

**Psychological and Organisational Issues in the Design of
Buildings and Workplaces**

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Intellectual Property and Publication Statements

The candidate confirms that the work submitted is his own, except where work which has formed part of jointly-authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

Davis, M. C., Leach, D. J., & Clegg, C. W. (2011). The Physical Environment of the Office: Contemporary and Emerging Issues. In G. P. Hodgkinson & J. K. Ford (Eds.), *International Review of Industrial and Organisational Psychology* (Vol. 26, pp. 193-235). Chichester, UK: John Wiley & Sons Ltd.

The first literature review (chapter two) is based upon the above work. Sections of the above have been incorporated into the description of methodology chapter (chapter five) and the final discussion (chapter eight).

The above review chapter was led by Davis and the literature review and synthesis were solely his work. Leach and Clegg provided advice and input regarding structure and writing style. Additionally they suggested links to wider topics.

Davis, M.C., Leach, D.J. & Clegg, C.W. (Under Review). Breaking Out of Open Plan: The Key to Office Communication. *Journal of Organizational Behavior*.

Sections based upon the above work have been incorporated into the second literature review (chapter three). Sections of the above have also been used as the basis for parts of the methodology chapter (chapter five) and final discussion (chapter eight).

The above paper was led by Davis and the literature review, method, analysis and discussion were solely his work. Leach and Clegg provided advice and input regarding structure and writing style. Additionally they assisted in interpretation of the findings and suggested links to wider topics.

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Publications Arising

Directly from the thesis

A number of publications, conference and organisational outputs directly relating to this research have been produced during the preparation of this thesis. These are detailed below:

Journal articles

Davis, M.C., Leach, D., & Clegg, C. (Under Review). Breaking out of open-plan: The key to workplace communication? *Journal of Organisational Behaviour*.

Book chapters

Davis, M. C., Leach, D.J., & Clegg, C.W. (2011) The Physical Environment of the Office: Contemporary and Emerging Issues. In G.P. Hodgkinson, & J.K. Ford (Eds.). *International Review of Industrial and Organisational Psychology* (Vol. 26, pp. 193-235). Chichester, UK: John Wiley & Sons Ltd.

Awards

US Academy of Management Organizational Behavior Division "Making Connections Award" (2010). The award recognises the

symposium submitted to the Academy of Management Annual Meeting that best creates bridges across boundaries between individuals or groups (e.g., between practitioners and academics, international and domestic scholars, academic disciplines, junior and senior scholars).

Peer reviewed conference presentations

Davis, M.C., Leach, D.J., & Clegg, C.W. (2010). *The Physical Environment: An Evolving Topic*. Paper presented at the 2010 Academy of Management Annual Meeting.

Ridgway, K., Cerulli, C., Davis, M.C., Challenger, R., Wiseall, S., Hill, P., Hollis, K., & Clegg, C. (2008). *Designing the factory of the future*. Paper presented at the International Conference on Applied Human Factors and Ergonomics (AHFEI).

International symposia organised

Davis, M.C. (2010). *Space that Works: New Directions and Opportunities for Research into Physical Workspace*. Symposium organised for the 2010 Academy of Management Annual Meeting.

Non peer-reviewed presentations:

McGourlay, J., Ridgway, K., Davis, M.C., Challenger, R., & Clegg, C.W. (2009). *Designing the Factory of the Future*. Paper presented at

Design for Human Performance, a one day conference organised by Arup, 26th February 2009, London, UK.

Davis, M.C. (2008). *Designing a "good" working environment.*

Paper presented at the Higher Education Facilities Management Network – Space Forum.

Reports to organisations

Davis, M.C., & Clegg, C. (2009). *Considering the potential risk of office space.* A report to Rolls-Royce plc.

Davis, M.C. (2008) *Workstation layouts: A report to Rolls-Royce plc.*

Davis, M.C., O'Neill, R., & Clegg, C.W. (2008). *Review of Literature with relevance to Open Plan Office Space: A report to Rolls-Royce plc.*

Presentations to organisations

Davis, M.C. & Clegg, C.W. (2009). *Considering the potential risk of office space.* Presentation to Rolls-Royce plc., 17th June 2009.

Davis, M.C. (2009). *Office Design.* Presentation to Rolls-Royce plc., 19th February 2009.

Related research streams

During the course of the preparation of the thesis a number of outputs concerning related research have also been produced, listed below.

These related outputs are in addition to the publications and dissemination arising directly from the subject of this thesis.

Journal articles

Davis, M.C., & Challenger, R. (2009). Climate change – Warming to the task. *The Psychologist*, 22, 112-114.

Book chapters

Davis, M.C., & Challenger, R. (In Preparation). Pro-environmental behaviour. In P.C. Flood, & Y. Freeney (Eds). *The Blackwell Encyclopedia of Management* (3rd Ed., Vol. 11). Oxford, UK: Blackwell.

Practitioner articles

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Davis, M. C. (2010). *Integration: The Route to Sustainable Behaviour?* Paper presented at the 2010 Academy of Management Annual Meeting.

Challenger, R., Davis, M.C., Gulko, T., & Robinson, M.A. (2010). *Going "green", going forward*. Paper presented at the Going Green Symposium, organised by the Division of Occupation Psychology.

Davis, M.C., & Challenger, R. (2009). *Promoting pro-environmental behaviour in the workplace: Reframing the green issue*. Paper presented at the 2009 Academy of Management Annual Meeting.

Davis, M.C., Challenger, R., & Clegg, C.W. (2009). *Climate change: A change in mindset? A discussion of the potential for organisational psychologists to help green people's behaviours at work*.

Paper presented at the 14th European Congress of Work and Organisational Psychology.

Davis, M.C., Challenger, R., & Clegg, C.W. (2009). *Can Occupational Psychology Help Save the Planet? A fresh look at being "green" at work*. Paper presented at the British Psychological Society's Division of Occupational Psychology Conference.

International symposia organised

Davis, M.C., & Russell, S.V. (2010). *Green Shoots: New Directions and Opportunities for Workplace Pro-Environmental Behaviour Research*. Symposium organised by the authors for the 2010 Academy of Management Annual Meeting.

Challenger, R., Davis, M.C., & Hughes, H.P.N. (2009). *Putting the 'Behaviour' back into Green Behaviour: Encouraging Pro-Environmental Actions in the Workplace*. All-Academy Theme Symposium organised by the authors for the 2009 Academy of Management Annual Meeting.

Non peer-reviewed presentations:

Davis, M.C., Challenger, R., Clegg, C.W., & Jofeh, C. (2009). *Understanding and Promoting Green Behaviour in the Use of Existing Buildings*. Paper presented at Design for Human Performance, a one day conference organised by Arup, 26th February 2009, London, UK.

Reports to organisations

Davis, M.C., Challenger, R., Clegg, C.W., & Heeley, M. (2008). *Understanding and promoting green behaviours in the use of existing buildings: A report to Arup.*

Presentations to organisations

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Abstract

Offices are evolving rapidly to facilitate organisational cost reductions and to better support contemporary working practices. This thesis explores the design and reconfiguration of physical workspace. Theories of the physical environment, work design and ideas from the design literature are drawn upon to understand interactions in modern workspace. The evaluation of a global engineering company's office reconfiguration programme provides the research context. Study one examines the relationships between features of contemporary office configuration (proximity and break-out areas), staff autonomy and communication. Data from 405 employees in differing offices were collected. Break-out areas and autonomy were positively related to communication. A three-way interaction was observed, suggesting that configuration affects groups of workers differently and that the environment-worker relationship should be considered as a system. Study two examines the trade-offs present in contemporary reconfigurations (reduced proximity and density, vs., increased break-out provision). The potential mediating role of crowding in the environment-worker relationship is also investigated. The research utilised a longitudinal quasi-experimental design. Data were collected from 296 respondents, at two time-points, in three offices. Reconfigurations that reduced individual workspace (density and proximity) were related to increased crowding. Inclusion of greater break-out provision within offices that reduce individual workspace appear not to trade-off negative

relationships with crowding and communication. Findings indicate that crowding partially mediates the relationship between density and proximity with communication. The implications of these findings for theory and practice are discussed. Future research and methodological directions are also articulated.

Table of Contents

Intellectual Property and Publication Statements.....	ii
Acknowledgements.....	iv
Publications Arising	vi
Directly from the thesis	vi
Journal articles	vi
Book chapters.....	vi
Awards.....	vi
Peer reviewed conference presentations.....	vii
International symposia organised.....	vii
Non peer-reviewed presentations:	vii
Reports to organisations	viii
Presentations to organisations	viii
Related research streams	ix
Journal articles	ix
Book chapters.....	ix
Practitioner articles	ix
Funding.....	x
Peer reviewed conference presentations.....	x
International symposia organised.....	xi
Non peer-reviewed presentations:	xi
Reports to organisations.....	xii
Presentations to organisations	xii
Abstract.....	xiii
Table of Contents	xv
List of Tables	xx
List of Figures.....	xxi
1. Introduction.....	1
1.1. Chapter synopsis.....	3
1.1.1. Chapter two.....	3
1.1.2. Chapter three.....	4
1.1.3. Chapter four	5
1.1.4. Chapter five	5

1.1.5. Chapter six	5
1.1.6. Chapter seven	6
1.1.7. Chapter eight	6
2. Contemporary and Emerging Issues in the Office Environment.....	7
2.1. Introduction.....	7
2.2. The rise of the open-plan office	10
2.2.1. Historical overview.....	10
2.2.2. Benefits of open-plan offices.....	13
2.2.3. Risks of open-plan offices.....	17
2.2.4. Individual and contextual factors affecting open-plan offices	22
2.2.5. A trade-offs perspective.....	25
2.3. The evolution of open-plan	27
2.3.1. The drivers of change.....	27
2.3.2. The form of the evolving office	31
2.3.3. The effects of evolving offices	36
2.4. Workspace change.....	40
2.4.1. New or reconfigured workspace involves change.....	41
2.4.2. Similarity to organisational change management.....	42
2.4.3. Successful user involvement in workspace design	45
2.4.4. Applying socio-technical principles.....	47
2.5. Summary.....	54
3. The Evolving Office: Research Opportunities.....	56
3.1. Introduction.....	56
3.2. Evaluation of contemporary office configurations.....	57
3.2.1. Office evaluation gap	58
3.2.2. Break-out areas	61
3.2.3. Density and proximity of co-workers	63
3.3. Integrating work design and workspace configuration	65
3.3.1. Benefits of combining work design and configuration.....	65
3.3.2. The role of autonomy.....	67
3.3.3. Work-workspace interaction.....	70
3.4. Trade-offs in reconfiguring workspace.....	72
3.4.1. Office reconfiguration involves change.....	72
3.4.2. A trade-offs perspective.....	74
3.4.3. Wellbeing.....	78
3.4.4. Crowding	81
3.4.5. Trading-off crowding	82
3.5. Psychological processes involved in office reconfiguration	83

3.5.1. Applying theoretical processes.....	84
3.5.2. Crowding as a process.....	86
3.5.3. Mediating process.....	88
3.6. Summary.....	90
4. Research Hypotheses.....	92
4.1. Break-out areas.....	92
4.2. Proximity of co-workers.....	93
4.3. Density of co-workers.....	93
4.4. Autonomy.....	94
4.5. The office as an interactive environment.....	95
4.5.1. Higher communication.....	95
4.5.2. Moderate communication.....	96
4.5.3. Lower communication.....	97
4.6. Wellbeing.....	98
4.7. Crowding.....	98
4.8. Trading-off crowding.....	99
4.9. Crowding as a mediating process.....	100
4.10. Summary.....	101
5. Research Context and Methodology.....	102
5.1. Context.....	102
5.1.1. Organisation.....	103
5.1.2. Office reconfiguration programme.....	103
5.1.3. Study one.....	106
5.1.4. Study two.....	109
5.2. Research design.....	112
5.2.1. A quasi-experimental approach to research design.....	113
5.2.2. Study one design.....	117
5.2.3. Study two design.....	117
5.3. Sample and data collection.....	118
5.3.1. Study one.....	118
5.3.2. Study two.....	119
5.3.2.1. Matched and unmatched cases.....	120
5.4. Measures.....	123
5.4.1. Physical environment.....	123
5.4.1.1. Break-out areas.....	124
5.4.1.1.1. Study one.....	125
5.4.1.1.2. Study two.....	126
5.4.1.2. Density.....	127

5.4.1.2.1. Study one	128
5.4.1.2.2. Study two	129
5.4.1.3. Physical proximity.....	129
5.4.1.3.1 Measurement	130
5.4.2. Psychosocial measures.....	131
5.4.2.1. Autonomy.....	131
5.4.2.2. Communication.....	132
5.4.2.3. Crowding.....	132
5.4.2.4. Wellbeing.....	133
5.5. Summary.....	134
6. Study One Analysis and Results	135
6.1. Introduction.....	135
6.2. Measures.....	137
6.3. Preliminary findings.....	137
6.4. Moderated multiple regression	138
6.4.1. Direct effects	141
6.4.2. Interactive effects	143
6.5. Summary.....	146
7. Study Two Analysis and Results.....	148
7.1. Introduction.....	148
7.2. Measures.....	150
7.3. Factor analysis.....	152
7.4. Sample distribution	154
7.5. Correlations	154
7.6. Analysis of variance	157
7.6.1. Crowding.....	157
7.6.2. Communication.....	159
7.6.3. Wellbeing.....	161
7.6.4. Subgroup analysis.....	162
7.6.4.1. Crowding.....	162
7.6.4.2. Communication.....	163
7.7. Preliminary mediation analysis	163
7.8. Potential follow-up analysis.....	168
7.9. Summary.....	169
8. Discussion.....	171
8.1. Introduction.....	171
8.2. Interpretation of study one findings	173
8.3. Interpretation of study two findings.....	177

8.4. Reflections on the research process.....	183
8.4.1. Study one.....	184
8.4.2. Study two.....	186
8.5. Theoretical extensions and opportunities.....	190
8.5.1. Theory integration and testing.....	190
8.5.2. Work design.....	193
8.5.3. Trade-offs.....	194
8.5.4. Change and implementation.....	195
8.5.5. Environmental sustainability.....	197
8.6. Practical and methodological extensions.....	198
8.6.1. The analysis of tipping points.....	198
8.6.2. Temporal/real-time data collection.....	200
8.6.3. Incorporating physiological data.....	201
8.6.4. Moving beyond basic productivity/business outcomes.....	202
8.6.5. Enhancing the precision of our measures through greater cross- disciplinary collaboration.....	203
8.7. Conclusion.....	205
List of References.....	209
List of Abbreviations.....	243
Appendix A: Office A Time One.....	245
Appendix B: Office B.....	246
Appendix C: Office C.....	247
Appendix D: Office A Time Two.....	248
Appendix E: Epistemology.....	249
Appendix F: Questionnaire.....	252

List of Tables

Table 4.1. Effects of interdependent variable combinations on communication	98
Table 5.1. Study one hypotheses to be tested.....	109
Table 5.2. Study two configuration changes between times one and two.	110
Table 5.3. Study two hypotheses to be tested.....	112
Table 5.4. Study two distribution of sample (number of respondents).	120
Table 5.5. Study two break-out area provision, per office.	127
Table 5.6. Study two setting density, per office.	129
Table 6.1. Study one measures.	137
Table 6.2. Study one means, standard deviations and intercorrelations amongst all variables.	140
Table 6.3. Study one moderated multiple regression analysis summary.	142
Table 6.4. Study one tests of slope difference summary.....	146
Table 7.1. Study two configuration changes between times one and two.	149
Table 7.2. Study two measures.	151
Table 7.3. Study two pattern and structure matrix with oblimin rotation of three-factor solution for measure items.	153
Table 7.4. Study two distribution of sample (number of respondents).	154
Table 7.5. Study two correlation table.....	156
Table 8.1. Summary of support for all tested hypotheses.....	172

List of Figures

<i>Figure 2.1.</i> Diagram illustrating development of the field.....	13
<i>Figure 2.2.</i> Schematic illustrating Duffy's (1997) distinction between differing office designs and their support for working practices.	35
<i>Figure 2.3.</i> Socio-technical system, illustrating the inter-related nature of an organisational system.....	50
<i>Figure 3.1.</i> Figure illustrating the trade-offs often involved in contemporary office reconfiguration and the potential counterbalancing of competing design features.....	77
<i>Figure 3.2.</i> Figure illustrating proposed mediation role of crowding in worker-environment relationship..	90
<i>Figure 5.1.</i> Diagram illustrating the relationship between reconfiguration phases and studies one and two.....	106
<i>Figure 5.2.</i> Study one distribution of sample.....	108
Figure 6.1. Study one: Three-way interaction between proximity, break-out and autonomy, with communication.	144
<i>Figure 7.1.</i> Study two: Perceived crowding by office over time.	159
<i>Figure 7.2.</i> Study two: Reported communication by office over time.	160
<i>Figure 7.3.</i> Study two: Reported wellbeing by office over time.....	161

1. Introduction

Senior leadership in a growing number of organisations, both private and public, is discovering that workplace design and management have an impact on organisational performance. In the U.S. and in the U.K., government organisations – particularly central government organisations – are discovering the positive effects of workplace redesign.

(Price, 2007, p. 102)

The statement above illustrates the enhanced attention that the design of workspace, or the reconfiguration of existing space, is gaining within organisations. The topic of the physical work environment is often regarded as the preserve of architects or facilities managers (Duffy, 2000); Industrial/Organisational (I/O) psychologists and management scholars have generally not involved themselves in the topic to a great extent (J. K. Chan, Beckman, & Lawrence, 2007). There is now, however, a renewed interest in the topic amongst organisational scholars (e.g., Elsbach & Pratt, 2007) and recognition of the role that workspace can play in influencing human behaviour (e.g., Allen & Henn, 2007).

There is a compelling argument for organisational scholars to give greater consideration to the role of the physical workspace within organisational practice and theory: humans do not live their lives and interact with one another in isolation of their physical surroundings

(Becker, 1981). The space people occupy helps shape how they behave and interact with one-another (e.g., Brookes & Kaplan, 1972, Elsbach & Pratt, 2007) and there is a need for this to be acknowledged more widely within organisational theory and practice.

This thesis will argue that there is an opportunity for I/O psychologists to contribute to a new wave of workspace literature. In the 1970s the introduction of open-plan working brought about a marked increase in studies evaluating the effects of office configuration on organisational behaviour (Brennan, Chugh, & Kline, 2002; Brookes & Kaplan, 1972; Oldham, Cummings, & Zhou, 1995). A fresh shift in workspace design is underway, stemming largely from an increase in knowledge based and collaborative working (T. J. Allen, 2007; Duffy, 2000). There is a need for researchers to evaluate the changes that are already happening in the design of office space, and also to be actively involved in the design of such spaces.

This thesis sets out to further this agenda. First, a multi-disciplinary lens is adopted to help draw together what is often a scattered and fragmented literature. Second, the implications that contemporary workspaces pose in relation to individuals and organisations are considered. Third, the association between contemporary office configurations and employee communication is investigated, together with the inter-relationship with job autonomy. Fourth, the reconfiguration of office space is evaluated. Fifth, the relationship between changes in physical proximity, density and break-out space with communication, wellbeing and crowding are explored.

Sixth, to further understanding of the reactions of employees to such change, the role of crowding a process in the worker-environment relationship is investigated. Seventh, the implications for theory and practice of these results will be discussed. Finally, a number of more general research and methodological directions will be proposed to aid future research.

The specific organisation of this thesis is described in the sections below:

1.1. Chapter synopsis

1.1.1. Chapter two

Chapter two reviews the design of office environments and their relationship with workers and organisations. The review draws from across a range of disciplines to provide a comprehensive account of what is a diverse topic. The history of the study of the physical work environment is presented, together with the benefits and pitfalls of adopting open-plan office configurations. The chapter continues by describing the emergence of contemporary offices designed to suit the modern organisation. The drivers of this evolution in design are discussed, together with the potential implications for individuals and organisations. Finally, the inherent change that office design or redesign embodies is highlighted. In particular, attention is drawn to the requirement for organisations to manage this change, together with the

potential benefit that a Socio-Technical Systems (STS) approach may offer.

1.1.2. Chapter three

This second literature chapter provides a more focussed examination of the broad issues reviewed in the previous chapter. Four opportunities for research are presented, each selected due to practical relevance or potential for theoretical advancement. First, the need for programmes of research that examine the relationship between contemporary workspace and workers is articulated. Break-out areas, and physical proximity and density, are identified as common office features requiring evaluation. Communication is presented as an intended aim of contemporary office reconfiguration that should be included as an outcome of such evaluations. Second, the case for integrating physical design and work design thinking, with reference to potential interactions, is made. Third, the trade-offs between positive and negative outcomes in office reconfiguration are presented as requiring testing. In particular, examining whether designs that increase break-out areas can trade-off reductions in individual workspace is highlighted as worthy of investigation. Fourth, investigating the role of psychological processes within contemporary office environments is identified as a research opportunity. Crowding is presented as a psychological process particularly relevant to modern reconfigurations that reduce individual workspace.

1.1.3. Chapter four

This chapter builds upon the previous one by presenting specific hypotheses related to the highlighted research opportunities. Nine hypotheses derived from the literature reviewed in chapters two and three are stated.

1.1.4. Chapter five

Chapter five provides the context and methodology for the current research. The organisational context in which the studies were conducted is described. Then the rationale and benefits of adopting a quasi-experimental research design are discussed. Subsequently, the structure and design of the comparative study and the longitudinal study are detailed. The process followed to collect data, and the nature of the research sample, are described. The chapter concludes by outlining the psychosocial measures used and explaining how the physical environment was measured.

1.1.5. Chapter six

Chapter six reports the findings from study one. First, the correlations between access to break-out areas, proximity and autonomy with communication are presented. Second, the results of moderated multiple regression (MMR) analysis are reported, the technique utilised to test for direct and interactive effects. Finally, to aid understanding of the identified interaction, the results of slopes difference tests are stated.

1.1.6. Chapter seven

Chapter seven presents the findings from study two. First the results of a Factor Analysis (FA) and the zero order statistics are provided. Second, the findings from a series of two-way Analyses Of Variance (ANOVA) are stated. This analysis investigated the presence of direct and interactive effects between the treatment conditions with communication, wellbeing and crowding. Third, the results of sub group analyses are then reported. Finally, analysis that tested the possible mediating role of crowding is presented.

1.1.7. Chapter eight

The final chapter in the thesis discusses the findings and wider research issues. First, the implications of study one and two's empirical findings are discussed first. Second, the research journey is reflected upon. Particular attention is given to the process and approach adopted during the course of the research. Third, the chapter provides ideas and directions for potential theoretical extensions and future research. These opportunities are described. Fourth, practical and methodological areas for refinement and extension are identified. Finally, the chapter concludes by summarising the key thoughts and contributions articulated throughout the thesis.

2. Contemporary and Emerging Issues in the Office Environment

2.1. Introduction

An organisation's workspace, the physical environment an organisation provides for its employees to carry out their work activities, constitutes the second largest financial overhead (after human resources) for most organisations (McCoy, 2005). Of the workspace provided, most employees in developed countries work in some form of office environment (Duffy, 1997) and studies of this practice have found that it plays a powerful role in shaping a diverse range of psychological and behavioural outcomes, including individual work motivation (e.g., Oldham & Brass, 1979), job satisfaction (e.g., Veitch, Charles, Farley, & Newsham, 2007), and patterns of interactions (e.g., Boyce, 1974; Ives & Ferdinands, 1974; E. Sundstrom & Sundstrom, 1986). Furthermore, the impact of offices upon their occupants' personal productivity has been estimated to be somewhere in the region of 20% (e.g., Leaman & Bordass, 2005).

Within the organisational literature, offices have been typically described as either traditional (sometimes referred to as enclosed or cellular offices) or open-plan. Traditional offices tend to house one or two individuals in private rooms, enclosed by walls, often containing most of the amenities required for their job (Danielsson & Bodin, 2008). Open-plan offices are characterised by a lack of interior walls, tend to be larger

and contain greater numbers of workers, with individual workstations arranged within the office in groups (Brennan et al., 2002; Brookes & Kaplan, 1972). Workspace design, however, is currently under organisational scrutiny due to the changing nature of work. It is evident that many organisations are re-evaluating their facilities to ensure their workspace meets the needs of an increasingly diverse and demanding workforce (see, e.g., Laing, 2006). Architects have noted a definite shift in terms of how employees, especially knowledge-based workers, spend their time, the kinds of task they engage in and, crucially, where they choose to work (Duffy, 2000). As Gillen (2006) commented "*Work environments are in a state of transition from something familiar and predictable to something not yet defined, multi-locational, virtual and physical*" (p.62). In response, organisations are increasingly investing in innovative offices, upgrading the open-plan office to support more nomadic, group based, flexible or remote working styles. However, office redesign is often based upon managers' own interpretations and experiences of employee work patterns, largely without specific research or professional input (e.g., Laing, 2006).

Optimising existing offices (embarking on office redesign) manifestly involves change for the individual workers concerned. Alterations to factors such as the physical layout or configuration of space (i.e., reconfiguration), and the provision of office facilities and services, can have significant effects on how individuals or teams go about their work (e.g., Laing, Duffy, Jaunzens, & Willis, 1998). However, despite the extensive change management literature (e.g., By, 2005; Kanter, Stein, & Jick, 1992; Luecke, 2003; Pettigrew, Woodman, &

Cameron, 2001; Weick, 1979), there is currently limited guidance on how the process of office design and implementation can be successfully managed. Developing an appreciation of managing such processes is important if we wish to avoid new offices, or the changes in working practices that they necessitate and/or foster, being rejected by disaffected workers or undermined by counterproductive work behaviours (e.g., Chapman, Sheehy, Heywood, Dooley, & Collins, 1995; Vischer, 2005b).

To ensure that this thesis provides a fresh insight into the study of physical work environments and focuses upon contemporary issues, this chapter collates and synthesizes, from a disparate range of sources, the findings of research that has investigated workers' reactions to, and interactions with, their workspace. Given the prevalence of open-plan offices, the value of such work environments is first appraised and then outcome-related contingencies are described. In so doing, this chapter differs from previous reviews that have bounded or compartmentalised the literature by physical feature or design choice, thereby examining the effects of the density of a workspace separately from the openness of an office's design (e.g., R. A. Baron, 1994; Elsbach & Pratt, 2007; Oldham et al., 1995; E. Sundstrom & Sundstrom, 1986). Second, ways in which open-plan offices are evolving to suit the modern organisation are reviewed, together with what the implications might be for individuals and organisations. Third, the need to manage the process of change that office design and reconfiguration involves is discussed. Some of the approaches that have been applied to date are examined and the similarity to wider organisational change principles are reflected on. The

chapter concludes by identifying how I/O psychology research can contribute to decision-making regarding optimal office design by extending current understanding of the role of contemporary office space.

2.2. The rise of the open-plan office

The office has emerged as the stereotypical place of work for the post-industrial age (e.g., Becker, 1981), with over 70% of workers occupying a form of open-plan office at the turn of the century (e.g., Brill, Weidemann, & BOSTI Associates, 2001; Vischer, 1996). In this section the benefits and risks of open-plan working are reviewed. Consideration is given to the trade-offs involved in pursuing an open-plan strategy, and the individual and contextual factors affecting open-plan outcomes are highlighted. In order to set the scene and provide appropriate context, the origins of research into the physical work environment are revisited and the rise of the open-plan office charted.

2.2.1. Historical overview

The physical environment was a major topic of interest for early I/O psychologists (circa 1910 onwards), with attention focusing predominantly on the effects of ambient conditions (e.g., lighting, temperature, ventilation) on workers' productivity (e.g., Morgan, 1916; Vernon, 1919). This approach is still reflected in the more recent ergonomic and environmental psychology literatures (R. A. Baron, 1994; Becker, 1981; Brennan et al., 2002; Oldham et al., 1995; E. Sundstrom &

Sundstrom, 1986). Notable relationships were established, for example between excessive noise and workers' health and productivity (R. A. Baron, 1994). However, the publishing of the Hawthorne experiments (Roethlisberger & Dickson, 1939) marked a watershed in organisational research, with this long-running field study publicly failing to establish a link between changes to the physical environment and worker productivity. The lack of success in establishing environment-behaviour links in the Hawthorne experiments coincided with a general decline in interest in the physical environment that would last until the 1960s (Oldham et al., 1995).

I/O psychologists conducted little research into the physical environment during the 1940s – 1960s; however, the topic was not wholly neglected and pockets of research activity by other disciplines did prevail. For example, social psychologists and architectural schools were researching the interaction of individuals with the built environment (albeit with limited attention to workplaces), demonstrating how the manipulation of the physical environment could produce profound differences in the way that people interact with one another. For example, the spatial configuration of furniture was found to influence the amount and nature of conversation between individuals (Osmond, 1959; Sommer, 1959), and the location of people within a building helped determine with whom they interacted and formed friendships (Festinger, Schachter, & Back, 1950).

The widespread introduction of open-plan and bürolandschaft (landscaped) offices in North America in the 1960s and 1970s (e.g., Brookes & Kaplan, 1972; Hundert & Greenfield, 1969; Zeitlin, 1969), saw

I/O psychologists and organisational scholars begin once again to become interested in the relationship between workers and their physical workspace (see Duffy, 1997, for an excellent review of the development of office environments). The effects that changes to established office design may have upon office occupants became a common concern and the issue was taken up by journalists (e.g., "The trouble with open offices," 1978, cited in Oldham, 1988) and scholarly researchers (Brookes & Kaplan, 1972; Oldham & Brass, 1979). Proponents of the open-office predicted that it would produce, for example, better inter- and intra-team communication (Brookes & Kaplan, 1972; Lee & Brand, 2005; Pile, 1976). Such claims helped persuade scores of corporations to experiment with the demolition of interior office walls and so began the rapid rise of open-plan offices.

The open-plan concept soon became a vehicle for organisations to reduce their fixed overheads (e.g., Duffy, 1997; Vischer, 2005b) and to increase the density of employees housed in previously enclosed spaces. Gradually design features, such as the inclusion of plants and angled desk placements were marginalised. At the same time, distances between neighbouring desks were reduced and circulation space sacrificed for "efficiency" gains (Laing, 2006). In turn, concern over effectiveness triggered a new wave of research into the effects of introducing open-plan working (Brennan et al., 2002; Oldham et al., 1995). These concerns are still influential within I/O Psychology and management research, with a continuing emphasis upon the examination of key aspects of open-plan configuration, for example the density of workers housed within the office, the proximity of co-workers to one-

another, and the openness of the office (e.g., De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005). See figure 2.1 for illustration of the development of the psychological field investigating the physical work environment.

Development of the Field

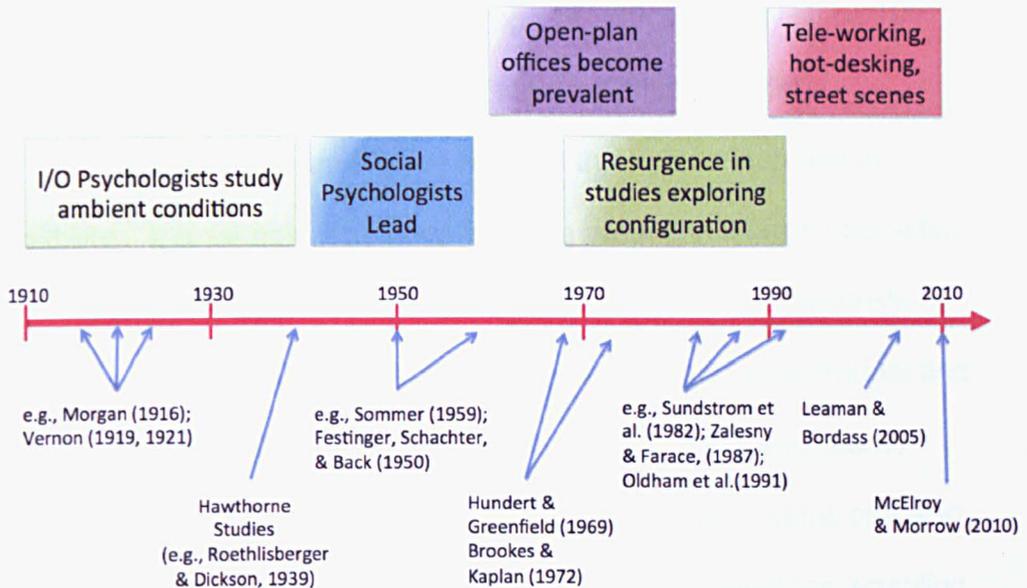


Figure 2.1. Diagram illustrating development of the field.

2.2.2. Benefits of open-plan offices

The open-plan office has become the dominant choice when considering workspace strategies (e.g., Brill et al., 2001; Vischer, 1996), primarily for economic reasons (Brookes & Kaplan, 1972; Duffy, 1997; Laing, 2006). Fewer interior walls (and enclosed offices) permit larger floor plans to be achieved, which allow greater numbers of employees to be accommodated (e.g., Marquardt, Veitch, & Charles, 2002; Vischer, 2005b). Increasing the density of workers housed within an office space through open-plan configurations has consequently become an important

method through which organisations attempt to reduce overheads (e.g., Duffy, 2000; Veitch et al., 2007; Vischer, 2005b). Higher office densities allow substantial savings to be made in either rental, land or build costs and lower services (e.g., heating and ventilation) and security charges (e.g., Duffy, 2000; Zeitlin, 1969). Reflecting these savings, the latest figures show a 40% increase in average UK office density since 1997 (from 16.6 m² per person to 11.8 m² today) (Offices, 2009b).

Cost savings can also be realised through an increase in flexibility. It is far easier to move furniture around in a large open-plan office than within enclosed offices. This flexibility reduces the costs of future reorganisations, with desks readily reorganised as individual and organisational requirements change, for example as project teams change or new technology is required. Individuals and teams can also be organised around work-flows and departmental groupings, enabling rationalisations such as the centralised storage of group files and work materials (e.g., Foland, Rowlen, & Watson, 1995).

In addition to financial benefits, another driver of the rapid adoption of open-plan offices has been the proposition that they aid inter and intra-team communication (Brookes & Kaplan, 1972). For example, advocates of the social relations approach have proposed that the physical environment is able to affect the frequency and nature of the interactions and communication that its inhabitants conduct (Festinger et al., 1950; Oldham & Brass, 1979; Zalesny & Farace, 1987). It has been suggested that offices which facilitate greater communication and interaction (e.g., those which place individuals close to one another and remove physical barriers to communication, as open-plan offices

frequently do) will allow individuals to share task relevant information, promote feedback and create friendship opportunities (Oldham & Brass, 1979), leading in turn to increased interpersonal relations, reduced conflict, increased job satisfaction and motivation (Zalesny & Farace, 1987). Indeed, studies have found that more open workspace generates greater group sociability (e.g., Brookes & Kaplan, 1972) and an increase in interaction has been typically observed (e.g., Boyce, 1974; Hundert & Greenfield, 1969; Ives & Ferdinands, 1974; E. Sundstrom & Sundstrom, 1986). Furthermore, open-plan configurations have been found to affect the pattern of interaction, with less time spent in formal meetings and an increase in informal communication (e.g., more conversations held around desks) observed following its introduction (Brennan et al., 2002).

Changes to an organisation's workspace can also act as powerful symbolism, with the physical environment communicating information about the organisation and its values (e.g., T. R. V. Davis, 1984); effectively supporting or undermining the desired culture and working practices (e.g., T. J. Allen & Henn, 2007; Becker & Steele, 1995; Higgins & McAllaster, 2004; McElroy & Morrow, 2010; Turner & Myerson, 1998). For example, design has been used to connect employees to organisational missions and functions, symbolically reflecting and promoting the organisation and its working culture. In the case of BMW's Central Building, for example, the physical flow of cars extends throughout the building, from the shop-floor through the design, technical and corporate areas, thereby connecting (both physically and symbolically) staff from all functions within the plant to the company's core business of making cars (Gannon, 2006).

Open-plan offices have been proposed as a means to initiate and support more open and collaborative working practices, to integrate business functions and to reflect a lack of hierarchy (e.g., Brennan et al., 2002; Brookes & Kaplan, 1972). McElroy and Morrow (2010) have recently reported a post-intervention study, incorporating a treatment and control group. They found that office refurbishment (involving the combined use of brighter décor, new furniture, greater openness and higher workspace density) yielded positive changes in employee perceptions of organisational culture, whereas no such changes were observed in respect of the control group. Employees in the refurbished, more open office reported their organisational culture as being more innovative, less formal, providing more professional control and fostering greater collaboration than their counterparts in the non-refurbished control office. In addition, occupants in the refurbished office were found to report greater co-worker satisfaction and affective organisational commitment. Findings in respect of workspace perceptions showed that although employees in the refurbished office were more positive regarding the layout of their office, they were significantly more dissatisfied with the amount of personal space and degree of distraction that accompanied the refurbishment. The study's design precludes the examination of the contribution of each individual aspect of the refurbishment, with only the effects of the combined intervention observable. Despite the confounding nature of the intervention, these findings support the proposition that a new workspace can aid the adoption of changes to working practices and culture. Physical features

appear to imbue meaning and serve to reinforce nascent change. (Higgins & McAllaster, 2004).

Exemplifying this line of reasoning, Hall and Ford (1998) describe the design of a new factory for Keltec which included the adoption of an open-plan office and manufacturing space to aid communication and improve quality processes. Following the redesign of the plant, which incorporated the removal of many of the physical barriers separating white collar and production teams, the staff demonstrated greater empathy and there was greater understanding between teams, together with speedier communications and resolution of problems. The removal of physical barriers was seen as symbolic of the desired cultural change within the factory and led to greater integration between design and manufacturing. Like the aforementioned McElroy and Morrow (2010) field study, this case study illustrates the potential for open-plan offices to not only cut overheads or affect the frequency of interpersonal interaction, but to also act as a catalyst for wider cultural change within an organisation (for further discussion of the symbolism of design, see T. R. V. Davis, 1984; Iris, Rafaeli, & Yaacov, 2005).

2.2.3. Risks of open-plan offices

The previous section highlighted the financial benefits that open-plan offices can deliver through savings on facilities and their associated overheads. Indeed, many organisations still regard the design of their office space as a largely technical issue, best left to facilities managers and furniture designers (Duffy, 2000). However, it is suggested that the

design of physical workspaces poses considerable risks (as well as an opportunity for gain) for organisations in financial, organisational and human terms. At present the limited attention paid to the interaction between workspace and individuals by businesses (Duffy, 2000) and, indeed, by organisation theorists (Becker, 1981) makes the design and implementation of new or reconfigured work environments a relatively unmanaged risk. There is a need for managers and researchers alike to consider the risks that housing employees in an open-plan office may pose and to evaluate whether the predominant open-plan format (Vischer, 1996) adequately satisfies user and organisational needs.

Although some of the findings about to be discussed concern environmental factors not solely related to open-plan offices, they are often associated with the implementation of open-plan working and as such are relevant considerations for designers, managers and staff. For example, reduced architectural privacy (through the lack of walls or significant screens) and increased density in open-plan offices can increase the frequency of uncontrolled interactions (for example conversations initiated by particular individuals, that other workers in close proximity have little or no opportunity to avoid). Although increased communicative spontaneity is one of the fundamental outcomes that open-plan configurations seek to promote (c.f., Brookes & Kaplan, 1972), open-plan offices risk negatively affecting cognitive processes and task performance and/ or contributing to stress (e.g., R. A. Baron, 1994; S. Cohen, 1980; G. W. Evans, Johansson, & Carrere, 1994; Oldham et al., 1995; Paulus & et al., 1976; Stokols, Smith, & Prostor, 1975; E. Sundstrom, Town, Rice, & Osborn, 1994).

One major risk of open-plan offices is the greater opportunity for cognitive overload or over-stimulation to occur. Cognitive theory indicates that negative outcomes will occur (e.g., withdrawal from the workplace, reduced environmental satisfaction or decremented task performance) when individuals are subject to excessive social interactions or distraction, that cause them to become overloaded (e.g., S. Cohen, 1980) or perceptually over-stimulated (Desor, 1972; Paulus, 1980). The proposition is that distractions in the environment can increase cognitive effort, adding to the demands that work may place upon employees, and once an individual's finite information processing capacity is exceeded, organisations run the risk that task performance and attention will diminish (R. A. Baron, 1994). Increased distraction or interruption (e.g., Brookes & Kaplan, 1972; Hedge, 1982; O'Neill, 1994; E. Sundstrom, Herbert, & Brown, 1982 1982; E. Sundstrom & Sundstrom, 1986; Sutton & Rafaeli, 1987), together with other risks, such as reduced levels of concentration (e.g., Oldham & Brass, 1979; Oldham & Rotchford, 1983) and lower levels of motivation (Oldham & Brass, 1979), have been consistently associated with high density, open-plan offices with relatively few physical screens between staff. Evidence regarding an organisational consequence of such reactions is provided by Craig's (2010) survey of 38,000 knowledge workers' use of predominantly open-plan office space which found that one of the biggest losses of productive time during the day stems from interruptions by colleagues.

A further risk is the exposure of workers to a lack of psychological privacy (e.g., Brookes & Kaplan, 1972; Hedge, 1982; Kupritz, 1998; O'Neill, 1994; Oldham, 1988; Oldham & Rotchford, 1983;

E. Sundstrom et al., 1982; E. Sundstrom & Sundstrom, 1986; Zalesny & Farace, 1987), which may result in inhibited overt behaviours; for example, personal or confidential discussions and work related feedback have been found to decrease under open-plan or higher density conditions (e.g., Oldham & Brass, 1979; Oldham & Rotchford, 1983). Psychological privacy concerns the amount of control individuals perceive they have over regulating their social contact with others, not least the degree to which they feel visually and/or acoustically exposed (e.g., Altman, 1975; E. Sundstrom, Burt, & Kamp, 1980). The organisational consequences of reduced psychological privacy, such as inhibited confidential discussions and feedback, will likely vary in relation to an employee's job role and level, in addition to the tasks in which they are engaged.

Environmental satisfaction, usually taken as the degree to which an individual is satisfied with their immediate workspace or area, has frequently been measured in some form in studies involving the physical environment (e.g., Brennan et al., 2002; May, Oldham, & Rathert, 2005; O'Neill, 1994; Oldham, 1988; Oldham, Kulik, & Stepina, 1991; E. Sundstrom et al., 1980; Eric Sundstrom et al., 1994; Sutton & Rafaeli, 1987). Open-plan workspaces (e.g., Brennan et al., 2002) and those offices with raised density or increased proximity of co-workers (e.g., May et al., 2005; O'Neill, 1994; Oldham, 1988; Oldham et al., 1991; E. Sundstrom et al., 1980) have been related to reduced levels of environmental satisfaction. Given that environmental satisfaction has been found to be positively related to job satisfaction (e.g., Veitch et al., 2007), and in turn to organisational commitment and turnover intent

(Carlopio, 1996), clearly another risk that needs to be managed when introducing open-plan working is the potential risk of a concomitant decrease in job or work satisfaction (e.g., Oldham & Brass, 1979; Zalesny & Farace, 1987). Indeed, satisfaction with the physical environment is included explicitly as a component of some measures of job satisfaction (e.g., Warr, Cook, & Wall, 1979).

Yet another risk that needs to be managed in open-plan workspace is noise. Noise, defined as unwanted sound (R. A. Baron, 1994), has often been reported as the greatest issue of dissatisfaction that staff raise when questioned about their open-plan work environments (e.g., Sutton & Rafaeli, 1987). Indeed, Leaman and Bordass (2005) describe noise as the issue that workers would most like to be able to control. The reduction in walls, screens and acoustical materials, in addition to increased numbers and groups of employees occupying a single space, can give rise to greater noise than would be experienced in single or low occupancy offices. In general laboratory studies have found relationships between increased background noise and detrimental task performance (e.g., Glass & Singer, 1972; Rashid & Zimring, 2008; Smith-Jackson & Klein, 2009). For example Perham, Banbury and Jones (2007) found serial recall of digits to be significantly reduced when participants were played background office noise. However, the evidence linking noise and real world job performance is more variable (e.g., G. W. Evans & Johnson, 2000; E. Sundstrom et al., 1982).

The risks associated with open-plan offices illustrate the need for workspace to be considered beyond traditional technical matters. The

organisational risk that office design or reconfiguration presents requires a structured response, both to identifying such risks and in evaluating the extent of the threat that they may pose - in essence appropriate risk assessment needs to be developed. Once such environmental risks have been identified mitigation strategies and techniques aimed at limiting or eradicating the effects may be employed. Later in this chapter the issue of mitigation is briefly revisited; the trade-offs between the risks and benefits of open-plan working is reflected upon; and the potential for the evolving office to satisfy competing user and organisational needs is explored.

2.2.4. Individual and contextual factors affecting open-plan offices

Within the management and I/O psychology literatures, researchers have attempted to investigate whether employee reactions to their workspace, open-plan in particular, is uniform (whether negative or positive). A number of studies have attempted to assess the effects that job-level and complexity might have on workers' interactions with their environments (e.g., Brennan et al., 2002; Carlopio & Gardner, 1992; Ferguson & Weisman, 1986; Hedge, 1982; Konar, Sundstrom, Brady, Mandel, & Rice, 1982; O'Neill, 1994; Oldham et al., 1991; E. Sundstrom et al., 1980; E. Sundstrom et al., 1982; Zalesny & Farace, 1987). With regard to job-level, Carlopio and Gardner (1992) found that managers were more satisfied in enclosed offices than their clerical colleagues. The latter preferred more open arrangements. Sundstrom et al (1982)

found that managers who relocated from enclosed to open workspace reported larger reductions in their privacy than other staff members who experienced reductions in their workspace (e.g., through the use of barriers, screens or cubicles surrounding their desk). In partial support of these findings, O'Neill (1994) found a weak but significant relationship between job-level and environmental satisfaction. Although job-level has not been found to be significant in all studies (e.g., Ferguson & Weisman, 1986; Oldham et al., 1991), overall results support the assertion that managers and supervisors respond more negatively to environments that reduce their privacy.

Mixed results regarding the effects of job-level may partly be explained by differences in operationalisation. Some studies simply classified respondents as managerial or not (e.g., O'Neill, 1994), others used aspects such as job type and number of supervisees (e.g., Ferguson & Weisman, 1986). Charles and Veitch (2002) have noted that, in the main, the literature points to groups of workers being differentially affected by variations in workspace density, with those individuals in lower-level jobs being less affected. Sundstrom et al (1994) have suggested that this is likely to be due to managers requiring greater confidentiality to perform aspects of their role. Alternatively or in addition, a symbolic interpretation would posit that managers and other higher-level staff may experience negative reactions, not simply because of the functional inadequacies of an open-plan office, but also because of the loss of status and differentiation that uniform or smaller open-plan workstations confer (for further discussions of this issue see T. R. V. Davis, 1984).

The effects of task-complexity on interactions with office space have also been investigated. For example Block and Stokes (1989) demonstrated that individuals performed better on a complex task in a room on their own, while a simple repetitive task was performed better in the presence of others. Furthermore, studies have found that specific skills can influence the relationship between job complexity and reactions to the physical environment. For example, stimulus screening skills — how well an individual is able to screen out unimportant, unwanted aspects of their environment (Mehrabian, 1977) — have been found to interact with job complexity, with stronger screeners reporting more favourable outcomes than weak screeners in more open or distracting conditions (e.g., Fried, 1990; Oldham et al., 1991). However, overall the literature is inconsistent, some field studies having not found significant relationships between task-complexity and the work environment (e.g., E. Sundstrom et al., 1980).

In addition to examining job-level and task-complexity, researchers have employed a range of theoretical approaches to assess how individuals perceive or react to their environments. Such approaches include cognitive theories, for example information overload (S. Cohen, 1980) and overstimulation (e.g., Desor, 1972; Paulus, 1980); social interference theory (e.g., Baum & Paulus, 1987; Oldham et al., 1995); and stress-based models (e.g., Paciuk, 1990). In general, cognitive approaches have suggested that workers who are not cognitively challenged by their work have greater capacity to accommodate unexpected social interactions or distractions (e.g., R. A. Baron, 1994).

2.2.5. A trade-offs perspective

Previous reviewers, (e.g., Elsbach & Pratt, 2007), have noted that the design of the physical environment involves trade-offs in the management of competing tensions between its different aspects. The evidence surrounding the benefits and risks of adopting an open-plan workspace strategy illustrates the need to ensure that potential negatives, such as increased distraction, noise and reduced privacy (e.g., Brookes & Kaplan, 1972; Hedge, 1982; Leaman & Bordass, 2005; O'Neill, 1994; E. Sundstrom et al., 1982; E. Sundstrom & Sundstrom, 1986) do not outweigh the financial and behavioural positives that might be delivered (e.g., Duffy, 2000; Hundert & Greenfield, 1969; Ives & Ferdinands, 1974; Zeitlin, 1969). However, mixed findings (Boyce, 1974; Brennan et al., 2002; Brookes & Kaplan, 1972; Hedge, 1982; Oldham, 1988; Oldham & Brass, 1979; Zalesny & Farace, 1987) illustrate the difficulty in attempting to draw clear-cut conclusions in regard to when an open-plan office is most appropriate for an organisation, or which aspects of such a design pose the greatest potential risk to an organisation (e.g., higher density levels, lower-level screens between or around workstations).

Although there are substantial risks to implementing an open-plan concept, there is the potential to minimise these effects. For example, techniques such as pumping in white noise (low-level unstructured noise from across the audible sound spectrum) or piped music, or the use of noise dampening materials, may be used to mask

intermittent office noise (e.g., human speech or telephones ringing) (e.g., Vischer, 1989), although their efficacy is not confirmed (Navai & Veitch, 2003). Furthermore, Brennan, Chugh and Kline (2002) have suggested that the use of agreed protocols may provide a technique with which to minimise the effects of disturbing unpredictable noise, such as co-worker conversations. In their evaluation of an office relocation, they commented that the increase in desk-side impromptu meetings, which accompanied the introduction of open-plan working, might have been avoidable if clear protocols had been agreed to regulate where such activities took place. The use of such behavioural protocols may be an alternative approach to reducing auditory interruptions, without resorting to costly technical or re-configuration techniques.

Designers need to be aware that employees may not react uniformly to open-plan offices (E. Sundstrom et al., 1982), as the tasks and roles that staff perform influence the extent to which the design poses a risk. Furthermore, differences in the configuration of open-plan space, such as the spatial density of employees, may make an office less suitable for some types of employee (Charles & Veitch, 2002). Consequently, housing large, diverse groups of workers within a uniform open-plan office may be counterproductive for organisations. A more nuanced view is required, one that recognises that open-plan inherently involves trade-offs. These trade-offs may in part be negotiated by varying the configuration of open-plan within an office, for example providing different forms of open-plan space for differing employees, striking a balance between competing needs. In summary, the flexibility of space that open-plan offices provide (e.g., Marquardt et al., 2002) may need to

be adapted and fine-tuned to suit the needs of diverse sets of employees.

2.3. The evolution of open-plan

Open-plan offices may have become the workspace solution of the 20th Century but the office continues to change and evolve (Laing et al., 1998), posing fresh challenges to I/O psychologists' understanding of workers' interactions with their environments. Open-plan is evolving in that the format is being adapted and modified to engineer spaces that better reflect modern workers and the modern business landscape. In this section the driving forces behind such changes are discussed, together with the form that these new offices are taking, and what is currently understood about the effects of their design.

2.3.1. The drivers of change

The design and operation of workspace has always been driven by a number of often competing interests, such as:

- (1) the cost of building, maintaining and servicing the space,
- (2) providing for the comfort and security of occupants,
- (3) accommodating new technologies (e.g., the emergence of personal computers),
- (4) supporting working styles and processes,
- (5) upholding organisational structure and corporate image,

(6) aiding recruitment (through providing an attractive place to work), and

(7) location

(e.g., T. J. Allen & Henn, 2007; Becker, 1981; Becker & Steele, 1995; Duffy, 1997; Duffy, McMahan, & Pringle, 1999; Laing, 2006; E. Sundstrom & Sundstrom, 1986; Vischer, 2005b). The work environment both reflects and accommodates the changing economic circumstances and the nature of work itself and so is prone to adaptation as business needs progress.

Just as new technology has shaped and influenced the nature of offices in the past (e.g., the typewriter produced large typing pools, the personal computer altered the nature of tasks performed at a desk), it is once again revolutionising the way we work and the space requirements that this entails. The advent of increasingly affordable laptop computers means that workers are no longer bound to a single desk to operate the technology; computers can be readily moved around an office or multiple locations. Indeed, battery power and wireless network connections mean that traditional desks are not a prerequisite for work at all – coffee tables, touch down spots or even just an individual's knee can be sufficient. Video conferencing, remote network access and re-routable telephone lines allow workers to work with colleagues and teams from around the globe (Axtell, Fleck, & Turner, 2004; Felstead, Jewson, & Walters, 2005; Laing, 2006). Co-location is no longer a necessity for work groups and teams may operate in temporally disparate patterns (B. F. Bell & Kozlowski, 2002), enabling interaction with colleagues in other time zones. As with the rise of open-plan working, the adoption of such

technologies is partly attributable to the organisational cost-saving that can be realised through the use of technologically enabled practices such as tele-working and home-working (e.g., Chapman et al., 1995; Felstead et al., 2005; Ng, 2010) which allow both transport and accommodation costs of employees to be reduced.

In addition to technological advances and cost reduction, the changing nature of work is an important driver of current office evolution (Laing, 2006). Key to this evolution is the continued growth of knowledge working, both as a percentage of the economy and of the labour force (Davenport, 2005). Knowledge work can be described as involving the application of 'theoretical and analytical knowledge', exemplified by individuals involved in areas such as product development or consultancy work (Parker, Wall, & Cordery, 2001). Knowledge work is often contingent upon the collaborative efforts of multiple individuals. Previously, open-plan offices enabled organisations to house workers in spaces that promoted inter and intra-team information sharing and interaction, by locating individuals proximally to one another and removing physical walls and obstructions (e.g., Brookes & Kaplan, 1972; Hundert & Greenfield, 1969; Ives & Ferdinands, 1974). Whilst useful in supporting knowledge working, such an approach remains a relatively blunt tool, as it fails to acknowledge the variety of tasks that modern knowledge workers may be involved in, the distributed nature of their interactions, and the shifting temporal nature of their roles and tasks.

Preliminary analysis (together with colleagues) of data gathered from the post-occupancy evaluation of a new Research and Development (R&D) facility supports the view that staff utilise different

workspaces dependent upon the task with which they are engaged. For example, it was found that within the new facility, 70% of the facility's staff spend at least 40% of their work time in spaces other than their individual workstation (predominantly in formal or semi-formal meeting spaces) (M. C. Davis, Leach, & Clegg, 2010). Differences in the nature of tasks individual knowledge workers engage in have been noted by Becker and Sims (2001), who discuss evidence regarding how the time spent on solo tasks and more collaborative activities can vary widely between individuals of similar job titles. Indeed Robinson (2010) analysed how design engineers spend their time and established that individuals averaged over 55% of their work time engaged in information behaviours (including answering colleagues' questions and conversing socially), with around 31% of time spent on solo technical activities. Furthermore, Craig's (2010) study of task and space use of over 38,000 knowledge workers found that on average they spend at least 40% of their time engaged in interactive or collaborative tasks. Collectively, these findings illustrate that knowledge workers frequently undertake a range of tasks, that these tasks may be undertaken in different workspaces, and that the combinations of tasks and spaces are likely to vary between individual workers.

The changing nature of work and workspace is causing fundamental shifts in how organisations approach their space planning and manage their staff (Laing, 2006). Architects and designers are being asked to deliver workspaces that are able to accommodate the competing demands of fluctuating occupancy levels, to enable employees to participate in a greater range of work tasks, and to facilitate

collaboration across work groups and departments – and to do so within budgets that are more constrained than ever.

2.3.2. The form of the evolving office

Alternatives to the established open-plan design and traditional enclosed offices are becoming more commonplace in practice (Gillen, 2006). One approach to accommodate the competing demands described previously is to design offices based primarily upon the patterns of work of its occupants and their respective needs for collaboration. Such designs often incorporate social hearts (or hubs) and “streets” that enable planned and unplanned encounters to take place. These offices also provide spaces that offer different functionality that all workers can access as and when required (for example team spaces, reading rooms, computer hubs, formal meeting rooms and café areas). Financial and space savings can be realised through reducing the provision of strictly “individual” workspaces, with the emphasis upon providing mixes of space that are appropriate to groups of workers (see, e.g., T. J. Allen & Henn, 2007; Becker & Steele, 1995; Gillen, 2006).

Other approaches such as utilising hot-desking (where desks are available to any worker as and when required) or hoteling (where unassigned desks are reserved by workers for a given period) within established open-plan workspaces are also being employed. This can allow organisations to reduce the total number of desks (and concomitant office space) as they no longer have to provide or assign desks to each individual. These practices can be particularly useful where workers

frequently work at client offices or spend a large amount of time travelling or in meetings. Such practices reflect the reality that office occupation rates are unlikely to be 100%, and in organisations which involve activities such as large amounts of travelling by sales staff or consultants, then this rate may be substantially lower (Markland, 1995).

To support more mobile or transient working patterns, non-traditional satellite offices or neighbourhood work centres have been adopted to allow workers (either from the same or from a number of different organisations) to use office space based upon their location (Cascio, 2000). Non-traditional satellite offices tend to be sited in convenient locations and draw workers from across an organisation based upon proximity rather than organisational structure.

Neighbourhood work centres serve a similar function, allowing workers to use offices closer to where they live or need to be; in these cases however, the offices are shared by a number of organisations, allowing access to a greater number of locations than a single organisation could provide (Fritz, Higa, & Narasimhan, 1995). Workers are able to 'hotel' at the office that is most convenient to them at the time, rather than, for example, being restricted to where their particular department is located or their company's nearest sole occupancy office.

Social and informal meeting spaces are also taking on enhanced roles in the evolving office. Becker and Steele (1995) observe that it is necessary for organisations to provide areas that allow workers to meet informally if intra- and inter-team collaboration is to flourish. This goes beyond simply removing office walls and partitions, or seating colleagues closer together; rather the focus is upon designing a variety of spaces

that can help to foster the types of interactions desired, in addition to allowing space for more individualistic tasks. Case studies exploring the provision of social space within contemporary office reconfigurations have consistently found that it helps to foster informal meetings and wider interactions (Becker & Steele, 1995). Furthermore, flexible workspace and easy access to meeting rooms have been related to higher job satisfaction and group cohesiveness (Lee & Brand, 2005).

Allen and Henn (2007) argue that it is important for the physical space to be configured to facilitate the communication and work patterns required by the job. This may mean providing what Becker and Steele (1995, p. 78) term "activity magnet areas", such as café areas where individuals may eat their lunch, have a drink, hold informal meetings with colleagues or use for quiet reading. McCoy (2005) notes that providing a mix of different meeting spaces close to teams can help increase impromptu meetings and serendipitous interactions (e.g., Peponis et al., 2007), thereby encouraging team communication and collaboration. Providing adequate space for impromptu meetings to occur within the office may help to maximise the potential of open-plan working (e.g., increased visibility and communication) while limiting negative effects on those working on solitary tasks (i.e., by moving impromptu meetings away from co-workers' desks).

In a similar vein Duffy (e.g., 1997) has suggested that modern offices should offer workers a variety of differing types of workspace, dependent upon the characteristics of their job and work styles. These characteristics include the degree of autonomy that the job entails, the level of interaction required between colleagues, the duration of the work

that they engage in and the amount of office-based time (occupancy level). Duffy (1997) articulated a schema comprising four differing workspace solutions that are best suited to supporting distinct types of workers and working patterns, based upon dimensions of autonomy and interaction (the hive, cell, den and club) (see Figure 2.2 for an illustration of this schema). According to Duffy (1997), increasing the fit between the design of the workspace and the demands of the work, will lead to more effective and satisfied employees (see also, Laing et al., 1998). More generally, this approach of satisfying needs and demands is incorporated under the umbrella of psychological needs-based approaches to workspace design (see also, Vischer, 1989). Such approaches have been found to be applicable in a range of organisational contexts, with working patterns and use of space largely explained by the particular classification system adopted (for additional representative examples see, T. Allen, Bell, Graham, Hardy, & Swaffer, 2004; Laing, 2006; Laing et al., 1998).

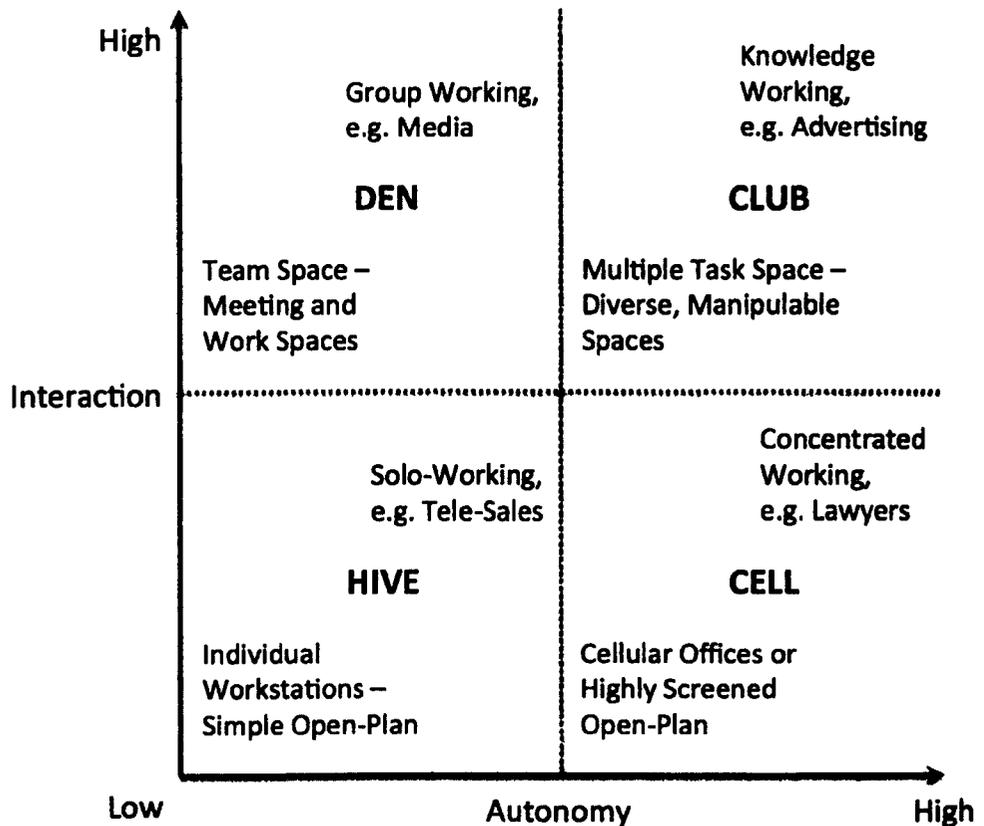


Figure 2.2. Schematic illustrating Duffy's (1997) distinction between differing office designs and their support for working practices.

(Figure based upon concepts developed by DEGW, Frank Duffy and Andrew Laing, published in Laing, A., Duffy, F., Jaunzens, D., & Willis, S. (1998). *New environments for working: The redesign of offices and environmental systems for new ways of working*. London: Construction Research Communications Ltd., page 23, reproduced by kind permission of DEGW.)

Turner and Myerson (1998) suggest, from their experience of both research and the design of new workspaces, that "it is the rich and

varied setting of the 'Club' which best illustrates the way the new office is going, with its high levels of both autonomy and interaction." (1998, p. 73). Duffy's (1997) schematic captures the way in which contemporary offices are becoming ever more diverse, ranging from the traditional enclosed single occupancy offices and high density open-plan forms, through offices containing large amounts of team space and meeting areas but which offer little individual desk space, to those which have large amounts of all of these spaces and more (e.g., reflective space, libraries and cafés).

2.3.3. The effects of evolving offices

Contemporary office designers are increasingly seeking to provide a mix of workspaces within largely open-plan offices that provide for workers' diverse needs and reflect their increasingly flexible work patterns (see, e.g., Laing, 2006). For instance, offices that incorporate a mix of differing workspaces (e.g., individual workspaces, quiet rooms, team-spaces, meeting rooms) to facilitate different styles of working and types of tasks have been successfully implemented by the architectural consulting group, DEGW, in a number of UK public sector refurbishment and reconfiguration projects (T. Allen et al., 2004). These projects have demonstrated that it is possible to design multiple workspaces, often within a broadly open-plan style office, which facilitate different levels of interaction, forms of working and technology use. For example, a refurbishment of the UK's HM Treasury offices involved the introduction of a large number of informal meeting areas, partly to increase the

amount of team-working space. This project was used to help support collaborative working and to ensure that the individual areas were sufficiently quiet to enable cognitively demanding work to be undertaken (i.e., space that is quiet enough for individuals not to require separate “quiet booths”). Within the UK Department for Trade and Industry, a flexible workspace concept was introduced utilizing modern IT (e.g., wifi, laptops, telephone systems that can reroute numbers to any desk) to allow hot-desking within open-team space. In addition, “touch down” spots (places with network connections around the facility to allow workers to use laptops without requiring a traditional workstation), project areas, quiet spaces, and a café were introduced to support flexible working around the building. Hot-desking and the inclusion of other work areas allowed the designers to reduce the individual desk space from 1:1 to 8:10, freeing space for a higher proportion of task relevant space.

Contemporary offices that involve a reduction in individual workspace (either to enable space rationalisation or to allow the inclusion of other activity areas) or changes to working practices (e.g., compulsory remote working to allow a reduction in the number of desks) have not been introduced without controversy. Offices where employees do not have their own desk or personal space have been criticised for failing to provide adequate personal control or territory for individual workers (e.g., Danielsson & Bodin, 2008), which in turn can lead to counterproductive work behaviours (see Brown, Lawrence, & Robinson, 2005 for a comprehensive review of literature concerning territoriality). Danielsson and Bodin (2008), however, have found somewhat conflicting evidence. They surveyed occupants of a number of different types of offices: cell

office (traditional single enclosed room/workspace); shared room (two to three people sharing a room); small, medium or large open-plan offices; 'flex-office' (no individual workstations but comprising a variety of spaces to support different types of working); and the 'combi-office' (employees spend more than 20% of their time in workspaces other than their own, e.g., team based space). Their findings indicate that workers are as satisfied in a flex-office as in a shared room or cell office, and more satisfied than in open-plan and combi offices. These results, although only based on a relatively restricted sample, suggest that in the right circumstances, flexible workspaces may offer both individuals and organisations a good solution to managing diverse work needs.

As noted by several authors there is very limited evidence with which to evaluate the effects that workspace concepts such as tele-working, desk sharing or hoteling might have on individual or organisational outcomes (De Croon et al., 2005; Ng, 2010; Vos & van der Voordt, 2001). There is a paucity of published work that describes the outcomes and contingencies for workers housed in these new workspaces, or for those who tele-work from home frequently. De Croon et al (2005), however, note that the limited evidence available suggests that desk sharing (or hot-desking) may improve communication between workers; although Vischer (2005b) has highlighted potential dangers of implementing such radical shifts in workspace use as it can be accompanied by rejection of the new working practices that accompany such designs.

However a recent study by Millward, Haslam and Postmes (2007) of workers who had been randomly assigned fixed desks or hot-

desking found relatively neutral reactions to the practice of hot-desking. For instance, they found that workers assigned to hot-desking were not alienated by the change, although they did place a higher value on electronic communication than their assigned desk counterparts.

Once again organisational cost saving is suggested as a driving force behind the rapid promotion and adoption of tele-working and home-working (e.g., Cascio, 2000; Felstead et al., 2005; Ng, 2010).

Encouraging employees to work at home, or from client sites or coffee shops, allows organisations to shift some of the costs of providing workspace onto other parties or the employee themselves. In return the employee may be able to take greater control over choosing the work area that they feel most comfortable in, and in managing their work-life balance. Indeed, one recent review has suggested that home-working may provide a number of benefits to employees, including wellbeing, and job and life satisfaction (Redman, Snape, & Ashurst, 2009), although empirical analysis examining the individual experience of such arrangements is limited.

In summary, contemporary offices are evolving from the established open-plan format, to become more diverse, less desk-bound and more adaptive in form. Organisations are redesigning their existing open-plan office space to optimise it for contemporary working practices. This change is driven in large part by the advances in mobile and communications technology (e.g., Duffy, 1997; Felstead et al., 2005; Laing, 2006) and a desire for further cost reduction (e.g., Duffy, 2000), as well as the increasing prevalence of knowledge working (e.g., Davenport, 2005) and the diverse range of tasks that employees engage in (e.g.,

Becker & Sims, 2001). Optimised open-plan or more flexible office spaces often utilise techniques such as hot-desking, or home-working, to allow space either to be saved or freed up to be used in different ways (e.g., T. Allen et al., 2004).

The prevalence of more sophisticated open-plan and flexible workspace is likely to accelerate as organisations continue to redesign or reconfigure existing office space and to invest in new buildings that reflect on-going technological advances and increasingly complex work and work patterns. In order to provide advice and insights that can inform the design and management of such environments, sustained research attention in this area is required, mindful of the fact that the introduction of new workspaces and the reconfiguration of existing ones in ways that affect an individual's territory, work practices or experienced control may produce negative reactions (Danielsson & Bodin, 2008).

2.4. Workspace change

This section reviews theory and research pertaining to the change that accompanies the design of a new workspaces or the reconfiguration of existing ones. While acknowledging that there is a substantial literature that concerns organisational change in general (e.g., Burnes, 1996; By, 2005; Clegg & Walsh, 2004), theory and case studies that have been applied specifically to the domain of contemporary office environments are focussed upon. The following will be discussed: the idea that new or reconfigured workspaces can involve

significant changes for employees; the similarities of the process of workspace design to organisational change; the role of user involvement in changing physical workspace; and the application of STS principles.

2.4.1. New or reconfigured workspace involves change

Whether a firm embarks upon a modest refurbishment of an existing open-plan office or seeks to introduce a highly contemporary workspace, for example incorporating aspects of flexible space and teleworking, the activity of design and eventual occupation will almost certainly usher in changes, both for individual workers and for the organisation as a whole. The design of a new office (or redesign of an existing one) often involves changes in spatial configurations, facilities or technologies that can significantly alter the way in which individuals and teams go about their work (e.g., Laing et al., 1998). This is aside from the altered sensory experience that features of a well-designed office, such as improved lighting or ergonomic furniture may deliver. More specifically, as has been previously discussed, the adoption of open-plan working can have major effects on employees' work experiences, most likely originating from differences in the frequency and nature of interactions (e.g., Ives & Ferdinands, 1974), visual and auditory distraction (e.g., E. Sundstrom & Sundstrom, 1986), and the location of other teams and colleagues (see also, McElroy & Morrow, 2010). Indeed, even modest reconfiguration of existing open-plan offices, for example introducing break out areas may significantly affect work experiences for better or worse. For instance, a greater level of

background noise for individuals located near the break out areas might have a detrimental effect on performance. Furthermore, introducing a radical new office concept, for example including street layouts, collaborative rooms and reduced individual workspace, may require workers to embrace new working practices, including a more informal approach to meetings (e.g., Brennan et al., 2002) and hot-desking (e.g., Duffy, 1997). All of these changes to the physical environment, therefore, require careful design, facilitation and implementation if the result is to reflect and meet the needs of individual employees (Becker, 1981).

2.4.2. Similarity to organisational change management

The design and implementation of a new office concept, or the re-configuration of an existing one, can be considered as a form of discontinuous organisational change as it introduces a one-time change to the group affected (Luecke, 2003). However, active management of the design process leading up to the introduction of a new office environment and support following its introduction can transform the process into a less discrete change. Indeed, a new office can initiate and support changes to working practices (e.g., enhancing collaboration) and culture (e.g., Turner & Myerson, 1998), transforming such interventions into incremental forms of organisational change. Badly managed, however, such interventions will breed resistance and resentment, as with any poorly orchestrated organisational change process.

Despite the substantial literature concerning change management within the management and I/O psychology domains (e.g., Brown & Eisenhardt, 1997; Burnes, 1996; By, 2005; Clegg & Walsh, 2004; Holman et al., 2000; Kanter et al., 1992; Kotter, 1996; Luecke, 2003; Pettigrew, 1985; Pettigrew et al., 2001; Van de Ven & Poole, 1995; Weick, 1979; Woodman, 1989), there is currently only a very limited acknowledgement of the potential for workspace to support or initiate change, whether intended or not (e.g., Lawler & Worley, 2006; McElroy & Morrow, 2010). Architectural and design-led studies exploring this issue have found that engaging end users in, and allowing them a degree of control over, the design process is beneficial both to the design of new workspaces and to aiding employee acceptance of changes to working practices (e.g., Blundell-Jones, Petrescu, & Till, 2005; Turner & Myerson, 1998). Studies examining the effects of end-user involvement in the design of information systems and work processes show similar positive findings (e.g., Mumford, 1983). Oldham, Cummings and Zhou (1995) have previously alluded to the potential positive effects of worker participation in the design of their own workspace. Studies of employee control over more specific features of their workspace (in the form of environmental control or physical adjustability) have generally found such opportunities to be related to increased job satisfaction, performance, communication, privacy and satisfaction with the environment (e.g., Huang, Robertson, & Chang, 2004; Lee & Brand, 2005; Lee & Brand, 2010; O'Neill, 1994). Architectural research exploring the effects of building design in healthcare settings suggests that the provision of control over the environment to patients is associated with tangible

individual benefits including improved treatment completion times, reduced medication levels, and enhanced wellbeing (e.g., B. R. Lawson & Phiri, 2003).

More broadly, Vischer (2005b) has proposed seven principles specifically for the management of effective workspace change, which emphasise how the design process may be used to empower stakeholders to challenge the status-quo, to re-evaluate work processes and structures, and to use the process to surface and overcome potential resistance. Underpinning Vischer's principles is a focus upon user participation and the bi-directional sharing of information and suggestions.

Vischer's (2005b) approach and the wider architectural practice commending user participation and engagement (e.g., Blundell-Jones et al., 2005) share similarities with much of the change management literature, in which employee involvement is actively encouraged as part of a change management strategy (e.g., Armenakis & Bedeian, 1999; Clegg & Walsh, 2004; Kanter et al., 1992; Mumford, 1983; Woodman, 1989). Supporting this principle, user involvement has been demonstrated as a key factor in determining the success of more general organisational change programmes (Holman et al., 2000).

It is suggested that the design of a new work facility encompasses similar issues to change programs in general, and to technology-led innovations in particular, due to the tendency for 'experts', such as IT professionals, to "design a system, and then push it at its end users" (Clegg & Shepherd, 2007, p. 215). In this context, the equivalent process is one whereby facilities managers or designers specify and

design a new office space without due involvement of the workgroups to be accommodated. This is in direct opposition to what has been described as “pull-based user-owned change” (Clegg & Walsh, 2004, p. 235), whereby end users pull the project through to successful completion by taking ownership of, and having input into, the design and implementation process, ensuring that it meets their needs. The involvement of employees provides a means to ensure that the work environment not only better reflects their requirements, but also allows them to take ownership over the process. Furthermore, acceptance of changes to workspace is important if new flexible concepts are being introduced that affect other aspects of work processes (e.g., introducing home or tele-working) (e.g., Baruch, 2001; Chapman et al., 1995; Daniels, Lamond, & Standen, 2001).

2.4.3. Successful user involvement in workspace design

A number of studies within the I/O psychology and management literatures have examined the effects of changes in physical office design or configuration (e.g., Brookes & Kaplan, 1972; Oldham, 1988; Oldham & Brass, 1979; Zalesny & Farace, 1987) on employee reactions; however, there has been limited examination specifically of the process of change (McElroy & Morrow, 2010) and of user involvement in particular. Case studies from environmental psychology and architectural spheres have demonstrated how the process of user participation in design can be used to successfully manage organisational change (e.g., T. Allen et al., 2004). Furthermore, related approaches that incorporate user

involvement (e.g., STS Design) support this contention (e.g., Mumford, 1983).

To highlight the techniques adopted and the potential benefits that user involvement may deliver a case study by Foland et al., (1995) concerning the introduction of open-plan working is described. This case study is presented as an exemplar of the work being conducted in this field and to indicate the potential for further investigation in the area.

Foland et al (1995) describe a project in which facilities managers at Amoco Oil & Gas embarked on a programme to rationalise their workspace costs and to embed team-based working, moving from enclosed to more open-plan workspaces. In a pilot, the facilities department worked closely with the leader of a specific work team to facilitate a highly participatory approach to the redesign of their office space. The process capitalised on the team's knowledge and expertise of their working practices, with staff involved in design decisions, for example furniture styles, seating arrangements, and use of workspace. The redesign became a process driven by the team's understanding of their work processes and needs. The emphasis was on how they could work more efficiently and how the new workspace could then be designed to support these changes in working practices. The authors noted that the process itself helped the department improve conflict resolution between team members and foster a greater understanding of group needs, as well as aiding the integration of interns and temporary workers within the teams taking part. The resulting new office, accompanied by the new ways of working it enabled and supported, produced a 25% decrease in project cycle times, 75% decrease in formal

meeting time, increased team learning, increased problem solving, and led to higher quality products (Foland et al., 1995, p. 683). However, when the organisation attempted to roll out the new office concepts across other work groups, they encountered resistance from workers, largely due to the top-down implementation and absence of a participatory approach (Vischer, 2005b). These outcomes show striking similarities to the wider change management literature (e.g., Clegg & Walsh, 2004) and earlier classic work on sociotechnical design in office environments (Mumford, 1983). As it had worked well in one situation, management believed that the office concept could be simply replicated across the wider organisation; they failed to appreciate the role that participatory design had played in crafting the most appropriate environment for that particular team and in helping the team to accept the resulting changes in work practices (c.f., Mumford, 1983).

2.4.4. Applying socio-technical principles

A related approach that is applicable to the design and management of workspace change, previously touched upon during the discussion of user involvement, is STS thinking (e.g., Cherns, 1976, 1987; Clegg, 2000; Mumford, 1983; Trist & Bamforth, 1951; van Eijnatten, 1997). STS thinking argues that an organisation is a complex system made up of a number of inter-related parts, including the individual staff, the work processes, the technologies and so forth. The approach grew out of a series of studies conducted at the Tavistock Institute of Human Relations, London, in the 1950s and 1960s (van

Eijnatten, 1997). Trist & Bamforth (1951) published seminal work based upon their observations of the 'long-wall' coal mining methods, following the introduction of large-scale machinery. The coal mining methods demonstrated the importance of autonomy, multi-skilling and self-supervision and the need for behavioural issues to be considered during technological design and implementation. STS thinking continued to evolve and Cherns (1976) enunciated nine core principles of STS design, later extended to 10 (Cherns, 1987). The approach has been refined further, with Mumford setting out the "Ethics" approach to the design of new information systems from the late 1970s onwards (e.g., Mumford, 1983; Mumford, 1995; Mumford & Weir, 1979). More recently Clegg (2000) elaborated and extended Chern's (1987) principles to apply to modern IT design (see van Eijnatten, 1997, for a comprehensive description and timeline of the development of STS theory, from its inception to modern advancements).

The application of STS theory has predominantly focussed upon the industrial sector and the introduction of new technologies (e.g., Advanced Manufacturing Technologies and office-based technologies) (Clegg, 2000), with limited attention having been paid directly to the design of the physical work environment. Previously Mumford (1983) applied STS principles to the design of information systems. Mumford's approach involves large amounts of user participation in the design and configuration of new information systems and seeks to use technology to help improve the work experience and organisational effectiveness of the system as a whole. For example, user involvement in the design and implementation of a new word processing system was used by Mumford

(1983) to find ways of meeting both user and organisational needs, increasing the acceptance of the system and its associated changes for all concerned.

Despite the success of applications of STS theories, I/O psychologists have rarely applied the ideas and principles to the design of the physical environment. Authors from across disciplines have, however, suggested that the physical work environment should be considered as part of the overall organisational system (e.g., T. J. Allen & Henn, 2007; Becker & Steele, 1995; Blyth & Worthington, 2001; Ferguson & Weisman, 1986; Haynes, 2007; B. Lawson, 2004; Preiser, 1994; Trist & Bamforth, 1951; Turner & Myerson, 1998).

It is suggested that in practice STS systems theory should be broadened to consider the whole work system, being applied more comprehensively to the design of the physical environment alongside the design of new processes, job roles and technologies (i.e., extending the scope of the work system under investigation). Furthermore, this new application domain provides excellent opportunities for us to explore how current STS design principles (e.g., Clegg, 2000) may be extended to take account of the specific challenges and contingencies that workspace design involves.

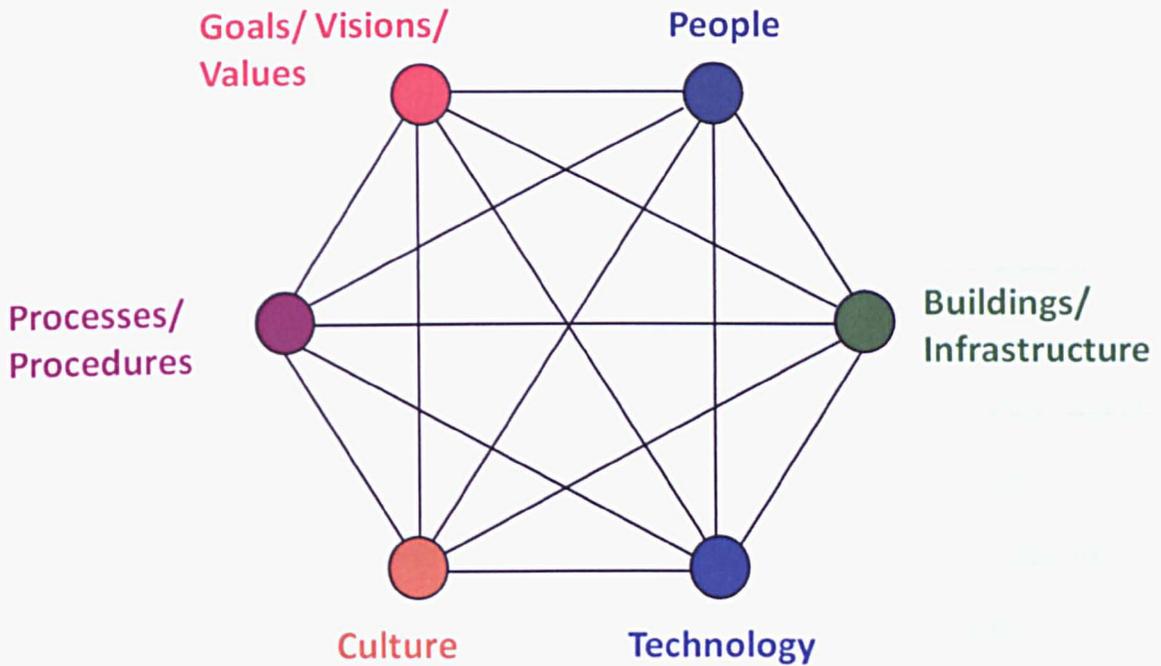


Figure 2.3. Socio-technical system, illustrating the inter-related nature of an organisational system.

(Source: Challenger, Clegg, & Robinson, 2010)

A systems approach is applicable to workspace design as it encourages conflicts or detrimental effects to be identified as decisions are made, minimising the likelihood of one part of the system, or set of drivers, forcing unintended change upon the others (see figure 2.3 for diagrammatic representation of the inter-related nature of a work system). STS theory acknowledges that design involves compromise, and this can be viewed as part of the process that establishes a balance between the competing elements of the work system (Clegg & Shepherd, 2007; Hendrick, 1997; Nadin, Waterson, & Parker, 2001). Indeed, as others have noted previously (e.g., T. J. Allen & Henn, 2007; Elsbach & Pratt, 2007; Eric Sundstrom et al., 1994) work environments involve

trade-offs between what is most appropriate or desirable for the staff and other stakeholders involved and what is necessary or possible within organisational and technical constraints. A STS approach to design can be viewed as one way of enabling and promoting open and systematic consideration of these competing demands, to help find new ways of working and working practices that may meet the joint needs of the various stakeholders and the organisation (Ridgway et al., 2008). A STS approach to the design of the physical work environment would encourage the integration of disciplinary knowledge and expertise, for example bringing together architects, engineers, psychologists, technology specialists, with users and stakeholders. To illustrate how the principles can be applied in practice, a recently completed case study that has investigated a STS approach to workspace design is presented.

Ridgway et al (2008) describe the application of this systems approach throughout the design of a new R&D facility. The design process was organised in a series of stages and included in particular: early work (prior to the architectural brief) on the goals, mission and vision of the new facility; development of a good understanding on the kinds of work and projects that would be undertaken, including the technologies that would be used; an understanding of the kinds of staff and numbers that would be employed; the definition of the working culture that the building was trying to promote and support; the design of the layouts of the office and shopfloor areas; the selection of décor and furnishings; the design of key social spaces, including meeting rooms, a social hub, and the dining and reception areas; and the overall design from sustainability and energy-use perspectives. The approach included:

extensive user and stakeholder involvement (using a range of techniques); multi-disciplinary design meetings (consisting of architects, facilities managers, other professionals and academics); and post-occupancy evaluations.

A key element of this process was the initial engagement and facilitation activities to define the brief for tendering architects, essentially setting the direction for the whole design process using scenario planning techniques (Clegg, Maclaren, Robson, Symon & Carey, 1996). These preliminary activities included workshops with stakeholders and staff to identify the organisational vision, structure and working practices for the Factory. During the stakeholder event, break-out groups discussed key questions relating to the Factory: What is our vision of the new factory? What excites us about this new factory? What are the key operational decisions we need to make before we start building? During the scenario planning workshop, stakeholders were encouraged to examine different scenarios for the new facility in terms of its main processes, staff and outputs.

Overall, this STS approach not only identified previously unknown requirements for the R&D facility, which would not have been highlighted without the involvement of frontline staff, but also ensured that design aspects of particular importance to stakeholders, and staff were not engineered out to reduce costs (e.g., the social heart and flexible break out areas) (Ridgway et al., 2008). The involvement of the staff provided insights into the functions that the workspace would need to provide and confirmed that a generic space would not be adequate to support the varied nature of the engineers' roles. It was especially

apparent that meeting space was a high priority and the level of space provided for this would need to be far higher than was anticipated prior to consultation (based on traditional assumptions as to the nature of the engineers' jobs), with a mixture of both formal and informal meeting spaces being supplied. Post-occupancy interviews have demonstrated that although the user involvement did not always result in employees feeling that they had had a meaningful impact on the end design (potentially due to budgetary constraints limiting some design features), they reported that the process had helped them to understand the change that was imminent and to feel included in the design process. Ultimately, the combination of techniques used to understand the human and organisational needs for the new workspace have resulted in a building that provides a mix of office and engineering space, reflecting the diverse tasks that the staff are involved in (McGourlay, Ridgway, Davis, Challenger, & Clegg, 2009).

In summary, the design and implementation of new offices alter how individuals and teams go about and experience their work (e.g., Laing et al., 1998; McElroy & Morrow, 2010) and can act as an enabler for wider cultural change (e.g., Turner & Myerson, 1998). The organisational change management literature (e.g., Brown & Eisenhardt, 1997; Burnes, 1996; Kanter et al., 1992; Kotter, 1996; Luecke, 2003; E. Mumford, 1983; Pettigrew, 1985; Pettigrew et al., 2001) argues that for such organisational changes to be successful, they need to be managed effectively. To date, however, there has been limited application of existing organisational change theory to this domain (McElroy & Morrow, 2010). Nevertheless, architectural and environmental psychology

principles (e.g., Blundell-Jones et al., 2005; Vischer, 2005b) have emphasised the importance of user involvement and information sharing during the design and implementation of new offices and buildings, as did earlier work informed by STS thinking (e.g., Mumford, 1983). Although these principles are similar to the central tenets of general change management theories (e.g., Kanter et al., 1992), it is suggested that the traditional technical nature of office design (being typically led by architects, engineers or facilities managers) makes it especially comparable to IT-led change programs. A STS approach (e.g., Clegg, 2000; Mumford, 1983) provides a framework which is well suited to the specific problem of managing workspace change, as its emphasis is upon not only user involvement and ownership, but also on finding ways of managing and coping with the competing interests and needs of various stakeholders. Approaches that maximise the involvement of staff and other stakeholders, focus upon the functional and human needs of the office occupants, and are open and transparent, appear more likely to result in successful workspace design than do traditional expert-led push-based approaches to design and change.

2.5. Summary

This chapter has taken a broad approach to reviewing the design of office environments, from the benefits and pitfalls of open-plan offices, through to the continuing optimisation of the office, to issues concerning the management of change. These areas present distinct, yet inter-

related opportunities for I/O psychology scholars to contribute to knowledge regarding configuring office design in contemporary organisations, the introduction of such space (and the change that this involves), and progressing theory building. It is clear that the issues raised are too broad to be tackled within a single, or even a number of, programme(s) of research. A more nuanced approach is required. Specifically, research that is focussed upon a smaller number of key issues that are of both practical and theoretical importance. In the following chapter a number of research opportunities that fulfil these criteria will be identified and specific areas that the present research seeks to address will be outlined. Drawing on these opportunities a series of hypotheses will then be articulated in chapter four.

3. The Evolving Office: Research Opportunities

3.1. Introduction

The previous chapter highlighted how the traditional open-plan office is evolving (Gillen, 2006; McElroy & Morrow, 2010). The evolution of form is largely spurred by an increase in knowledge working (Davenport, 2005) and a drive to further reduce costs (Brennan et al., 2002). The diverse, complex and highly interactive nature of such work (Drucker, 1999b; Parker et al., 2001) is forcing a re-evaluation of the type of office space that organisations provide their employees, with a shift towards improving communication and collaboration (De Croon et al., 2005; Duffy, 1997; Price, 2007; Turner & Myerson, 1998) as well as reducing costs (Duffy, 2000; Ellington, 2007; Steiner, 2005).

To-date, practice is charging ahead of theory and research in this area. Innovative and flexible offices are often being designed based upon managers' intuitions or experience of employee work patterns (Gillen, 2006). Organisational researchers have been slow to assess the effects of such developments (J. K. Chan et al., 2007; McElroy & Morrow, 2010). A significant body of work on the effects of the introduction of office concepts, such as new IT systems (Clegg, 2000; Mumford, 1983), open-plan offices and adjustments in spatial features (e.g., Brennan et al., 2002; Brookes & Kaplan, 1972; May et al., 2005; Oldham, 1988; E. Sundstrom et al., 1982; E. Sundstrom & Sundstrom, 1986; Sutton & Rafaeli, 1987), has already been amassed. However, there now lies an

opportunity for an acceleration of studies that look to guide decision-making regarding optimising office configurations and contribute towards theoretical understanding of contemporary office environments. This opportunity provides the basis for a focussed programme of research that explores the relationships and outcomes of contemporary office configurations.

This chapter will focus upon the specific research gaps that have been identified within the wider literature and which form the basis for the empirical work in this thesis. The opportunities that these areas provide for a contribution to the body of knowledge and practice regarding workspace design are articulated. First, the opportunity to conduct nuanced research evaluating common features of contemporary office configurations is discussed. Second, the potential for work design and workspace configuration to be integrated is introduced. Third, the trade-offs involved in reconfiguring offices to contemporary workspace is explored. Fourth, the opportunity to consider psychological processes involved in office reconfiguration is presented.

3.2. Evaluation of contemporary office configurations

Research that empirically explores the efficacy of features of contemporary office configuration is limited and current findings regarding effects are mixed (e.g., T. Allen et al., 2004; Danielsson & Bodin, 2008; McElroy & Morrow, 2010; Pugsley & Haynes, 2002). The

research base that has examined the effects of office configuration upon workers was largely amassed during the 1970s and 1980s when traditional open-plan working was on the ascendance (Brennan et al., 2002; McElroy & Morrow, 2010; Oldham et al., 1995). Many of the subsequent studies have continued the trend of assessing the effects of this design choice (De Croon et al., 2005) with limited consideration of new design developments. This section begins by discussing why research is required to address the gap concerning evaluations of contemporary office configurations. Subsequently, three common features of contemporary office configurations are identified, namely: break-out areas, physical proximity and density. The anticipated relationship between workers and these workspace features are discussed.

3.2.1. Office evaluation gap

Practitioner and design orientated evaluations of contemporary workspaces have often been descriptive in form or primarily concerned building performance data (e.g., T. Allen et al., 2004; Laing et al., 1998). More organisationally focussed evaluations have lacked the necessary sample size or adequate research design to be generalisable with confidence (e.g., Danielsson & Bodin, 2008; Lansdale, Parkin, Austin, & Baguley, 2011; Peterson & Beard, 2004). Alternatively, studies that have explored the effects of contemporary configurations have confounded such changes with the introduction of more general open-plan working (e.g., McElroy & Morrow, 2010). With open-plan offices the predominant

office design (Brill et al., 2001; Vischer, 2005a), workers can be expected to be much more likely to move from an open-plan office to a more contemporary office configuration in practice, than from a traditional office. Research ought to reflect this reality and concentrate on the reconfiguration (rearrangement of furniture and types of workspace) of existing open-plan offices to more contemporary workspace.

The previous chapter discussed the breadth of concepts and design features that may feature in contemporary office designs. Indeed, contemporary office environments can take many forms (Danielsson & Bodin, 2008; Gillen, 2006). The reality of commercial property ownership and management means that the majority of organisations will be tenants rather than owner-occupiers, constraining the scope of office design/redesign (Duffy et al., 1999). Practically, organisations are often limited to adapting large, open office space, with services already fixed and installed. Achieving highly bespoke designs, e.g., incorporating street scenes or central hubs, are often restricted to organisations in a position to commit to commissioning their own buildings (Ridgway et al., 2008; Vischer, 2005b). Essentially, adopting more contemporary office designs will most often involve reconfiguration of office furniture and spatial arrangements, rather than the design or redesign of architectural features.

Evaluation of the effectiveness of new office configurations and concepts has often been measured in terms of capital or operational savings and returns (Laing et al., 1998; Price, 2007). This is despite the frequently articulated aim of such office designs to increase interaction and communication amongst occupants (e.g., T. J. Allen & Henn, 2007;

Duffy, 1997; Gannon, 2006; D. J. Hall & Ford, 1998; Littlefield, 2009). Interpersonal communication is intertwined with notions of knowledge work (Drucker, 1999b) and related outcomes such as creativity and innovation (Csikszentmihalyi, 2003; McCoy, 2005). Communication can be viewed as an important behavioural outcome and it has a well established relationship with spatial configuration (Sommer, 1959), However, its inclusion as a variable within workspace studies has declined over time (c.f., De Croon et al., 2005; Elsbach & Pratt, 2007; Oldham et al., 1995). A focus upon communication within studies considering contemporary office configurations offers an opportunity to provide insight into how effective the environments are at aiding knowledge workers. Given the diversity and nature of work that knowledge workers engage in, establishing comparable forms of performance or productivity is becoming more difficult (Davenport, Thomas & Cantrell, 2002). The transactional nature of the jobs (Parker et al., 2001) makes collaborative or communicative behaviours relevant in this regard.

The previous chapter highlighted a number of different design trends that are being reflected in contemporary office configuration. To assist research conduct and to reflect common practice, it is necessary to focus evaluation upon a specific number of these trends. Identified changes to workspace include a trend towards reducing individual work areas either to increase space for other task areas (e.g., collaborative space) or to co-locate greater numbers of workers or both (Price, 2007; Vischer, 2005b). Looking across case studies, facilities management and architectural literatures (e.g., Ellington, 2007; Gannon, 2006; Laing et al.,

1998; Littlefield, 2009; Markland, 1995; Pugsley & Haynes, 2002; L. I. Scott, 2005), three office configuration features appear to be frequently used to achieve this in practice. These are: the incorporation of breakout areas (Becker & Sims, 2001; Steiner, 2005); the provision of greater physical proximity and/or; density (Offices, 2009b). To enable focussed research that reflects likely contemporary offices, these factors, and their relationship with communication, will be considered in more depth in the following subsections.

3.2.2. Break-out areas

Break-out areas are a design option that is being increasingly incorporated into open-plan offices to support group discussions and to improve the speed of interactions (e.g., Steiner, 2005). Their uptake is typically due to a combination of factors, including low installation costs, flexibility, and ease of access. Break-out spaces are often non-reservable (e.g., Duffy, 1997; Wineman & Serrato, 1999), and can be located near specific groups of workers or in central office areas.

Office break-out areas differ from traditional meeting rooms or “team rooms” as they tend to be located within open-plan offices themselves. Similarly, they differ from larger-scale social spaces, such as café areas, in terms of their proximity to employees’ workspace (i.e., desks); social areas are often located outside the immediate office area. Due to this proximity, office break-out areas facilitate intra-office interactions, whereas central social areas provide greater opportunity for spontaneous inter-office and inter-departmental interaction (e.g., T. J. Allen & Henn,

2007; Laing et al., 1998; Wineman & Serrato, 1999). Although there is a growing architectural and design literature that discusses the potential benefits of flexible office space, and the inclusion of break-out areas in particular (e.g., T. J. Allen & Henn, 2007; Becker, 2007; Becker & Steele, 1995; J. K. Chan et al., 2007; Duffy, 1997; Gillen, 2006; Laing, 2006; Laing et al., 1998; Price, 2007; Turner & Myerson, 1998), research that empirically explores the efficacy of such a design is in its infancy. One such study found a relationship between break-out areas and increased levels of collaboration and control amongst individuals (McElroy & Morrow, 2010). Furthermore, such areas have been reported as conducive to team interactions and communication, aiding the performance of a cross-functional team (Peterson & Beard, 2004).

Psychological theory, in particular the social relations approach, supports the proposition that break-out space will aid office communications (Festinger et al., 1950; Oldham & Brass, 1979; Zalesny & Farace, 1987). Seminal works have demonstrated that the spatial configuration of furniture influences the amount and type of conversation between individuals (e.g., E. Hall, 1966; Osmond, 1959; Sommer, 1959). More open workspaces have been found to generate greater group sociability (e.g., Brookes & Kaplan, 1972), to increase interpersonal interaction and communication (e.g., T. J. Allen, 1977; Boyce, 1974; Goodrich, 1982; Hundert & Greenfield, 1969; Ives & Ferdinands, 1974; E. Sundstrom & Sundstrom, 1986; Zeitlin, 1969), and to enhance informal communication (Brennan et al., 2002). The inclusion of break-out space within an office can be seen to act in a similar fashion, through reducing physical barriers to meeting and interacting with colleagues.

The incorporation of such space near teams can increase impromptu meetings (McCoy, 2005) and “serendipitous interactions” (e.g., Peponis et al., 2007). These forms of interaction can enhance and facilitate team communication and collaboration (Wineman & Serrato, 1999).

3.2.3. Density and proximity of co-workers

The physical distance between individuals can help to shape the level and nature of interactions in which they engage (Wineman & Serrato, 1999). Increasing the numbers of workers housed within a given office space can allow substantial facilities management savings to be made (e.g., Duffy, 2000; Zeitlin, 1969) and there is a long term trend towards more dense working environments (e.g., Vischer, 2005b). A number of different measures have been used to operationalise these constructs. The most widely used is *setting density*, being defined as the number of employees within an office divided by the total area (Oldham et al., 1995). *Spatial density* refers to the number of employees within a given distance (E. Sundstrom et al., 1980). Similarly, *physical proximity*, refers to how close employees' desks are physically located to one another (Oldham et al., 1995).

A social relations standpoint suggests that closer proximity to co-workers will be of benefit to communication because it makes it easier to interact and access greater numbers of nearby colleagues (Zalesny & Farace, 1987). Studies have found that communication and interaction patterns can be improved by greater proximity (T. J. Allen & Henn, 2007). Classic social psychology has demonstrated that location and proximity

can help determine with whom individuals interact and form friendships (Festinger et al., 1950). In the office, knowledge workers' probability and frequency of interaction with others (and by extension their communicative network) is greatly influenced by physical proximity (T. J. Allen, 2007; T. J. Allen & Cohen, 1969; T. J. Allen & Hauptman, 1987; Kraut, Fussell, Brennan, & Siegel, 2002). Furthermore, an increase in the number of co-workers within the immediate vicinity has been found to increase information exchange and task facilitation between workers; a reduction in such conditions has been found to decrease information exchange and friendship opportunities (Szilagyi & Holland, 1980).

Similarly, an increase in density can be expected to reduce the physical barriers to communication, in line with social relations reasoning (Oldham & Brass, 1979). An increase in setting or social density means that more workers are located within a single office. Consequently, the effort required to locate individuals is reduced as more are housed within the same space and potential numbers of colleagues to interact with is increased. The reduction in distance required to travel to reach colleagues, through more colocation, also suggests that the likelihood of interaction will be increased (T. J. Allen, 1977; T. J. Allen & Hauptman, 1987). There has been mixed field evidence regarding the specific role of increased density and communication (O'Neill, 1994; Oldham & Rotchford, 1983). However, increased setting density has been related to increased forms of communication, including job feedback and friendship opportunities within open-plan offices (Szilagyi & Holland, 1980).

3.3. Integrating work design and workspace configuration

Previous organisational studies of the physical work environment have highlighted the role that changes to spatial configuration can play on individuals' perceptions of their job and work role (e.g., Oldham & Brass, 1979; Szilagyi & Holland, 1980). In particular, aspects of the work environment, such as density and physical proximity (Fried, 1990; Oldham, 1988). Despite I/O psychologists' extensive expertise in work and job design (major drivers of office evolution), there has been scant research combining the two areas (Humphrey, Nahrgang, & Morgeson, 2007). In this section, the benefits of combining work design and workspace configuration are introduced. Then, the role of autonomy within knowledge workers' roles and its influence over the use of space is discussed. Finally, the anticipated interactive nature of the worker-environment relationship is described in systems terms.

3.3.1. Benefits of combining work design and configuration

Architectural design colleagues are leading the way in identifying emergent designs and offering explanations as to how work roles, tasks and culture may influence workspace requirements and interactions (e.g., Duffy, 1997; Laing, 2006; Turner & Myerson, 1998). There is a growing appreciation that the physical work environment may play a part in shaping employee work perceptions and related outcomes (e.g., wellbeing). Authors have called for greater research activity in this area

(Humphrey et al., 2007). Indeed, investigation of the physical environment has been emphasised as important in aiding greater understanding of work design (Grant, Fried, & Juillerat, 2011).

A varied provision of workspace within an open-plan office may provide a solution to the tensions that a unitary office environment poses some workers. For example, contending with distraction or a lack of communicative privacy and maximising the opportunity for spontaneous interaction (Brookes & Kaplan, 1972; Hedge, 1982; Kupritz, 1998; O'Neill, 1994; Oldham, 1988; E. Sundstrom et al., 1982; E. Sundstrom & Sundstrom, 1986; Sutton & Rafaeli, 1987). Currently, however, there is little evidence with which to confidently identify employees' workspace needs. Case studies point to broad job types or sectors as being more or less suited to such environments (Duffy, 1997; Laing et al., 1998), however, fine grained analysis of psychological or job characteristics amongst these groups is lacking. Research targeted at identifying the effects of contemporary office environments on different groups of workers, would allow investment to be directed at the individuals or teams most likely to benefit from such designs.

Evaluating contemporary office reconfigurations presents an opportunity to combine aspects of the office configuration and job design literatures. This holds the potential to facilitate further theoretical integration and parsimony (Locke & Latham, 2004). Established environmental theoretical perspectives, including the social relations approach (Festinger et al., 1950; Oldham & Brass, 1979), have already been drawn upon in considering the relationship between contemporary

office features and communication. Such approaches can be considered together with aspects of work design theory. To facilitate more focussed discussion it is necessary to direct attention towards aspects of work design that are both practically and theoretically relevant. Job autonomy features as a recurrently strong aspect of work design (Humphrey et al., 2007) and its relevance to the discussion of modern workspace is discussed in the following subsection. This exploration takes influence from the architectural design literature and the interaction between the nature of employees' roles and their physical environment.

3.3.2. The role of autonomy

Autonomy has been identified as key to knowledge working (Drucker, 1999a) and instrumental to the worker-environment relationship (Duffy, 1997), with communication a much desired outcome (Price, 2007). Organisational researchers have argued that the environment is able to affect individuals' perceptions of job autonomy (Oldham & Rotchford, 1983), however they have tended to view it simply as a reaction to the physical environment (e.g., Oldham & Brass, 1979; Oldham & Rotchford, 1983; Szilagyi & Holland, 1980) rather than a factor with which it interacts to shape behaviour. There is an opportunity not only to consider the role that autonomy has to directly influence work-related outcomes, but also how it interacts with the physical environment to shape such behaviours.

The generally positive role of control and autonomy has been noted within many areas of I/O research. Substantial investigations have

demonstrated links between control, work demands and stress outcomes (Sonnentag & Frese, 2003). High demands are much more bearable and even enjoyable when accompanied by high levels of personal control (e.g., Daniels & Guppy, 1994; de Jonge & Kompier, 1997; de Lange, Taris, Kompier, Houtman, & Bongers, 2003; Karasek & Theorell, 1990; Kasl, 1996). Additionally being in control is also related to self-confidence and thereby to subsequent performance (e.g., Bandura, 1977; Stajkovic & Luthans, 1998). Workers afforded greater control over their work tasks have shown greater intrinsic satisfaction with their work (Wall, Kemp, Jackson, & Clegg, 1986). Furthermore, the literature as a whole suggests that the provision of choice over aspects of one's environment and the perception of control over these choices is beneficial, with individuals being more satisfied with their environment (e.g., Barnes, 1981). As a result of these previous findings in related domains, it is expected that autonomy will provide a useful and likely source of interaction with the physical work environment.

There has been limited testing explicitly exploring the effect of job-level autonomy on workspace related outcomes or it's interaction with workspace to predict these. However, findings from related concepts suggest that autonomy will influence communication both directly and interactively with the physical workspace. Control over the work environment, either through specific perceptions of control over environment features (Lee & Brand, 2005; Lee & Brand, 2010) or an ability to adjust ergonomics, e.g., rearranging personal workspace or adjusting furniture, (Huang et al., 2004; O'Neill, 1994), has been found to affect work related outcomes, including communication. Huang,

Robertson and Chang (2004) suggest that environmental control allows individuals to deal with task and work demands more effectively, through optimising their immediate office surroundings to support collaborative and solo tasks. Moreover, actual and perceived control is strongly related to the concept of psychological privacy (e.g., Altman, 1975; E. Sundstrom et al., 1980). Psychological privacy concerns the control individuals perceive they hold over regulating social contact with, and access to, others (E. Sundstrom & Sundstrom, 1986). Autonomy has been directly linked to the frequency of workspace interactions (Oldham & Rotchford, 1983), with privacy attributed to the likelihood of confidential discussions (Oldham & Brass, 1979).

The previous findings demonstrate that work role characteristics are related to individuals' relationship with their environment and can affect behavioural outcomes (e.g., Fried, Slowik, Ben-David, & Tiegs, 2001). Concepts related to autonomy, such as psychological privacy, have demonstrated that perceptions of control can influence interaction and discussions (Oldham & Brass, 1979; Oldham & Rotchford, 1983). Furthermore, individual control is beneficial to office communication as it provides a means for workers to optimise their workspace to support such interactions and tasks (Huang et al., 2004). In essence, the autonomy that workers enjoy may allow them to customise their space, choose to utilise different task areas or withdraw from the office entirely to undertake work.

3.3.3. Work-workspace interaction

Duffy's influential architectural taxonomy of modern offices (Duffy, 1997) proposes that workers' autonomy and interaction strongly influence their environmental needs. Essentially, the nature of the work and role determines the space required to adequately support the worker in their job. Likewise, the nature of the environment can influence a worker's behaviour through effective support or inhibition. The implicit interactive nature of the worker-environment relationship has not adequately been explored within the organisational literature to date.

With a focus on communication, break-out areas, physical proximity, density and autonomy have been introduced as key variables in the design of contemporary offices. Here, it is argued that there is a need to consider these variables in more sophisticated, interactive terms, to better appreciate their relationships with communication. This perspective is based on architectural, facilities management, and STS arguments that advocate the interdependent nature of sub-systems (e.g., between work processes and procedures, technologies and the physical environment) within an overall organisational system (e.g. T. J. Allen & Henn, 2007; Becker & Steele, 1995; Blyth & Worthington, 2001; Duffy, 1997; Ferguson & Weisman, 1986; Haynes, 2007). In other words, break-out areas, physical proximity, density and autonomy should be treated in combination rather than in isolation to predict communication (c.f., Fried et al., 2001; Oldham et al., 1995; Zalesny & Farace, 1987).

A systems approach was introduced in the previous chapter when discussing the design or redesign of workspaces and the change

that this embodies. Approaches such as STS emphasise the relationships between workers, their jobs, organisational processes and environments (Cherns, 1976). Such organisational systems are not static or linear, workers' roles influence how they use space, just as the physical environment can support or inhibit particular tasks (c.f., T. J. Allen, 2007). Relationships between work design and physical design can be conceptualised as part of an overall organisational system. As such, these domains do not have to be viewed as separate experiences or processes, they can be expected to jointly interact to influence how individuals behave or experience their workplace.

Empirical studies provide some support for this approach, with interactions found between the worker, job characteristics and the physical environment (e.g., Fried, 1990; Leather, Beale, & Sullivan, 2003; Oldham & Fried, 1987). More widely, perceptions of the physical workspace, reactions to it or workspace requirements, have been found to be influenced by work or job characteristics (Duffy, 1997; Ferguson & Weisman, 1986; O'Neill, 1994; E. Sundstrom et al., 1982). For example, job complexity, tenure and density have been found to interact to predict job and co-worker satisfaction; with high job complexity, high tenure individuals most adversely affected by increases in density, whereas high complexity, low tenure individuals performed well regardless of density (Fried et al., 2001). Examination of the joint effects and relationships of work design characteristics and features of the physical environment will aid researchers. It would allow STS principles (Cherns, 1976; Clegg, 2000; McGourlay et al., 2009) and design led concepts (T. J. Allen & Henn, 2007; Duffy, 1997) regarding the interactions between aspects of

work and environment to be tested. Associated findings may help to guide managers in the selection of work environments to suit particular groups of workers (Wineman & Serrato, 1999).

3.4. Trade-offs in reconfiguring workspace

Contemporary office designs have been introduced with varying success (Vischer, 2005b). Part of this variability can be ascribed to the often competing tensions that office reconfiguration involves, with trade-offs needing to be negotiated (Elsbach & Pratt, 2007). For example, workers may need to accept reduced individual workspace in return for an increase in collaborative or other task space. This section begins by introducing the trade-offs and change inherent in workspace reconfiguration. Then, a trade-offs approach is offered as a perspective to understand the reconfiguration process and contrasting outcomes. Subsequently, two negative outcomes (wellbeing and crowding) expected to follow office reconfiguration are discussed. Finally, the potential for office configuration to trade-off potential negative outcomes is explored.

3.4.1. Office reconfiguration involves change

As discussed previously, two of the major drivers of office evolution are the desire for overhead cost savings and improvements in outcomes such as communication (e.g., Duffy, 2000; Ellington, 2007).

Whilst these sets of aims are not mutually exclusive, they do present challenges for managers looking to implement successful office reconfiguration. Design decisions regarding the proportion of break-out areas to provide and the level of proximity and occupant density need to be negotiated. Currently, there is little guidance regarding how these factors interact and influence not only communication, but also wider organisational concerns such as employee stress or wellbeing. Individual case study accounts suggest that there may be tipping points at which reconfigured offices become detrimental to employees (e.g., T. J. Allen & Henn, 2007). Furthermore, with the majority of workers already housed within open-plan offices, adopting contemporary office configurations will almost certainly involve change to the layout of existing office space. Systematic investigations regarding changes to the configuration of contemporary offices, e.g., increases in setting density, that may produce negative behavioural or psychological outcomes, do not appear to have been performed.

Office reconfiguration or redesign is acknowledged to embody change for the workers concerned (Higgins & McAllaster, 2004). McElroy and Morrow (2010) have highlighted the limited attention that workspace as a driver, or process, of change has received within the management literature. Authors have noted that office reconfigurations involving large-scale change for office occupants can produce negative behavioural outcomes (Vischer, 2005b). The wider change management literature also promotes continual change processes over discrete change (e.g., Luecke, 2003). Although a small number of studies (e.g., Foland et al., 1995) have explored the role of employee involvement and engagement

in office design, research examining the reconfiguration of traditional to contemporary workspace is lacking.

The literature demonstrates that office designs are able to simultaneously elicit both positive and negative psychological and behavioural reactions from their occupants (Brennan et al., 2002; Brookes & Kaplan, 1972). There is also evidence that the way in which new or reconfigured workspace is designed or introduced can significantly alter employee reactions to such space (e.g., Vischer, 2005b). To-date the consideration both of design trade-offs and the change involved in its implementation, have been neglected. Research tackling this issue would help inform the configuration and introduction of contemporary office space (c.f., Gillen, 2006).

3.4.2. A trade-offs perspective

Architectural case studies have demonstrated strategies that aim to balance the competing needs of operational cost reduction and increased communication. A common strategy is the combined increase in the number of office occupants and incorporation of greater collaborative or discussion space (T. J. Allen & Henn, 2007; Ellington, 2007; Littlefield, 2009). To achieve such a design, individual desk-space must often be reduced, or other strategies implemented to reduce the amount of individual workspace provided. For example, the introduction of teleworking, hot-desking, or staggered working hours (Duffy, 2000; L. I. Scott, 2005), to boost shared space. Use of smaller desks or less spacing between desks (i.e., greater proximity) have been used to both

maintain office density levels (where extra task space is required) and to enable increased density (e.g., T. Allen et al., 2004). Increasing occupant levels (density) has historically been (e.g., Becker, 1981; Oldham et al., 1995; E. Sundstrom & Sundstrom, 1986), and continues to be (Offices, 2009b), a popular method of maximising the efficiency of office space (Vischer, 1989).

The need to distinguish between forms of density and physical proximity was highlighted previously. This requirement for distinction is especially pertinent when considering the introduction and design of contemporary office space. Although density and proximity are often linked, and sometimes used interchangeably (Oldham et al., 1995), changes to one does not always necessitate changes in the other. Classic laboratory studies have demonstrated that under controlled conditions manipulations in proximity and density can produce differing effects (e.g., Worchel & Teddie, 1976). To-date there has been limited field research that has simultaneously explored the effects of changes to proximity and density, on psychosocial or behavioural outcomes. Noticeable exceptions include Zhou, Oldham, and Cummings (1998), and Oldham and Fried (1987), both of whom included physical measures of both proximity and density. However, the cross-sectional nature of the research designs in these studies precludes judgements regarding causality or the proportionate effects of change in these variables on individuals (Cook & Campbell, 1979; Gill & Johnson, 2010). This point is important in considering how contemporary workspace is introduced. Designers and managers charged with the task of increasing the numbers of occupants in an office could choose a number of strategies to

achieve this. One option would be to protect individual work areas (and minimise increases in proximity) but with the trade-off of reduced meeting, circulation or informal areas to increase office density. A second might be to increase the physical proximity of workers (and fit more desks into a smaller area), but to balance the reduction by using some of the gain to provide additional (or protect existing) alternative task areas (Littlefield, 2009). A third option, and probably the most favoured in terms of achieving cost reduction, would be to increase both the physical proximity and overall density of an office to provide the greatest overall increase in occupants (Offices, 2009a). The trade-off in the third option would be that it allows existing meeting and informal areas to be maintained. Currently there is little empirical guidance available to managers regarding trade-offs in the form of contemporary office that produce advantageous outcomes for individuals and organisations.

Despite a paucity of empirical evidence, designers have asserted that an increase in discussion or collaborative space may counterbalance the effects of decreases in personal space or increased density (e.g., T. Allen et al., 2004) (see, figure 3.1, for illustration). The approach is parsimonious with theoretical assertions, such as Duffy (1997), that it is the degree of task space relevant to the job that is key to success, as opposed to simply the amount of individual space that employees are afforded. Additionally, it is suggested that more varied workspaces better support knowledge workers (see figure 2.3). Furthermore, Turner and Myerson (1998) and Laing (2006) emphasise the importance of ensuring that contemporary workspace reflects the tasks of workers, rather than simply prioritising individual work areas. This logic suggests that

contemporary offices may be able to maintain or improve employee reactions when occupancy is increased, by increasing the provision of alternative task space. In effect, this design compensates for reductions in individual work areas that the change introduces.

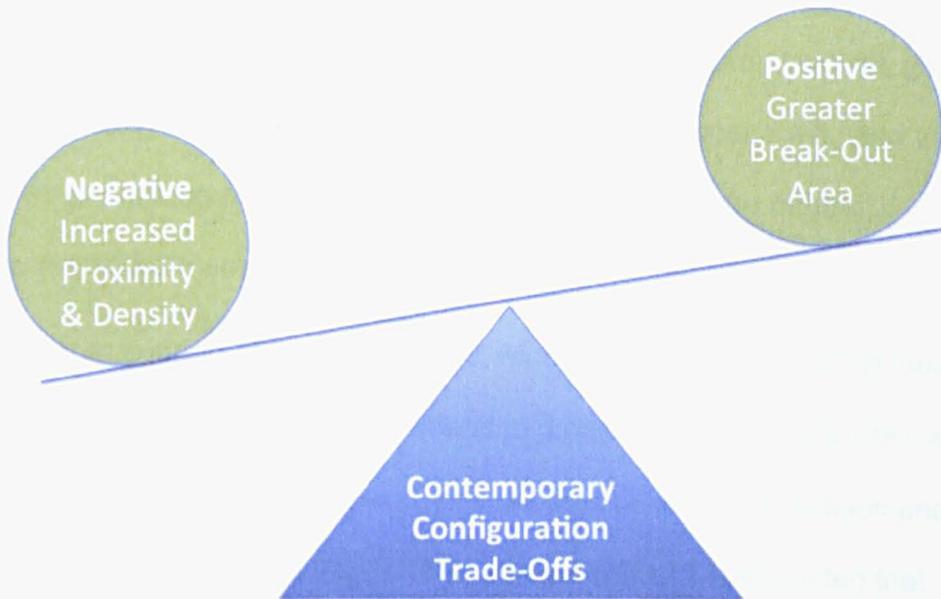


Figure 3.1. Figure illustrating the trade-offs often involved in contemporary office reconfiguration and the potential counterbalancing of competing design features.

An trade-offs approach is supported by Vischer's (2005b) notion of the "socio-spatial contract". This suggests that the design of contemporary workspace needs to be mindful of the transactional nature of the relationship between workers and their environment. The socio-spatial contract is essentially a specific aspect of an employees' psychological contract with the organisation (Conway & Briner, 2009; Rousseau, 1996). The socio-spatial contract concerns the expectations that

individuals hold regarding the type and form of workspace that they will receive from their employer. In common with other conceptualisations of the psychological contract (Conway & Briner, 2009), when an organisation amends the form of the socio-spatial contract to the detriment of the employee, negative behaviour can result (Vischer, 2005b). The concept suggests that office reconfiguration involves give and take. A reconfiguration that reduces individual space will need to offer something additional in return to gain a positive (or neutral) response from employees.

In support of this perspective, McElroy and Morrow (2010) found contemporary office reconfigurations to produce contrasting positive and negative employee reactions. These findings corroborate Elsbach and Pratt's (2007) notion of trade-offs in design. Whilst it is expected that contemporary configurations that increase density, proximity and break-out provision will yield positive results for worker communication (see earlier in this chapter), existing literature suggests that negative effects can also be anticipated. To illustrate this further, two anticipated negative trade-offs are discussed below.

3.4.3. Wellbeing

Changes to two of the highlighted workspace factors, namely, proximity and density, can be expected to produce negative employee outcomes. Increased density and physical proximity have been negatively related to a range of outcomes, including; performance, job satisfaction, environmental satisfaction and turnover intentions (e.g.

Carlopio & Gardner, 1992; Charles & Veitch, 2002; De Croon et al., 2005; May et al., 2005; Oldham et al., 1995; E. Sundstrom & Sundstrom, 1986; Zalesny & Farace, 1987). Although there have been broad investigations of negative effects, it is necessary to refine discussion to enable more focussed examination.

There is an opportunity to contribute to the field and examine the relationship that contemporary office environments have on workers' wellbeing. This is particularly relevant given the increasing emphasis of organisations on the aim of using workspace to improve employee wellbeing (Vischer, 2007b), in addition to the wider emphasis on wellbeing within I/O practice and research (Warr, 2007). Individual wellbeing is becoming an ever more mainstream topic, with greater employee awareness and policy attention, for example, becoming a government measured outcome (Cameron, 2010). Wellbeing can be considered a concept worthy of greater investigation within the context of contemporary office configuration as it can have widespread implications (Daniels, 2011) and may be indicative of organisational effectiveness. For example, work conditions that lower wellbeing or cause employees to become stressed have been related to work effectiveness (Warr, 1996). Conversely, employees experiencing heightened work related wellbeing have been associated with increased productivity (Wright & Cropanzano, 2000). Often where wellbeing has been measured in relation to the physical environment, it has been in relation to technical aspects of the building (e.g., ventilation, lighting) (Rashid & Zimring, 2008) and not the overall configuration of the workspace. There has also been a tendency to concentrate on stress reactions rather than affective wellbeing (De

Croon et al., 2005). There is an opportunity for I/O researchers to explore the effects of introducing contemporary work environments on employee wellbeing and examine the efficacy of designers' aims.

Although the direct evidence between workspace configuration and employee wellbeing is limited at present, existent literature that has examined related processes and outcomes offers an insight. In particular, it is suggested that being located in high density, or high proximity, situations increases the likelihood of interruptions or distractions (Brookes & Kaplan, 1972; O'Neill, 1994; E. Sundstrom & Sundstrom, 1986). Compensating for, or employing strategies to minimise the effects of more dense physical environments requires effort on the part of the individual (M. G. Evans, 1991). Such increased interactions and the use of coping mechanisms (Baum & Paulus, 1987) can contribute to increased perceptions of stress or reduced wellbeing (Brennan et al., 2002; De Croon et al., 2005; G. W. Evans & Johnson, 2000). However, studies that have explicitly addressed affective wellbeing are minimal. Previously, there has been conflicting evidence regarding the effects on stress perceptions, or health outcomes in field settings (De Croon et al., 2005). However, given the anticipated negative effect upon stress perceptions (M. G. Evans, 1991) and the suggestion that workspace in general can affect wellbeing (e.g., Danielsson & Bodin, 2008; Fjeld, Veiersted, Sandvik, Riise, & Levy, 1998; Phil Leather, Pyrgas, Beale, & Lawrence, 1998; Veitch et al., 2007) it is expected that increases in density or proximity will be negatively related to wellbeing.

3.4.4. Crowding

A second expected negative outcome that offers an opportunity for interesting insight is the perception of crowding. The change to contemporary office space often comes at the cost, or trade-off, of reduced individual workspace (e.g., T. Allen et al., 2004). Reductions in personal space have long been associated with the experience of crowding (Oldham, 1988). However, there are no studies, that the author is aware of, that have explored the relationship between contemporary office reconfiguration and crowding. Perceptions of crowding are likely to be central to how individuals perceive workspace (c.f., May et al., 2005). Additionally, the assumption within a trade-offs approach, that increased collaborative areas may counteract reductions in personal space, needs to be tested.

Crowding is defined as a subjective reaction to a perception of the physical environment and is thus distinct from objective physical measures of density or proximity (Stokols et al., 1975). The experience of crowding has been described as involving the feeling that one possesses an inadequate amount of space or controls too little of it (Y.K. Chan, 1999; De Croon et al., 2005). Strong associations between crowding and density and proximity have been established in laboratory and domestic settings (Oldham, 1988). There has been less consistent relationships between features of the physical environment and crowding in office settings (De Croon et al., 2005). For example, Zhou, Oldham, and Cummings (1998) failed to find a direct relationship between either proximity, or density, with perceptions of crowding, nor through a

combination of density and proximity. However, the balance of evidence (Elsbach & Pratt, 2007; E. Sundstrom & Sundstrom, 1986) suggests that crowding can be expected to be significantly related to the physical features of the office, including proximity and density.

3.4.5. Trading-off crowding

The idea that employees' reactions to, and interactions with, their environment are influenced by subjective perceptions and psychological interpretation are well established (e.g., Becker, 1991; Blyth & Worthington, 2001; E. Sundstrom & Sundstrom, 1986; Veitch et al., 2007). For example, O'Neill and Carayon (1993, cited in Charles & Veitch, 2002) found that perceived enclosure was much more highly associated with office occupants' satisfaction with privacy than physical measures of enclosure. This suggests that physical design and spatial configuration can influence how individuals perceive environments with similar headline characteristics (e.g., offices with the same spatial density) (Vischer, 1989). To date, the author is aware of no study that has explored whether changes to the spatial configuration, such as an increase in the provision of break-out space, can help to trade-off increases in density and proximity.

Office designs which reduce individual work areas and increase density, but increase the proportion of collaborative break-out areas, are likely to alter the perception of the architectural space (c.f., Becker & Steele, 1995; Charles & Veitch, 2002). Having access to and being aware of break-out areas may reduce the overall sense of crowding, as

this shared space will increase the total office space available to individuals. A trade-offs perspective predicts that sacrificing individual space for collaborative space, such as break-out areas, will counterbalance reduced personal space. Research that examines the effects of introducing differing forms of contemporary office space would allow potential trade-offs with crowding to be identified. Such work would help guide designers and managers in designing office space that provides spatial configurations that minimise the experience of crowding for its occupants.

3.5. Psychological processes involved in office reconfiguration

A great deal of the writing on contemporary workspace has originated from design led domains (see previous literature review chapter). The psychological processes and responses that individuals experience in such spaces have not been prominent. The attention has instead focussed upon architectural design issues (e.g., Gillen, 2006), operational issues (e.g., Preiser & Vischer, 2005), and working practices and technologies (e.g., L. I. Scott, 2005). This section first introduces the need to apply theoretical processes to the study of workers' interactions with reconfigured offices. Second, crowding is considered as a specific psychological process related to contemporary offices. Third, the role of crowding as a mediator between office reconfiguration and psychological and behavioural outcomes is discussed.

3.5.1. Applying theoretical processes

Contemporary office designs involve aspects of office configuration that have been researched by applied psychologists over a number of years, e.g., density and proximity. These studies have led to the formulation of cognitive (e.g., S. Cohen, 1980; Desor, 1972; Oldham et al., 1995), social (Festinger et al., 1950; Zalesny & Farace, 1987) and psychological (Altman, 1975; Vischer, 2007b) theories that attempt to explain the interaction between people and their environment. The diverse and often contradictory evidence for and against the various theoretical approaches has led researchers to conclude that no one theory or process will explain the relationships that individuals experience with their work environment (Elsbach & Pratt, 2007). As such there is a need to explore which existing aspects of theory, or individual processes, hold relevance for the contemporary office. It was suggested earlier in this chapter that there is a clear opportunity to integrate work design and physical environment approaches. Similarly, there is an opportunity to explore in greater depth specific psychological processes that may affect how contemporary offices are perceived. An understanding regarding which psychological processes are efficacious in explaining individuals' responses will aid progressive theory building and integration (c.f., Hodgkinson & Healey, 2008).

Specifically, core psychological processes or reactions have been identified as important in shaping how individuals react to their physical environments (Baum & Paulus, 1987; P. A. Bell, Greene, Fisher,

& Baum, 1996). For example, perceived control (e.g., Huang et al., 2004), psychological privacy (E. Sundstrom et al., 1982) and perceived crowding (O'Brien & Pembroke, 1982) have all been demonstrated as affecting individual's reactions to the physical work environment. These concepts have often been measured as outcomes in their own right or as proxies for the physical work environment (De Croon et al., 2005; Oldham et al., 1995). However, psychological interpretations or appraisals are suggested to influence the way in which employees respond to their physical workspace (Ferguson & Weisman, 1986). In essence, it is the psychological interpretations of the physical environment, rather than the physical environment directly, that influence subsequent psychological and behavioural outcomes (Bechtel & Churchman, 2002).

Approaches such as the trade-off approach neglect the specific psychosocial reactions that individuals experience in relation to their physical environment. Accounts of contemporary office environments and their benefits are often provided in isolation to existing knowledge of psychological processes (e.g., T. Allen et al., 2004; Ellington, 2007; Laing et al., 1998). Researchers and managers would benefit from a greater understanding of why variations in contemporary office designs may cause differing reactions. Knowledge regarding the psychological processes that contemporary work environments elicit will allow integration between psychological and architectural theory.

3.5.2. Crowding as a process

I/O scholars have conducted numerous studies exploring the effects of changes in the spatial configuration of offices over the years, with changes in physical density or proximity often examined (Fried et al., 2001; May et al., 2005; O'Brien & Pembroke, 1982; Oldham, 1988; Szilagyí & Holland, 1980). Perceptions of crowding in particular have long been associated with changes to the provision of personal space within both social, experimental and I/O psychology (Aiello, DeRisi, Epstein, & Karlin, 1977; Baum & Paulus, 1987; De Croon et al., 2005; Dean, Pugh, & Gunderson, 1975; Epstein & Karlin, 1975; Freedman, 1975; May et al., 2005; Schopler & Stockdale, 1977; Zhou et al., 1998). The introduction of contemporary office configurations often result in increases to both proximity and density (Littlefield, 2009; Offices, 2009b). Understanding regarding the effects of contemporary office space would be aided by examining the relationship between workers and their environment, in light of processes such as crowding.

Contemporary offices that combine increases in density and proximity in such a way that they exacerbate a sense of crowding may accentuate the negatives outcomes, in relation to the positives. In addition to being conceptualised as a stress reaction in its own right (particularly amongst individuals exposed to high levels of stimulation or social interference, Oldham et al., 1995; Stokols, 1972), crowding is also an antecedent to further health and wellbeing detriments (De Croon et al., 2005). In particular two aspects of the crowding reaction can be

viewed as detrimental to wellbeing and communication. First, avoidance or coping strategies are suggested to be employed to enable occupants to deal with the demands of a crowded environment (Baum & Paulus, 1987; Zhou et al., 1998). Coping with demanding environments can often require greater individual effort and personal resources, potentially coming at a cost of greater stress or reduced wellbeing (e.g., Hockey & Earle, 2006). Additionally, experiencing and coping with heightened levels of crowding can cause discomfort for individuals (E. Sundstrom & Sundstrom, 1986) and lower wellbeing. Coping strategies have been found to include withdrawing from the workplace (physically and psychologically) to avoid the experience of crowding (Baum & Paulus, 1987; May et al., 2005; Oldham & Rotchford, 1983; Vischer, 2007b). A tendency to withdraw from the workplace can be expected to reduce individuals' availability for interaction and consequently the degree of office communication supported.

A further anticipated outcome of crowding on office occupants, based upon the behavioural constraint perspective (Stokols, 1972), is that feelings of crowding restricts behavioural freedom and lowers control (Y.K. Chan, 1999). A reduction in perceived control has been consistently linked to reductions in wellbeing and heightened stress reactions (de Jonge & Kompier, 1997; Karasek & Theorell, 1990; Sonnentag & Frese, 2003). Specifically a lack of perceived control over or within the physical workspace has been linked to stress and wellbeing (Huang et al., 2004; McLaney & Hurrell, 1988; Vischer, 2007b). A sense that behaviour is constrained by the environment, with it being too crowded to perform certain actions, may also have a significant effect. Donald and Siu (2001)

identified a lack freedom to move as detrimentally linked to health and wellbeing. Furthermore, a sense of behavioural constraint may reduce individuals' perception that they are able to utilise break-out areas, or hold impromptu discussions around their desks.

3.5.3. Mediating process

Previously in this section, the notion of psychological interpretations of the physical environment acting as a process affecting further behavioural and psychological outcomes was introduced. The I/O psychology literature directly exploring the introduction of contemporary office design is sparse (McElroy & Morrow, 2010). There appears to have been no exploration as to the role of psychological processes that may affect how workers react to modern office space. This presents a major opportunity for I/O psychologists to apply established processes to this area, to investigate whether they are substantiated in new contexts.

In the previous section crowding was introduced as an expected negative trade-off associated with the introduction of contemporary office space. However, it is suggested that conceptualising crowding as purely an outcome is too simplistic. A more nuanced consideration is required. For the reasons discussed previously, crowding is well suited to examination of environments that reduce individual workspace. Furthermore, it has been established as a mediating variable within more traditional office environments. Research has identified the perception of crowding as an intervening variable, between the work environment and further behavioural and psychological outcomes (May et al., 2005). For

example, De Croon, Sluiter, Kuijer and Frings-Dresen's (2005) demands-resources model of the work environment, contains the experience of crowding as a central process. There is an opportunity to explore the role of psychological perceptions and processes in the context of modern office configurations.

The experience of crowding may act as a process that affects the reactions individuals exhibit in relation to the physical aspects of their work environment. Indeed, the experience of crowding has been viewed both as an outcome in itself, as well as an antecedent to further reactions. Corroborating this view, there is evidence that crowding acts as a mediating process, affecting the relationship between the physical environment and individuals' psychological and behavioural reactions (De Croon et al., 2005; May et al., 2005). The perception of crowding has previously been found to fully mediate the relationship between spatial density and both tardiness and environmental satisfaction amongst receptionists in various medical workplaces (May et al., 2005). Oldham and Rotchford (1983) established that a range of environmental reactions (incorporating crowding) partially explained differences in the relationship between office characteristics (including setting density) and work and social satisfaction. They also found that this relationship explained differences in the tendency for individuals to withdraw from the work environment during discretionary periods. Other researchers have also provided support for the role of crowding in the relationship between environment and psychosocial outcomes (Carlopio & Gardner, 1992). It is anticipated that crowding will act as a mediating process between the

configuration of the physical environment and higher-level psychosocial and behavioural outcomes (see, figure 3.2).

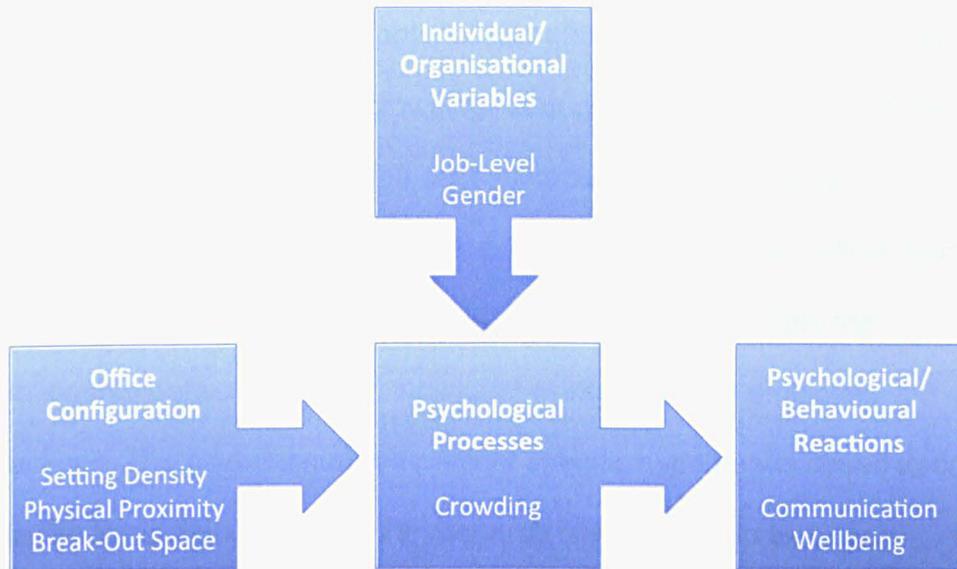


Figure 3.2. Figure illustrating proposed mediation role of crowding in worker-environment relationship. Demonstrates the instrumental nature of individual psychological processes in affecting psychological and behavioural reactions to the configuration of the physical environment. Individual and organisational variables are suggested to alter worker perceptions, expectations and consequent psychological processes.

3.6. Summary

This chapter has identified a number of research gaps relating to the configuration and evaluation of contemporary work environments. Attention has been drawn towards the need for studies that explicitly explore the effects of common features of contemporary office configurations. The potential to consider the interaction between the work

environment and workers jobs and roles has also been articulated. The idea that office reconfiguration involves trade-offs and that these may result in both positive and negative outcomes for workers has been discussed. Furthermore, the potential for office reconfiguration to trade-off negative effects such as crowding, through the use of break-out areas has been proposed. Finally, the case to consider psychological processes in interpreting workers' reactions to contemporary office space has been made. Specifically, crowding is expected to mediate the relationship between reduced individual workspace and employee reactions. The next chapter will present specific hypotheses based upon this literature. Subsequently, the research design used to test each hypothesis will be described.

4. Research Hypotheses

The previous two literature chapters have introduced the topic of the physical work environment, highlighted the emerging trends and focussed upon relevant research opportunities. This chapter presents the specific hypotheses that have been derived from the previously outlined literature.

4.1. Break-out areas

The social relations approach suggests that break-out space will support increased communication (Festinger et al., 1950; Oldham & Brass, 1979; Zalesny & Farace, 1987). The inclusion of break-out space within a contemporary office can be considered a means of reducing physical barriers to meeting with colleagues (c.f., Peponis et al., 2007). Providing such meeting spaces close to teams can be expected to increase meetings (McCoy, 2005) and aid collaboration (Wineman & Serrato, 1999). In sum, break-out areas can provide a convenient and cost effective space for conducting spontaneous or short discussions within the office (see section 3.2.2 for further discussion). It is therefore expected that access to break out areas will improve communication.

Hypothesis 1: Access to a break-out area will be related to greater levels of communication.

4.2. Proximity of co-workers

A social relations standpoint also suggests that increased physical proximity to other co-workers will ease interaction due to easy access to a greater number of nearby colleagues (Zalesny & Farace, 1987). Physical proximity has been demonstrated to affect the probability and frequency of interaction between knowledge workers (T. J. Allen, 2007; T. J. Allen & Cohen, 1969; T. J. Allen & Hauptman, 1987). Additionally, proximity appears to aid information exchange between co-workers (Szilagyí & Holland, 1980). These findings suggest that close proximity to co-workers will facilitate increased levels of interaction and information exchange between office occupants (see section 3.2.3 for further discussion).

Hypothesis 2: Higher proximity to co-workers will be related to increased communication.

4.3. Density of co-workers

Similarly to physical proximity, it is expected that density will be positively related to communication. Specifically, increased setting density has been related to higher job feedback and increased friendship opportunities (Szilagyí & Holland, 1980). Higher density can also be expected to reduce the effort required to locate and interact with co-workers (c.f., T. J. Allen & Hauptman, 1987) (refer to section 3.2.3 for further discussion). It is therefore expected that increased density will

have a positive effects on employee communication amongst contemporary offices.

Hypothesis 3: Increased density will be positively related to communication.

4.4. Autonomy

Aspects of workers' roles and jobs have been suggested to interact with the physical workspace (Oldham & Fried, 1987) and to directly affect workplace communication. Specifically, autonomy has been related to the frequency of workspace interactions (Oldham & Rotchford, 1983). The related concept of privacy has been found to affect the likelihood of confidential discussions occurring (Oldham & Brass, 1979). In addition, individual control affords workers the opportunity to optimise their workspace to support interactions and aid communication (Huang et al., 2004) (see section 3.2.2 for greater detail). It is therefore expected that job autonomy will positively influence office communication.

Hypothesis 4: Autonomy will be positively related to office communication.

4.5. The office as an interactive environment

The physical work environment and work design have been suggested to interact as part of the organisational system (T. J. Allen & Henn, 2007; Duffy, 1997). Interactions have been established between individuals, job characteristics and the physical environment (e.g., Fried, 1990; P. Leather et al., 2003; Oldham & Fried, 1987). Based upon these findings and a STS approach, the configuration of the physical work environment and autonomy are expected to interact to predict level of office communication (see section 3.3.3 for further explanation). The specific form of the interaction is explicated next.

4.5.1. Higher communication

It is expected that individuals who possess higher levels of autonomy will derive most benefit from environments that afford access to break-out areas and higher levels of physical proximity or density. These individuals should be better able to utilise and exploit break-out areas (Duffy, 1997; Laing, 2006; Turner & Myerson, 1998), and regulate interactions around their desk areas (Brennan et al., 2002). Under such conditions workers should be able to benefit from increased individual interactions with closely seated co-workers, together with access to break-out areas as-and-when required (T. J. Allen & Henn, 2007; Peterson & Beard, 2004; Steiner, 2005). Hence, these workers should be able to increase the speed and quality of both individual and team communication.

4.5.2. Moderate communication

Workers in offices that incorporate break-out areas but relatively low physical proximity or density should still benefit from improved ease of group and in-depth discussions (e.g., Wineman & Serrato, 1999); but this would be contingent upon them possessing higher levels of autonomy to make use of the areas (Huang et al., 2004; Lee & Brand, 2005). Lower autonomy workers may feel unable (or that they are not permitted) to make use of the break-out areas as and when it is needed, or their working practices may be too inflexible to allow them to work in such spaces (i.e., the prescribed way to work bounds them to their desk). As individuals are seated at a greater distance from their co-workers, spontaneous informal information seeking and conversations may be lower than for those colleagues in higher proximity or density conditions (T. J. Allen & Henn, 2007).

Likewise, it is expected that individuals without access to break-out areas but in higher proximity, or higher density, and higher autonomy conditions will report moderate communication. Such workers should benefit from easier access to immediate colleagues (via proximity or density) and to regulate (via autonomy) the form of these interactions. If they are unable to control the nature of the increased desk based interaction, psychological privacy could be reduced. This, in turn, might limit the benefit of higher proximity or density, diminishing certain types of communication, such as confidential discussions and feedback (c.f., Oldham & Brass, 1979; Oldham & Rotchford, 1983).

4.5.3. Lower communication

It is contended that individuals without access to break-out areas, lower levels of autonomy and in lower proximity to, or density with, co-workers will be most disadvantaged. These workers will have comparatively fewer colleagues in their immediate vicinity and less opportunity for spontaneous interaction (c.f., Peponis et al., 2007). Lower autonomy workers should also be less able to influence the nature of the interactions around their desk area and as such may suffer from reduced psychological privacy (E. Sundstrom et al., 1980). They will also be unable to withdraw to other areas, such as break-out space (c.f., Oldham & Rotchford, 1983), to conduct confidential or group discussion.

An aim of this research is to test for these interdependencies: to examine relationships between differing combinations of access to break-out areas, physical proximity, or density, and autonomy with communication. The following table (table 4.1) depicts the expected outcomes.

Hypothesis 5. Break-out area, physical proximity, density and autonomy will jointly predict communication.

Effect on Communication	Access to Break-out Area	Proximity/ Density	Autonomy
Most Optimal	Yes	Higher	Higher
Mid Range	Yes	Lower	Higher

	No	Higher	Higher
Least Optimal	No	Higher	Lower

Table 4.1. Effects of interdependent variable combinations on communication

4.6. Wellbeing

One of the anticipated negative trade-offs associated with the introduction of contemporary office configurations is a reduction in wellbeing. The workspace has been suggested to affect individual's wellbeing (e.g., Danielsson & Bodin, 2008; Fjeld et al., 1998; Leather et al., 1998; Veitch et al., 2007). Furthermore, the work environment has been shown to be related to the related experience of stress (G. W. Evans, Johansson, & Carrere, 1994), with physical proximity and density in particular linked to heightened stress perceptions (Wineman, 1982) (see section 3.4.3 for further discussion). It is expected that increases in density or proximity will be negatively related to wellbeing.

Hypothesis 6: Contemporary office designs that increase density or proximity will be negatively related to wellbeing.

4.7. Crowding

A second negative trade-off associated with the introduction of contemporary office configurations is perceived crowding. Numerous

studies within laboratory and domestic settings have demonstrated strong relationships between crowding and density and proximity (Oldham, 1988). Previous reviews of the physical work environment literatures have found the weight of research to support increased perceptions of crowding associated with reduced individual work areas (Elsbach & Pratt, 2007; E. Sundstrom & Sundstrom, 1986) (see section 3.4.4 for further information). It is expected that crowding will be significantly related to the levels of proximity and density within an office.

Hypothesis 7: Contemporary office configurations that increase physical proximity or density will be positively related to perceptions of crowding.

4.8. Trading-off crowding

Office designs which reduce individual work areas and increase density or proximity, but increase the proportion of collaborative break-out areas, are likely to alter the perception of the architectural space (c.f., Becker & Steele, 1995; Charles & Veitch, 2002). Having access to and being aware of break-out areas may reduce the overall sense of crowding, as this shared space will increase the total office space available to individuals. A trade-offs perspective predicts that sacrificing individual space for collaborative space, such as break-out areas, will counterbalance reduced personal space (increases in density and proximity) (see section 3.4.5 for greater discussion). It is anticipated that contemporary office configurations that both increase the provision of

break-out space, as well as proximity and density, will reduce perceptions of crowding and related negative effects.

Hypothesis 8: An increase in proximity and density, together with increased break-out provision, will be related to lower crowding.

4.9. Crowding as a mediating process

The experience of crowding has been proposed to act as a mediator, within the relationship between the physical environment and individuals' psychological and behavioural reactions (Altman, 1975; De Croon et al., 2005). Crowding has often been related to changes in proximity or density within work environments (Aiello et al., 1977; Baum & Paulus, 1987; Dean et al., 1975; Freedman, 1975). Furthermore, crowding is expected to negatively relate to wellbeing and communication due to behavioural constraints or the use of coping mechanisms (Baum & Paulus, 1987; Zhou et al., 1998). Crowding has previously been found empirically to mediate the relationship between density and psychosocial and behavioural reactions (Carlopio & Gardner, 1992; May et al., 2005; Oldham & Rotchford, 1983) (see section 3.5.3 for further discussion). Crowding is expected to mediate the relationship between increased density, proximity and both communication and wellbeing.

Hypothesis 9: Perceptions of crowding will mediate the relationship of density and proximity, with communication and wellbeing.

4.10. Summary

This chapter has outlined a number of research hypotheses relating to how individuals' work design and office configuration interact to predict communication. Hypotheses relating to the design and implementation of contemporary workspace have been articulated. In addition, the potential of crowding as a process in the worker-environment relationship is to be explored. The subsequent chapter describes the methodology and research design that will be utilised to test the hypotheses as detailed in this chapter.

5. Research Context and Methodology

The previous chapter presented the research hypotheses to be explored in this thesis. This chapter explains the research design employed to examine these hypotheses. The research was conducted in two stages, based on the access opportunity to evaluate an organisation's office reconfiguration programme. This permitted testing of all of the previously presented hypotheses in two studies.

This chapter is organised into a number of focussed sections. First, the organisational context in which the research is conducted and the office reconfiguration programme are described. Second, the general methodological approach and individual research designs for the two studies are outlined. Third, the sample and method of data collection are detailed. Fourth, the measures used across both studies are presented and explained.

5.1. Context

This section introduces the organisation within which the research was conducted. Then an overview of the organisation's office reconfiguration programme is provided. Subsequently, the two phases of this reconfiguration programme (and the corresponding studies they gave rise to) are described.

5.1.1. Organisation

The two studies reported in this thesis arise from the evaluation of a global aerospace organisation's office reconfiguration programme, undertaken in a number of its UK offices. The organisation is a leading designer and manufacturer of a range of advanced technology and engineering products, predominantly employing highly skilled, professional knowledge workers. Existing working relationships with the organisation enabled access to the occupants of newly reconfigured offices, in addition to staff in existing offices. This access permitted the design of studies to measure the effects of differing open-plan office designs and implementations.

The organisation's performance is very much dependent upon the cooperation, knowledge transfer and decision making that occurs within and between various areas (e.g., product design, engineering, manufacture, support). Success in these areas therefore hinges upon effective communication. Of particular concern is ensuring that experience gained on previous projects is utilised in the design of new products. The nature of the skilled work that the company engages in often requires problems to be resolved as and when they occur.

5.1.2. Office reconfiguration programme

The organisation has been focussed on increasing communication within their offices for some time and has utilised large

traditional open-plan offices for many years. This has allowed managers to co-locate the majority of individuals for a particular project, or to group functional units in single offices. In addition, break-out spaces have been incorporated, but in a piecemeal fashion. The decision to include such spaces and their size was often dependent upon the judgment of local managers. The aim of these design decisions was to help support more spontaneous meetings (to reduce the load on traditional meeting rooms) and to speed up inter-personal interactions.

The organisation decided to embark upon a more formal and structured office reconfiguration program. The aim was two-fold. First, to enable the offices to accommodate future workforce growth, thereby reducing costs associated with providing additional buildings. Second, they sought to increase communication and interaction within the office, which involved introducing a new style of desk to seat employees closer to their co-workers. A longer-term aim of this new desk configuration was to increase the total number of employees within the existing office buildings (raise the setting density within each office). A reduction in overall office space provision is required by the organisation as it decommissions a number of large office blocks over the next decade. Existing offices typically incorporated large corner facing desks that provided generous distances between co-workers. Reconfigured offices introduced much shallower straight bench style desks and longer rows of adjacent desks, which reduced the distance between neighbouring individuals. As a result, proximity was significantly increased in the reconfigured offices (see later measures section for details).

The organisation was interested in assessing how successful the reconfigurations had been, together with evaluating the utility of break-out spaces. The break-out areas had been included in the re-configured offices in a similarly varied manner to the traditional offices. In addition, the organisation began to implement the reconfiguration in different ways. Initially, the increase in physical proximity was not associated with increased setting density, with some desks being left vacant or space preserved for future desks (phase one). Over time the organisation looked to introduce both an increase in physical proximity and setting density simultaneously to maximise the occupant load (i.e., to house greater numbers of occupants within the office buildings), (phase two). This second phase of reconfiguration also included an increased provision of break-out space. In addition to altering the form of new reconfigurations, the organisation also began to increase the number of occupants housed within some of the offices reconfigured during the first phase. The organisation was concerned to examine whether this new approach would result in more negative effects than the previous strategy. This change in the reconfiguration programme (between phases one and two) permitted the testing of the research hypotheses over two studies. The two studies correspond to the two phases of the reconfiguration programme (illustrated in figure 5.1).

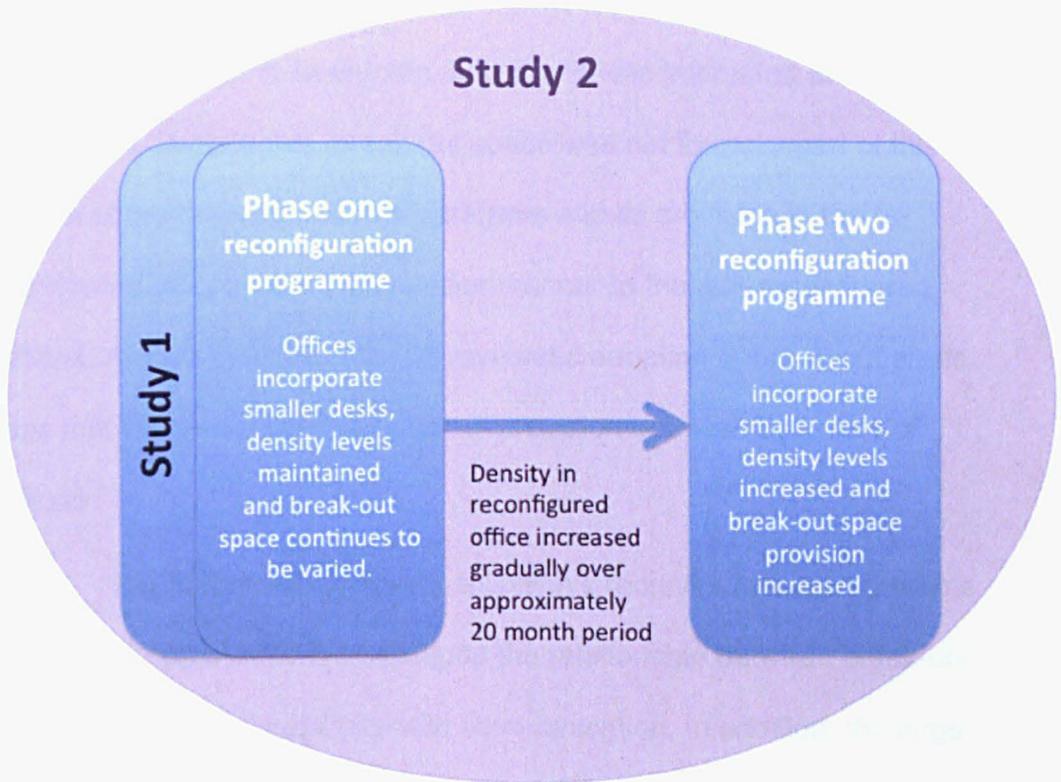


Figure 5.1. Diagram illustrating the relationship between reconfiguration phases and studies one and two.

5.1.3. Study one

The organisation had implemented new desk configurations in a number of its offices, increasing the physical proximity of neighbouring individuals. The reconfigured offices included provision for future staff increases and storage. This, coupled with greater break-out provision in some of the reconfigured offices, resulted in there being no significant difference in setting density between existing and reconfigured offices. The implication of this lack of change in density precluded its examination in study one.

The organisation had experimented with the incorporation of break-out areas in its open-plan offices and was interested in evaluating their utility. Despite this, break-out space was not formally part of this phase of the reconfiguration programme and its provision in the re-configured offices varied in a similar manner to the non-reconfigured offices. A consequence of the idiosyncratic adoption of break-out areas was that there was good variation in provision between both sets of offices.

The first phase of the organisation's reconfiguration programme offered an opportunity to investigate the relationship between break-out areas and physical proximity with communication. In addition, the large numbers of knowledge workers housed within these offices afforded the investigation of the relationship between autonomy, workspace and communication. Exploring interactive effects is well suited to cross-sectional research designs and analysis (e.g., Fried et al., 2001). This first phase of the reconfiguration programme offered a natural fit for a single time-point research design.

The organisation provided access to five reconfigured offices and five equivalent traditional (non-reconfigured offices) during the first phase of the programme (see appendix A – C for exemplars of the office layouts). This produced an opportunity to study five offices in which occupants were sat more closely (in higher proximity) to co-workers, than individuals in five similar but non-reconfigured offices. Within all ten offices, individuals' access to break-out areas differed. Some offices included a greater amount of break-out space than others, enabling

access for a greater proportion of staff. Across all offices however, individuals had divergent access to these spaces, often dependent upon their position in the office. These conditions led to a 2 x 2 quasi-experimental comparative design, in which individuals belonged to either higher or lower proximity conditions and either had access to break-out areas or not (see figure 5.2 for distribution of respondents between the comparison groups).

		Physical Proximity	
		<i>Lower</i>	<i>Higher</i>
Break-out Area	<i>No</i>	67	82
	<i>Yes</i>	80	176

Figure 5.2. Study one distribution of sample.

The design of study one permitted the following hypotheses to be tested:

No.	Hypothesis
1	Access to a break-out area will be related to greater levels of communication.
2	Higher proximity to co-workers will be related to increased communication.
4	Autonomy will be positively related to office communication.
5	Break-out area, physical proximity, density and autonomy will jointly predict communication (see table 4.1 for the specific form of the anticipated interaction).

Table 5.1. Study one hypotheses to be tested.

5.1.4. Study two

Study two examined the effects of the second phase of the organisation's reconfiguration programme. Following the initial phase of office reconfigurations, the organisation began to increase the setting density in one of the reconfigured offices. This was in keeping with part of the organisation's longer-term aim to rationalise its workspace. The decision was also taken to reconfigure one of the previously surveyed traditional offices, this time with the intention of simultaneously raising the setting density in tandem with increasing physical proximity. In an attempt to trade-off potential negative effects of increased setting density, the organisation chose to increase the proportion of break-out space in

the reconfigured office. In addition to break-out tables and chairs, a number of sofas were introduced to the reconfigured office to provide greater informal meeting space.

To explore the effects of these changes in office configuration, three offices were made available for evaluation by the organisation. These included the newly reconfigured office that underwent a simultaneous increase in setting density, physical proximity and break-out space (office A). Secondly, the previously reconfigured office that experienced an increase in setting density was included (office B). Finally, a traditional office that had experienced a limited, natural reduction in setting density was also included in the study (office C). See appendices A, B, C and D for plans of the offices. This permitted a quasi-experimental study design, consisting of the three offices, surveyed over two time-points (with time two approximately twenty months following time one), pre and post-treatment. See table 5.2 for treatment conditions.

	Office A	Office B	Office C
Setting Density	Increase (1.1m ² less per person)	Increase (1.5m ² less per person)	Decrease (0.9m ² more per person)
Physical Proximity	Increase (20cm closer to nearest co-worker)	No Change	No Change
Break-out Area	Increase (0.4m ² more per person)	No Change	No Change

Table 5.2. Study two configuration changes between times one and two.

The change in emphasis of the reconfiguration at phase two provided an opportunity to examine the effects of a change from traditional open-plan office space to more a contemporary configuration. The naturally occurring change that the organisation planned to introduce embodied a trade-offs perspective. It explicitly sought to mitigate the anticipated negative effects of increased proximity and density through providing more informal break-out areas. This programme provided a clear opportunity to examine the assumptions of a trade-offs approach (Duffy, 1997; Elsbach & Pratt, 2007). In addition the change experienced by occupants of office B concerned solely density. This allowed the relationship between density and communication to be examined, something that the programme at phase one did not permit. The investigation of crowding as a potential process within the worker-office relationship is suited to a longitudinal examination. Exploring such a relationship is predicated upon change and the second phase of the reconfiguration programme provided such a context. The specific hypotheses that were tested during study two are detailed in table 5.3.

No.	Hypothesis
3	Increased density will be positively related to communication.
6	Contemporary office designs that increase density or proximity will be negatively related to wellbeing.
7	Contemporary office configurations that increase physical proximity or density will be positively related to perceptions of crowding.
8	An increase in proximity and density, together with increased break-out provision, will be related to lower crowding.
9	Perceptions of crowding will mediate the relationship of density and proximity, with communication and wellbeing.

Table 5.3. Study two hypotheses to be tested.

5.2. Research design

Prior to the design of the research studies it was necessary to reflect upon the methods of investigation that would be most appropriate to both the research problem and the context under examination. Details of the epistemological stance adopted are provided in Appendix E. In this section, the rationale for the general quasi-experimental approach to the research design that was selected is outlined. Then the specific form of the design for studies one and two are discussed.

5.2.1. A quasi-experimental approach to research design

Observations of changes to the physical environment provide researchers with an ideal opportunity to utilise quasi-experimental methodology. In this case, the two phases of the organisation's reconfiguration programme suited two different forms of quasi experiments, studies one and two. The natural variation between and within traditional and reconfigured offices during phase one permitted a comparative quasi-experimental design (study one). The change over time and variation in form of office configuration between phases one and two of the reconfiguration programme allowed the design of a longitudinal quasi-experiment (study two).

Quasi-experiments are similar to traditional experiments in that they involve the study of a change in an Independent Variable (IV) (e.g., the removal of partition walls); however, they occur in field settings and do not require the experimenter to either directly control the manipulation of the IV, nor to randomly assign participants to treatment groups (see, Grant & Wall, 2009, for an extensive description and discussion of quasi-experimental methodology). This means that interventions such as the introduction of open-plan working can be studied opportunistically (M. C. Evans, 1975), that is, without the researcher necessarily having to control how or to whom it is introduced (see, Oldham & Brass, 1979, for an example of a classic open-plan office quasi-experiment). To date the use of quasi-experiments has been one of the great strengths of the literature on the design of workspaces, as the technique provides the opportunity to achieve high levels of external validity and strengthen causal

inferences (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2001). Indeed, as discussed by Grant and Wall (2009) the Hawthorne experiments can be considered one of the earliest exemplars of the quasi-experimental method in use in this particular context.

Quasi experiments have been used effectively throughout a number of I/O psychology domains, with job design benefitting particularly (Holman, Axtell, Sprigg, Totterdell, & Wall, 2010). Despite the strengths of the approach, quasi-experiments have been found to feature in less than 1 percent of the articles published in top tier applied psychology and management journals (Grant & Wall, 2009). Longitudinal quasi-experiments are even less prominent, likely due to the difficulties in collecting data over extended periods (c.f., Holman et al., 2010). However, there has been a consistent call for a greater use of the research design within the field (Campbell & Stanley, 1966; Grant, Fried, Parker, & Frese, 2010). Although the study of the physical work environment does present examples of strong quasi-experimental design (Oldham et al., 1995), the author is unaware of any longitudinal quasi-experiments that have explored contemporary workspace configuration.

Quasi-experimental designs have been successfully employed in a number of studies in this area though. For instance, Oldham (1988) surveyed three open-plan offices of the same company to examine the effects of change. Occupants of the first moved to a new office which incorporated partitions whereas those of the second moved to a new, lower density office. The third office acted as a non-equivalent control (i.e., where no change occurred). Surveys were administered prior to the

office moves and again after occupancy. The quasi-experimental design allowed comparisons to be made between times one and two for all three groups. The findings showed that both the introduction of lower density open-plan workspace and the use of partitions were accompanied by increased perceptions of privacy and environmental satisfaction, together with reduced crowding in office occupants, in comparison to the control group. Workers in the lower density open-plan office also reported increased work satisfaction. An inference of these findings is that the presence of physical screens or a lower density of workers within an open office configuration reduces excessive stimulation from the surrounding environment.

Variations upon quasi-experimental designs have been applied within the workspace literature, including comparative post-occupancy designs (e.g., McElroy & Morrow, 2010) – in effect single time-point quasi-experiments. Comparative post-occupancy designs involve analysis of the effects of a change in configuration or design compared to other offices (offices which have usually either undergone different modifications or no-change) (Oldham et al., 1995). This form of comparative, single time-point, post-occupancy evaluation, allows the researcher to overcome some of the weaknesses inherent in cross-sectional designs. By capitalising upon naturally occurring treatment conditions and controls, causal judgements about IVs and Dependent Variables (DV) are strengthened (Cook & Campbell, 1979; Shadish et al., 2001). It is possible to assess the change that occurs between similar groups of participants subject to differing treatments. Unlike longitudinal quasi-experiments however, it is more difficult to discount whether other

differences between the control and experimental groups are the cause of observed change (McElroy & Morrow, 2010). It is possible to limit this problem by using multiple groups (offices) that have undergone the same treatment, thereby reducing the chance of any observed differences between the treatment and control groups being the work of other third variables (Shadish et al., 2001).

Longitudinal quasi-experiments and single time-point quasi-experiments both offer advantages over other widely employed research designs within the workspace domain. Amongst the myriad of designs, studies have used: cross-sectional single-site post-occupancy surveys, where occupants of an individual office are questioned about their perceptions of their new office environment; and single office pre/post-occupancy surveys, e.g., without a control group (Oldham et al., 1995). These approaches allow the investigator to gain an understanding of occupants' perceptions of their individual offices. However, by their very nature, they do not allow comparisons to either other similar offices, comparisons to alternative designs or objectively over time (Campbell & Stanley, 1963). These designs make it difficult for researchers to access either causality, causal placement, rule out additional third variables or control for same source (or time-point) bias (Breakwell, Hammond, & Fife-Schaw, 1995; Cook & Campbell, 1979; McElroy & Morrow, 2010).

It was decided to use longitudinal and single time-point quasi-experiments in this thesis, given the opportunity that the problem domain offers to use such techniques. Furthermore, the organisation's offices presented a unique opportunity for study due to the relative

standardisation, in terms of corporate appearance, work nature and roles, office size and established open-plan work conditions. These conditions lend themselves well to quasi-experimental study as they permit well matched control or non-equivalent control groups. The benefit that the quasi-experimental approach offers over other traditional research designs is compelling.

5.2.2. Study one design

Study one compares data across ten offices, differing in terms of either higher or lower physical proximity and whether individuals have, or have not, access to break-out areas. The naturally occurring variation in the physical environment across the ten offices results in a 2 x 2 quasi-experimental design (see figure 5.2). This design allows for the interaction of the differing physical environmental configurations (proximity and break-out area) to be assessed together with individual perceptions of control and their reported communication. This design results in a mix of overt, self-reported objective and self-reported psychosocial measures and is discussed in more detail in the subsequent study one method subsection.

5.2.3. Study two design

Study two employs a longitudinal quasi-experimental design to assess the effects of changes in physical proximity, setting density and break-out area, on psychosocial outcomes (crowding, communication

and wellbeing). Three different offices and treatment conditions provide an opportunity to assess the effects of both an increase and decrease in setting density, where physical proximity and break-out areas are unchanged; together with the effects of a simultaneous increase in all three physical variables. The data is collected pre/post intervention, allowing comparisons over time for the same office, as well as between treatment conditions. The physical variables are purely objective assessments of the treatment groups' offices. Outcome variables utilise self-report psychosocial measures. Again, the mix of sources reduces the likelihood of common method variance or other confounding effects (Cook & Campbell, 1979; Grant & Wall, 2009; Holman et al., 2010; Podsakoff & Organ, 1986; Shadish et al., 2001).

5.3. Sample and data collection

This section describes the participant samples and manner of data collection for both studies one and two. The need to conduct matched and unmatched case analysis for study two is articulated followed by an outline of the process to achieve this. Finally, the results of the matched and unmatched analysis are provided.

5.3.1. Study one

An online survey was administered to employees within the UK offices of the organisation (see appendix F for exemplar questionnaire

that contained the study items). The office reconfigurations were organisationally driven and therefore the employees had not been randomly assigned to the high or low proximity groups. An attempt was made to ensure similarity between the workers' roles and the variation in break-out space between the high and low proximity offices. The sample comprises 405 respondents (258 in reconfigured high proximity offices and 147 in the no change, low proximity, offices) with an overall response rate of 27 percent. The sample consists of 82.7 percent males and 17.3 percent females, in line with the gender ratio within the organisation. 21.2 percent of the sample are of managerial level, 60.2 percent of a technical level, and 18.6 percent are administrative or support staff.

5.3.2. Study two

An online survey was administered to employees within the organisation (see appendix F for exemplar questionnaire that contained the study items). The sample comprises 296 respondents (143 at time one and 153 at time two), with 33 (22 percent) matched cases (responses provided at both times one and two). This provided an overall response rate of 29 percent at time one and 28 percent at time two. At time one, the sample consists of 85.3 percent males and 14.7 percent females. 25.2 percent of time one respondents are managerial level, 61.5 percent of a technical level and 13.3 percent are administrative or support staff. At time two, the sample consists of 81.0 percent males and 19.0 percent females. 13.1 percent of time two respondents are

managerial level, 75.2 percent of a technical level and 11.7 percent are administrative or support staff. The distribution of staff between the three offices, over time, is shown in table 5.4.

	Office 1	Office 2	Office 3	Total
Time 1	27	75	41	143
Time 2	43	62	48	153
Total	70	137	89	296

Table 5.4. Study two distribution of sample (number of respondents).

5.3.2.1. Matched and unmatched cases

The initial analysis of the sample gained from times one and two showed a relatively low number of matched responses for the intended analysis (33 cases in total). As a consequence, there were a number of unmatched cases (individuals that only completed questionnaires at either time one or time two), with 110 unmatched cases at time one and 120 at time two. This posed a choice: to analyse only the matched data or to treat the entire dataset as un-related and analyse it separately at times one and two. Either approach would be undesirable. In the first scenario, the small n across the three groups would produce a low statistical power preventing meaningful analysis (J. Cohen, 1988; Tabachnick & Fidell, 2007). The second approach would prevent assessment of the treatment change over time and also reduce the sample size. Instead, a procedure to examine differences between

matched/unmatched cases was followed (described in detail by Leach, Jackson, & Wall, 2001). This was selected as it allows for the most comprehensive analysis of the data, and to capture the effects of the treatment change over time.

Leach, Jackson and Wall (2001) provide a procedure for examining the extent to which matched and unmatched cases differ. If the matched and unmatched cases are shown to be equivalent in nature, then both sets of cases can be combined and treated as one. To calculate the difference between the different sets of scores, combined differences scores were calculated for each of the DVs (crowding, communication and wellbeing). Estimates for the overall difference between the matched and unmatched cases for each variable were then assessed, to see if the responses differed significantly. The steps involved in this analysis are provided below.

The first step involved calculating the difference scores for each of the DVs. This calculation involved subtracting the time two mean from the time one mean, for both the matched (D_p), and unmatched (D_u) cases, for each variable. Expressed algebraically: $D_p = \mu_{p1} - \mu_{p2}$, $D_u = \mu_{u1} - \mu_{u2}$, with μ_{p1} representing time one matched variable means, μ_{p2} representing unmatched, μ_{u1} corresponding to time two matched and μ_{u2} to unmatched variable means.

Next, to reach a combined difference score, Leach, Jackson and Wall's (2001) advise to weight the two difference scores was followed. This ensured that the combined difference scores (D), for each variable, were unbiased and minimised the standard error (S) (and related

variance S^2). To calculate the combined difference scores (D), the matched (D_p) and unmatched (D_u) difference scores were added together, weighted inversely by their variances. This can be represented by: $D = (D_p/S_p^2 + D_u/S_u^2)/(1/S_p^2 + 1/S_u^2)$, with the standard error calculated by using: $S = 1/\sqrt{(1/S_p^2 + 1/S_u^2)}$. In these formulae S_p represents the standard error of D_p , S_u corresponds to the standard error of D_u .

Finally, the t - statistic for the combined difference scores were calculated to assess the significance of any change in the DVs between times one and two. Division of the combined difference score (D), by its standard error (S), produced a t - distribution of $N_p + N_{u1} + N_{u2} - 3d.f$. In this equation, N_p refers to the number of matched cases, N_{u1} to the number of unmatched time one cases and N_{u2} to the number of unmatched time two cases. The statistical significance of the t - statistic reflects whether there is a significant difference between time one and time two scores of the DVs.

The outcome of the analyses demonstrated that for perceptions of crowding, communication and wellbeing, the combined test produced results equivalent to those achieved using separate matched and unmatched tests. The lack of variance between the composite and separate analyses indicated that it would be appropriate to consider the matched and unmatched cases as comparable (Leach et al., 2001). In light of this finding, the matched and unmatched cases were combined to form composite time one and time two groups. This approach allows a larger data set to be retained ensuring adequate statistical power (J. Cohen, 1988), whilst enabling all time one and time two cases to be

considered as related. In the subsequent analysis (chapter seven), all results relate to these composite groups.

5.4. Measures

This section describes the various measures that were utilised within both studies one and two. First, the techniques used to measure the physical environment are detailed, together with the rationale for the operationalisations selected. Second, the perceptual measures employed are detailed, together with a rationale for their use and their scale reliability.

5.4.1. Physical environment

The nature of office reconfigurations or redesigns means that investigators are able to design their studies around observable changes to the environment that may simultaneously affect multiple groups of individuals. The opportunity to measure overt aspects of the environment enables increased validity and confidence in the IVs (e.g., Breakwell et al., 1995). It also reduces the chances of common method variance (Podsakoff & Organ, 1986) posing problems with the study design, as it provides independently observed data which can be used to complement self-report psychosocial or organisational forms of data (Mertens, 1998). Within the two studies, three physical variables have been measured,

namely, break-out areas, setting density and physical proximity. The operationalisation and measurement of these will be discussed in turn.

5.4.1.1. Break-out areas

There has been a lack of explicit definition or operationalisation of key contemporary office concepts, including break-out areas. Limited operational specificity has been found not only within the organisational (or behavioural) literatures, but also across architectural and design domains (Danielsson & Bodin, 2008). Although these latter disciplines discuss the concept of contemporary offices in greater depth and frequency than the former (e.g., McElroy & Morrow, 2010), specific definitions of individual design options have not been well articulated. To counter this, a specific definition of “break-out area” has been developed for use within the two studies in this thesis (as touched upon in the previous chapter). This definition was achieved through the review of previous studies that have explored the effects of break-out areas (McElroy & Morrow, 2010; Peterson & Beard, 2004; Pugsley & Haynes, 2002) and theoretical discussion of their role within contemporary offices (T. J. Allen & Henn, 2007; Becker, 2007; Becker & Steele, 1995; J. K. Chan et al., 2007; Duffy, 1997; Gillen, 2006; Laing, 2006; Laing et al., 1998; Price, 2007; Turner & Myerson, 1998). Further inspection of case studies and showcases of contemporary offices (e.g., T. Allen et al., 2004; Gannon, 2006; McLaren, 2006; Littlefield, 2009; Marberry, 2004) aided the interpretation of what constitutes a break-out area.

Consequently, *break-out areas* are defined as:

1. Informal meeting spaces, often including comfortable seating, tables, sofas or café style furniture.
2. Typically non-reservable, designed to be used “as and when”.
3. Positioned close to employees’ primary workspace (i.e., desks).
4. Located within the main office – not in a separate room (this would more likely be a team room or traditional meeting room) or a single central location in the building (such as larger social areas, e.g., café or hub).

5.4.1.1.1. Study one

Access to a break-out area was assessed by asking respondents “Does your team's workspace include a break-out area (e.g. an area that can be used for informal or spontaneous meetings or chats)?”. This item required individuals to report “yes” or “no”. In this context teams referred to large functional units in which individuals were located. It was decided to use a self-report item to measure access to a break-out area as this allowed individual level data as to break-out space provision. This self-report item was regarded as being clear and unambiguous without obvious demand characteristics (Weber & Cook, 1972). Self-report measures of the physical environment have been used in past studies (e.g., Fried, 1990; E. Sundstrom et al., 1980). The overt nature of the physical environment has been suggested as a factor that should lead to high concordance between external and perceptual measures of such factors, as has been found in similar areas such as job design (Fried, 1990). To further validate this measure, the general pattern of results

within each office was inspected, specifically the proportion of break-out area per person was calculated. To calculate this, the computer aided design (CAD) office plans for each of the examined offices were obtained from the organisation. The architectural CAD programme, ArchiCad 15, was then used to measure the total area of each office that constituted break-out areas. This total break-out area was then divided by the number of office occupants to arrive at a value of break-out area per person (in m²). Respondents in offices with higher amounts of break-out space reported greater access to break-out areas. The level of break-out space varied amongst the higher and lower proximity offices, with higher proximity offices containing between 0.1 – 0.7 m²/person and lower proximity offices containing 0.0 – 0.4 m²/person. The overt observation of the proportion of break-out space provided only an overall office measure of break-out space however, whereas the self report data delivered individual level data. For this reason the individual reports of access to break-out space were chosen to be included in study one.

5.4.1.1.2. Study two

Break-out provision was measured at the office level. The total area of break-out space was calculated using the CAD drawings for each office and the method described previously. The break out area provision (m²/person) for each office is provided in table 5.5.

Office	Time 1	Time 2
A	0.4m ² /person	0.8m ² /person
B	0.2m ² /person	0.2m ² /person
C	0.0m ² /person	0.0m ² /person

Table 5.5. Study two break-out area provision, per office.

5.4.1.2. Density

Two different operationalisations of density have previously been discussed in chapter three, namely *setting density* and *spatial density*. Setting density has been the most commonly used by researchers and has been operationalised as the number of employees within an office divided by the total area (Oldham et al., 1995). The alternative form, spatial density, refers instead to the number of employees within a given distance (E. Sundstrom et al., 1980). It was decided to utilise setting density as the measurement of density in the current studies for two reasons. The first was to allow comparison to a greater number of prior studies, aiding interpretation of results and enhancing the potential impact. Secondly, setting density directly relates to the “net area per person”, an industry standard for the measurement of office density (Offices, 2009a). The net area per person is calculated by dividing the Net Internal Area (NIA) of an office by the number of occupants. NIA is, again, an industry standard, referring to the total internal area of an office (excluding unusable areas such as toilets, stairways, plant rooms, or

entrance halls) (Valuation Office Agency, 2011). Basing the academic operationalisation of density on an industry wide standard enables consideration of industry gathered data (e.g., Offices, 2009b). Conversely, it also provides face validity and increases the likelihood of the industry and organisations being able to appreciate the studies' findings. Adoption of the net area per person operationalisation of density also allows a clear and consistent measure to be introduced to other researchers.

Previous studies that have explored the effects of density and explicitly employed a measure of setting density have been inconsistent, or vague, in their method of calculation. For example, May, Oldham and Rathert (2005) excluded areas covered by furniture from their measurement of available space for employees. Sutton and Rafaeli (1987) specified the whole office as making up the usable area in their density operationalisation. Meanwhile, Oldham (1988) explicitly used a measure of spatial density, referring to the amount of space available per employee, but did not specify what constitutes this office space. Consequently, standardised use of a well defined and understood industry standard for measuring workspace density, such as net area per person, will greatly aid researchers in this area.

5.4.1.2.1. Study one

Setting density was measured by again examining the office CAD plans. For both studies one and two, ArchiCad 15 was used to calculate the NIA for each of the examined offices. The NIA was then

divided by the number of occupants in each of the respective offices, providing a measure of the net area per person (in m^2). Offices were found to vary between setting densities of 8.1 and 11.1 m^2 /person. The higher and lower proximity offices were both distributed amongst this range and therefore setting density was not utilised as a variable within study one.

5.4.1.2.2. Study two

Setting density was calculated for each of the three offices at times one and two, in line with the previously described method. The setting densities (m^2 /person) for each of the offices are provided in table 5.4.

Office	Time 1	Time 2
A	9.0 m^2 /person	7.9 m^2 /person
B	9.2 m^2 /person	7.2 m^2 /person
C	8.1 m^2 /person	9.0 m^2 /person

Table 5.6. Study two setting density, per office.

5.4.1.3. Physical proximity

Interpersonal distance or physical proximity has been defined as the distance between a person and their nearest co-worker (Paulus, 1980; E. Sundstrom et al., 1980). Oldham and Fried (1987) and Sundstrom, Burt and Kamp (1980) both operationalised interpersonal distance as the distance between the centre of an individual's desk and

the centre of their nearest co-worker's desk. These two studies measured physical proximity on an individual basis, requiring named and matched responses between the physical environment and questionnaires. This approach is difficult when dealing with large numbers of participants and when the organisation requires anonymity of response. Roberts, Hulin and Rousseau (1978) argue that when individuals within a study all experience the same macro-variable, then it is legitimate to assign them the same value. In this case the occupants can be considered to experience largely the same physical proximity to co-workers. Occupants are seated at identical desks, in uniform rows and layouts. The result is that individuals are seated the same distance away from their nearest co-worker, as their desks are adjacent to at least one other individual (most are mid row and therefore have co-workers on either side). By the definition of physical proximity, the regimented nature of the office environments in this research results in near identical distances to the nearest co-worker.

5.4.1.3.1 Measurement

The method of measurement for physical proximity was identical in both study one and study two. Physical proximity was calculated by measuring the typical distance between the midpoints of two adjacent desks, in the reconfigured and traditional offices, using ArchiCad 15 and the CAD office plans. This produced a distance, in cm, between adjacent individuals for both groups. Individuals were then allocated to either of these groups based upon their office coding. Respondents were asked to

select the office in which they worked from a predefined list (this was corroborated utilising tracking of the online survey). The office locations were then coded as to whether they had undergone the corporate reconfiguration program and consequently whether they were higher or lower physical proximity. The reconfiguration resulted in individuals being 20 cm closer to each adjacently seated co-worker. The procedure for determining higher or lower physical proximity offices was the same in both studies.

5.4.2. Psychosocial measures

5.4.2.1. Autonomy

Study one included autonomy as a perceptual variable. Autonomy was measured using a six item measure developed to examine job level autonomy by Jackson, Wall, Martin and David (1993). This measure has been used extensively in I/O psychology and organisational behaviour studies examining aspects of work design and related issues (e.g., Axtell et al., 2000; Holman et al., 2010; Ohly & Fritz, 2010; Parker, 1998; Parker, Wall, & Jackson, 1997). The six items included "Can you vary how you do your work?" and "Can you decide how to go about getting your work done?". Items were measured on a five-point likert scale. The measure demonstrated high internal reliability (Cronbach's $\alpha=0.84$).

5.4.2.2. Communication

Both studies one and two included communication as an outcome variable. Perceptions of office communication have not been measured in a standardised way in previous studies, with a number of different items used (e.g., Huang et al., 2004; Lee & Brand, 2005; O'Neill, 1994; Oldham, 1988; E. Sundstrom et al., 1982). Past studies have relied upon single items (e.g., Huang et al., 2004) or have not conceptually isolated solely communication (Oldham, 1988). It was decided to use a robustly developed two-item measure of communication (O'Neill, 1994) that was designed to explicitly relate to internal office communication. These items were complemented by an item published by Lee and Brand (2005) which relates more directly to modern offices. These three-items were: "The office environment allows to me to communicate effectively with others"; "How satisfied are you with your ability to communicate with others in your workspace?"; and "I can hold small, impromptu meetings in my office or work area as needed". The items were measured on a five-point likert scale. The measure demonstrated good internal reliability in study one (Cronbach's $\alpha=0.74$). In study two the measure again demonstrated good internal reliability (time one Cronbach's $\alpha=0.70$, time two Cronbach's $\alpha=0.78$).

5.4.2.3. Crowding

Study two included perceived crowding as an outcome variable. A well defined and developed measure of workplace office crowding, by Oldham (1988) was selected. This three-item measure clearly and

directly taps individual perceptions of crowding and has been successfully used in later workplace studies (e.g., May et al., 2005). Three items measured perceptions of office crowding (taken from Oldham, 1988), these were: "I often feel 'crowded' while at work", "my office does not have enough space for the number of employees currently working in it" and "individual workstations are located too close to one another". All items were measured on a five-point likert scale. The measure produced strong internal reliability (time one Cronbach's $\alpha=0.81$, time two Cronbach's $\alpha=0.82$).

5.4.2.4. Wellbeing

Study two included affective wellbeing as an outcome variable. Wellbeing was measured using Warr's (1990) shortened depression-enthusiasm scale. Warr's (1990) measure of job wellbeing has been widely applied throughout organisational psychology, organisational behaviour and occupational health literatures (e.g., Daniels & Guppy, 1994; Holman et al., 2010; Mäkikangas, Hyvönen, Leskinen, Kinnunen, & Feldt, 2011; Parker, Williams, & Turner, 2006; Sonnentag, 2001) and has demonstrated consistently high validity. Three items examined participants' wellbeing, with items measuring the depression-enthusiasm continuum (taken from Warr, 1990). Respondents were asked to indicate the extent to which their job, over the past month, had made them feel: "miserable", "depressed" and "gloomy". The items were measured on a five-point likert scale. The measure showed strong internal reliability (time one Cronbach's $\alpha=0.83$, time two Cronbach's $\alpha=0.91$).

5.5. Summary

Two studies, based upon quasi-experimental methodology, were designed to explore the effects of contemporary office environments on workers. The studies utilise objective measures of the physical environment, in addition to psychosocial measures. Specifically, study one employs a 2 x 2, single time-point design, examining the effects of higher or lower proximity conditions and access, or not, to break-out areas. The use of psychosocial measures allows the relationships between the environmental variables, autonomy and communication to be explored. Study two is a longitudinal pre-post intervention study, examining three different treatment groups. One group experienced a simultaneous increase in physical proximity, setting density and break-out areas. Another experienced solely an increase in setting density and a third experienced only a reduction in setting density. All measures of the physical environment were based upon objective measurements. Psychosocial measures of crowding, communication and wellbeing were administered to participants to understand the effects of the variations in office configuration. The effects of the treatment conditions were designed to be assessed by comparing pre/post intervention scores and comparing between treatment groups. The analysis procedures and results will be described and discussed in the following two chapters.

6. Study One Analysis and Results

6.1. Introduction

This chapter presents the findings from study one. A comparative quasi-experimental design was utilised to examine the effects of an increase in physical proximity (achieved via an office reconfiguration programme) and varying provision of access to break-out areas across ten offices. The provision of informal meeting space, differences in physical proximity and individual control on reported office communication was evaluated. It was expected that the nature of contemporary work environments and knowledge working would be inter-related. To test for inter-relationships, analyses were performed to look for interactive effects between the workspace variables and autonomy in predicting communication. It was expected that access to break-out areas and closer proximity to co-workers will be beneficial to knowledge workers, in particular those with higher levels of autonomy (see pages 92 – 98 for detailed hypotheses and discussion).

In this chapter the distribution of responses across the varying physical office configurations will be presented, demonstrating the balanced comparative nature of the current study. Then the correlations between the IVs and communication will be reported, providing support for further, more advanced analysis of the data. Subsequently, the results of the moderated multiple regression (MMR) will be described. The MMR were conducted in line with accepted procedures (Arnold &

Evans, 1979; Dawson & Richter, 2006; M. G. Evans, 1991) and highly appropriate for testing complex interactions, particularly in this domain (e.g., Fried et al., 2001). This form of regression analysis allows the direct and interactive effects to be jointly assessed (Tabachnick & Fidell, 2007; Wall & Jackson, 1996). Following the identification of a significant three-way interaction, a graph combining slopes for each of the groups involved is presented. To aid understanding of the interaction, the differences between these groups is then tested using slopes difference tests (Dawson & Richter, 2006). First, however, a summary of the variables used in this study is presented.

6.2. Measures

Five constructs are utilised in study one and are detailed in table

6.1 below (described in detail in the previous chapter):

Construct	Items	Source	Cronbach's α
Proximity	Coded by office location	Observed	N/A
Break-out space	Dichotomous objective question	Original	N/A
Autonomy	Six items, five point likert scale	Jackson, Wall, Martin and David (1993)	0.839
Communication	Three items, five point likert scale	O'Neill (1994), Lee and Brand, (2005)	0.736
Role	Three categorical classifications	Original	N/A

Table 6.1. Study one measures.

6.3. Preliminary findings

To check for common method variance Harman's ex-post single factor test was used (Podsakoff & Organ, 1986). The test failed to find any single uncorrelated latent variable that significantly explained the covariance amongst the study items. The findings suggest that common

method variance is not an issue in this study (Noblet, Rodwell, & McWilliams, 2006). Zero order correlations (see table 6.2) demonstrate that neither access to a break-out area nor proximity is significantly correlated with autonomy and proximity is not significantly correlated with communication. Relationships between break-out areas, autonomy and communication are weak to moderate. Access to a break-out area is positively related to communication ($r = 0.25, p < 0.05$). Autonomy is significantly positively correlated with communication ($r = 0.18, p < 0.05$). Gender and job role (both dummy coded) were also included in the analysis. Gender was not found to relate to any of the research variables, whereas job role correlated with autonomy and communication (e.g., managers reported higher levels of autonomy and communication than technical and administrative/support employees), indicating that job role should be controlled for in the main analyses.

6.4. Moderated multiple regression

To test more extensively the direct and interactive effects of break-out areas, physical proximity and autonomy on office communication, MMR analyses were undertaken. MMR can be used to test for interaction effects through the joint analysis of both direct and cross-product terms (in this case two and three-way interactions) (Wall & Jackson, 1996). The interaction effects are tested based upon the incremental additional variance explained by each of the cross-product terms, over that which is attributable to the direct terms (e.g., Dawson &

Richter, 2006; Parker & Sprigg, 1999; Wall & Jackson, 1996) – essentially the significance of the ΔR^2 (%) is examined once the two-way terms and then the three-way terms have been entered into the regression analysis.

Variables	X	S.D.	1	2	3	4	5	6	7	8
1. Gender	0.83	0.38	--	0.13*	0.23**	-0.42**	0.04	-0.17**	0.03	-0.01
2. Managerial	0.21	0.41		--	-0.64**	-0.25**	-0.04	-0.01	0.17**	0.06
3. Technical	0.60	0.49			--	-0.59**	-0.08	-0.00	-0.11*	0.04
4. Admin/Support	0.19	0.39				--	0.14**	0.01	-0.03	-0.11*
5. Break-out Area	0.63	0.48					--	0.14**	0.04	0.25**
6. Proximity	0.64	0.48						--	0.02	-0.02
7. Autonomy	3.60	0.72							--	0.18**
8. Communication	3.62	0.87								--

$N = 405$, * $p < 0.05$, ** $p < 0.01$

Table 6.2. Study one means, standard deviations and intercorrelations amongst all variables.

Prior to this, all of the continuous variables were centred, in line with recommended procedures for conducting moderated regression (Aiken & West, 1991). In regard to job role (dummy coded), managers represented the reference group (J. Cohen, Cohen, West, & Aiken, 2003). The regression analyses were run in four steps, in accordance with the recommended procedure for this test (e.g., Arnold & Evans, 1979; Dawson & Richter, 2006). The control variable (job role) was entered at Step One, the main effects (access to a break-out area, proximity and autonomy) at Step Two, then the two-way interaction terms (the cross-products of the independent variables) at Step Three, and finally the three-way interaction term (the product of all the independent variables) at Step Four. One-tailed tests of significance were used to test the various direct and interactive effects as the direction of the hypotheses had been stated priori. The results are summarised in table 6.3.

The job role variables entered at Step One account for 1.4 percent of the variance in office communication, with administrative/support staff reporting significantly less communication than managerial colleagues at all steps of the analysis.

6.4.1. Direct effects

The main effects terms at Step Two account for an additional 9.2 percent of the variance in office communication scores. In particular, access to break-out areas and autonomy, each relate significantly and positively to communication. These findings confirm the previous correlation results and

support hypotheses one and four. Thus, individuals who report being able to access a break-out area report significantly higher communication than colleagues without such access. Furthermore, workers reporting higher levels of autonomy also reported increased levels of communication, compared to lower autonomy individuals. These relationships hold after controlling for job type. The relationship between proximity and communication is non-significant, contrary to hypothesis two.

IV's B	Model 1	Model 2	Model 3	Model 4
Technical	-0.076	-0.015	-0.012	0.017
Admin/Support	-0.307**	-0.239*	-0.235*	-0.217
Break-out (a)		0.445***	0.464***	0.473***
Proximity (b)		-0.085	-0.069	-0.057
Autonomy (c)		0.206***	0.114	-0.014
a*b			-0.022	-0.025
a*c			0.052	0.330*
b*c			0.103	0.391**
a*b*c				-0.503**
R² (%)	1.4*	10.6**	10.9	11.8*
Δ R² (%)	1.4*	9.2**	0.3	1.0*

Controlling for Job Role

N = 405

**p*<0.10, two-tailed

***p*<0.05, two-tailed

****p*<0.01, two-tailed

Table 6.3. Study one moderated multiple regression analysis summary.

6.4.2. Interactive effects

The three-way interaction term, entered at Step Four, explains an additional 1 percent of the variance in communication scores. This finding supports hypothesis five, indicating a significant interaction between the three IVs and communication. Thus, as predicted, access to a break-out area, physical proximity and autonomy, interact to jointly predict level of communication. To better understand the nature of the three-way interaction, four break-out–autonomy groups were created (with cut-offs at +/- one standard deviation from the mean) and one communication–proximity slope was plotted per group (Aiken & West, 1991) using Dawson's Excel worksheet (Dawson & Richter, 2006). The slopes are plotted graphically in figure 6.1. The differences between the slopes were then examined following recently adopted good practice (e.g., Perry, Witt, Penney, & Atwater, 2010) and employing Dawson and Richter's (2006) test of slope difference. Essentially this test calculates the differences between each of the four regression slopes (created for the graphical plot) and the standard error for each of the differences of each pair of regression slopes. To assess which pairs of slope differ significantly from one another, the difference between each pair is divided by its corresponding standard error (Dawson & Richter, 2006). The statistical significance of these differences are then subject to Bonferonni adjustment, indicating which pairs of slopes differ using conservative estimates. The slopes difference tests are reported in table 6.4.

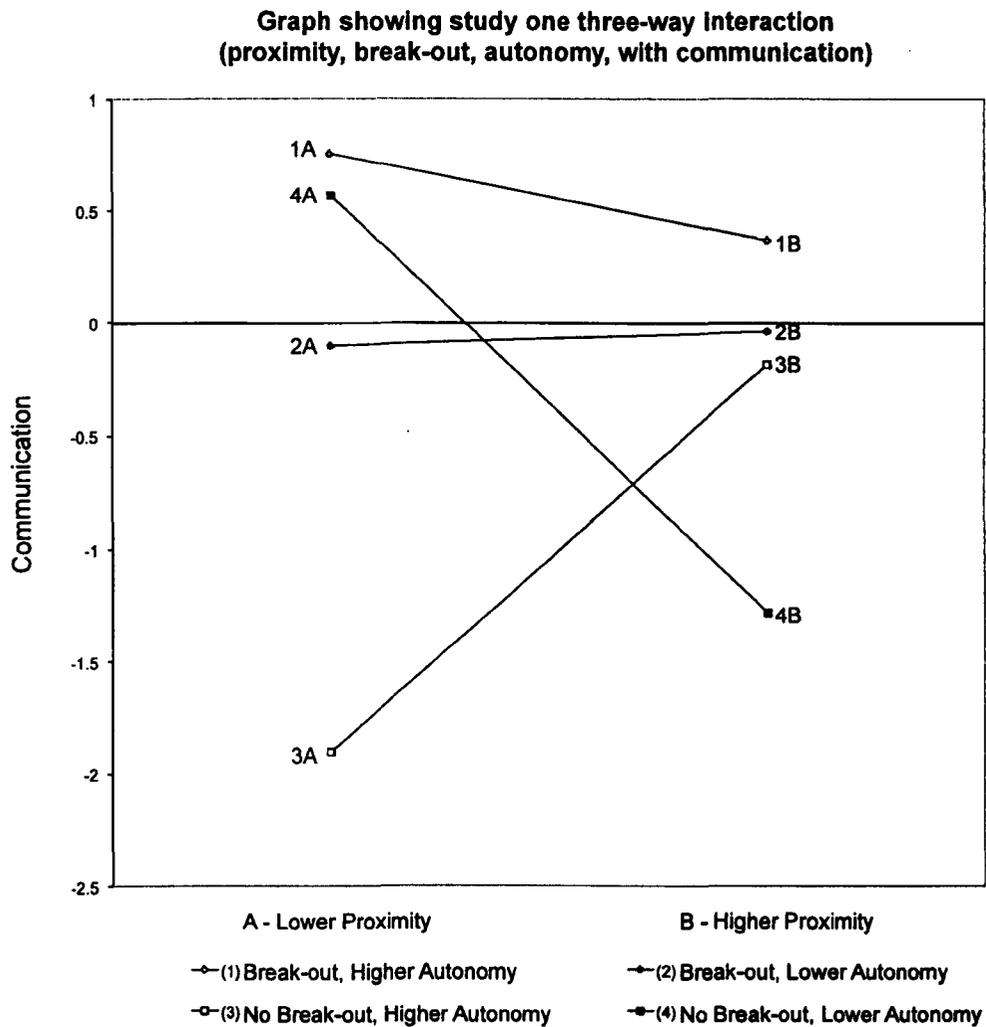


Figure 6.1. Study one: Three-way interaction between proximity, break-out and autonomy, with communication.

The difference between the no break-out, higher autonomy (see slope 3) and the no break-out, lower autonomy slopes (see slope 4) were found to be significantly different ($t=2.235$, $p<0.05$), suggesting highly contrasting effects of higher proximity for these groups. No break-out, higher autonomy groups report higher levels of communication in higher proximity conditions, compared to individuals in lower proximity conditions

(see slope 3, figure 6.2). Thus greater physical proximity may potentially overcome a lack of informal meeting space for these particular individuals. Conversely, the no break-out, lower autonomy groups report reduced communication under higher proximity conditions (see slope 4).

Contrary to our expectation, proximity did not produce a marked difference between the communication scores of individuals with access to break-out areas and higher autonomy (see slope 1). Both groups of workers reported relatively high levels of communication, supporting the arguments that workers with access to break-out areas and autonomy are well placed to exploit these areas (Duffy, 1997) and to regulate interactions around their desk areas (Brennan et al., 2002). The relationship between proximity and communication was also non-significant for individuals with access to a break-out area and lower autonomy (see slope 2).

Against our earlier prediction, the higher autonomy, lower proximity and access to break-out area group (see group 1A) reported the greatest levels of communication, above that reported by the higher proximity group (see group 1B). The higher autonomy, higher proximity and without access to break-out area group (see group 3B) reported moderate communication, as anticipated. A further interesting finding concerns individuals in the lower proximity group who had little access to break-out areas and lower autonomy (see group 4A). They report communication equivalent to those individuals with access to break-out areas, higher autonomy and higher proximity (see group 1B). These findings will be explored further in the discussion section.

Slope Difference	t
1 (High Break-out, High Autonomy) and 2 (High Break-out, Low Autonomy)	-0.723
1 (High Break-out, High Autonomy) and 3 (Low Break-out, High Autonomy)	-1.750
1 (High Break-out, High Autonomy) and 4 (Low Break-out, Low Autonomy)	1.458
2 (High Break-out, Low Autonomy) and 3 (Low Break-out, High Autonomy)	-1.607
2 (High Break-out, Low Autonomy) and 4 (Low Break-out, Low Autonomy)	1.585
3 (Low Break-out, High Autonomy) and 4 (Low Break-out, Low Autonomy)	2.235*

Note. Group numbers correspond with groups listed in figure 6.1. Slope difference tests calculated with Dawson and Richter's (2006) recommendations.

* $p < .05$.

Table 6.4. Study one tests of slope difference summary.

6.5. Summary

The statistical analysis of study one data has found support for a number of the stated hypotheses. Break-out areas were found to positively relate strongly, and significantly, with communication, providing support for hypothesis one. Contrary to hypothesis two, physical proximity was not found to significantly relate to communication. Support was found for hypothesis three, with autonomy positively relating significantly with communication. Hypothesis four was generally supported, with a three-way interaction between break-out space, proximity and autonomy with communication identified. However, the form of the interaction differs from

that which was specified a priori. The implications of these findings for both research and practice are discussed and expanded upon in the later discussion chapter. Specifically, the support for the inter-related nature of the relationships between knowledge workers, contemporary office configurations and communication is examined further. In addition, the positive direct effects of break-out space and higher autonomy on communication are discussed. The possible reasons for the stark differences in communication experienced by workers without access to break-out areas in differing proximity and autonomy groups are also discussed.

7. Study Two Analysis and Results

7.1. Introduction

This chapter presents the findings from study two. The second study evaluated the effects of differing forms and implementation of a corporate office re-configuration programme. A longitudinal quasi-experimental design was utilised to explore the effects of increases in physical proximity, setting density and break-out space. Study two examines the effects of changes in break-out space, physical proximity and setting density on office perceptions of crowding, communication and wellbeing.

Data were collected from three experimental groups, at two time points, approximately 20 months apart. Occupants of office A experienced a simultaneous increase in physical proximity, setting density and break-out space (see table 7.1 below). Staff housed in office B experienced an increase in only setting density and those in office C experienced solely a decrease in setting density.

	Office A	Office B	Office C
Setting Density	Increase (1.1m ² less per person)	Increase (1.5m ² less per person)	Decrease (0.9m ² more per person)
Physical Proximity	Increase (20cm closer to nearest co-worker)	No Change	No Change
Break-out Area	Increase (0.4m ² more per person)	No Change	No Change

Table 7.1. Study two configuration changes between times one and two.

In this chapter the results of a FA using Principal Component Analysis (PCA) are presented. The FA is used to explore the independence of the theoretical constructs under examination (Todman & Dugard, 2007). Then, an overview of the distribution of the sample is provided, across the three office conditions and over time. Next, details of the zero order statistics are provided. The chapter then reports the analysis of the effects of the treatment conditions on the three outcome variables (perceptions of crowding, office communication and wellbeing): two-way ANOVAs are performed to establish any direct and interactive effects of the IVs on the DVs, then, to provide a finer grained picture of the form of the identified relationships, sub group analysis is employed, utilising one-way ANOVAs. This set of procedures is well established and suited to investigating the effects of quasi-experiments (Clegg, Wall, & Kemp, 1987). Finally, the results of a set of ANOVA and ANCOVA analyses are reported. This

analysis is utilised to test for the mediating role of crowding. The analysis is based upon the widely applied causal steps process (R. M. Baron & Kenny, 1986; James & Brett, 1984). Discussion is also given to the additional extensions to this procedure that could be implemented in future studies. To begin with, a review of the variables used in this research phase are provided (see table 7.2 below).

7.2. Measures

Six constructs are utilised in study one (discussed in pages 123 - 133), detailed in table 7.2. overleaf:

Construct	Items	Source	Cronbach's α
Physical Proximity	Coded by office location	Observed (typical distance between adjacent colleagues)	N/A
Setting Density	Coded by office location	Observed (average m ² /person of overall office space)	N/A
Break-out space	Coded by office location	Observed (average m ² /person of break-out space)	N/A
Crowding	Three items, five point likert scale	Oldham (1988)	0.81 T1 0.82 T2
Communication	Three items, five point likert scale	O'Neill (1994), Lee and Brand, (2005)	0.70 T1 0.78 T2
Wellbeing	Three items, five point likert scale	Warr (1990)	0.83 T1 0.91 T2
Role	Three categorical classifications	Original	N/A

Table 7.2. Study two measures.

7.3. Factor analysis

Similarly to study one, Harman's ex-post single factor test was employed to check for common method variance (Podsakoff & Organ, 1986). No single uncorrelated latent variable was found to significantly explain the covariance amongst the items, suggesting that there is not a substantial amount of common method variance (Noblet et al, 2006). A FA was also performed to examine whether the individual items corresponded to their theoretical constructs (Tabachnick & Fidell, 2007). The author is not aware of the research variables having been combined together before. Factor analysis allows a judgement to be made regarding the degree to which items group together and can be explained by distinct latent variables (Todman & Dugard, 2007).

The nine research items were subjected to PCA. The correlation matrix showed a number of coefficients above the 0.30 threshold. The Kaiser-Meyer-Okin value was 0.77, above the recommended minimum value (Tabachnick & Fidell, 2007), and Bartlett's Test of Sphericity was statistically significant. These findings demonstrate data suitability for PCA.

PCA results showed three components emerged, each with Eigen values greater than one. The components explained 38.6 percent, 23.7 percent and 11.9 percent of the total variance respectively. Visual inspection of the screeplot suggested a distinct break after component three, with the gradient of the plot altering significantly. The three component solution explained 74.3 percent of the total variance.

To help understand item loadings onto components, an oblimin rotation was employed. The newly rotated solution showed strong, clearly defined loadings, along the theorised lines. The crowding items were found to load strongly onto component one, the wellbeing items onto component two and the communication items onto the third (see table 7.3).

Item	Pattern Coefficients Component:			Structure Coefficients Component:			Communalities
	1	2	3	1	2	3	
CRWD1	0.875	0.006	0.006	0.873	0.081	-0.378	0.762
CRWD3	0.869	0.009	0.049	0.848	0.072	-0.333	0.721
CRWD2	0.809	-0.001	-0.081	0.845	0.089	-0.435	0.719
WELL2	-0.038	0.907	0.027	0.029	0.897	-0.185	0.807
WELL1	-0.025	0.891	-0.029	0.065	0.896	-0.243	0.804
WELL3	0.086	0.863	-0.021	0.170	0.876	-0.276	0.776
COMM1	0.090	-0.090	0.911	-0.317	-0.312	0.894	0.814
COMM2	-0.072	-0.129	0.767	-0.419	-0.328	0.832	0.711
COMM3	-0.058	0.147	0.752	-0.374	-0.047	0.740	0.572

Note. CRWD – crowding, WELL – Wellbeing, COMM – communication.

Major loadings for each item are bolded.

Table 7.3. Study two pattern and structure matrix with oblimin rotation of three-factor solution for measure items.

7.4. Sample distribution

The preliminary findings show that the sample contained a balanced distribution between times one and two; the office subsamples were weighted towards office B, but were all of sufficient size for the intended analysis (Tabachnick & Fidell, 2007) (see table 7.4, below).

	Office A	Office B	Office C	Total
Time 1	27	75	41	143
Time 2	43	62	48	153
Total	70	137	89	196

Table 7.4. Study two distribution of sample (number of respondents).

7.5. Correlations

Bivariate correlations for the research variables at both times one and two are shown in table 7.5 below. Zero order relationships demonstrate that crowding (*mean*=3.25, *S.D.*=1.12, *mean*=3.66, *S.D.*=1.08, times one and two respectively) was significantly correlated with communication (*mean*=3.53, *S.D.*=0.84, *mean*=3.41, *S.D.*=1.02) at both time one ($r = -0.46$, $p < 0.01$) and time two ($r = -0.45$, $p < 0.01$). The consistently strong relationship supports hypothesis nine, suggesting that increased perceptions of crowding are related to lower levels of office communication. Communication was significantly negatively correlated with wellbeing (*mean*=1.95, *S.D.*=0.77, *mean*=1.97, *S.D.*=0.91) at time one ($r = -0.18$,

$p < 0.05$) and time two ($r = -0.35$, $p < 0.01$). The relationship between communication and wellbeing was weak to moderate at time one and two respectively. This finding implies that higher levels of enthusiasm are associated with higher levels of office communication. In sample one administrators were negatively correlated with sex ($r = -0.36$, $p < 0.01$) supporting the observation that in this subsample administrators were more likely to be female. A weak negative correlation between sex and communication ($r = -0.19$, $p < 0.05$) at time one, suggests that women reported slightly reduced communication scores in comparison to men.¹

¹ The main analyses were run with and without gender controlled for. The pattern and nature of the results did not differ between the two sets of analyses. As the correlation between gender and communication was only present at time one, and was relatively weak, the analyses reported in this thesis did not control for gender. This was deemed most appropriate given the sample size and desire to maintain statistical power (c.f., Tabachnick & Fidell, 2007).

Variable	1	2	3	4	5	6	7
1. Sex	-	0.14	0.22**	-0.45	0.13	-0.04	-0.05
		N=153	N=153	N=153	N=151	N=153	N=143
2. Manager	0.10	-	-0.68**	-0.14	0.03	0.04	-0.02
	N=143		N=153	N=153	N=151	N=153	N=143
3. Technical	0.16	-0.73**	-	-0.64**	-0.02	-0.11	0.04
	N=143	N=143		N=153	N=151	N=153	N=143
4. Administration/ Support	-0.36**	-0.23**	-0.50**	-	0.00	0.11	-0.03
	N=143	N=143	N=143		N=151	N=153	N=143
5. Crowding	-0.16	-0.13	0.02	0.14	-	-0.45**	0.10
	N=143	N=143	N=143	N=143		N=151	N=143
6. Communication	-0.19*	0.11	-0.08	-0.03	-0.46**	-	-0.35**
	N=143	N=143	N=143	N=143	N=143		N=143
7. Wellbeing	0.09	-0.07	0.16	-0.15	0.12	-0.18*	-
	N=143	N=143	N=143	N=143	N=143	N=143	

Note – Correlations below the diagonal, time one. Correlations above the diagonal, time two.

*. Correlation significant at the 0.05 level (2-tailed).

**. Correlation significant at the 0.01 level (2-tailed).

Table 7.5. Study two correlation table.

7.6. Analysis of variance

To investigate the effects of the treatment groups, a series of ANOVAs were conducted. Two types of analysis were performed. First, three two-way between groups ANOVAs were run to explore the effects of the treatment conditions over time (variations in physical proximity, setting density and break-out space), on each of the DVs (crowding, communication and wellbeing). In line with previous research, a conservative approach to hypothesis testing is adopted and a Bonferroni adjustment is applied to the two-way ANOVAs (Zhou et al., 1998). A Bonferroni correction allows the researcher to maintain a Type I error value of 0.05 (J. Cohen & Cohen, 1983). Second, one-way ANOVAs were performed to provide subgroup analysis of identified interaction effects.

7.6.1. Crowding

A moderate to large (partial eta squared=0.08) interaction effect (J. Cohen, 1988) between time and office group with perceptions of crowding was identified, $F_{(2, 288)}=12.67$, $p>0.01$ (see figure 7.1). Significant main effects were also established. Office location, $F_{(2, 288)}=5.89$, $p>0.01$ (partial eta squared=0.04), and time, $F_{(1, 288)}=18.58$, $p>0.01$ (partial eta squared=0.06), were significantly related to perceptions of crowding. Post-hoc comparisons using the Tukey HSD test suggested that only offices B ($M=3.64$, $SD=1.03$) and C ($M = 3.22$, $SD = 1.15$) differed significantly from one another.

These findings support hypothesis seven, that an increase in setting density will be associated with increased perceptions of crowding amongst office occupants. Both offices A and B, which experienced setting density increases, reported statistically significant increased perceptions of crowding. Counterparts housed in office C, which had experienced a small reduction in density, reported slightly lower perceptions of crowding at time two than time one, however this change was not statistically significant. The magnitude of change in office A's crowding scores between times one and two contradicts hypothesis eight. This finding suggests that an increase in break-out space does not trade-off an increase in density and proximity. Interestingly, a gradual introduction of increased setting density (as in office B) was associated with less reported crowding than the office incorporating increased break-out space (office A). The identified moderate main effect between time and crowding adds further support to proposition seven, demonstrating that a significant change in perceptions of crowding did occur between times one and two, as predicted. A main effect was also identified between office group and crowding, with the Tukey HSD test suggesting a significant difference between offices B and C. This finding is based upon the average of times one and two for each office and therefore does not allow analysis of the stepped changes in office configuration.



Figure 7.1. Study two: Perceived crowding by office over time.

7.6.2 Communication

A moderate to small (partial eta squared=0.03) interaction effect between time and office group with reported communication was established, $F_{(2, 290)}=4.11$, $p=0.017$ (see figure 7.2). No significant main effects were identified. Post-hoc comparisons using the Tukey HSD test suggested that only offices A ($M=3.23$, $SD=1.01$) and B ($M=3.60$, $SD=0.92$) differed significantly from one another. The form of the interaction (see figure 7.2) does not support hypotheses two. Office B, which experienced

an increase in density, appears to report stable communication between times one and two, contrary to expectation. On inspection of figure 7.2, it would appear that only for office A was reported communication adversely affected over time, contrary to hypothesis eight.

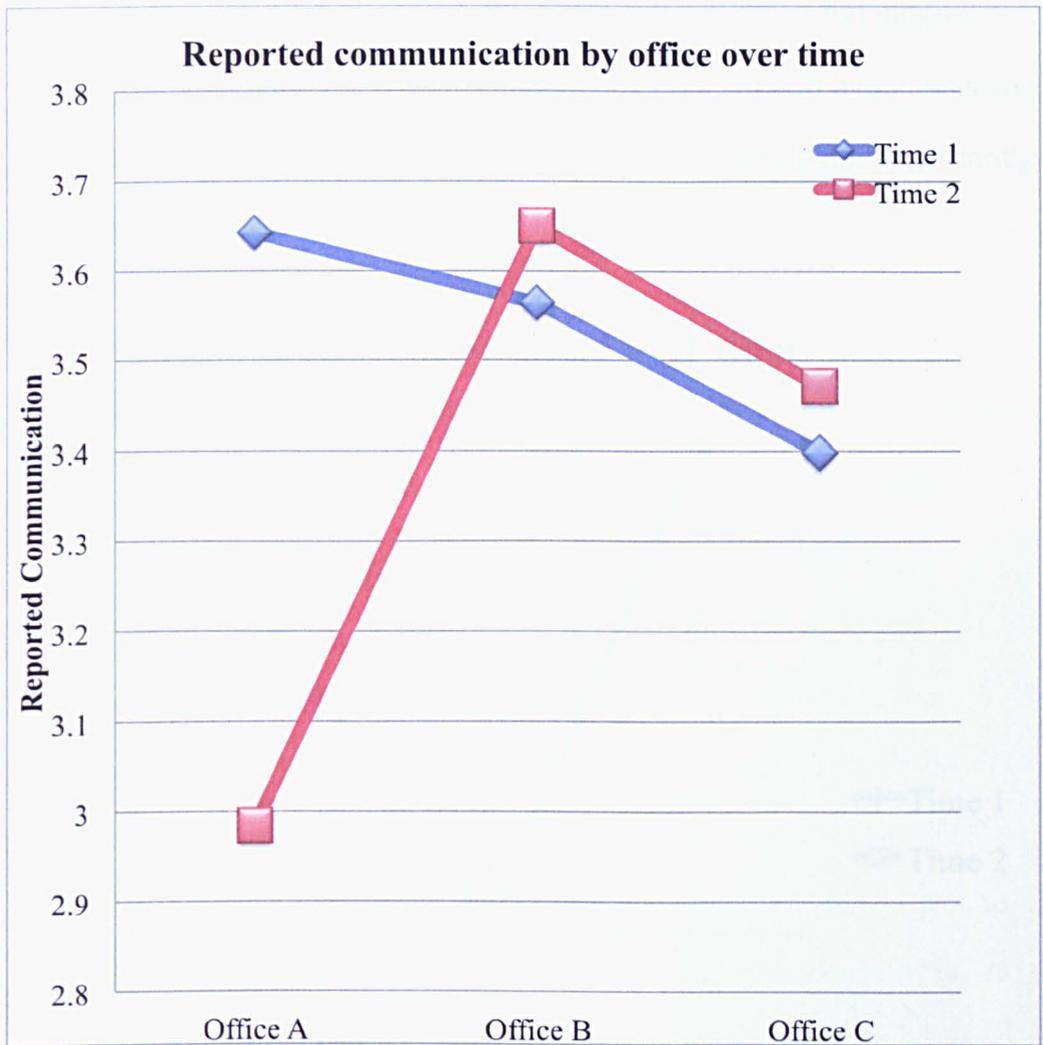


Figure 7.2. Study two: Reported communication by office over time.

7.6.3. Wellbeing

No interaction effect was found between time and office group with reported wellbeing. A significant moderate to small main effect was established with office group, $F_{(2, 280)}=3.75$, $p>0.05$ (partial eta squared=0.03). Post-hoc comparisons using the Tukey HSD test suggested that only offices B ($M=1.81$, $SD=0.75$) and C ($M=2.1$, $SD=0.89$) differed significantly from one another. This finding does not support hypothesis six, suggesting that offices that reduce individual workspace do not significantly affect wellbeing (see figure 7.3).

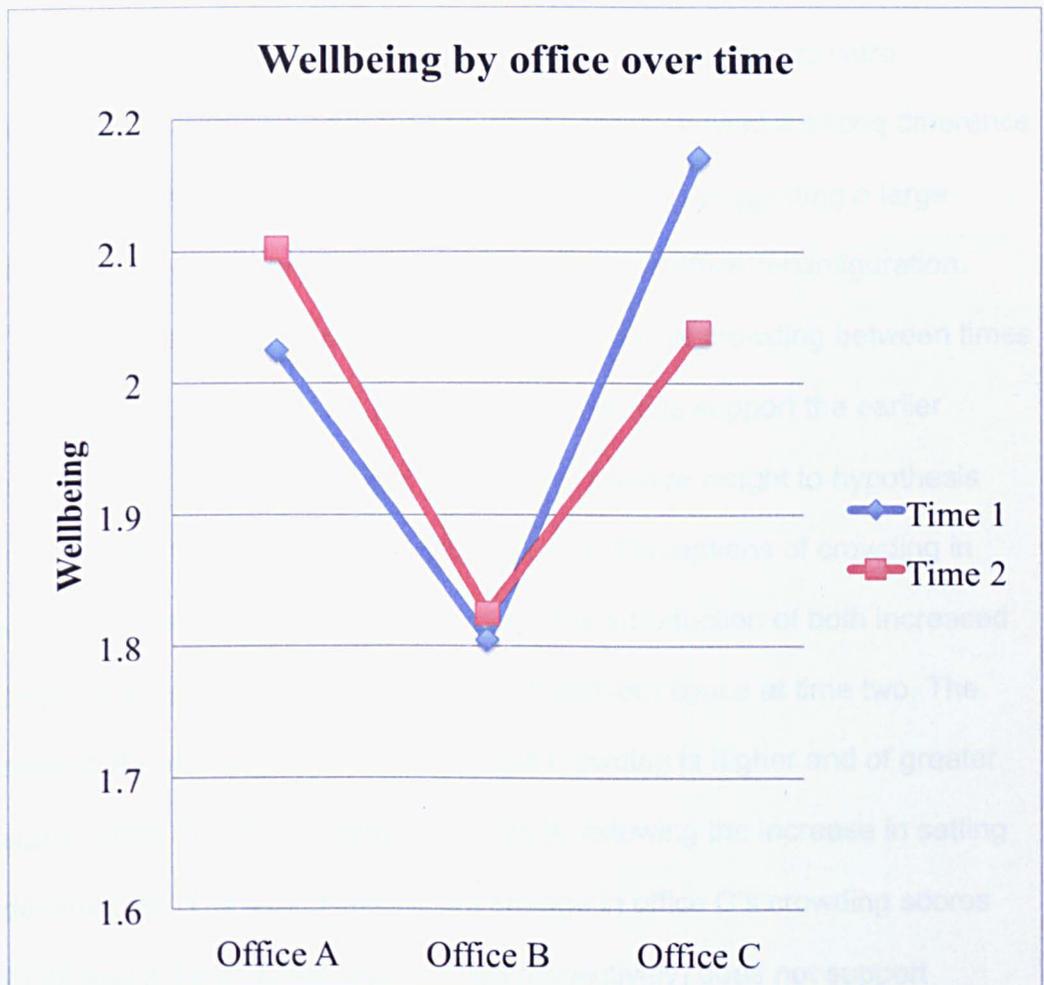


Figure 7.3. Study two: Reported wellbeing by office over time.

7.6.4. Subgroup analysis

Next, a series of one-way ANOVAs were employed to systematically examine the nature of the interaction effects (Tabachnick & Fidell, 2007). Subgroup analyses were conducted by examining potential simple effects between individual offices and both crowding, and communication, over time.

7.6.4.1. Crowding

Out of the three one-way ANOVAs performed to probe the nature of the interaction between location and time with crowding, two were statistically significant. Office A crowding scores showed a strong difference between times one and two, $F_{(1, 68)}=41.46$, $p>0.01$, suggesting a large increase in perceptions of crowding following the office reconfiguration. Office B also showed an increase in perceptions of crowding between times one and two, $F_{(1, 135)}=4.10$, $p>0.05$. These findings support the earlier interpretation of figure 7.2 and lend further positive weight to hypothesis seven, whilst contradicting hypothesis eight. Perceptions of crowding in office A increased significantly following the introduction of both increased physical proximity, setting density and break-out space at time two. The magnitude of this increase in perceived crowding is higher and of greater significance than that reported in office B, following the increase in setting density only. The lack of significant change in office C's crowding scores (3.32 and 3.12 for times one and two respectively) does not support proposition seven, as it would have been expected to observe a reduction in perceptions of crowding. It is possible that the reduction in setting density

was not of sufficient size to provide a means of testing the inverse of hypothesis seven adequately, this will be discussed in more detail in the discussion.

7.6.4.2. Communication

The one-way ANOVAs demonstrated that only office A's communication scores differed significantly between times one and two, $F_{(1, 68)}=7.76, p>0.01$. The communication scores for office A showed a statistically significant reduction between times one and two, suggesting that the office reconfiguration had a detrimental effect on the occupants' communication. This finding is contrary to hypothesis eight, undermining the trade-offs reasoning. The lack of a significant change in the communication scores for occupants of office B is contrary to expectations, hypothesis two. It had been expected that there would be positive effects of increased setting density on communication. However, these findings suggest that it is only the joint introduction of increased proximity and setting density, as occurred in office A, that is related to significant change in office communication. These findings will be discussed further in the subsequent chapter.

7.7. Preliminary mediation analysis

Finally, Analysis Of CoVariance (ANCOVA) was used to provide a preliminary indication of the role of crowding in the interaction between time and office condition, on communication. To test hypothesis nine, it was

necessary to establish whether crowding mediated the relationship between increased physical proximity and setting density, with communication and wellbeing. The well established causal steps process was followed (R. M. Baron & Kenny, 1986; James & Brett, 1984) to examine whether perceptions of crowding acted as a mediating variable. This approach argues that to establish mediation, it is necessary to fulfil four criteria (Wood, Goodman, Beckmann, & Cook, 2008). Firstly, it must be demonstrated that the IV affects the proposed mediating variable. Secondly, the potential mediator must be shown to affect the dependent variable. Thirdly, the independent variables should be significantly related to the DV. Finally, the relationship between the IV and DV should be reduced when the proposed mediating variable is controlled for. Full mediation can be claimed when the relationship between the IV and the DV is completely removed following the introduction of the mediator (R. M. Baron & Kenny, 1986; Muller, Judd, & Yzerbyt, 2005; Wood et al., 2008). A significant reduction in the relationship between the IV and the DV, but which is short of full mediation, can be described as partial mediation (R. M. Baron & Kenny, 1986).

It was decided to analyse this relationship using ANOVA and ANCOVA techniques as it is well suited to quasi-experimental research designs and has been successfully employed previously (e.g., Madjar & Shalley, 2008). Furthermore, forms of regression modelling, the more common form of mediation analysis (Wood et al., 2008), would be inappropriate for this data set. The use of regression analyses in this context requires the use of matched data and consequently, in this case, the statistical power would be much reduced by the sample size.

Experimental designs involving observed IVs, with clear conceptual distinctions to the moderator, provide robust conditions for mediation analyses (Muller, Yzerbyt, & Judd, 2008). When a covariate is hypothesised to be a mediator, controlling for the covariate using ANCOVA analysis allows the magnitude of any reduction in the effects of the IV to be assessed (Yzerbyt, Muller, & Judd, 2004). If a reduction in effect size is observed, this acts as an indication of mediation.

The previously reported ANOVA analyses demonstrate that the combination of physical proximity and setting density are indeed significantly related to perceptions of crowding, satisfying mediation conditions one (see table 7.6). One-way ANOVA analyses were performed to test step two of the causal steps process, examining whether perceptions of crowding were significantly related to either communication or wellbeing. The results demonstrate a clearly significant relationship between perceptions of crowding and communication, reported in table 7.4. No significant relationship was found between crowding and wellbeing, however, $F_{(1, 274)}=1.21$, $p=0.28$. As a consequence, no further mediation analyses were performed in relation to wellbeing.

For communication, prior ANOVA analysis satisfied step three of the causal steps. A significant interaction was found between proximity and density, with communication, albeit negatively (see table 7.6). Finally, to test step four, an ANCOVA analysis was performed. When perceptions of crowding were controlled for as a covariate, the interaction between office and time, with communication, became non-significant, $F_{(2, 287)}=1.04$, $p=0.36$. Once crowding had been controlled for, a moderately significant

main effect was identified between office location and communication, $F_{(2, 287)}=9.05$, $p>0.01$ (partial eta squared=0.06). The significant reduction in the strength of relationship between physical proximity, setting density and communication suggests perceptions of crowding act as a strong partial mediator. This finding implies that it is the change in perceptions of crowding that influences change in office communication, as opposed to variation in the physical environment directly. This result supports hypothesis nine.

	Step 1 ANOVA DV: Crowding			Step 2 ANOVA DV: Communication		Step 3 ANOVA DV: Communication			Step 4 ANCOVA DV: Communication		
Variable	M.S.	<i>F</i>	η^2	M.S.	<i>F</i>	M.S.	<i>F</i>	η^2	M.S.	<i>F</i>	η^2
Office	6.41	5.89**	0.04			2.11	2.47	0.02	6.01	9.05**	0.06
Time	20.20	18.58**	0.06			1.83	2.16	0.01	0.14	0.21	0.00
Office*Time	13.77	12.67**	0.08			3.49	4.11*	0.03	0.69	1.04	0.01
Crowding				7.57	7.77**				53.26	80.12**	0.22

Table 7.6. Study two mediation analysis.

* $p < 0.05$

* $p < 0.01$

7.8. Potential follow-up analysis

A number of analytic techniques have been suggested to enable more fine grained follow up analyses to tests of mediation, such as a test of differences in products of coefficients e.g., a Sobel Test (Sobel, 1982). Alternatively bootstrapped sampling of the indirect effects can be used to assess standard errors (Efron & Tibshirani, 1993; Preacher & Hayes, 2004). Structural Equation Modelling (SEM) is an alternative, technique to ANOVA/ANCOVA, to simultaneously assess all elements of the causal steps approach (e.g., Holman et al., 2010). However, these techniques rely upon possessing sufficient matched individual cases to provide adequate statistical power to perform the analysis. Unfortunately, the nature of the current data set precludes the use of such techniques.

In the absence of further analysis, it is not possible to make firm statements about the form of the mediation relationship. It is possible that the order of variables may be different to that previously suggested, however the strong theoretical link and observed nature of the IVs makes this unlikely (Yzerbyt et al., 2004). It is also not possible to rule out more nuanced forms of mediation, for example it could be the case that proximity is exerting a form of moderation on the mediating variable (Muller et al., 2005).

7.9. Summary

The statistical analysis reported in this chapter has established noteworthy findings and added support to a number of hypotheses. Perceptions of crowding were found to strongly correlate with communication, supporting hypothesis nine. A moderate to large interaction effect was identified between office group and time, with crowding. The analysis demonstrates that an increase in setting density is significantly related to increased perceptions of crowding, supporting hypothesis seven. Subgroup analysis demonstrated that the joint introduction of increased proximity, setting density and break-out space was related to a substantial increase in perceptions of crowding. This negative effect was far higher than when the increase in density followed some time after an increase in proximity, contrary to hypothesis eight. A moderate sized, significant interaction was identified between time and treatment group, with communication. Individuals who experienced a simultaneous increase in physical proximity, setting density and break-out space (office A) reported significantly reduced communication, contrary to hypothesis nine. Contrary to expectations (hypothesis three), workers who had experienced solely an increase in setting density reported no difference in communication. Only a main effect of office group was identified when examining wellbeing. This suggests that changes to spatial configuration had no significant effect upon wellbeing, contrary to hypotheses six. Mediation analysis demonstrated that perceptions of crowding partially mediated the effects of the treatment groups with communication, offering some support for hypothesis nine. The implication is that the psychosocial perception of

crowding, resulting from configurational change, partially mediates subsequent communication. The theoretical and practical implications of these findings are discussed in greater depth in the following discussion chapter.

No.	Hypothesis	Tested in study no.	Supported
1	Access to a break-out area will be related to greater levels of communication.	One	Yes
2	Higher proximity to co-workers will be related to increased communication	One	No
3	Increased density will be positively related to communication.	Two	No
4	Autonomy will be positively related to office communication.	One	Yes
5	Break-out area, physical proximity, density and autonomy will jointly predict communication.	One	Yes
6	Contemporary office designs that increase density or proximity will be negatively related to wellbeing.	Two	No
7	Contemporary office configurations that increase physical proximity or density will be positively related to perceptions of crowding.	Two	Yes
8	An increase in proximity and density, together with increased break-out provision, will be related to lower crowding.	Two	No
9	Perceptions of crowding will mediate the relationship of density and proximity, with communication and wellbeing.	Two	Yes

Table 8.1. Summary of support for all tested hypotheses.

8. Discussion

8.1. Introduction

This chapter is organised into six sections. The first section explores the implications of the empirical findings of both studies one and two in turn. The second section reflects upon the process and approach adopted during the course of the research. The third considers the potential extensions for theory and opportunities for future research. The fourth outlines the practical and methodological areas for refinement and extension. Finally, the fifth section summarises the key contributions, concluding the thesis. Prior to this discussion, table 8.1 summarises the hypotheses tested during both empirical studies and highlights whether they were supported by the analysis.

8.2. Interpretation of study one findings

The focus of study one was to examine the relationship between three predictor variables (access to break-out areas, physical proximity and autonomy) with communication. This section of the discussion explores the nature of the research findings.

Support was found for hypothesis one, that individuals with access to break-out areas also report significantly higher levels of communication. It is believed that this finding is the first direct empirical examination of the relationship between break-out space and communication. The positive finding corroborates the prior architectural observations regarding the role of break-out areas in supporting communication (e.g., Peterson & Beard, 2004; Turner & Myerson, 1998). It also indicates that reducing physical barriers to meeting, in accordance with social relations thinking (Festinger et al., 1950; Oldham & Brass, 1979), helps facilitate communication.

Support was also found for hypothesis four, with job autonomy being significantly positively related to higher communication. The finding indicates that employee autonomy is significantly related to communication and interaction (Oldham & Brass, 1979; Oldham & Rotchford, 1983).

Support was not found for hypothesis two however. Against expectations, and social relations reasoning (e.g., Zalesny & Farace, 1987), increased physical proximity was not associated with increased communication. It is possible that the change in proximity, or the relatively high levels of proximity between both conditions, constrained potential effects. This is discussed in great detail later in this chapter.

Although the findings support hypothesis five regarding the inter-related nature of the physical environment-worker relationship (Ferguson & Weisman, 1986) closer inspection of the form of the interaction, shows that the pattern of effects is slightly different to that hypothesised. General support was found for the social relations approach. This proposition is backed by the high communication reported by groups with access to break-out areas and higher autonomy (see slope 1). The higher levels of communication of higher autonomy relative to lower autonomy break-out groups (see slope 1 and slope 2 respectively) supports the observation from the design literature that it is higher autonomy workers who are most suited to and able to utilise break-out areas (Duffy, 1997; Laing, 2006). A lack of significant difference between higher and lower proximity for individuals with access to a break-out area (slopes 1 and 2) suggests that for these individuals, differences in proximity in the range observed were mitigated by the benefit of break-out areas.

The perception of psychological privacy (Altman, 1975) offers a lens through which to understand the discriminatory effects of physical proximity and to refine the social relations interpretation. Psychological privacy is related to the amount of control workers feel they have over regulating their social contact with others (E. Sundstrom & Sundstrom, 1986). An inability to control desk-side interactions can affect psychological privacy (E. Sundstrom et al., 1980) and inhibit particular forms of communication (Oldham & Brass, 1979). Differences in psychological privacy may explain the striking difference between the two groups of workers without access to break-out areas, who show strongly contrasting effects of proximity and autonomy (see slopes 3 and 4). In the absence of a break-out area, the

reasoning articulated earlier in the thesis would lead one to expect that higher physical proximity would mitigate the effect on communication. A compensatory role of higher physical proximity is observed, but only for those individuals with the autonomy to regulate the interactions that occur around their desks (see group 3B, figure 2). In other words, proximity appears to compensate for a lack of access to break-out areas, where the individuals possess the autonomy to manage their privacy. Individuals without the autonomy to manage the increased interactions associated with higher proximity conditions (c.f., T. J. Allen & Hauptman, 1987) reported much lower levels of communication (see group 4B).

A systems view of the physical environment-worker relationship supports the idea that certain changes within such a system may compensate for the effects of changes made elsewhere (c.f., Becker & Steele, 1995). The design literature suggests that an increase in collaborative space (or other complementary workspace), can counterbalance the effects of reduced individual space or formal meeting space (e.g., Duffy, 1997; Vischer, 2005b). A compensatory effect on communication can be observed for workers with lower autonomy situated in higher proximity conditions with access to break-out areas. Access to break-out areas is likely to have provided space (to the extent that they were able to utilise it) for confidential discussions, trading-off the reduction in desk area privacy (see group 2B) and corresponding effects with communication.

Psychological privacy and the organisational context may also explain the unexpectedly positive communication score for individuals in

lower proximity, lower autonomy and without access to break-out areas condition (see group 4A). It was predicted that this group of workers would be most negatively affected. It is possible, however, that the lower physical proximity may actually have been beneficial for this specific group of workers. An understanding of the organisation suggests that workers with more autonomous roles tend to occupy broader roles, requiring a greater degree of collaboration or interaction with colleagues. Individuals within lower autonomy roles tend to have more task focussed or solitary roles (in line with previous work sampling research, e.g., Robinson, 2010) requiring interaction with a small number of specific colleagues. Not being reliant upon group meetings may explain the lack of a dampening effect of an absence of break-out access. In the absence of higher autonomy to withdraw from the work environment (Oldham & Rotchford, 1983) or to customize it (Huang et al., 2004), the greater interpersonal distance and desk area may have provided sufficient psychological privacy for the limited communication, e.g., one-on-one conversations, required by their role (E. Sundstrom et al., 1980). Essentially, the environment was adequate for their style of interactions. Conversely individuals with higher autonomy in lower proximity conditions and without access to a break-out area (see group 3A) are likely to be disproportionately affected as they rely on collaboration and group interactions more than their lower autonomy colleagues.

The findings highlight a “winners and losers” phenomenon, with particular groups of workers positively or negatively affected by differing forms of office configuration. This is further corroborated by the consistent effect of job role. Administrative/support staff reported significantly less

communication than managers at all steps of the analysis, highlighting again the differential effects of role on communication. This finding can be viewed as a reflection of the way in which workspace demands vary in accordance to the work characteristics and requirements. Workers have previously been found to be affected differently by the physical environment, based upon their work, job or role (May et al., 2005; E. Sundstrom et al., 1982; Zalesny & Farace, 1987). The complex interaction identified in this study lends further weight to a more nuanced approach to workspace planning.

8.3. Interpretation of study two findings

Study two examined the effects of the introduction of reconfigured contemporary offices, involving change to setting density, physical proximity and break-out space, on individuals. Workers' perceptions of crowding, communication and wellbeing were analysed. The form and implications of the study's findings are discussed in this section.

Despite some support from the interpretation of study one's findings, the data analysis from study two undermines the argument for taking a trade-offs perspective to contemporary office reconfiguration. There was a lack of consistent support for the anticipated combination of positive and negative outcomes of the office reconfigurations. The specific relationships leading to this interpretation are discussed below.

A trade-offs perspective suggested that increased density or proximity within reconfigured offices would be related to higher

communication. The results from study two do not support hypothesis three, with density change appearing unconnected to occupant communication. Employees in the two offices that were subject solely to increased or decreased setting density showed no significant difference in their communication scores between times one and two. This finding is contrary to social relations reasoning (Oldham & Brass, 1979), but is in line with previous studies that have either found no relationship or a negative one with communication (e.g., O'Neill, 1994). Furthermore, taken together with the earlier lack of support for hypothesis two in study one, it suggests that at the relatively high levels of density and proximity within the surveyed offices, changes in these factors do not relate to communication. Without access to lower density and lower proximity offices within the current study it is not possible to judge whether the lack of relationship is an artefact of the context.

Contrary to the expected negative trade-offs of contemporary office configuration, no effects of office configuration were observed in respect of wellbeing (hypothesis six). This finding is surprising given the arguments that the need for coping strategies to overcome increased environmental stimuli would negatively affect wellbeing (Baum & Paulus, 1987; G. W. Evans, Johansson, & Carrere, 1994). It does fit with the inconsistent empirical results of field based workspace studies that have explicitly examined relationships with stress perceptions (De Croon et al., 2005). It is worth noting that within the current study wellbeing scores were distributed towards the lower end of the depression-enthusiasm continuum (indicating positive affect) (Warr, 1990). It is possible that the current physical work environment provided adequately for the occupants' basic needs (e.g.,

Maslow, 1999; Vischer, 1989) and provided a good enough “fit” to the work tasks engaged in that wellbeing was not adversely affected (c.f., Preiser, 1983; Vischer, 2007b; Zeisel, 2005). Due to the lack of correlation between crowding and wellbeing, and the lack of relationship between the treatment groups and wellbeing, it was not possible to test the mediation relationship between office configuration, crowding and wellbeing (hypotheses nine). The lack of relationships suggest that wellbeing does not seem to be significantly related to the physical environment, or perceptions of it. This is counter to the earlier reasoning based upon theories of occupant comfort and stress (e.g., Huang et al., 2004; Vischer, 2007b).

Support was found for crowding acting as an intervening process in the relationship between office configuration incorporating density or proximity change and occupant communication (hypothesis nine). The occupants of the two offices that underwent contemporary office reconfigurations were found to report significantly higher perceptions of crowding following the changes. This finding is in line with hypothesis seven but contrary to hypothesis eight. Subgroup analysis demonstrated that when density was increased, either on its own (as in office B), or alongside increased proximity (as in office A), crowding appeared to increase significantly. The negative relationship between changes in density and proximity are consistent with previous empirical studies (Oldham, 1988). It can be inferred from this result that office reconfigurations that increase density or proximity may adversely affect workers' crowding reactions. The setting density for office A and B at time two was $7.9\text{m}^2/\text{person}$ and $7.2\text{m}^2/\text{person}$ respectively. The similarity in spatial configuration seems to be reflected in very similar post-treatment mean crowding scores for offices

A and B. This observation suggests that despite crowding being a subjective perception (Stokols et al., 1975), it may be relatively stable across individuals and groups when in similar environments.

Support was found for the view of crowding as a process explaining the interaction of workers with their office environments (e.g., May et al., 2005). Within this phase, crowding was found to partially mediate the relationship between contemporary office configurations and communication (in line with hypothesis nine). The highly significant relationship between crowding and communication in both the ANOVA, and correlational analysis, support hypothesis nine. This adds further weight to previous findings that have shown crowding to be associated with negative behavioural and psychological strategies such as withdrawal from the workplace (Baum & Paulus, 1987; Oldham & Rotchford, 1983) or lowered control (Y. K. Chan, 1999) and in behavioural constraint (Stokols, 1972). The relationship between crowding and communication may be as a result of the influence of one of these outcomes, or none at all. Unfortunately within the current study design it is not possible to examine how crowding may be negatively related to communication. However, experience from the previous study, and knowledge of the organisation, suggests that any reduction in job autonomy may negatively affect individual's ability to access break-out areas. Such inhibition would be expected to adversely affect communication, as group and informal discussion would be reduced.

No relationship was identified between crowding and wellbeing however, counter to the other prediction of hypothesis nine. The lack of

relationship is surprising given previous findings that have linked office configuration to stress perceptions and reactions (De Croon et al., 2005).

The study's findings do not support hypothesis eight, as inferred from the trade-offs perspective. This proposed that including a greater proportion of break-out areas within offices that increased proximity and density, would trade-off (c.f., Elsbach & Pratt, 2007; Vischer, 2007b) negative relationships with wellbeing or communication (hypothesis eight). Office A's occupants reported a larger rise in crowding perceptions between times one and two, than workers in offices B or C. Indeed, office A occupants reported the highest levels of crowding out of all three offices. Furthermore, office A was the only office that experienced a significant decline in communication between times one and two. This suggests that the office reconfiguration was related to negative outcomes, despite including a greater proportion of break-out space than office B. Architectural theory suggests that including increased task or collaborative space should counterbalance reductions in individual workspace (e.g., Duffy, 1997). This does not appear to have occurred in this case.

One possible explanation for the incongruence with the architectural theory may be how the break-out space had been implemented. The reconfiguration resulted in the additional break-out space being grouped together and located in one corner of the office, adjacent to the leadership cluster. This placement may have resulted in two effects. Firstly, grouping the break-out areas in one place, rather than distributing them around the large office may have affected the perception of the overall space (c.f., Becker & Steele, 1995). A large proportion of the office space was occupied

solely by rows of individual desks (smaller and more densely grouped than at time one), without the inclusion of more break-out areas within this space it is unlikely that the sense of crowding would be mitigated. Secondly, the nearby presence of the leadership team may have inhibited the use of the increased break-out space, with workers less inclined to engage in informal communication within sight of management.

The results can also be interpreted in light of a change perspective. Allen and Henn (2007) have noted in case studies how gradual increases in occupancy have not been noticed by occupants at the time and that gradual increases in density are often only apparent once a tipping point is reached. Separating office configuration changes into steps in office B may have allowed individuals time to acclimatise to altered workspace conditions, one spatial change at a time. This approach means that the process became a continual rather than discrete form of change (Luecke, 2003), potentially enhancing acceptance. Office design or reconfiguration presents challenges for occupants in terms of adapting to altered space. Incremental change may reduce the likelihood of individuals viewing the changes as substantial as if they were all introduced in one go. Large scale change, especially where it is centrally imposed can prompt counterproductive work behaviours and sabotage (Vischer, 2005b). The provision of time to adapt to change may also have provided occupants chance to develop strategies to deal with increased environmental stimuli (e.g., increased interactions), prior to further increases. This approach may also alter the interpretation of the extent of crowding within the workplace, with gradual increases in density less noticeable than a one-time change.

Study two's results can be seen to partially support this view, with office B's communication scores not significantly changing between times one and two. This is in stark contrast to office A, which reported a significant decrease in communication between times one and two. Occupants of office B did report a significant increase in crowding following a gradual increase in setting density. Although the magnitude of this increase was less than that of office one, the overall level of crowding between the two offices was very similar. These findings suggest that gradually introducing the increase in density may not have altered the sensory experience, and resultant crowding perception. However, the continual nature of the change (Luecke, 2003) may have prevented the increase in crowding from negatively affecting communication. The finding suggests that gradual change may be an effective method of introducing contemporary office reconfigurations.

8.4. Reflections on the research process

The preparation of this thesis has provided an opportunity to reflect upon the research journey involved in the design and analysis of the two studies. With the benefit of hindsight and with the wider perspective developed over the course of time, there are a number of improvements that could have been made to counter certain methodological constraints. Furthermore, there are additional theoretical avenues that both studies may have benefited from incorporating. Firstly, the specific limitations and improvements of the first study are discussed.

8.4.1. Study one.

This study adopted a comparative methodology to explore the effects of contemporary work environments on communication. The research gathered data across a number of offices and examined differences in their physical configuration. The research design allowed the complex nature of the physical work environment to be analysed and interactions to be identified. However, some limitations should be noted. The cross-sectional nature of the design prevents attributions of causality, and, being conducted in a single organisation, limits wider generalisation. In the future it would be worthwhile to examine whether these findings hold across differing sectors or over time.

The study focussed upon communication, due to its importance as an intended outcome of contemporary office reconfigurations (Price, 2007) and relevance to modern knowledge driven organisations and workers (Davenport, 2005). The study utilised a self-report measure of communication. Privacy concerns and a lack of relevant organisationally recorded data precluded individual level overt measures of communication. The research could have been enhanced with, and future studies would benefit from, office or team-level objective measures of communication. For example, forms of observation could have been used that did not identify individual participants, but which measured the degree of use of break-out areas (c.f., Breakwell, Hammond, Fife-Schaw, & Smith, 2006). Alternatively, anonymised logs could have been kept by workers in meeting spaces to record the amount and nature of discussion occurring within the offices.

Finally, privacy considerations permitting, social network analysis is a technique that would allow not only the frequency of interactions to be assessed, but also the reach of contemporary office innovations (in terms of patterns of communication across an office) (c.f., J. Scott, 2000).

Psychological privacy (Altman, 1975) has been used as a lens through which to interpret some of the findings from study one. The psychological process has been implicated as important in how workers respond to and interact with their environment within this research. Previous findings have also established psychological privacy as playing an important role in the worker-environment relationship (Brookes & Kaplan, 1972; Kupritz, 1998; Oldham, 1988; Zalesny & Farace, 1987). It would have aided the explanatory power of this study if a relevant measure of psychological privacy had been included for analysis.

Initially, when this research was being planned and organisational access agreed, it was anticipated that the organisational reconfigurations would be more radical in nature. For example, there was discussion about significantly increasing the levels of break-out, reflective and group space. The 2008 financial crisis, and subsequent recession, reduced the organisation's capacity to follow a reconfiguration programme that was not orientated around maximising the asset load and either maintaining or increasing the space available for individual workstations. It would have been desirable to assess not only access to break-out areas, but also other task space, such as group working areas or reflection space. To date, only case studies or purely descriptive accounts have examined the effects of multiple design features such as these simultaneously on individuals (e.g.,

T. Allen et al., 2004; T. J. Allen & Henn, 2007; Gillen, 2006; Wineman & Serrato, 1999). Future studies would greatly aid research knowledge in this area by including measures of multiple task spaces. Such research would allow assumptions contained in architectural theory (e.g., Duffy's, 1997, taxonomy) and present real-world trends (Littlefield, 2009) to be rigorously assessed.

Studies of job or work design have to-date largely neglected the relationship between these factors and the physical environment (Humphrey et al., 2007). Future studies should explore the interaction of contemporary work environments and modern work. Such extensions could examine the interactions with emerging work design (Oldham & Hackman, 2010), or practices, for example, hot-desking, hoteling, or teleworking (Cascio, 2000). The findings from this first study demonstrate that groups of workers are differentially affected by their physical environment. To enable more detailed analysis of this phenomenon, consideration of the nature of work tasks and roles that employees undertake is required. These issues are discussed more widely in the following extensions and opportunities section.

8.4.2. Study two.

This study utilised a longitudinal quasi-experimental methodology to explore the effects of the introduction of differing contemporary work environments on crowding, communication and wellbeing. This study gathered data at two time points, permitting change over time to be analysed. The design allowed the effects of two differing contemporary

office configurations to be examined, together with differences in the way they were introduced. It also enabled the role of crowding in employees' reactions to their environments to be explored. Despite strengths, certain aspects of the research design do pose limitations.

The quasi-experimental design involved two treatment conditions (contemporary office configurations) and one control condition (traditional open-plan office). The comparison between groups allowed judgments to be made regarding the effects of changes in spatial configuration. The traditional office (office C) provided a good non-equivalent control condition (Cook & Campbell, 1979; Grant & Wall, 2009), as it was identical in size to offices A and B, contained very similar groups of workers and was similar in configuration to office A at time one. When the research programme was originally designed, it was anticipated that office C would remain unchanged, both in terms of configuration and setting density. Over the course of the research it emerged that due to project changes, that the office would experience a reduction in setting density. Although this had the advantage of allowing the effects of a decrease in density to be assessed, had the office maintained its original occupant numbers it would have provided a purer control condition (Cook & Campbell, 1979).

A further limitation of the quasi-experimental design is the confounding of break-out space and increased proximity or density. Although the joint introduction of configurational changes allows the trade-off approach to be evaluated, it does not allow the individual effects to be separated. The confounding effects could have been overcome if additional

experimental groups had been available. These could have been used to examine changes in break-out spaces independently.

Response rates at time two were low for participants who had previously completed the survey at time one. This low repeat response rate was common across all three offices. A general questionnaire fatigue may partly explain the low response rate, with individuals often receiving requests to complete staff surveys. Although attempts were made to stress the value of completing what may have appeared to be the same questionnaire for a second time, it was not possible to engage with individual workers face-to-face. Personal briefings or office meetings may have increased the strength of the survey request. This difficulty in accessing workers directly was exacerbated by a change in the manager responsible for delivering the reconfiguration programme, complicating access. The low number of repeat respondents severely limited the number of matched cases within study two's dataset. Although a rigorous procedure was followed to establish the similarity of matched and unmatched data (Leach et al., 2001), the lack of matched data constrained the analytical techniques available for use. A greater proportion of matched cases would have strengthened causal inferences and allowed non-matched individuals to be used as a "quasi-control group" (Campbell & Stanley, 1963; Oldham & Brass, 1979; Shadish et al., 2001). A larger set of matched data would also have allowed for techniques reliant upon individual cases (e.g., advanced forms of regression or SEM analyses) to be used to test the mediating role of crowding in a more sophisticated manner (Holman et al., 2010; Sobel, 1982).

Similarly to study one, this study could be improved through the use of observable measures of communication. Furthermore, the use of office level analyses provides the opportunity for office level measures of productivity or other business outcomes to be collected (e.g., Breakwell et al., 2006; Foland et al., 1995). The collection of such data would allow the effects of contemporary office reconfiguration, or the manner in which it is implemented, on organisations to be better assessed. Sensitivities within the organisation prevented the collection of data that may have indicated office performance. When planning the study, attention focussed upon attempting to identify and agree on the use of metrics that the organisation already collected. An alternative approach could have been to develop independent measures that may not have raised such issues with the organisation. Similar commercial sensitivities prevented the disclosure of the costs involved in the reconfigurations, or the relative costs involved in incorporating either lower density or increased task space. Collection of such data, in this, or future studies, would enable some form of cost-benefit analysis as to the efficacy of such configurations and improve the basis of discussions regarding design trade-offs.

This research addressed the design and practice led suggestions that contemporary offices may be able to trade-off the loss of individual or personal space by the increase in group or other task space (Laing, 2006). Although the reconfiguration employed in office A incorporated an increase in break-out space, the increase may not have been of a magnitude sufficient to make a significant difference to individuals. Future studies would benefit from investigating office designs that incorporate a greater degree of break-out space, or that have significantly increased the

proportion of other task areas. Furthermore, the placement of the break-out areas should be investigated to explore whether there are optimal configurations to support individuals or alter the architectural experience. This theme is expanded upon in the following two sections.

8.5. Theoretical extensions and opportunities

The extensive literature undertaken as part of this thesis together with the findings from the two empirical studies provide an insight into how theory in this area may be extended.

8.5.1. Theory integration and testing

The literature on workspace design and its impact can be characterised by an absence of a unifying theoretical approach (c.f., Hodgkinson & Healey, 2008; Locke & Latham, 2004). Theories and frameworks have been drawn from social relations, cognitive psychology, systems thinking, symbolic, and physiological standpoints to investigate relationships between workers and their physical environment (e.g., Altman, 1975; Baum & Paulus, 1987; Becker, 1981; Carnevale, 1992; S. Cohen, 1980; Cummings, 1978; T. R. V. Davis, 1984; De Croon et al., 2005; Desor, 1972; Duffy, 1997; Elsbach & Pratt, 2007; Ferguson & Weisman, 1986; Festinger et al., 1950; Geen & Gange, 1977; Oldham et al., 1995; Paciuk,

1990; Paulus, 1980; Schuler, 1980; Steele, 1973; Stokols et al., 1975 1975; E. Sundstrom et al., 1980; Sutton & Rafaeli, 1987; Vischer, 1989).

However, none of these approaches has received overwhelming empirical support (e.g., R. A. Baron, 1994; Elsbach & Pratt, 2007; Oldham et al., 1995). Although use of a diverse range of theoretical stances has enabled a broad view to be taken of the topic, it has also meant that there has been a lack of consistency in terms of outcome evaluation (i.e., a range of outcomes have been measured), making it difficult to assess theoretical efficacy and consistency. In effect, the variety of approaches has meant that research attention has been spread relatively thinly. The field requires greater direct empirical testing of competing theories, or processes, to allow informed and incremental theorisation to progress (Oldham & Brass, 1979; Zalesny & Farace, 1987).

It has been noted that it is unlikely that there will be a single process or theory explaining the interaction of workers and their workspace (e.g., Elsbach & Pratt, 2007). The complexity of the physical office and its constituent parts may partly explain this, but it is proposed that greater effort is required to integrate successful aspects of these competing theories. Within study two, the role of crowding was examined and support was found for it acting as a partial mediator in the worker-environment relationship. Furthermore, the interpretation of the interactions between autonomy, break-out space, proximity with communication in study one, suggests that psychological privacy holds a strong explanatory power. Continued exploration of well established psychological processes, such as these, within the context of contemporary office environments would help establish which common theoretical elements are relevant to modern

offices and which are worthy of integration. Indeed, while a single meta-theory is not necessarily desired, for such an exercise would in all probability yield a cumbersome outcome, integration within congruent theoretical approaches would be welcome (cf., Hodgkinson & Healey, 2008; Locke & Latham, 2004). Indeed, a STS approach (Cherns, 1987; van Eijnatten, 1997) may provide an organising framework within which to integrate varying processes and theoretical facets. It is possible that differing processes may apply to varying aspects of the worker-environment relationship and an overall view of the system would allow these to be organised. Depending on the aspect of the worker-environment relationship under examination, the relevant theory could be selected.

The strong role of autonomy within study one illustrates the need to further explore the role of control (in its many forms) in this area. Indeed, the ability to exert control over one's environment is explicit within social interference theory (e.g., Baum & Paulus, 1987; Oldham et al., 1995) and the environmental comfort model (Vischer, 1989), in addition to being implicit in cognitive theories, such as overload (e.g., S. Cohen, 1980). Although direct testing of control as a process involved in the interaction of individuals with their environment is still in its infancy (e.g., Huang et al., 2004; Lee & Brand, 2005; Lee & Brand, 2010; O'Neill, 1994), study one's results demonstrate that this is an area to be capitalised upon. Indeed, the importance of being able to move and act with freedom and control has been suggested as being intimately related not only to individuals' wellbeing but also to their creativity at work (Csikszentmihalyi, 2003). Becker (1991) argues that an ability to adjust the workspace may be significant in

influencing how individuals feel about and behave in all aspects of their work life.

8.5.2. Work design

Study one has demonstrated the potential for aspects of individuals' work design to influence and interact with the physical work environment. A link between work characteristics, such as autonomy, or workers' job types, and the physical environment have been found in previous studies (e.g., Fried et al., 2001). However, current research that has explored work design and its relationship to the physical environment have largely treated the relationship as static and uni-directional. The earlier review chapters have demonstrated that knowledge workers often engage in a variety of tasks during the course of the day (e.g., Becker & Sims, 2001; Craig, 2010) and that the space individuals utilise can vary on a daily, weekly or monthly basis (e.g., Laing, 2006; Ridgway et al., 2008). Unfortunately, however, to date there has been limited theoretical acknowledgement that worker demands and interaction with workspaces are dynamic (but for a notable exception see, Duffy, 1997). Clearly, therefore, this issue warrants greater attention. Such an approach would be in line with the progression occurring within other established areas of organisational theory, not least job design, which have sought to incorporate the dynamic nature of the work practices into contemporary models (e.g., Clegg & Spencer, 2007); indeed, activities such as job crafting require temporality to be dealt with explicitly (e.g., Wrzesniewski & Dutton, 2001).

It is clear there are opportunities to link areas of theory-building and expertise that are currently treated as separate and distinct domains. Thus extending the argument above about job design and job crafting, to date there have been few attempts either theoretically or empirically to examine the extent to which physical environments shape and influence job designs and the opportunities for job crafting. Hence, although it is clear that physical layouts and proximity to other staff influence patterns of social interaction (Oldham & Brass, 1979; Zalesny & Farace, 1987) and thereby shape the social and relational aspects of work (see, Grant & Parker, 2009; Kilduff & Brass, 2010), there is a need to explore further the constraints that workspaces place on job design. Additionally, looking at it in the opposite direction, there is also a need to examine the ways in which people may craft their jobs to shape and change their environments. This need is borne out by the results of study one, which raises the prospect that the autonomy workers' enjoy in their job may affect whether they need, or are able to utilise, break-out areas. As Humphrey, Nahrgang and Morgeson (2007) have noted in their comprehensive review of the work design area, there is a necessity for research and theory to take into account the role of the physical environment.

8.5.3. Trade-offs

A trade-offs perspective has been highlighted as a means of interpreting the often conflicting outcomes from office reconfigurations (Elsbach & Bechky, 2007; McElroy & Morrow, 2010). Although study two found mixed evidence in favour of a trade-offs approach, the approach is

being used to support reductions in individual workspace in practice (T. Allen et al., 2004; Littlefield, 2009). As a consequence it merits further investigation to explore adequately whether office designs that incorporate different ratios of individual, collaborative or other task spaces, support the principles of design off-setting. In particular, it is anticipated that the efficacy of a trade-offs approach to office reconfiguration is likely to be intertwined with individual work and organisational factors. For example, the space requirements and mix of task space may vary significantly between different organisations, offices, groups and individuals (Duffy, 1997; Laing, 2006; Vischer, 2007a). A trade-offs perspective offers a useful lens to explain the complex mix of outcomes that accompany modern office reconfigurations. However, the practical implications regarding how to balance these tensions remain an area to explore.

8.5.4. Change and implementation

The potential for office design or reconfiguration to act as a driver of change has been highlighted as an area of research ripe for investigation (McElroy & Morrow, 2010). Currently, literature that has examined the role of workspace in supporting organisational change has predominantly featured descriptive or case study accounts (e.g, Foland et al., 1995; Vischer, 2005b). There lies an opportunity to conduct comparative studies to test the efficacy of differing forms of office reconfiguration, or design process, in supporting desired organisational change. Furthermore, the link to, and integration with, existing theories and methods of organisational change and development are yet to be made (e.g., By, 2005; Luecke,

2003). If workspace design can be demonstrated as congruent to existing tools and techniques, this could offer a significant theoretical extension.

The implementation of new office design, or reconfiguration, have been highlighted as potential means of supporting organisational change. For example, through encouraging inter-group communication or reducing physical barriers between employees and management (T. R. V. Davis, 1984; D. J. Hall & Ford, 1998; Turner & Myerson, 1998). However, the process of design itself has been severely neglected in terms of organisational research. Study two examined whether the nature of the implementation of contemporary office reconfigurations affects individuals' perceptions of their office space (crowding) and related outcomes (communication and wellbeing). The findings suggest that the way in which change is introduced may alter the reactions of staff, e.g., maintained communication following a gradual increase in density. This exploration only just scratches the surface in terms of the permutations that may be used to introduce a change in workspace. Indeed, as the earlier literature review has suggested, existing techniques such as STS and user involvement in the design process (T. Allen et al., 2004; Foland et al., 1995; Vischer, 2005a) may provide a framework for guiding successful design, implementation and user acceptance (e.g., Clegg, 2000; E. Mumford, 1983). Future research that explores this opportunity using structured, comparative means, would provide valuable insight into the efficacy of these competing techniques.

8.5.5. Environmental sustainability

A further timely extension relating to the design of the physical office environment concerns research to support the design, implementation and operation of sustainable buildings. The activities of private and public sector organisations generate a significant proportion of world carbon emissions, waste generation and water usage (M. C. Davis & Challenger, 2009). The build and operation of work facilities is an important contributor to an organisation's environmental impact, and there is an increasing awareness of the role that new technologies and improved design may play in improving building performance (e.g., Natsu, 2008). However, technology or innovative design on its own is unlikely to be able to bring the required environmental gains – gaining an understanding staff behaviours and needs is also massively important. Wener and Carmalt (2006, p158) have noted that *"Some of the oft-cited ecological benefits of green buildings are dependent on the ability to correctly predict user behavior."* Appreciating how individuals respond to different work environments and conditions will be critical in ensuring that new technology or design features are used appropriately, so as to avoid counterproductive behaviours. For example, failing to provide adequate storage facilities for staff may lead to shelving being added after the building is built, obstructing efficient ventilation systems and necessitating less efficient 'work-arounds' (e.g., opening external windows and doors) (for further discussion see Wener & Carmalt, 2006). The configuration of offices and other workspaces can affect staff uptake of sustainable activities, for example, by making sustainable behaviours more convenient and reducing perceived behavioural barriers. The location of recycling receptacles is a good

illustration of this principle in practice, with the placement of recycling bins having been found to influence recycling rates in academic buildings (Ludwig, Gray, & Rowell, 1998). Presently there are only limited, indicative studies that can help guide designers and organisations in using design to support more sustainable behaviours or improve the efficiency of ecologically inspired work buildings. Exploring and understanding the linkages between design and sustainable behaviours thus represents a major opportunity and priority for future research.

8.6. Practical and methodological extensions

A number of practical and methodological suggestions can be made to aid researchers in designing studies that are better able to exploit and examine the opportunities and challenges of this field:

8.6.1. The analysis of tipping points

The literature is rife with examples of where compromises, or trade-offs, need to be made in the design of offices, for instance, between providing a workspace that is open and one that provides too many distractions. It is believed that there is an opportunity to explore these trade-offs through looking for tipping points that occur within these relationships. This is something that has become more apparent through the two studies presented in this thesis. The lack of main effects of proximity on communication in study one, and the limited relationship

between configurational change and wellbeing in study two, suggests that within this context there was not a broad enough range of spatial change. This is supported by previous case study accounts that have described tipping points in effects occurring when a certain office density has been reached (T. J. Allen & Henn, 2007). Detection of such a change in effects may require a larger range of difference between office configurations and more nuanced measurement.

The issue of potential tipping points is not something that has received noticeable attention amongst field studies in the literature. However, identifying specific points of inflexion at which aspects of the physical environment (e.g., the proximity of co-workers, the amount of available meeting space) are likely to produce greater detrimental effects than benefits would be of real value. In addition to advancing understanding of the relative effects of such workspace factors, more meaningful advice and guidance could be offered to designers, managers and staff who have to resolve competing demands in this area. Evidence from specific areas of the workspace literature, however, indicates that an appreciation of tipping points will require systematic analysis. For example, multiple factors (e.g., job complexity, screening ability, gender, and tenure) have been found to affect reactions to density (Epstein & Karlin, 1975; Fried et al., 2001; Oldham et al., 1991). Understanding the complex nature of tipping points will be a challenge for future research but such inquiry should yield information of both practical and theoretical interest.

8.6.2. Temporal/real-time data collection

Research has demonstrated that the nature of tasks, and the space that workers utilise to fulfil them, vary over time and between individuals (e.g., Becker & Sims, 2001; Craig, 2010). This implies a highly individual and changing nature of modern work and clearly links to emerging concepts of work and job design regarding job crafting (e.e., Clegg & Spencer, 2007; Grant et al., 2011). In addition, it reflects the interactive nature of the worker-physical environment relationship that study one identified. Capturing the temporality of such interactions, and the potentially changing experience, requires techniques that are more sophisticated than those generally employed in the domain of workspace evaluation and employee-environment interaction. Two related techniques, the Experience Sampling Method (ESM) and Work Sampling Method (WSM) are examples of tools that may suit such purposes (e.g., Ayoko, Ashkanasy, & Jehn, 2010). ESM captures within person, temporal experiences within natural settings, which is achieved through asking participants to provide information regarding their subjective experience on multiple occasions (often at frequent points each day over a period of time) (Totterdell, 2006). WSM is similar and requires participants to identify and record the tasks they are involved in at any given point in a similar fashion (e.g., Robinson, 2010). Although diaries and online surveys have often been used to collect data of this kind in the past, Personal Digital Assistants (PDAs) are being recognised as providing advantages to collecting data in this regard. PDAs allow efficiency of data processing, fast input of responses and portability (Robinson, 2010; Totterdell, 2006). These techniques can be extended to the study of the physical workspace (Ayoko et al., 2010), allowing researchers to capture

what tasks employees are engaged in, where they are performing them, and the related psychological experience. The collection of such rich, real-time data can help inform how knowledge workers use office space in practice and guide the development of new theory and integration with emerging work design theories. Furthermore, such an approach may yield more sophisticated techniques for the optimisation and reconfiguration of existing office space.

8.6.3. Incorporating physiological data

Research concerning the evaluation and effects of open-plan offices within field settings has been dominated by perceptual and self-report measurements, with the inherent dangers of common method bias (e.g., Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Spector, 1992). The collection of physiological data would allow objective insights to be gained into the effects that an office change, for example the introduction of more workers, might elicit in individuals (Elsbach & Pratt, 2007). Ayoko, Ashkanasy and Jehn (2010) suggest electrocardiograph (ECG) and blood pressure monitoring as techniques that researchers might utilise to assess physiological reactions to working in open-plan space. It is contended that serum cortisol (a prominent stress hormone) sampling would also yield valuable information with which to appraise such reactions. Collecting data of this kind would enable a more direct integration of findings with related literatures (e.g., occupational stress), and would also provide another source of "hard" data for designers and other stakeholders (c.f., Ganster, Fox, & Dwyer, 2001).

8.6.4. Moving beyond basic productivity/business outcomes

As discussed throughout this thesis, design and re-design of working space require compromises and trade-offs (Elsbach & Pratt, 2007; Ridgway et al., 2008). The earlier literature review highlighted that the basis upon which to make these decisions is currently weighted towards technical or operational considerations, with data readily available regarding financial implications of pursuing different office strategies (e.g., the financial savings of reducing an office floor plan or minimising build costs is easily calculable). However, when considering the costs of such changes on human behaviour and reactions to redesign, objective evaluations are much harder to calculate due to a paucity of measurement of explicit organisational outcomes in current research. Although self-report evaluations (e.g., individual productivity) are typically available (e.g., Leaman & Bordass, 2005), future studies that utilise measurements of time use (e.g., Craig, 2010) or higher level organisational outcomes such as project completion times (Foland et al., 1995) would provide designers and practitioners with more robust data on which to determine the effects of office design on individuals and organisations. Overall, the provision of bottom line indicators would enable I/O psychology researchers to offer a credible argument in favour of design choices that may not be the most financially attractive in the short run, but which deliver longer term human and organisational benefits.

8.6.5. Enhancing the precision of our measures through greater cross-disciplinary collaboration

A lack of standardisation of definition and operationalisation, both within the behavioural literature and in relation to standards and practices used in other disciplines (e.g., architecture and facilities management) hampers comparison across studies, thereby limiting generalisability. There is a need for researchers to adopt more closely defined constructs when considering office space, in addition to being aware of measurements and norms commonly used by other disciplines. This thesis has attempted to pay reference to and utilise where possible, existing industrial measures of workspace. Indeed, the lack of adoption of a common measurement in research involving density, despite the industry standard NIA, was discussed in the earlier methodology chapter (chapter five).

At a broader level, offices are inherently difficult to classify due to the sheer differences in building types, structures, nature of the physical services, and furniture systems, together with the variance that organisational structures and cultures bring to bear on office design. The task of classifying such concepts is undoubtedly more difficult for I/O psychology researchers than for those from more design-led professions and disciplines, whose expertise lie in understanding such physical forms (Veitch et al., 2007). Although it is probably unrealistic to expect researchers to adopt a single classification for office types, future research that seeks to understand differences between traditional enclosed space, open-plan office concepts, and new flexible offices, would benefit from paying reference to the distinctions made by Duffy (1997, see figure 2.2),

Brennan, Chugh and Kline (2002) and Danielsson and Bodin (2008). These classification systems distinguish between variations in open-plan concepts; however, Danielsson and Bodin (2008) use a more comprehensive categorisation that allows future office concepts to be more precisely defined and studied. As illustrated in chapter two, their typology incorporates architectural thinking to classify seven office types: cell office, shared room office, small open-plan office, medium-sized open-plan office, large open-plan office, flex office, and combi office. A standardised approach to recognising, recording and reporting differing types of office design will enable researchers to make more stable judgments between and within competing concepts, reducing some of the current inconsistencies. For example, the term open-plan has often been applied generally within the literature, based upon relatively loose criteria (Brennan et al., 2002; Danielsson & Bodin, 2008; Ferguson & Weisman, 1986; Oldham et al., 1995) that has resulted in noisy data. For instance, some offices defined as traditional enclosed offices contain sections of open-plan (e.g., Brookes & Kaplan, 1972; Zalesny & Farace, 1987).

One way of enabling and encouraging the adoption of more sophisticated and useful typologies will be for I/O psychologists to work together in projects with designers and architects – as with other domains, there is much to be gained from inter-disciplinary working (Clegg & Shepherd, 2007). It is also clear that architects and other designers may have much to gain by working with I/O psychologists. Theory-based practical methods and toolkits developed through such people centred, multidisciplinary working may provide a tangible way forward for improving building design (c.f., Axtell, Pepper, Clegg, Wall, & Gardner, 2001).

8.7. Conclusion

This thesis has contributed to I/O psychology's knowledge regarding the interaction of workers' with contemporary office environments and the potential impact of differing forms of office reconfiguration. Study one has reinforced the role of the physical environment in shaping behaviour. The approach has gone beyond largely case-study accounts of contemporary workspace (e.g., Gillen, 2006; Laing et al., 1998) and demonstrated the role of break-out areas. The research provides further support for the need to consider the attributes of the physical work environment alongside job design (Humphrey et al., 2007) and to address the changing nature of work and work roles (Muller et al., 2005 2005; Oldham & Hackman, 2010). This is the first empirical work that the author is aware of that substantiates designers' propositions that worker autonomy and work characteristics interact with contemporary workspaces (e.g., Duffy, 1997; Turner & Myerson, 1998). The findings have demonstrated that office design should accommodate the needs of varying groups of workers, and that there is a need for synergy between physical and work design. The role of autonomy in the environment-communication relationship highlights how workspace design cannot be separated from organisational behaviour and theory. This poses a challenge for further acknowledgement of the physical environment within organisational behaviour theory (Humphrey et al., 2007).

Study two provides the first longitudinal quasi-experimental investigation that the author knows of, of the introduction of a contemporary office reconfiguration. The exploration of the simultaneous introduction of increased density, proximity and break-out space allowed suggestions regarding design trade-offs (Elsbach & Pratt, 2007; McElroy & Morrow, 2010; Vischer, 2005b) to be evaluated. The findings challenge the approach, with break-out space appearing not to mitigate negative effects associated with reduced individual workspace. Furthermore, the study highlights the need for I/O researchers to investigate how office reconfiguration is implemented, with a gradual increase in density seeming to limit negative employee reactions. The opportunities for linking such future programmes of work to the existing organisational change literature is substantial (c.f., Higgins & McAllaster, 2004).

The second study has also provided evidence for the role of psychological processes in influencing workers' reactions to contemporary workspace. The findings demonstrate that designers need to be aware of the psychosocial perceptions individuals form of their environments and how these might affect their reactions (De Croon et al., 2005). Environments that result in an increased perception of crowding may reduce communication. There is a pressing need to explore further psychological processes (e.g., privacy) within contemporary workspace. Such work will enable greater theoretical progression (c.f., Locke & Latham, 2004) and provide an insight into design and behavioural strategies that may be used to help mitigate detrimental effects of contemporary office configuration (c.f., Vischer, 2005b).

This thesis has articulated how the open-plan office has become the most popular office design (Brill et al., 2001) and how it continues to adapt to reflect the changing nature of organisations and work. The continuing advancement of information technologies, cost rationalisation (Elsbach & Bechky, 2007) and growing proportion of knowledge workers within the economy (e.g., Davenport, 2005) can be expected to continue to drive office adaptation. Evolution in office configuration is likely to throw up an ever-increasing range of environments in which individuals and groups will work. There is an opportunity not only to reflect the changing nature of the office in future research, but also to influence the form that these redesigns take and to promote consideration of the effects on individuals, organisational cultures and processes. The literature would benefit in particular from research examining the effects of new working practices that may accompany redesigned or highly flexible open-plan office space, such as hot-desking, home or tele-working (e.g., Baruch, 2001; Chapman et al., 1995; Daniels et al., 2001; De Croon et al., 2005; Ng, 2010; Vos & van der Voordt, 2001).

Currently, innovative offices and workplaces are often being designed and optimised without the support of professional architects or designers (Laing, 2006). There is a risk that without sustained research attention from I/O researchers, in addition to design colleagues, the impact of emerging office configurations may not be adequately evaluated. As a consequence, the opportunity to help guide such design to maximise the positive effects on both staff and organisations could be missed.

The design and redesign of the physical work environment and the emergence of contemporary configurations present exciting research opportunities. Addressing these opportunities also pose substantial challenges for I/O psychologists and practitioners however. I/O psychologists have a professional duty to understand the complex interactions between employees, their ways of working and the environments within which they work. There is also a responsibility to try to influence the design of these inter-dependent systems. This will make heavy demands of I/O psychologists' empirical and theoretical work and capabilities to make it available to the stakeholders involved. The complexities of the area and the breadth of professional understanding required to address it necessitates true interdisciplinary working (McGourlay et al., 2009). In order to enable effective research and practice there is a need for more joined-up and systemic approaches to theory building (Locke & Latham, 2004). Additionally, practical implementation of new knowledge in this area would be aided by the development of theory-based practical approaches and toolkits, as applied to the area of work design (Axtell et al., 2001). The continuing evolution of the modern office presents a fresh and emerging new area of practice for I/O psychologists. It is an area that has the potential to widen the relevance and influence of psychology across design disciplines and to address organisational practice.

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List of Abbreviations

- ANOVA – Analysis Of Variance
- ANCOVA - Analysis Of CoVariance
- CAD – Computer Aided Design
- CM – Centimetres
- COMM – Communication
- CRD – Crowding
- DV – Dependent Variable
- ECG - Electrocardiograph
- ESM – Experience Sampling Method
- FA – Factor Analysis
- HM – Her Majesty's
- HSD – Honestly Significant Difference
- NIA – Net Internal Area
- IT – Information Technology
- IV – Independent Variable
- M² – Square Metres
- MMR – Moderated Multiple Regression
- I/O – Industrial/Organisational
- PCA – Principal Component Analysis
- PDA – Personal Digital Assistant
- R&D – Research and Development
- SD – Standard Deviation
- SEM – Structural Equation Modelling

STS – Socio-Technical Systems

UK – United Kingdom

WELL – Wellbeing

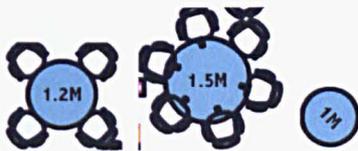
WSM – Work Sampling Method

Appendix A: Office A Time One

Traditional open-plan office configuration:



Key:



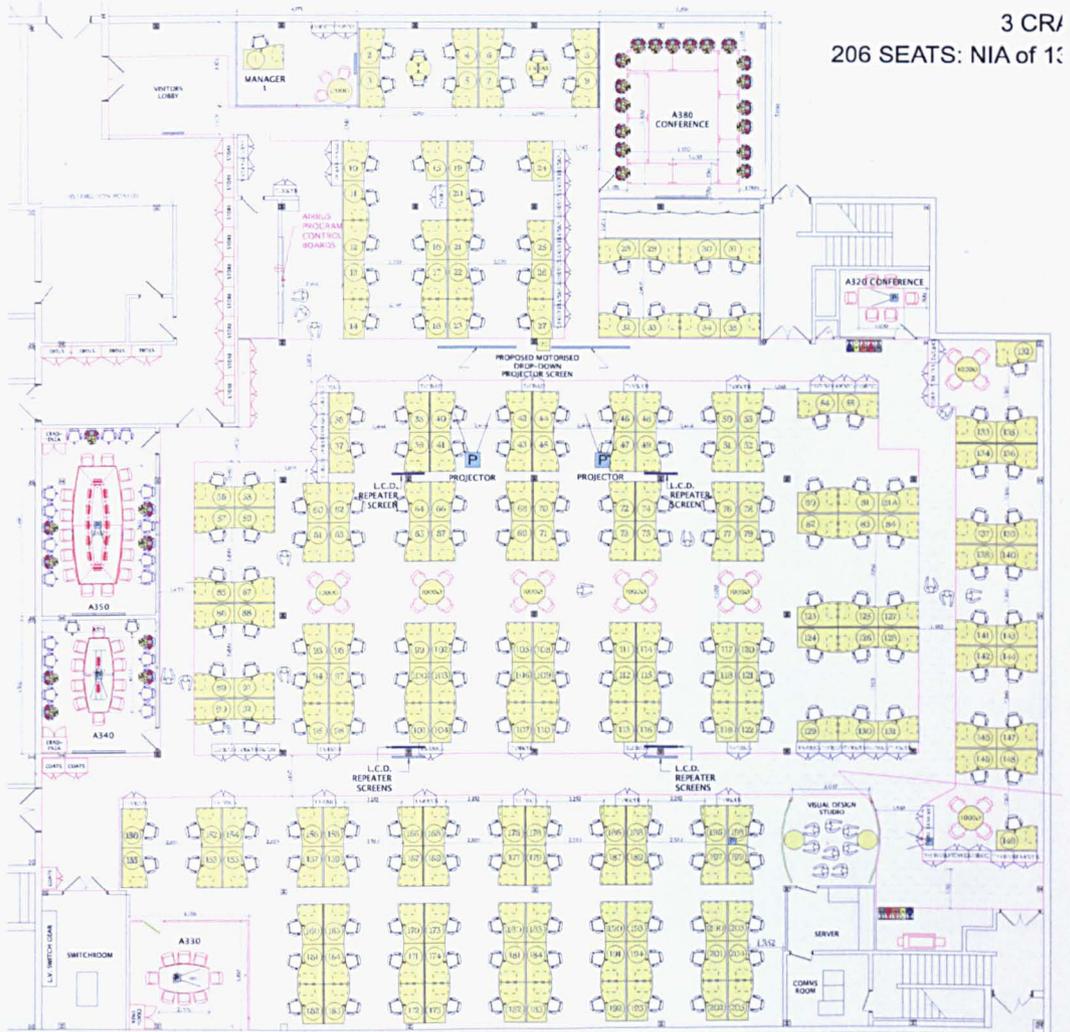
Forms of break-out space



Individual workspace (traditional desks)

Appendix B: Office B

Reconfigured open-plan office:



3 CR/
206 SEATS: NIA of 1:

Key:



Break-out space



Individual workspace (new desks)

Appendix C: Office C

Traditional open-plan office configuration:



Key:



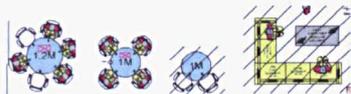
Individual workspace (traditional desks)

Appendix D: Office A Time Two

Reconfigured open-plan office:



Key:



Forms of break-out space



Individual workspace (new desks)

Appendix E: Epistemology

Methodological researchers stress the need to ensure that 'the problem under investigation properly dictates the methods of investigation' (Bryman, 1984, p. p76). With this in mind, the nature of the research problem was considered prior to the selection of the epistemology and corresponding research design.

The research questions considered in this thesis concern the evaluation of reconfigured open-plan. Office reconfigurations or redesigns inherently embody overt, observable changes to the environment. Within open-plan offices, housing large numbers of people, these changes to the physical environment will simultaneously affect numerous occupants. To assess the impact of the physical environment on groups of workers, previous office reconfiguration studies from the organisational and environmental psychology domains have predominantly adopted quantitative research methodologies (De Croon et al., 2005; Oldham et al., 1995; E. Sundstrom & Sundstrom, 1986).

The quantitative paradigm is primarily based upon positivism, 'the view that scientific knowledge is the paragon of rationality' (Howe, 1988, p.13). Sale et al (2002) describe the fundamental ontological position of quantitativism as the belief that the only truth that exists is one single objective reality and that this reality is not dependent upon human perception or subjective experience. From an epistemological standpoint, both investigator and subject are independent of one another and the

methodology employed is often empirical in nature (Howe, 1988). The quantitative approach emphasises the operationisation of constructs, hypothesis testing, causality, objectivity and replicability (Bryman, 1984). Quantitative epistemology leads the investigator to adopt a style of methodology that stresses the objective study of behaviour, stemming from the empiricist philosophical rationale. This meaning that the paradigm requires the investigator to take a detached role, outside of the phenomena being studied and to uses tools of measurement to quantify, that which is being studied (Johnson & Onwuegbuzie, 2004). This appears particularly appropriate where one is examining multiple offices, where overt changes can be observed. Instruments such as surveys, psychometrics and quasi experimentation are often used in such research research, they allow external checks, replicability in other contexts, e.g., across sectors, validity and for the easy application of statistical analysis (Breakwell et al., 1995; Myers, 2007).

Architectural, facilities design and applied psychological studies have employed quantitative research methods, albeit with differing emphasises. In practice, architectural and facilities management post-occupancy studies of office environments are characterised by an emphasis upon comparisons of perceptual measures of the environment itself (e.g., lighting, storage, noise) (Preiser & Vischer, 2005; Walden, 2004; Wineman, 1982). Studies originating from the organisational or psychologically based disciplines have more often instead focussed upon psychosocial reactions to the environment (De Croon et al., 2005; Ferguson & Weisman, 1986), as opposed to perceptions of the physical environment. The intent of the research has been directed less at understanding occupant satisfaction

with the environment (Ferguson & Weisman, 1986), rather towards understanding the interaction and effect that the design of office space may have on individual and work-related outcomes. Evaluations from both traditions have sought to combine perceptual measures with overt evaluations of the environment to produce comprehensive accounts of new office designs. The research studies in this thesis follow this tradition and seek to explore the relationships between the physical environment and worker psychosocial and behavioural outcomes.

1. Introduction

Thank you for taking the time to participate in this study.

Firstly, please take a moment to read the information regarding the study we are conducting, how the results will be used and how you can contact us on the following page.

Next, please create a survey code.

Then, answer all the questions in order (this should take no longer than 10 minutes).

If you need to close the web browser before you have answered all the questions - your answers will automatically be saved and you can complete the survey from the same point, by accessing the website from the original web link you were sent. Please note, you must use the same computer in order for this to work.

Please click the "next button" to proceed to the next page.

2. Research Overview

Information about the study

We are psychologists from the Socio-Technical Centre at the University of Leeds working in partnership with [redacted] to evaluate their newly refurbished and existing office space. This page is designed to provide you with some detailed information about this study.

What is the aim of the study?

To evaluate a range of office types within [redacted], to identify aspects of the physical environment that contribute to worker satisfaction and effectiveness.

Why is this important?

The way in which employees use and react to their physical work environment is increasingly recognised by businesses as a key factor in the success of their project teams. This is underscored by the fact that for most organisations, the physical workspace constitutes their second largest financial overhead. Growing evidence is relating office features and design to outcomes including job performance, motivation and employee well-being. It is estimated that 20% of productivity gains (or losses) may be attributable to the impact of buildings on their occupants.

What does the study involve?

We are asking everyone in key offices (these offices have been chosen either because they have been recently refurbished, are about to be refurbished or are a good comparison to the others) to complete a questionnaire. The questionnaire will ask you to answer questions about: your perceptions of the office environment, how you use the office, your work (e.g. type of work you do and how you go about it) and a few general questions about yourself.

What will the results be used for?

First, the results of this research will be used to identify the most successful aspects of the working environment, helping to inform [redacted] longer-term office refurbishments. This will take account of workers' satisfaction and seek to promote high quality workspace that meets both employee and organisational needs. Secondly, the study will be used as part of a PhD thesis and future academic publications.

Is it confidential?

The investigation is administered independently of [redacted] and all information provided will be treated in the strictest of confidence. [redacted] and everyone who takes part in the study will be informed of the findings of the research. This will be in the form of summary reports. However, NO REPORT WILL IDENTIFY ANY INDIVIDUAL OR TEAM and at no point will your employers be able to view the results of individual workers or their contributions. The research meets the strict ethical guidelines required by the University of Leeds and the professional ethical conditions of the British Psychological Society. All participation is voluntary and there is no obligation to take part.

More information about myself, our research centre and the University of Leeds generally, can be found on our website: <http://www.SocioTechnicalCentre.org>

If you have any further questions, please feel free to contact me using the details provided below.

Thank you in advance for taking part in this project.

Matthew Davis

Email: m.davis@leeds.ac.uk

3. Create a Survey Code

Please fill in the three boxes below to create a survey code.

The unique survey code that is created allows your responses to be matched together over time, whilst avoiding us having to ask for your name or other identifying information.

First Question

The first two letters of the town that you were born in, e.g. DO

First Letter

Second Letter

Second Question

The day of your birth, e.g. 09

First Number

Second Number

Third Question

The first two letters of your mother's Christian (First) name, e.g. PA

First letter

Second Letter

4. About you

Please answer the following questions about yourself.

The following information will not be used to identify you and will never be passed to [REDACTED] in a way that allows you to be matched to your responses. The answers you provide are strictly confidential.

Office Location

Which office do you work in?

Office

Are you:

Male

Female

Your job role

Please select the job type that best describes your role from the drop down list:

Job

Are you in a supervisory role?

Yes

No

How long have you worked for [REDACTED]?

Number of years

5. The Design Phase

On this page and the following ones, you will be asked a number of questions. For each statement you are asked to tick one response, e.g. agree or disagree, which best fits your views.

Please answer all questions as openly and honestly as possible. Respond according to your first reaction. Do not spend too long on one question.

The questions below ask you about your experience during the design of your office space.

To what extent:

	Not at all	Just a little	A moderate amount	Quite a lot	A great deal
Did you receive information about design options during the design of your office space.	<input type="radio"/>				
Did you make decisions about how the office should look or be used?	<input type="radio"/>				
Did you influence the choice of design options for your office?	<input type="radio"/>				
Were you kept informed about how the office space would look?	<input type="radio"/>				
Were the office's design and features explained to you before it was built?	<input type="radio"/>				
Did you take part in activities to determine the layout and use of space in the office?	<input type="radio"/>				
Did you discuss the potential design options with members of the design team?	<input type="radio"/>				
Did you share your thoughts and ideas for the office with your managers or the designers?	<input type="radio"/>				
Were you able to shape the design of your office?	<input type="radio"/>				

6. About your workspace

The following questions ask you to think about the environment in which you work.

To what extent do you agree with the following statements?

	Strongly Disagree	Slightly Disagree	Neither Agree Nor Disagree	Slightly Agree	Strongly Agree
I am often distracted by noise while working in my workspace.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I determine the organization/appearance of my work area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can personalise my workspace.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my workspace, I can often overhear the conversations of my immediate neighbours.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am too exposed to the view of others while in my workspace.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The variety of work environments needed for my job is available to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can hold small, impromptu meetings in my office or work area as needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The office environment allows me to communicate effectively with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am often bothered by visual distractions while working in my workspace.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I am talking in my normal voice in my work space, someone in another workspace can overhear me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can adjust, re-arrange, and re-organise my furniture as needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. About your workspace

The following questions ask you to think about the environment in which you work.

Please rate how satisfied you are with each of the below:

	Very Dissatisfied	Dissatisfied	Neither Satisfied Nor Dissatisfied	Satisfied	Very Satisfied
The quality of lighting in your work area?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The air movement in your work area?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The privacy provided by your workspace?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The overall air quality in your work area?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your access to a view of outside from where you sit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The temperature in your work area?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your ability to communicate with others in your workspace?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of light for computer work?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of lighting on the desktop?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of storage you have in your workspace?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of reflected light or glare in the computer screen?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of space you have for displaying things on notice boards or other vertical surfaces?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
What is your degree of satisfaction with the indoor environment as a whole?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Generally, how satisfied are you with the physical environment in which you work?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. About your workspace

The following questions ask you to think about the environment in which you work.

To what extent do you agree?

	Strongly Disagree	Slightly Disagree	Neither Agree Nor Disagree	Slightly Agree	Strongly Agree
I can communicate effectively with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The storage units (e.g. shelves, cabinets, paper storage devices) are appropriate for the kind of materials I need to store.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can talk with my co-workers in confidence while at my workstation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to contact colleagues whom I deal with frequently.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to re-arrange the furniture in my workspace.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual workstations are located too close to one another.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It's difficult to work at my station because I have to worry about disturbing others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can easily adjust the position of storage units (e.g. paper storage devices, shelves and cabinets).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My office does not have enough space for the number of employees currently working in it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My office area enhances my communication with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am unable to have a personal or private discussion while at work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to reorganise my desk area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel "crowded" while at work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have easy access to other groups and individuals that I interact with frequently.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Where you spend your time.

The following question concerns where you spend your time during the day.

These questions ask where you spend your time and are not concerned with the tasks performed there or the length of the working day. These are purely to help us to understand where people spend their time within the office as a whole and provide a greater understanding of what types of space we need to design into new buildings.

What percentage of your time do you spend in each of the following workspaces (please ensure the amounts entered total 100%)?

Individual Work Space (For example, your desk at which you usually do your computer work)

Formal Meeting Space (For example, the board room or other formal meeting rooms)

Break-out Space (For example, space that can be used for impromptu brainstorming, chats or informal meetings)

Social Space (For example, where you can sit together for lunch or coffee)

Canteen, elsewhere on site

Other Areas (Any area that does not fall into the previous categories, for example, the reception or corridors)

Does your team's workspace include a break-out area (e.g. an area that can be used for informal or spontaneous meetings or chats)?

Yes

No

10. About Your Job

These questions ask you to think about your job role.

To what extent:

	Not at all	Just a little	A moderate amount	Quite a lot	A great deal
Can you control how much work you have to get done?	<input type="radio"/>				
Can you vary how you do your work?	<input type="radio"/>				
Do you plan your own work?	<input type="radio"/>				
Can you control the quality of your work?	<input type="radio"/>				
Can you decide how to go about getting your job done?	<input type="radio"/>				
Can you choose the methods to use in carrying out your work?	<input type="radio"/>				

To what extent:

	Rarely or Never	Occasionally	Often	Very Often	Constantly
Do you find work piles up faster than you can complete it?	<input type="radio"/>				
Do you find yourself working faster than you would like in order to complete your work?	<input type="radio"/>				
Are you under constant pressure at work?	<input type="radio"/>				
Does it seem like you have too much for one person to do?	<input type="radio"/>				

During the last 6 months, to what extent have you:

	Not at all	To a little extent	To some extent	To a great extent	To a very great extent
Thought of new ideas.	<input type="radio"/>				
Had ideas about how things might be improved.	<input type="radio"/>				
Found new ways of doing things.	<input type="radio"/>				

11. How You Feel

These questions ask you about how you feel at work.

During the past month how much of the time has your job made you feel:

	Never	Occasionally	Some of the time	Most of the time	All the time
Tense	<input type="radio"/>				
Calm	<input type="radio"/>				
Relaxed	<input type="radio"/>				
Worried	<input type="radio"/>				
Anxious	<input type="radio"/>				
Comfortable	<input type="radio"/>				
Miserable	<input type="radio"/>				
Depressed	<input type="radio"/>				
Gloomy	<input type="radio"/>				