might be quite close to having done the reading. I am quite comprehensive in this and I like to read things which are meant to be rubbish or out of date because they sometimes suggest things that have fallen out of favour....I tend to jump around quite a lot in no particular order, and I don't organise my notes. I am desperately un-organised they are all jumbled together. I am like a happy bee - someone I think Alcuin said, moving from flower to flower collecting pollen, in my case it is information". P35: 35:12 (49:56)

10.6 Discussion

This chapter charts an important transition in the formation of the model. The chapter details the analysis at three points of the study. The initial analysis considered the qualitative descriptions of activities and behaviours and their relative position within the information behaviour of interviewees. The process involved mapping each activity and the order in which it was performed for each interviewee and from this identifying the appearance of stages. The results of this analysis suggested a three stage model of information seeking. The diagrams indicating primary activities and strategies clustered around a conception of timing\ordering or behaviours. Each stage was mapped out and the relationship noted in diagrammatic form with the aid of Network View Diagrams from the Atlas-ti qualitative analysis package.

In suggesting this pattern the study was indicating a further confirmation of the results of some previous models of information behaviour that specify stages or sequential behaviours. most especially exemplified by Kuhlthau's Information Search Process (1993). Kuhlthau's stage typifies the stage conceptualisation, though the theme of stages is present in Krikelas (1983), Marchionini (1995), Spink (1999), and Wilson (1999) and many others working in the field of information behaviour. Other studies have examined aspects of stage theory and using a similar approach to Kuhlthau confirmed in later studies by researchers including Swain (1996).

The diagrammatic form of analysis was useful in revealing data patterns, in this case the level of co-occurrence between "stages" was visible most clearly in a graphical form. The analysis highlighted a non-resolvable issue with the initial analysis: that the three stages identifiable were highly similar in their composition. The simple stage explanation also accounted for only partial quantities of data, not the full, or majority of the data, the remaining data was not attributable to linear explanations. The results at this point did not therefore favour a serial or stage explanation of information seeking behaviour for the interdisciplinary information seekers interviewed and pointed to a need for further analysis.

Within the present study the unaccounted data could have been "forced" into the three stages by broadening the definitions. However, it was more important and within the Naturalistic Inquiry approach, methodologically acceptable, to seek an understanding of the whole data.

The chapter details the development of alternative explanations that incorporated the whole body of data found by the study. Subsequent iterations of analysis combined to form a third level analysis which consciously looked for the explanation. Analysis of underlying themes and behaviours within descriptions by Interviewees suggested that activities and approaches were not bound chronologically as in a problem solving conceptualisation, but in terms of concurrent, continuous, cumulative and looped cycles occurring throughout a research project. At a micro level there was similarly a sense of non-sequential behaviour: It was possible to view any information behaviour could conceivably lead to any other. The combination of descriptions and coding of identified events by occurrence and co-occurrence replaced the notion of "time" initially identified within the data.

In forming an explanation of the whole data it was necessary to move away from time. and to embrace data which indicated perceptions of stages. non-linear descriptions. looping. iterative, dynamic patterns of activities and strategies and beyond this to a high level of abstraction rooted in data, an emergent non-linear model. which is presented in the next chapter.

The core idea emerging from this chapter is that of non-linearity as an alternative framework for understanding information seeking behaviour. The findings suggested a stageless viewpoint that took full account of the exceptions to stage theory mentioned by researchers such as Kuhlthau (1991: 370) who suggested that her model is only "an

approximation of common experiences" (1991: 370). Nonetheless existing models, with the exception of Ellis's Behavioural Model, have propagated or at least accepted, the view that information seeking behaviour and human problem solving behaviour (Wilson, 1999) take place in a linear fashion.

As early as 1992, Wagner was pointing to the need for a non-linear model of dynamic search strategies. Only when searching for literatures on non-linearity did this theme appear. Wagner suggested that hypertext is a non-linear way of presenting information. Some researchers already consider information retrieval within hypertext to be non-linear and identify this as a better system than the linear information retrieval available in Online Catalogues. Wagner (1992: para 6) suggested the need for theories of users interaction with information systems before the application of non-linear technology to information retrieval in libraries, while Yang, Shindler and Keen (2000) applied linear and non-linear problem solving ideas to teaching multimedia. Neither apply directly to information seeking behaviour, but both are highly indicative of the crossover between different disciplinary literature and concepts of problem solving.

Other researchers, for example Lueg (2002), have described problems with linear problem solving. Lueg described how Artificial Intelligence as a discipline had traditionally adopted a linear approach to understanding problem solving, as a rationalistic view of human cognition. Lueg pointed to developments in the field of artificial intelligence and problem solving as useful for information science, particularly that linear simplifications of problem solving outside of context fail to grasp the depth and complexity of the problem solving process, as also indicated by Davenport and Prusak (1998). Non-linearity is however more familiar in the discussion of information retrieval in hypertext systems which are traditionally conceptualised as non-linear, for example Rada (1991) suggested the use of hypertext networks as a way to represent mental models rather than as lines.

The present work includes provision for loops or iterations, but specifies that any patterns are dynamic and non-linear for each individual within each information seeking project and through time. These ideas tend to confirm the idea that each person exists within a context and has a unique position that changes from moment to moment. To understand information seeking behaviour in this way also indicates a substantial link with problem solving if we are to adopt the logic of Wilson (1999). Other diverse literatures suggest that a vague idea of non-linearity exists without developing a framework of explanation. Such ideas strengthen the concepts emergent from the study presented here and suggest that the non-linear framework developed in this study has potential to contribute to the further understanding of human behaviours.

11 Conclusion: A non-linear model of interdisciplinary information seeking behaviour

The components described in the previous chapters come together in a single conceptual model represented in Figure 21. The model illustrates the core processes of interdisciplinary information-seeking behaviour. Opening, Orientation and Consolidation in a way that reflects the experience of information seekers and places these in an interactive relationship with the contextual interactions labelled Cognitive Approach, Internal Context and External Context.

The relationship of core processes is described in the portrayal of non-linearity detailed in chapter 10. In this the model provides an information seeker with a beginning based on Opening, Orientation or Consolidation. This is possible as the model takes account of the interaction between the information seeker and their Cognitive Approach and Context (Internal and External). Each is a central contribution to information seeking. Elements of each process are essential for a complete information seeking event.

The relationship of core processes indicated by the conceptualisation of information seeking as non-linear and dynamic offer a particularly useful insight into explaining information seeking experiences. With each information-seeking experience, or contextual change, the model suggests that opportunity and need for information-seeking changes too. The relationship of core processes and developing context (which includes previous information-seeking and developing knowledge) interact freely to allow each core process to offer a potential feed into any other and to be re-iterative over time.

The absence of stages and the interactivity of the model are analogous to an information seeker at every moment holding a whole palette of information opportunities from which choices could be made. Expressed over time the model works dynamically down through successive levels, each maintaining the overall picture, of Opening, Orientation and Consolidation. The top level model is a representative snapshot of a continuum of information seeking behaviours. The interactivity and shifts described by the model show information-seeking to be non-linear, dynamic, holistic and flowing.
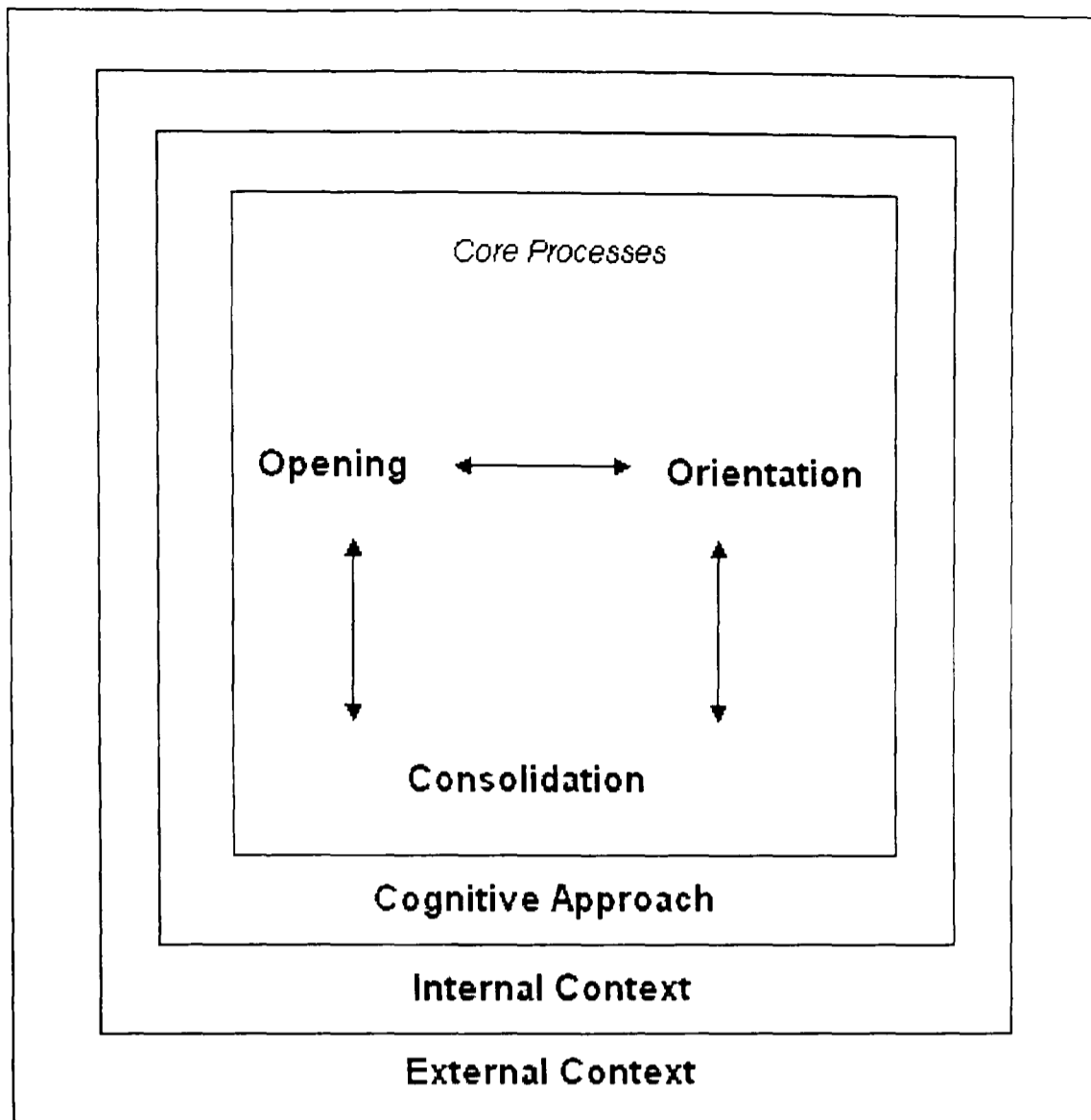
Figure 21 A non-linear model of interdisciplinary information behaviour

Opening activities and strategies form the heart of the information generating aspect of the Model. Each of the activities and strategies identified as belonging to Opening was dependent upon an interaction with the other core processes and with Context and Cognitive Approach. The second level of detail represented in Figure 22 highlights the relationship of activities and strategies within the top-level model.

Orientation

Reviewing, Picture Building,
Identifiying Keywords,
Source Identification and
Source Selection, Problem
Definition

Opening

Breadth Exploration,
Eclecticism, Networking,
Keyword Searching,
Browsing, Monitoring,
Chaining, Serendipity

Consolidation

Refining, Sifting,
Incorporation,
Verifying, Finishing,
Knowing Enough

External Context	Cognitive Approach	Internal Context
Time, Project, Access, Navigation, Social, Organisational	Flexible, Adaptable, Open and Opening, Nomadic Thought, Holistic	Knowledge and Understanding, Feelings and Thoughts,

Figure 22. Interdisciplinary Information Behaviours within the Non-linear model.

The nature of the interaction was represented in the non-sequential, non-linear, timing of the model described in chapter 10. As an explanation of information seeking the whole situation of the information seeker is taken into account, replete with all of its associated decisions and background. Collectively these aspects work within the model to provide a view of interdisciplinary information seeking.

The strength of the core processes was in illustrating that not only were events not in a particular order, but that not everyone would do all of the micro-level components all of the time. The Opening concept was representative of a palette of opportunities and possibilities.

The nature of the interaction between the core processes of the model was a recurrent theme from high level conceptual elements down to examples at the lowest level, examples such as Keyword Searching which interacted with Knowledge and Experience, with Source Selection and Identifying Keywords. At each point in the model similar interactions suggested a relationship of activities and contexts within the model as dynamic and evolving.

Opening implies in its use of language a beginning. A deeper reading of the activities and strategies detailed in this chapter shows some activities as early within an information seeking process, but also that Opening was found to be present throughout Information Seeking.

Orientation takes the basics of an information need, which underlies much that is necessary in the activity of "Opening"; but also adds specific aspects of building a picture of the topic, the research fields, and resources that are needed for successful information seeking.

Each of the discrete Orientation tasks draws on the activities and strategies identified above as "Opening" and together these processes interacted with Opening (discussed in the previous section) and Consolidation (discussed in the next section) to form the core information behaviours of the respondents. Each aspect presents a way of developing an understanding of an information seeking topic and providing for both more information seeking through Opening and reflection through Consolidation. Elements of Orientation have a recognisable background in previous literatures, as illustrated in the discussion section of chapter 6. The study gains from this in the independent derivation of similar functions. The differences between the activities in the present study and those of others suggest both significant variations and also valuable additions to theoretical understanding of information behaviour.

Consolidation was identifiable in the presence of information already obtained by information seekers upon which processing took place. All have an element of processing information towards creation of result. Hence, for example, Sifting and Refining activities interact with relevance criteria and information gained, and also feedback into further information seeking. As information was collected and sources highlighted, Sifting, the process of deciding which material and sources were relevant took place, it was a recurrent process of selecting and pruning. The concepts of judging relevance and of relevance criteria were important properties of Sifting. Incorporation was identified as a key organisational process. Interviewees found it necessary to pause in their diverse information seeking to "take on board" the material they had been exposed to. The process of incorporation took place as a combination of thinking, writing, discussing with colleagues. Incorporation was recurrent throughout information seeking, while Verifying and Finishing Off were less prominent. An information seeker's estimation of Knowing Enough was an important property of Consolidation behaviour.

As a core process Consolidation contributed reflection upon new information and prepared information seekers for further Orientation and Opening activities.

Collectively the core processes present the basis of interdisciplinary information seeking. The identification of Cognitive Approach within the model is an indication of the value of ways of thinking about an information problem and the underlying organisation of mind that appeared within the findings of this study. Finally these elements are seen to be influenced by and to influence the Context (both External and Internal) of the information seeker.

We may summarise that Opening contributes activities and strategic behaviour that bring the information seeker into contact with information. Orientation contributes a grouping of activities based on forming a picture of the subject and problem, and of the disciplines involved.

Consolidation contributes by enabling the reflective process. of judging, developing. and setting the basis of further information seeking or completion of information seeking. Collectively these components and the interactions between them form the basis of a non-linear model of interdisciplinary information seeking behaviour.

11.1 The new model in context

Throughout the preceding chapters comparisons with existing models are made. At the level of activities there are substantial similarities and substantial differences co-existing. These differences are in the identification of a key role for Serendipity, the adoption of Breadth Exploration as a strategy of interdisciplinary information seeking. and the complementary strategy of Eclecticism: These aspects offer some prominent differences at the behavioural level.

There are similarities between the findings presented here and previous studies, in this respect the dominant contribution of Networking, Keyword Searching, and Browsing is noteworthy. These activities are firmly identified as part of the information behaviour field and confirmations of processes and the prevalence of activities such as browsing and networking are not surprising. The vast literatures have recorded much on these areas.

However, the identification of Picture Building as a complex physical and mental process within Orientation offers a considerable extension of existing investigations that talk of mental models and mental maps. In this characteristic the participants of this study, perhaps because of their interdisciplinarity, were explicit in their awareness of how they found information and built knowledge of their subjects.

Significant factors emerged in the portrayal of Cognitive Approaches. These confirmed the existence of "features" speculated upon by Bates (1996) and Klein (1996), and yet were derived independently of previous literature. The existence of these approaches contributes much to understanding the patterns of behaviours described by participants and offers some insight into the area of cognitive styles and individual differences.

These aspects are placed within a detailed framework of External Context and Internal Context that specifically identifies the issues and opportunities arising from an individual's experience of information seeking behaviour within and interacting with Context. Individually these aspects of the model and its relationship to previous work are interesting. However they hold far more interest as part of the Model of Non-Linear Information Seeking Behaviour.

The Nonlinear Model of Interdisciplinary Information Seeking Behaviour presented piece by piece in chapters 4 to 10 represents a considerable change from previous information behaviour models. In Chapter 2 a review of the background literature gave a context for the study and allowed the reader to compare the present study with previous models.

Conceptually, stages and non-linearity represent the most difficult transition in the interpretation of information behaviour of interdisciplinary researchers. Existing studies have illustrated linear patterns over a considerable period of time and there is a body of evidence to support these findings.

Kuhlthau's (1993) model is a particularly clear example of stage theory, as is the early contribution of a stage model by Krikelas (1983). The most prominent models in place within information science at present, with the possible exception of Ellis (1987) contain stages or analogies thereof. Even Ellis's model has been repackaged into a stage format by Wilson's (1999) interpretation of his model. Wilson's own information behaviour model, the "overarching framework" adopts an essentially linear principle to ordering behaviours and considers information behaviour within the ideas of problem solving and causation.

In this view not even Ellis's characteristics of information behaviour escapes the designation of being a stage model. However, Ellis's own assertions suggest the absence of sequence within the model (1987; 1989). The weakness of Ellis's model in this regard was the lack of a fixed and coherent explanation that demonstrated a non-sequential framework. Perhaps the use by Ellis of starting and ending suggests indeed a degree of stages that implicitly, as Wilson suggests, points to stage theory.

Conceptually all the previous models that we may draw upon, including Wilson's information behaviour model, take a starting point to mean that an information problem has arisen. Previous Models of Information Seeking have considered the concept of Starting (Ellis, 1987), Initiation (Kuhlthau, 1993). These are both clearly defined by their originators as first activities. A close reading of Ellis (1987) suggested that Starting was considered to be embryonic, something to be added to with the passage of time and that Starting could "change almost immediately to chaining" (Ellis, 198: 83). For Kuhlthau the stages have a conceptualisation as much more Stage bound. Indeed, Initialisation appears at the beginning and leads into other stages once completed. Similarly Marchionini (1995) and Spink (1999) accept the prevalence of stages within their very different models. Even within the Bates Berrypicking model (1989) from an IR perspective, useful though the concept is, there is still a starting point and a progression moving forwards from that point..

Underlying the conceptualisation of stages, is the concept of information problem solving which is strong within the work of Wilson (1999; Spink, Wilson et al., 2002), Kuhlthau (1993) and of Eisenberg and Berkowitz (1990) too. In these information seeking is seen as a linear sequence of activity moving from problem identification through to problem solution. The conceptualisation of information seeking as a linear progression is also adopted by Spink (1999) in her model.

Although there are differences in the conceptualisation of stages and non-linearity, one area of overlap remains. This is in the identification of feedback and looping. The present

model sees an interaction through looping and iterations of the palette of possibilities, while previous models such as those of Leckie Pettigrew and Sylvain (1996) suggest a feedback loop between information seeking and information sources, indicating some interaction between components. In a similar line of thought Kuhlthau's model points to repetition of stages until satisfactory results are achieved (1993). Within the considerable body of literature Brown's (1991) synthesis of research also included cyclic, dynamic processes, yet in this it was merely a complex literature review without an empirical basis.

Throughout this section the portrayal of the dominant position of stage theory contrasts harshly with the reality of the non-linear model presented in this thesis. However, when the model is considered as an explanation of interdisciplinary information behaviour, and considered as a full explanation of information behaviour it takes on a different aspect. Previous models of information behaviour have tended towards the inclusion of exceptions and exclusion clauses for the interpretation of information behaviour. For example Kuhlthau suggested that the model is only "an approximation of common experiences" (1991: 370), a point which is confirmed in Swain (1996) who found that not all stages of Kuhlthau's model would be used and that the stages were not necessarily adopted in the same order as that suggested by Kuhlthau. Wilson's considered his model to be an overarching framework for research and avoids the issue of dealing with individual stages, effectively evading the question.

Fundamentally each of these models contrasts with the model presented here. Particularly as the model presented here contains a sufficient framework to engender identification of the relationship between each core process and the information seeking experience; and below this each activity and strategy is included and provided for within a complete framework. That framework allows further exploration at a theoretical and conceptual levels to take the model forwards for further testing, hypothesis generation and testing, the testing of the model in other contexts by naturalistic inquiry and the generalisation of the model using positivist methods.

The findings presented here add considerably to the body of knowledge available to explain information behaviour and provide for a new perspective from which to view information seeking behaviour.

11.2 Implications and future research

The model offers a complex multi-layered tool to explain and further explore interdisciplinary information behaviour and goes further to suggest a foundation for the exploration of general information-seeking behaviour. The implications for existing theory, information skills training and future research are wide and suggest a revision of our

understanding of the fundamental concepts of information science. Briefly seven main implications are derived from the new model presented in this study, these are presented below.

1). The existence of a pattern of sequential stages is effectively compromised as a means of understanding progression through information-seeking. The data suggests that a problem-solving framework, as adopted in many existing models (e.g. Kuhlthau, 1993; Wilson. 1997). was not present. Instead, the results explicitly point to problem definition and more widely information-seeking behaviour to be cumulative, reiterative, holistic, and context-bound, with the model as shown in Figure 1 representing one slice of a temporal continuum within which a palette of non-linear behaviours exists.

2). The model forms the core of a non-linear explanation that embraces both problem solving and information seeking. One considerable implication of non-linear problem solving/ non-linear information seeking is that an holistic approach, as identified in Cognitive Approach within the present model, is essential to non-linear problem solving. A serial viewpoint requires only a conception of one part of the whole, rather than a picture of what the whole might be. Such a line of thought has the potential for several lines of future inquiry involving the study of problem solving and information seeking behaviour.

3). The conception of loops represents a repeat of activities and a sense of movement through information seeking. It is possible to consider this nonlinear interpretation of information seeking behaviour as offering a framework with which to extend and re-interpret the successive search phenomena highlighted by Spink (1999).

4). The phenomena suggest that further observation would reveal chains of action as information seekers move through the palette of possible patterns of behaviour represented by the core processes. Following this description by interviewees it would be feasible for future research to map out the pattern of activities to reveal the full scope of the pattern described. The qualitative data suggests the pattern appears to suggest a shifting / flowing usage pattern following the usage patterns of interviewees throughout information seeking: Orientation – Opening – Consolidation – Opening – Orientation – Orientation – Opening – Consolidation", "Opening – Consolidation- Opening – Opening – Orientation – Opening – Consolidation – Consolidation – Orientation", "Consolidation – Opening – Orientation – Opening – Consolidation". The size of task involved in mapping this data suggests further research would be usefully engaged in mapping the patterns in some depth. Related lines of inquiry would be to investigate whether individuals focus on individual elements of the Orientation. Opening. Consolidation model to the reduction of their use of the others. That is to say do they have preferred information seeking patterns. This could usefully be connected with a joint study of Cognitive Styles and Learning Styles to develop a complex understanding of the cognitive aspects of information seeker behaviour within the new model.

5). Conceptually the advent of a new model offers an alternative explanatory framework for user information behaviour that represents a shift between earlier linear models and the beginnings of a new generation of studies considering information behaviour from within a complex non-linear model. The new model addresses anomalous patterns of behaviour and missed stages noted in the application of previous models. The model offers a credible alternative framework for understanding information behaviour and its existence immediately suggests a need to reconsider some key concepts in further research.

6). The use of models of information-seeking to set the agenda for teaching information skills has been a crucial element in library and information studies curriculum design over the last fifteen years. The direct practical influences of the model are found in the potential for revising the teaching of information literacy and library skills. The new model offers the basis of a framework for educators and library professionals to teach both academic and non-academic, expert and non-expert information users in a manner that reflects practical behaviours and real-world solutions rather than applying stage theory.

7). As a tool for understanding information behaviour at the level of information-seeking within a context the model is credible and of potential interest to a wide audience. Initial examination of other contexts suggests that the model's core processes are echoed at the level of individual search episodes. This suggests different and successive layers of activity within the same model. Each layer maintains the overall picture, much like the composition of a fractal. Future studies will need to approach the highly focused question of search episodes to develop this aspect of the model.

11.2.1 Further research

Two pilot studies have begun to confirm the basic transferability of the model to other contexts, these were: (a) A pilot study has tested the basic theoretical aspects of the nonlinear model in the context of *single* discipline academic researchers within the department of History at the University of Sheffield during August 2002. This allowed an informal exploration using the interview guide from the present study and followed this with a brief training session using the nonlinear model as a framework to teach information skills. (b) A further pilot study applied the model in the teaching context. A small pilot involving 20 taught Masters degree students within the Department of History at the University of Sheffield. This utilised the model as a tool for structuring and explaining the teaching of information skills. The results begin to suggest that the model is transferable and capable of flexible use as a tool in teaching information seeking skills.

Formal pilot studies are being designed as a prelude to the investigation of two substantial interest areas that develop from the implications (1), (3), (4), and (5) of the this study, these are:

(1) Exploration of the model through a series of research projects using both naturalistic and pluralist approaches. Particular contexts for development of the model are Academic Research environment beyond the interdisciplinary context, Distance Learning and Adult Education, and Non-Specialist Information Seekers.

(2) An extension of the work into the domain of Educational research considers development of the Kolb (1984) model of learning styles and the non-linear model of information seeking behaviour to explore the potential for a combined learning and information theory. Cornerstones of this line of inquiry will require development of an Inventory for Knowledge, Information, and Learning Styles.

Three further lines of inquiry are planned to follow up the implications of the non-linear model. These are firstly represented in a further theoretical development of the implication (3) relating to successive searching which will explore the application of non-linearity to the concepts of successive searching, relevance judgements and relevance criteria are in progress. A second exploration is to follow up implication (6), the impact on information skills teaching. This will implement the model as a framework for teaching Information Literacy to undergraduates. The third inquiry is to explore implication (2), initially as a theoretical exercise, but with the aim of applying nonlinear problem solving to contexts beyond Information Behaviour.

11.3 Concluding remarks

The aims of this study were to define interdisciplinarity; to develop an understanding of interdisciplinary information seeking behaviour, from within the faculties of arts and humanities, social science, science, engineering, and medicine; to develop a model of interdisciplinary information seeking behaviour; and to compare that model with single discipline models existing in the literature. Three specific research questions are addressed in this study (1) What are the activities, strategies, contexts and behaviours used and perceived to be used by interdisciplinary information seekers?; (2) What is the relationship of the processes, contexts and behaviours as part of interdisciplinary information behaviour?; and (3) How can the information-seeking behaviour of interdisciplinary researchers be represented in an empirically grounded, theoretical model?

In presenting the model and the details of individual behaviours and their relationship to previous research these questions are answered and lead to the new directions for research. Specifically the study's first research question was answered through the identification of behaviours and strategies present in the description of the model. These behaviours extend previous research and point to the value of considering both internal context and external

context alongside individual activities to enable a holistic portrait of information-seeking behaviour. The behaviours identified emphasise the variety of approaches in use. while also indicating that these are flexible and only fully understandable within a view of the passage of time in a project and the interaction of behaviour and context.

In considering the emergence of a model the second and third research questions were fully addressed. As an outcome of a naturalistic inquiry, the model is context-specific. but already highly transferable, as begins to be indicated by the informal pilot studies described in the previous section. The model considers new aspects of interdisciplinarity and tackles the concept in greater depth than previous studies and the activities and behaviours identified have some crossover with existing models, which strengthens the interpretations of the data presented here, although the relationship of activities in this holistic context highlights different aspects of importance.

To conclude, this thesis offers a new, Non-Linear Model of Information Behaviour. which contrasts with earlier models of information behaviour and represents a potential cornerstone for a shift towards a new perspective for understanding user information behaviour. Bound by naturalistic approach to define a particular context it offers a potential guide for a reinterpretation of information behaviour as a dynamic flowing holistic process and in this points to many lines of future investigation and applications.

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Appendix A: Participants and the use of disciplines

Participant Number	32	37	38	45	33	42	46	30	31	35	36	40	41	44	5	1	9	21	23	24	25	28	39	15	4	17	13	6	16	27	34	43	7	8	18	12	10	26	3	11	20	22	2	
Discipline																																												
Art																																	1											2
English Language	1		1	1	1	1		1	1	1														1																			3
English Literature	1			1	1	1	1	1	1	1	1	1				1								1					1														8
History	1				1	1	1	1	1	1	1	1	1	1																													12
Legal History													1																														1
Literary History												1																															1
Music															1						1																						2
Philosophy			1			1						1	1	1								1													1								4
Political Science			1								1	1		1														1															5
Civil Engineering																																											1
Engineering															1														1		1			1									4
Mining															1														1														2
Architecture																																1												1
Architectural Psychology																														1														1
Biomedical Science																																				1								1
Environment																											1													1				1
Environmental Psychology																							1																					1
Ethics								1							1	1	1	1	1	1	1											1												1
Folklore																								1																				2
Information Studies																							1																					1
Natural History																																												

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Participant Number	32	37	38	45	33	42	46	30	31	35	36	40	41	44	5	1	9	21	23	24	25	28	39	15	4	17	13	14	6	16	27	34	43	7	8	18	19	12	10	26	5	7	20	30	11	3
Discipline																																													1	
Risk Assessment																								1																						2
Theatre/Drama Performance																																										1				1
Clinical medicine																										1	1																			1
Clinical sciences																										1		1																		1
Clinical therapy																																														1
Dermatology																											1	1																		1
Embryology																1												1																		1
General Practice					1																					1		1																		1
Genetics																										1	1	1		1	1															4
History of Medicine																														1	1															1
Medicine																													1								1								2
Nursing																										1			1																	3
Occupational therapy																										1			1																	3
Physiotherapy																										1			1																	3
Speech and Language therapy																									1														1							3
Toxicology																											1	1																		1
Trauma rehabilitation																											1																			1
Work Psychology																																								1						1
Archaeology										1																	1	1		1																4
Biochemistry																											1	1																		3
Biology																													1	1	1															3

Participant Number	32	37	38	45	33	42	46	30	31	35	36	40	41	44	5	1	9	21	23	24	25	28	39	15	4	17	13	14	6	16	27	34	43	7	8	18	19	12	10	26	3	11	20	22	2
Discipline																																													
Chemistry																																													1
Computer Science																		1		1	1	1		1								1													6
Ecology																					1									1	1	1		1											4
Health Informatics																					1																								1
Hydrology																								1																					1
Microbiology																								1																					1
Occupational Psychology																										1																			1
Plant science																														1	1														2
Psychology	1						1									1	1	1	1	1	1	1		1	1				1	1	1	1	1	1	1	1	1	1	1	1	1	1			21
Statistics																																1													1
Taxonomy																																1													1
Anthropology										1	1																											1							5
Architecture																																	1	1	1										3
Business/Commercial							1																							1				1		1	1			1					4
Communication Studies													1																																1
Criminol...																																													1
Cultural Studies						1	1																															1	1						5
Economics																																							1						

Participant Number	32	37	38	45	33	42	46	30	31	35	36	40	41	44	5	1	9	21	23	24	25	28	39	15	4	17	13	14	6	16	27	34	43	7	8	18	19	12	10	26	3	11	20	22	2	
Discipline																																														
Education and Learning																		1		1					1	1							1			1	1									7
Geography									1			1																				1	1		1			1				1				7
Heritage Management																																										1				1
Landscape																													1						1											2
Language studies						1																		1					1						1											4
Law													1																																	1
Leisure																																								1						1
Leisure Management																																								1						1
Linguistics			1																																		1		1			1				4
Management														1			1																								1	1	1	1		6
Marketing		1												1									1																		1		1		1	6
Personnel																																									1					1
Sociology		1			1		1		1	1	1				1			1		1															1	1	1	1	1		1	1	1	1	1	19
Tourism																																									1					1
Waste management																																									1					1
Broad Humanities - Any area						1																																								1
Broad Social Science – Any Area						1																																								1
Professional Practice																																	1			1										2
Number of discipline in participants' research	3	3	3	5	4	4	4	4	4	4	5	7	5	3	4	4	2	5	3	4	5	5	3	7	2	8	5	5	8	5	8	6	6	6	7	5	6	6	5	8	4	6	5	7	4	222

Table 14. Summary of participants and their use of disciplines

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Appendix B: Interview Guide

DEFINITION

1) Please define what you understand by the word "interdisciplinary" *(Probe:* Seek clarification of this definition if necessary).

2) Have you previously worked in a mono disciplinary area? *(Probes:* What was the area? / For how long?).

APPROACH

3) How do you approach the task of researching on a new area? *(Probe:* How focused are your thoughts? / *Probe:* How do you define your topic in the beginning? / *Probe:* How do you draw together ideas?).

4) How would you characterise the approach you take to solving the information problem?

ACTIVITIES AND STRATEGIES

5) Describe for me the things that you do to find information.

(Probe at each step for what you (do/need/feel/think), where you look).

6) Please think of an overview of an entire project from a title or area through to completion: Tell me about the activities and places that you look as you progress through a project. *(Probe:* At the beginning. / *Probe:* Once you are a little further into the area what would you do? / *Probe:* A little later in your research perhaps when you have done some searching or worked for a while on the topic. / *Probe:* As your work progresses and towards completion of your research?).

CHANGES OVER TIME:

7) Do you feel that there is a difference in what you were looking for, and what activities you do, at the beginning and as you move through?

8) Do you change what you do to find information, or perhaps put different emphasis on activities or sources at different points in a project?

(Probe: If you use the same strategies and activities, can you describe them for me? / *Probe:* If you use different strategies and activities, can you describe them for me? / *Probe:* How do the activities you describe fit in with your overall strategy of information-seeking?).

9) When you change from one topic to another do you change the things you do to find information? *(Probe:* In what ways?).

10) Does what you do to find information change as you move from between different types of topic? *(Probe:* In what ways?).

INFORMATION NEED

11) When you are looking at interdisciplinary topics: a) What information do you need to find? b) What do you look for? (If there is a difference in either of these questions: *Probe:* Why is there a difference? (Asked only if there is one).

INFORMATION SOURCES

12) Where would you look for information? (Prompt: e.g. Information sources – types e.g. Database, Library Shelves, WWW).

13) How do you identify new or useful information sources? (*Probes:* When looking at a range of sources how do you decide which ones will be worth using? / When looking at the results of a search how do you decide which results are relevant?).

DIFFERENCES

14) What differences do you think there are between working on a mono-discipline topic and working on a topic that might cover two or more disciplinary areas? *(Probe:* Thinking about how you find out about a interdisciplinary area, in the ways you have described, is that the same, or is it different from, single discipline topics? / *Probe:* If it is different, why do you think that is?).

15) Do you find some strategies or activities work more effectively, or indeed less effectively, in research for *interdisciplinary topics? (Probe:* Why do you think that is so?).

MOVING ON

16) What tends to move you on to using a new strategy or activity to find information?

17) When are you satisfied that you have enough information and can therefore move on to a new question, activity or different way of searching?

PROBLEMS AND ISSUES

18) Please describe for me any problems or issues raised by interdisciplinary topics. (Prompt Examples generated from previous interviews:- perhaps in identifying content, access to information sources, identifying resources, judging relevance) / *Probe:* Have you had any difficulties in locating information for this topic? (*Probe:* Why do you think that is?).

RECOMMENDATIONS AND ADVICE

19) What would you recommend to someone starting a similar topic to improve their chances of finding relevant information?

PERCEPTION OF STAGES

20) How would you perceive your process of information-seeking: Is it as clearly defined stages or as many smaller parts or something else?

DEMOGRAPHICS

21) Age, Professional Status, Academic Background, Disciplines.

Appendix C: Examples of the Analysis Process

Item 1: Examples of Coding Scheme

The use of code label prefixing allowed related facets to be displayed together within the alphabetic lists used throughout the Atlas-ti software. This simplified the logistics of coding within Atlas-ti and overcame the frustration of scrolling through long code lists.

As codes were identified as facets of the same larger category, renaming took place to allow ease of identification. For example, Core Processes in the final model were listed with the prefix of C:. Other codes were given a combination of single word, phrase and in viva labels, and in the course of analysis given word or letter prefixes. For example:

> C: Cognitive Approach
> C: Consolidation
> C: Opening
> C: Orientation
> Browsing
> Browsing and Serendipity
> Browsing and Short Time
> Browsing Not Practical if Access to Scattered Materials Required
> Browsing Selectively
> Browsing: Surfing the Library
> Browsing: undirected characteristic
> Chaining
> Chaining: Author (Citation and Reference) Searching: Forward Chaining
> Chaining: Bibliographic References Lists: Backward Chaining
> Chaining: Following Leads
> Chaining: Source Chaining

Item 2: Example of Transcript Coding

Atlas-ti permitted multiple codes to be applied to each text segment, and allowed codes and quotations to be linked quickly and easily. For example in this paragraph extracted from an interview the underlined text was coded to indicate Chaining activity, and the italic text denotes material coded as Networking activity, the same paragraph was also coded to include Information Sources, Use of the Web, Use of Email, and Library Catalogues.

> "I use library catalogues, on the web, I suppose, so that is a subset of the web, but that is one specific thing that I would explore. <u>There is also a certain amount of just browsing through hard copy, I mean of going to the library, finding things that look as though they might be promising and reading their bibliographies and seeing where that material came from and pursuing it, in many ways I still find that as interesting a way as any of looking at people's footnotes and citations, because things that are not massively important in their work might be exactly the kinds of things that I am looking for - that kind of thing.</u> *There is also the thing of contacting people as well, and people are often a better, or good complimentary source.* I have got more brazen about just emailing people out of the blue and again I'll probably do that via the internet if I find they have a homepage and they say they have certain interests then I'll probably email them. That is very ad hoc and hit and miss, some people are great and others turn out not to have the same interests or whatever. I don't know those are the major ones."

Item 3: Examples of Memos and Comments

The use "Memos" and "Comments" permitted the researcher to develop extended commentaries on the transcripts and coding process. At the simplest level. this was used to identify the purpose of a code or category to ensure consistency of coding, and at a more complex level performed the function of documenting concepts and themes, emergent theories and collection of draft text for the writing up process. The use of Atlas-ti greatly simplified and enhanced the flexibility with which process took place.

The following extracts from the coding for "Picture Building" are annotated with [ ] and underlining to illustrate the purpose of each part of the Memo or Comment.

Example of a Comment

"Definition: The concept "Picture Building" encompasses the processes or directions identified by respondents to be their way of grasping what a whole subject area is about, and where their own research will overlap, integrate, or otherwise interact. Picture building is defined here as the way information seekers created an overview of a subject and constructed their "understanding" of what a subject was about, without an immediate need to go into any depth". [The definition of each code contained sufficient information to ensure consistent coding.]

"e.g. P9:9:25(93:97)   I am much more likely to do it that way than get stuck into the details and actually discover that it is not so relevant. So I tend to be mapping out and seeing how it all fits together as that predominates as I am building the picture and at a later stage I will then get down to the details and pull in all the articles and read them in greater detail". P9: 9:25 (93:97)" [The researcher made note at the same time that quotation P9:9:25 was particularly nice for inclusion in the relevant chapter.]

Example of a Memo

"Context of Code: Contrasts with code Reviewing - which considered the view of accomplishment to date, Picture Building placed this within a cumulative structure, a construct of the information seeker". .

"Relationships appearing: The process of Picture Building appears in a direct relationship with the level of knowledge and understanding already held by the respondents. "Picture Building" and higher knowledge and social networks shows a connection". [In these two points, formative ideas of how this code related to others were noted.]

"Processes: The process of Picture Building was deeply entwined with Knowledge and Previous Experience and Information gained through Opening. The clearest and most graphic form of mapping process included a paper component for some interviewees on which ideas and Reviewed material was sketched out containing words, concepts, notes of sources, boxes, notes, arrows and lines linking the various components". [Memos were particularly useful to note how the codes related to larger processes and emerging concepts.]

"The creation of a taxonomy aided the development of an understanding of shape and function of disciplinary components. Examples are useful in thinking about this, e.g. P2: 2:30 (223:243). "What does Picture Building produce? What meaning it holds for those who are being studied? "Map" of the subject to enhance further investigations?" [The researcher made extensive use of Memos to note thoughts, questions and make a record of particularly articulate or interesting quotations with a view to writing up.]

Item 4: Examples of Network Views

Each core process and each code within that process was explored visually with representations of the connections and interactions of activities, events, and timing illustrated during the analysis. These are expressed in the choice of chapters, sections, and order of presentation of points within sections. Network views allowed codes, connections (represented by lines and symbols), and quotations (the small boxes with numbers in) to be viewed and manipulated collectively.