# INVESTIGATING GESTURE IN CHILDREN WITH AUTISM: DEVELOPMENT, INPUT AND INTERACTION

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# SUMMARY

Early typical gesture development is characterised by deictic gestures, which gradually integrate with speech. Relatively little, however, is known about gesture development in atypical populations. This study traces in detail the pattern of gesture development in children with Autistic Spectrum Disorders (ASD) prior to the two word stage of language acquisition with a specific focus on development, professional and parental input, and adult-child interaction. It extends previous research by combining linguistic and psychological methodologies to provide an in-depth, detailed, longitudinal profile from different perspectives.

Eight participants with ASD were recruited, aged between 2;0 and 3;6 years and were followed for up to eight months during their attendance on a first intervention programme designed to facilitate social and communication skills. The participants' vocabulary and gestural repertoire were assessed on commencement and completion of the project using the Gesture Checklist created for this study using normative data collected from fifty four typically developing children aged 6 to 24 months. During attendance on the programme the participants were recorded weekly alternating between nursery and home. The video data was analysed using micro-genetic and qualitative methods.

The study found that a) *development*: compared to typically developing children the participants were found to be delayed in both vocabulary and gesture, corresponding to the varying impact of their respective impairments, b) *input*: the adults adapted their gestures to the participants, but gesture was not sensitive to the participant's developmental level, c) *interaction*: the adults used several different communication strategies to support the child's interaction, the professionals showing a greater range than the parents.

The study provides a more detailed and in-depth account of gesture development in children with ASD than earlier work, and extends our knowledge of gestural input and gesture in interaction, thus contributing to our wider understanding of both gesture development and its role in communication.

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# Chapter 1

# INTRODUCTION

Gesture studies is a relatively young and exceedingly dynamic field of research, populated by diverse contributors, including linguists, psychologists, anthropologists, neurologists and computer scientists. Gesture has provided insights into the origin of language (Armstrong, 2003; Corballis, 2002) furthered knowledge of the brain and communication (Kelly *et al.*, 2004; Kelly *et al.*, 2007; Lausberg *et al.*, 2007), and given lifelike personas to computer interfaces with artificial intelligence (Wachsmuth, 2008). This thesis explores the development of gesture in young children with Autistic Spectrum Disorders (ASD). This chapter presents the theoretical background which informs the thesis, by providing a general introduction to gesture, ASD and the field of cognitive development research.

## 1.1 Defining gesture

Gesture is a vital part of communication which occurs without conscious thought in everyday conversation. As we talk our hands perform gestures, supporting our thoughts and ideas, but without the grammatical and semantic constraints of speech. Gesture is integral to communication, forming complex relationships to speech. In early development, gesture is one of the first forms of communication to appear.

Gesture is an intentional action, usually performed by the hand or arm in the area of the upper torso, for the most part accompanying speech and often in face to face interaction. We are adept at differentiating between intentional communicative movements and other movements such as mannerisms and fidgeting (Arendsen *et al.*, 2007; Kendon, 1978 cited in Kendon, 2004). Although primarily hand and arm movements, a gesture will be performed by the part of the body which rewards economy of effort with successful communication. The head can be used to mark assent or dissent, or can be used as a means of indicating by tilting and jerking actions. Facial expressions and the direct manipulation of objects are excluded from this definition of gesture.

There are several different forms of gesture. Some gestures, such as HEAD NOD[1], or THUMBS UP can be paraphrased in words; in this case "yes" and "good" respectively. Others are similar to mannerisms, such as repetitive and rapid flicks of the fingers when thinking. However the majority of gestures used by adults contain imagery and support speech, either by reinforcing or providing additional semantic content. These gestures, termed imagistic, are often perceived as idiosyncratic and fleeting and have received the most attention from researchers in recent years.

### 1.1.1 Are gestures communicative?

As interest in gesture deepened a fundamental question concerning the nature of imagistic gesture led to a lively debate throughout the 1990s. Their primary function was unclear; either they were mainly cognitive and facilitated lexical retrieval, or primarily communicative and conveyed additional semantic information not found on the verbal modality. As imagistic gestures are frequent in conversation this was a question which merited immediate attention.

The lexical retrieval hypothesis (Krauss *et al*, 2000) states that gestures are primarily intra-personal; they aid the individual in retrieving words from the lexicon. Support for this position is three fold. Firstly gestures occur, albeit less frequently, in non face to face communicative situations, such as on the phone (Krauss *et al.*, 1996). Secondly gestures containing imagery are difficult to interpret without accompanying speech which leads to the conclusion that gestures are not designed for the recipient, but rather aid the speaker (Krauss *et al.*, 1996; Krauss *et al.*, 1995; Krauss *et al.*, 1991). Thirdly gestures increase during periods of disfluent speech and accompany open class words (Hadar & Butterworth, 1997).

This position has been attacked on several fronts. Gestures may be associated with whole phrases rather than single words (McNeill, 1992) and contain additional information to speech which is treated as communicative by the interlocutor (Beattie & Shovelton, 1999). If the lexical retrieval account is correct then gesture will be implicated in the successful resolution of tip of the tongue (TOT) states, yet no significant correlation has been found (Beattie & Coughlan, 1999). Gestures are designed with the recipient in mind in terms of orientation (Ozyurek, 2000) and content (Bavelas *et al.*, 2002 -b). By the end of the decade the evidence firmly

[1] The convention of referring to specific gestures by capital letter to differentiate from speech will be adopted for the purposes of this thesis.

supported the communicative argument, although most researchers acknowledge that there is some truth in the claim that gestures aid lexical retrieval. This conclusion is influential in the understanding of gesture in this thesis which addresses the question of how gesture as a communicative form develops.

### 1.1.2 The development of gesture

Given that all gesture is primarily communicative, it follows that gesture is likely to feature amongst early communication attempts by the child. Gesture links to early socio-communicative development and is present in pre-verbal children as a means of social interaction before language is available. Early gestures include requesting or showing objects and pointing (Blake & Dolgoy, 1993.; Blake *et al.*, 2005). Gesture also plays a role in the support of first words and in the transition to two word speech (Butcher & Goldin-Meadow, 2000; Capirci *et al.*, 2005; Iverson *et al.*, 1994; McEachern & Haynes, 2004; Pizzuto & Capobianco, 2005).

Whilst much is known about this period of gesture development in typically developing children, interest is beginning to widen to children with communication disorders. Thus far gesture has been studied in relation to Down's Syndrome (Iverson *et al.*, 2003), Williams Syndrome (Bello *et al.*, 2004), aphasia and Specific Language Impairment (Fex & Månsson, 1998). This thesis develops this line of research and considers gesture development in relation to children with Autistic Spectrum Disorder (ASD).

## 1.2 Autistic Spectrum Disorders

ASD is a developmental disorder affecting social and communicative abilities in the child. ASD has received considerable research interest since its identification in the 1940s. This introduction gives a brief account of our developing understanding of this disorder.

### 1.2.1 A brief history of ASD

Two founding papers on ASD were published almost simultaneously; the first by Kanner (1943) and the second by Asperger (1944). In his influential paper Kanner identified two key features, *extreme autistic aloneness* and an *anxiously obsessive desire for the preservation of sameness.* Many of Kanner's insights continue to inform current practice and understanding of this disorder, however he also noted that his sample of eleven children all had highly intelligent and professional parents, and although Kanner never endorsed such a view, unfortunately his observations grew into the "refrigerator mother" theory which claims that the cause of ASD is an unloving and threatening environment (Bettelheim, 1956, 1967; cited in Happé, 1994). This idea influenced early intervention (Rutter, 1999) and proved difficult to discredit.

Throughout the 1970s and early 1980s attention turned to documenting and fully investigating the core behaviours of ASD. This effort resulted in a seminal paper by Wing and Gould (1979) where the phrase "triad of impairments" was first coined. This phrase refers to the three core areas of difficulty for individuals with ASD, namely social development, communication and imagination in the form of repetitive behaviour and obsessive interests (Rutter, 1999). Additionally other associated features include a desire for routine, savant abilities, excellent rote memory, preoccupation with parts of an object, improved perceptual discrimination, and impaired generalisation of knowledge (Happé 1994). ASD is a developmental disorder with a broad phenotype. In order to capture some of this diversity autism has been reclassified as Autistic Spectrum Disorders, an umbrella term which encompasses ASD, atypical autism, and Pervasive Developmental Disorders (PDD). Current research is concerned with exploring the borderlands of ASD and other related disorders, such as Asperger's Syndrome and Pragmatic Language Impairment (Bishop, 2000; Bishop *et al.*, 2000; Botting & Conti-Ramsden, 2003).

### 1.2.2 The three levels of autism

Since its identification, a wealth of research has been devoted to furthering our understanding of ASD. As a neurodevelopmental disorder ASD can be considered on several different levels, the biological, or medical model, the behavioural level, and the cognitive level. Each approach has yielded different insights into the nature of ASD.

Beginning with the medical model, estimates for the prevalence of ASD vary from 30 to 60 cases per 10,000 (Rutter, 2005), ASD occurs in all families and cultures. It appears that the prevalence of ASD has increased in recent years, although this may be partially accounted for by more accurate identification, especially in the milder cases (or high functioning autism). A neurobiological basis for ASD is now firmly established, and it is likely that multiple genes are implicated. The relevance of genetics as a cause can be seen as ASD is four times as common in boys as girls, and it is five to ten times more frequent in siblings of individuals with ASD than in the population at large (Frith, 2003). There appears to be some links between ASD and other brain abnormalities as there is a high incidence of epilepsy associated with ASD (Levisohn, 2007), and the incidence of ASD increases as IQ decreases (Happé, 1994). Despite this correlation impaired IQ is not universal across individuals with ASD. It is believed that the frontal cortex and brain stem may be affected (Rutter, 1999). Pre and peri-natal difficulties can also lead to ASD.

The better understanding of the causes of ASD has led to increasingly developmentally focused interventions which operate at the behavioural level. Intervention programmes aim to promote social and communicative abilities and provide a structured environment. Diagnosis is made on the basis of behavioural information, with reference to the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, 1994) or the 10th edition of the World Health Organisation's International Classification of Diseases (ICD-10, 1992). In order to be diagnosed with ASD children must show impairment in all three areas of social development, communication and imagination. Currently reliable diagnosis occurs at the age of two to three years, often initiated by a delay in the development of language. Parents frequently report social difficulties experienced by the child prior to diagnosis. In the cases of high functioning autism or Asperger's Syndrome diagnosis may not occur earlier than five to nine years old. As there is some indication that the earlier the intervention begins the better the outcome, efforts are currently underway to gain reliable diagnosis at eighteen months old (Charman *et al.*, 2002).

Three influential cognitive accounts have been proposed to explain the behavioural profile of ASD. The social impairment is commonly attributed to deficits in the development of a theory of mind; that is the ability to understand that others may hold different beliefs to yourself. The ability to infer another's thoughts forms the bedrock of our social interactions. The desire for sameness, need for routine, and repetitive and stereotypical actions have been related to deficits in executive functions. These are higher order cognitive processes which determine priorities, plan actions, and control the ability to switch between tasks. The third proposal, weak central coherence, claims that people with ASD have a processing style biased towards fine detail rather than global information. This may account for generalisation difficulties and preoccupation with, often seemingly irrelevant, details. As cognitive development is atypical in ASD it is necessary to have a framework with which to relate this development. The formulation of such frameworks will be the focus of the next section.

## 1.3 Approaches to development

Development can be considered as a series of changes which add complexity to the internal structure of a system (Bates & Elman, 1993). Change is induced by input and development leads to a gradual convergence on the final steady state. There is little debate that children are predisposed to acquire language and to develop cognitively, but what is debatable is the nature and role of the input. Such questions have been central to the discussion of cognitive development through out the twentieth century, and are of continuing relevance in contemporary research.

### 1.3.1 Founding models of cognitive development

Two highly influential models of cognitive development are those proposed by Piaget (1967) and Vygotsky (1962). These far-reaching theories have guided research since their acceptance, and continue to shape current thought. Piaget and Vygotsky sought to explain cognitive development in very different ways; Piaget emphasising the child's actions on the world, and Vygotsky concentrating on social interaction mediated by language.

According to Piaget a child develops cognitively through interacting with the physical world in self-directed problem solving activities. The child progresses through different stages of development which unfold in a predetermined sequential order. Piaget claimed that these stages are global across all development. The child is incapable of learning concepts, or forming representations which are associated with a stage which is in advance of their current development. This has immediate and obvious implications for teaching. Although children may appear to have learnt novel concepts, they may be reciting the correct answer from memory, whilst the underlying concept remains elusive. The most crucial input from this perspective is the child's interaction with the physical world. The social input, that provided by parents, teachers and peers becomes secondary.

Some aspects of Piagetian theory have not stood the test of time. Experimentation has shown that children have more innate ability than Piaget believed. The concept of global stages has been segmented into domains of cognition. Thus linguistic knowledge is distinct from social knowledge, which again is distinct from knowledge of the physical world. Instead of holding one generalised theory, the child may hold multiple theories, each corresponding to a different cognitive domain.

Vygotsky believed that human knowledge originates in socially meaningful interaction. Cognitive development begins externally through social interaction, which is then transferred to an internal process which leads to development of higher cognitive processes such as problem solving. Central to Vygotsky's theory is the concept of the zone of proximal development. This refers to abilities and tasks which are just beyond the scope of the child, but which can be successfully completed with help. It is social interaction, both formal and informal, which comprises the essential input. The adult scaffolds the child's emerging behaviours by using their expertise to simplify tasks, thus making them attainable to the child. Vygotsky's reflections on the cognitive development of the child were by no means complete, meaning they are open to many interpretations (Wood, 1998).

### 1.3.2 The influence of computers

Both Piaget and Vygotsky proposed their frameworks before computers became an essential part of life. As computers became more commonplace they provided an ideal analogy for the way the brain processes information, which in turn led to further advances in cognitive development modelling. The original goal of information-processing models was to explain the data collected under a neo-Piagetian framework, in terms of the growth of information processing abilities. Such models share two fundamental components: the available memory storage of the child and the level of complexity at which the child is capable of processing information. Both of these increase with age. Development can be viewed as changes in one or both of these components, thus separating such effects became the central research question, for example by specifying the conceptual complexity of a given task.

One of the challenges for the information-processing approach is to closely integrate the models with advances in neuroscience and biology. Connectionist modelling has arisen partly as a response to this challenge. Connectionist models attempt to replicate the processing style of the brain through neural networks. The network is endowed with information through initial connections and algorithms through which the system learns when presented with stimuli. The system develops more connections thus increasing the complexity of the network as further stimuli are presented. This can be seen to replicate the human brain, as the initial network represents innate abilities, stimuli is the input and algorithms may indicate operating constraints which lead to the most efficient learning from the child. This process may also give insights into atypical development, by manipulating the initial state or algorithms to replicate the difficulties experienced by the child.

### 1.3.3 Contemporary models of cognitive development

Our current understanding of cognitive development can be seen as a hybrid of key aspects of earlier theories. From Piaget the notion that the child learns through actions and experience is retained. Vygotsky contributes the acknowledgement that social interaction and language is central to development. Connectionist modelling has shown us that learning is incremental, context-dependent and fragmentary, but results in a causally coherent framework of knowledge. Finally information-processing models reveal the nature and range of the higher-order cognitive processes necessary for the organisation of the child's experiences. Thus the child is born with innate capabilities and core principles which allow them to make efficient use of all experiences, be they physical, emotional, social or cultural, in order to further their knowledge and learning.

The development of gesture in children with ASD will be investigated within this newly emerging framework. In order to fully explore gestural development, three separate strands will be pursued. The first concerns the child's own learning, termed hereon development, the second is the gestural input of the adults, and thirdly adult-child interaction will be considered as the interface between the first two strands. It is hoped that this will provide supporting evidence for the view of development described above. A secondary investigative theme will be the role of gesture in intervention programmes designed for children with communication disorders.

## 1.4 Outline of thesis

The thesis aims to give a full exploration of the development of gesture in children with ASD from pre-verbal to two word communication. Chapters 2 and 3 provide a detailed review of gesture and ASD. Chapter 4 presents specific research questions and methodologies. Chapter 5 assesses the participants' gesture by means of a checklist developed for this project. The three main strands of development, input and interaction are investigated in turn in Chapters 6, 7 and 8. Results are discussed separately in Chapter 9 before the strands are unified in further discussion. Finally conclusions are drawn in Chapter 10.

# A REVIEW OF GESTURE AND ITS DEVELOPMENT

This chapter aims to introduce current research into gesture. It is divided into three main sections. The first defines gesture and limits the scope of the study. The second section reviews current research into the adult gestural system, finally the development of gesture in the early years is reviewed.

## 2.1 The borderlands of gesture

A broad definition of gesture was given in the previous chapter, yet gesture shares many features with other non-verbal communication, sign language and body language resulting in difficulties in precisely defining boundaries. This section will consider similarities and differences in an attempt to draw a line between gesture and other behaviours.

### 2.1.1 Gesture and sign

For native sign language speakers there is a clear difference between gesture and sign (Hoiting & Slobin, 2007), but this distinction is not so evident when the first language is a spoken, rather than signed language. Gesture and sign belong to a continuum of communication using the manual modality, shown in Figure 2.1 (based on Kendon, 1982; developed by McNeill, 1992).

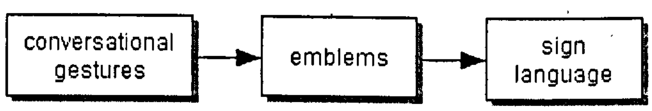



**Figure 2.1: a continuum of communication using the manual modality**

The term *conversational gestures* applies to a constellation of gestures most often used in conjunction with speech in face to face interaction (see Section 2.2.1.1). They highlight spatio-motoric aspects, such as size, shape, location, speed and direction of an utterance (Kita & Ozyurek, 2003), this is demonstrated in Figure 2.2 by a gesture describing a spiral staircase. The forefinger draws a helix travelling upward accompanied by the words "those winding stairs in the church tower". The geometry of the staircase is represented through gesture. Speech is required for the correct interpretation of the imagery of these gestures.

*Emblem* is a term first used by Efron (1941 [1972]). These gestures are culturally specific (Morris, 1979) and have a precise, paraphrasable meaning, resulting in the possibility of autonomous use. Some examples are the thumbs up sign for "OK", the thumb rubbing on the tips of the fingers of a curled hand for "money" (Kendon, 2004), and the South African black urban youth sign for "street wise" – the little finger and thumb extended with the rest of the fingers closed (Brookes, 2005). It should be noted that all gestures (conversational and emblems) can occur in conversation.

The final step on the continuum is sign language. These include fully fledged languages such as British or American Sign Language (BSL and ASL) and sign languages for specific and restrictive use, such as gestures for crane operators, or those used by monks with a vow of silence (Kendon, 2004). Manual sign systems are used to support language for individuals with communication disorders. Examples are Makaton (Grove & Walker, 1990), a manual sign system used with individuals with learning difficulties, and Babysign (Pizer *et al.*, 2007) which is used to promote communication with pre-verbal children.

Figure 2.2: imagistic gesture for SPIRAL STAIR

Figure 2.3: imagistic gesture for ROLL DOWN

The continuum varies along five measures: autonomy to speech, conventionality (McNeill, 1992), hierarchical structure, the ability to segment, and the timing of delivery (Grove, 1997). Conversational gestures rarely occur in isolation from speech. They form an ancillary system to the main verbal modality. A similarly formed gesture can result from very different verbal descriptions. Consider the spiral staircase gesture in Figure 2.2, with a gesture describing the movement of a ball rolling down a hill (Figure 2.3). Both gestures have an extended index finger describing circular motion, they differ only in orientation; one vertical, the other diagonal.

Sign language is completely autonomous from speech, can express meaning in all contexts and has no restrictions. It achieves autonomy from speech through high levels of conventionality. Similar to spoken language, sign languages are highly codified and abstract. Emblems form a middle ground. They are also highly conventional which allows independence from speech, but the meaning becomes highly dependent on the correct form. When diving the gesture for everything being OK is to touch the thumb to the fore finger creating a circle whilst the other three fingers are extended. Any deviation from this, for instance touching thumb to ring finger or not extending other fingers, negatively impacts on the interpretation of the meaning. The further from the target form the less likely it is that the gesture will be understood. In contrast conversational gestures tend to be fluid and dynamic, with far greater tolerances in terms of interpretation.

The remaining three measures all reflect the increasing language-like properties of sign compared to gesture. Sequences of conversational gestures occasionally occur. There is no hierarchical structure governing the combinatorial order. It is rare for multiple emblems to occur together. In contrast, sign language is subject to syntactic structure. Signs can be segmented into smaller units of meaning, equivalent to the morphology of spoken language. The ability to segment and recombine allows greater flexibility. This ability is lacking in gesture, where movements tend to be global representations of spatio-motoric information. Finally the morphological and syntactic element of sign language leads to signs being delivered with utterance-like timing. The delivery of gesture is dependent on the patterns of the accompanying speech.

So in conclusion there is a clear theoretical, if not practical, divide between signs and gestures. For speakers who have knowledge of sign systems such as Makaton, there is an inevitable amount of influence on gesture: the Makaton sign PIG is a movement of the fist in a circular motion around the nose. Although the iconicity of this sign is evident, it is not immediate. In other cases such as BOOK the Makaton sign (both hands held palm together then moved away from each other as if covers of an opening book) may be indistinguishable from a gesture produced by someone with no knowledge of Makaton.

### 2.1.2 Gesture and non-verbal communication

Non-verbal communication provides additional resources for interaction. Many of these resources are interwoven in conversation, and together form the fabric of communication. By no means exhaustive, the main additional contributors are eye gaze, facial expression and body language.

Eye gaze is a crucial aspect of face to face interaction. It either initiates or deliberately rejects interaction (Finnegan, 2002). Mutual eye gaze allows monitoring of the other, and can invite responses from a listener (Bavelas *et al.*, 2002 -a). Young children follow the eye gaze direction of adults, and respond to such attentional cues as if it were a pointing gesture (McGregor, 2008).

Body language and posture can reveal much about a person's internal state. It is sometimes difficult to draw a distinction between body language and gesture. Mannerisms, fidgeting and postural shift, whilst undeniably communicative, are not gesture. Gesture is an intentional communication, it is central to the main conversational thread, which other bodily movements are not (see Clark, 1996 for a detailed discussion). Although a precise and non-subjective division between these behaviours is hard to formulate, in practice human beings excel at the interpretation of bodily movements (Arendsen *et al.*, 2007).

### 2.1.3 Gesture and play

Prior to the age of 12 months sensorimotoric play dominates. Children will explore, bang or shake objects. From 12 months functional play develops. Objects, such as a car, are used as they would be in real life (Mayer & Musatti, 1992). It has been argued (Escalona, 1973 cited in Capone and McGregor, 2004) that these play schemes are early gestures; an enactive name of the object. There is evidence to suggest that these play schemes do have some relationship to first words as children with larger vocabularies can engage in incongruent play schemes, e.g. using a toy car as a phone or perform a play scheme on a featureless object, such as using a brick as a car (Bates *et al.*, 1980; cited in Capone & McGregor, 2004). By 20 months children begin to replace these play schemes with empty handed versions (Capirci *et al.*, 1996; J. M. Iverson *et al.*, 1994). The empty handed versions are increasingly symbolic and there is a general consensus that these are gestural.

## 2.2 The adult gesture system

The focus of this section is to define gesture in terms of form and function. This leads to a review of the literature regarding gesture's relationship with speech, insights which culminate in proposals for the processing architecture underlying speech and gesture. The final part moves toward gesture development as it considers gestural changes apparent in child directed talk.

### 2.2.1 Categorising gesture

This section will review existing gesture categorisation schemes, firstly the form, then function. The final part discusses a possible combination of the two approaches and implications for the conceptualisation of gesture.

#### 2.2.1.1 Gesture form

McNeill (1992) devised a comprehensive typology of gesture form. Conversational gesture is subdivided into three different forms: deictic, imagistic and beat gestures (Figure 2.4).

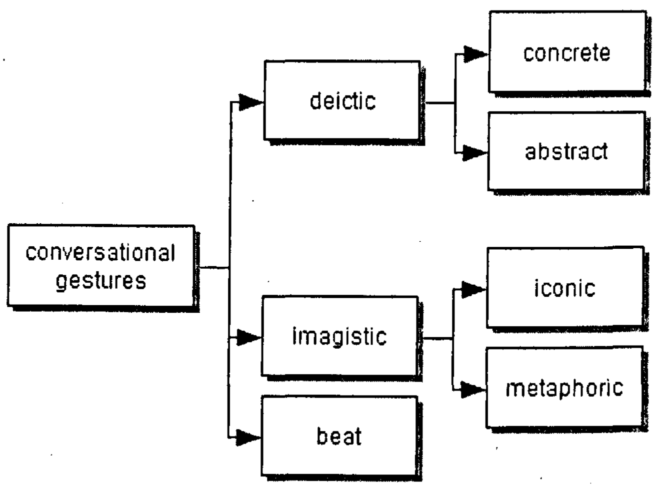



**Figure 2.4: categorisation of conversational gestures**

Deictic gesture is used to identify a referent, most commonly by pointing. Deictic gestures can be concrete or abstract. Concrete deictic gestures indicate a real world object or location. Abstract pointing is used to delineate a spatial area to represent the topic of conversation, i.e. a downwards point referring to *here and now* compared to a backwards point referring to some event in the past.

Imagistic gestures bear some semantic relation to the speech they accompany. As with deictic gestures these are further divided into iconic and metaphoric. Iconic gestures represent concrete real world actions or objects, such as imitating the action of unscrewing a jar lid. Metaphorics represent abstract concepts, such as the horizontal spread hand quickly and repetitively raising and lowering through $45^{o}$ with the meaning that something is borderline (Kendon, 2004).

Beats are rhythmic, repetitive and rapid movements, such as a flick of the fingers. They coincide with stressed syllables (Krauss *et al.*, 2000) and are used to emphasize speech.

In this categorisation there is some overlap between form and function. Deictic gestures are locational or provide specification, yet are similar in form as a body part extends towards the referent. Iconic and metaphoric gestures may provide imagery but they tend to be double handed, tracing fluid and non-repetitive movements. It seems that form and function may cleave along similar lines. As a consequence of distinguishing by form these categories are mutually exclusive.

#### 2.2.1.2 Gesture function

An alternative approach is to classify according to the function gesture fulfils in conversation, allowing for multiple functions. Theoretically functional analysis of gesture requires several assumptions (Gerwing, 2007). Firstly that gesture is social and communicative, secondly that it is part of a collaborative achievement of interaction, thirdly that it is sensitive to contextual influences, and fourthly that it is systematic.

The functions of gesture can be identified objectively by analysing the immediate context, prior and subsequent conversational turns and the accompanying speech. No *a priori* scheme of gesture coding is imposed on the data. A subset of data is analysed inductively which leads to coding definitions and procedures applicable to specific research questions. Initial coding schemes can be refined by returning to the data, before application to the full data set. .Thus coding schemes are individually tailored to each data set and research question.

Bavelas and colleagues have used this approach to show that beat gestures have a pragmatic purpose, managing conversational strategies through turn-taking (Bavelas, 1994), and that gestures are sensitive to common ground becoming less complex, precise or informative when there is shared knowledge (Gerwing & Bavelas, 2004). Furthermore gestures varied within a single speaker dependent on whether the information was new (resulting in larger, clearer, more complex gestures) than when the information was previously given.

This approach highlights the complexity inherent in human interaction, and provides clues towards the role of gesture in communication.

#### 2.2.1.3 Gestures do contain some conventionality

Kendon (2004) has linked both form and function by developing the idea of gesture families. For example the "palm up" family have the function of receiving or inviting, the "palm down" family, contain the idea of stopping or interrupting. The palm up or palm down orientation is incorporated into different hand forms. Kendon cites twelve different variations of the palm down family, with meanings ranging from command, to rejection, and separation. This observation indicates that there are conventions governing gesture choice. This conclusion runs counter to many theories of gesture (Goldin-Meadow, 2003; McNeill, 1992) but is a reasonable supposition. Gestures produced by different people are strikingly similar. Consider again the SPIRAL STAIR gesture (Figure 2.2). There are many ways that the stairs could be represented gesturally. The fore and index finger could be made to walk up (or down) each stair; or the hand could be moved as a fist, as opposed to extension of the finger. If the production of iconic gestures is truly spontaneous, immediate and idiosyncratic then surely differences should occur frequently?

Little is currently known about the generation of gestures, as yet no intelligent (AI) system can spontaneously produce gestures that humans will understand (de Ruiter, 2007). Research in this area proposes that gestures are constructed from a pre-existing repertoire of gestural elements (Calbris, 1990; cited in de Ruiter, 2007). Gesture generation is likely to be constrained by shared knowledge of highly salient features and conventions for the representation of this information.

### 2.2.2 Gesture and speech

The overwhelming majority of gestures in the adult system occur with speech. An early and particularly striking finding in gesture research is the close temporal association between speech and gesture (McNeill, 1992). The stroke (main movement) of the gesture is timed precisely with the relevant tone unit (identifying the nucleus of the utterance through analysis of intonation) of the accompanying speech. This is preserved by the gesture being held motionless, before or after the stroke, in order to coincide with the phonological peak syllable when necessary.

In a single utterance both modalities share a common semantic theme. In imagistic gestures the gestural modality carries information which reinforces or adds to speech. A commonly quoted example (from Ozyurek *et al.*, 2005) is that of a gesture which depicts an object rolling down a hill, with accompanying speech: "it rolled down the hill". The gesture encodes the speed of the rolling object, the length of the hill, the steepness of the incline etc. (Figure 2.3). In this example manner (rolling) and path (down) are encoded on both modalities yet gesture provides additional spatio-motoric information which is not verbally apparent.

Gesture form can be influenced by linguistic features of its associated language. In a cross linguistic study Ozyurek *et al.* (2005) compared English to Japanese and Turkish speakers. In English path and manner can be encoded in a single clause (bounced across), whereas Japanese and Turkish require separate clauses (move across in a bouncing fashion). English speakers tended to combine path and manner into a single gesture (such as the ROLL DOWN gesture in Figure 2.3). The other speakers produced two separate gestures, one representing path and the second manner. Lexical differences were also preserved, therefore speakers of English would use the verb swing accompanied by an arcing gesture, languages which did not have a comparable verb were more likely to result in a straight gesture. These results indicate that there are linguistic influences on gesture form.

Further evidence for the closeness of language and gesture can be found in the study of communication disorders. When the verbal modality is unavailable the gestural system adapts and takes on a greater role in communication. This is true of aphasia (Goodwin, 2000) and of deaf children of hearing parents (Goldin-Meadow, 2003). Perhaps the most convincing evidence for a closely allied verbal and gestural communication system comes from disfluent speech. When speech is disrupted in stammering the hand performing a gesture also freezes for the duration of the disruption. Both restart simultaneously (Mayberry & Jaques, 2000).

Additional support for the close relationship of speech and gesture is provided by recent research on mirror neurons. Mirror neurons are neurons located in Broca's and Wernicke's area which are activated both on the production and perception of meaningful manual and mouth actions (Rizzolatti & Arbib, 1998). Mirror neurons may provide clues about the origins of language as means of a social communication (Rizzolatti & Arbib, 1998). Mirror neurons are implicated in the recognition of gesture as emblems, mannerisms and actions on objects all activate a similar network (Villarreal *et al.*, 2008). However recognition of emblems was found to also activate areas of the brain relating to semantic retrieval. This agrees with a second study (Skipper *et al.*, 2007) where gestures were presented with speech. The authors conclude that the mirror system is involved with both the extraction of semantic information from iconic gestures, the integration of the information into the process of speech comprehension and that the mirror neuron system may be dynamic depending on the motivations and goals of the individual.

### 2.2.3 Theories of speech and gesture production

The apparent unity of speech and gesture raises questions of production in terms of planning and execution. Processing architectures can be formulated to address these questions. In a review of current proposals de Ruiter (2007) emphasises the division between proposals which posit an ability to generate gestures compared to those where gesture is idiosyncratic and spontaneous. All architectures are configured to be compatible to Levelt's (1989; developed in Levelt *et al.*, 1999) speech processing model. Two will be discussed here; the Window Architecture and the Unified Architecture.

The Window Architecture is named from the metaphor that gesture is a window on the mind, that gesture provides a glimpse of the speaker's thoughts. It is associated with Growth Point Theory (McNeill, 1992; McNeill & Duncan, 2000), and endorsed by Beattie (2003). There are several stages in the realisation of speech resulting from thought. Firstly thought has to be translated into communicable form. This occurs in the conceptualiser (Figure 2.5 and Figure 2.6) involving macro-planning (what will be communicated) and micro-planning (how it will be communicated). The resulting concept is sent to the formulator. The formulator retrieves the appropriate lexical entries, incorporates them into a syntactic framework, checks morpho-syntactic agreement and finally a motor programme is generated which results in overt speech. Speech is conventional and hierarchical which creates the need for the formulator. In contrast, for proponents of the Window Architecture, gesture is neither of these. It therefore bypasses the linguistic structure and, consequently, may betray the hidden thoughts of the speaker.

There are several problems with this proposal. Firstly gesture is assumed to be intentional communication which directly contradicts the proposition that gestures are unintentional slips. This architecture does not allow the linguistic structure to influence gesture form, and thus is unable to account for the cross-linguistic variation in gestural depiction of manner and path (Kita, 2000). Finally it is not clear at which point thought is converted into a motor programme corresponding to the production of a gesture.

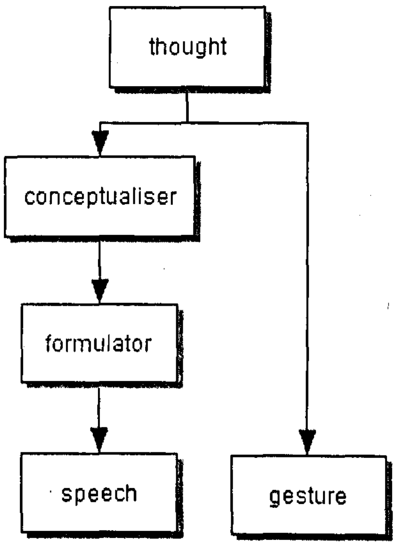


**Figure 2.5: Windows on the Mind Processing Architecture**

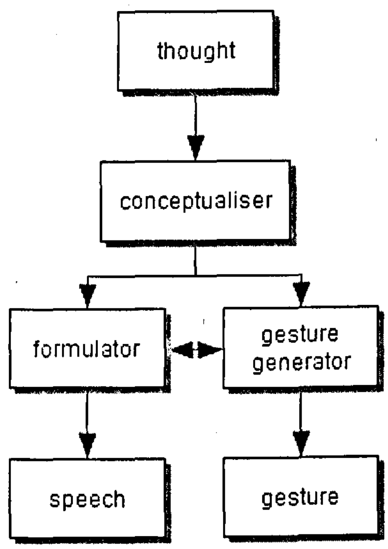


**Figure 2.6: Unified Processing Architecture**

The Unified Architecture (Figure 2.6) combines aspects of the Interface Hypothesis proposed by Kita *et al* (2007) and the Sketch Model proposed by de Ruiter (2000). The first transformation of thought into communicable form occurs in the conceptualiser. Relevant parts of the utterance are selected for gestural representation, accounting for the semantic coherence observed between speech and gesture. Conversion of concept to gesture occurs in the gesture generator. This involves blending gestural features from the gestural repository, hand allocation, environmental constraints to constrict the gesture to available gesture space, recipient design including the number and location of recipients and the generation of a motor programme. Suggesting that the gesture generator and formulator are linked provides a mechanism for the linguistic influences on gesture form to occur. It also allows the two motor programmes (verbal and gestural) to be executed in unison, thus explaining the temporal synchronicity between speech and gesture.

The evidence points to a strong link between gesture and speech. Gesture production is a complex process, closely aligned to the speech process. The window on the mind metaphor does not seem able to account for the linguistic influences on gesture, nor the tailoring of gesture to the recipient. The alternative architecture has the capacity to account for the complexities of the relationship between speech and gesture, suggesting that the two modalities are different aspects of the same underlying communicative system.

### 2.2.4 Child-directed gesture

The role of gesture in child-directed speech has not been extensively researched. The two main areas of focus are firstly systematic changes in gesture in child–directed interaction and secondly the role that gesture plays in ostensive naming. Each will be discussed in turn.

Speech is adapted when used in conversation with young children. This is a consistent feature across European and Asian languages and is often referred to as "motherese". Speech becomes syntactically simplified, vocabulary and propositional complexity is restrained, speech becomes more fluent and more accurate and is primarily concerned with the immediate context (Snow, 1995). By extension gesture may also be subject to similar adaptation. In short, is there a "gesturese" and if so in what ways does gesture change?

This question was first investigated by Bekken (1989) who found gestural differences between adult-adult and adult-child interaction. Gesture was less frequent in the adult-child condition, and deictic gestures increased whilst iconic gestures decreased. Iverson *et al* (1999) and Ozcaliskan and Goldin-Meadow (2005) have extended this early work. Iverson *et al* studied maternal gesture in Italian speakers, a culture known to be gesture-rich (Kendon, 2004). They recorded children in spontaneous free play with their mothers at 16 months and 20 months of age. Ozcaliskan and Goldin-Meadow recorded American children and caregivers, recording dyads when children were 12 months, 18 months and 22 months old. Similar results were obtained by these two studies. No changes were discernable in the gestural input regardless of developmental changes in the children. Therefore neither age, nor linguistic development, affects the gestural input from the adult. Secondly, large individual differences were discovered across the adults, but these remained stable within the individual, thus reflecting individual interacting styles.

Adults use relatively little gesture when interacting with young children (15% of utterances contained gesture in the Iverson *et al* study, and 10% in the Ozcaliskan and Goldin-Meadow study). Gesture is overwhelmingly combined with speech. The cross-modal combinations were examined for the internal relationship between gesture and speech. Three different combinations were coded. Gesture was used to *reinforce* speech when it conveyed the same semantic information (point at dog and say dog). Gestures *disambiguated* speech when used with deixis, pronominals or attention-directing expressions (point with "there", "yours" or "look!"). Finally gesture *supplemented* speech when gesture provided additional semantic information not encoded on the verbal modality (point to food and say "hot"). Reinforcing combinations were the most frequent. In terms of the types of gesture used, deictic gestures were the most common, with some emblems and occasional iconic gesture, confirming the earlier findings of Bekken (1989).

A third study (O'Neill *et al.*, 2005) investigated the effects of two different situations on maternal gestures. English children were recorded at 20 months old in two conditions; free play with their parent or engaged on a counting task (counting the number of toys in three different baskets). No changes were found in gesture rate, gesture type or relationship to speech across the two conditions. Earlier findings of large individual difference amongst the mothers were replicated, and these differences remained stable across the conditions. The prevalence of deictic gestures and the tendency of gestures to occur with speech were also confirmed. However this study did demonstrate some differences when compared to the previous two. The gesture rate was much higher (29% for the free play condition, and 28% for the count task). Disambiguating cross-modal combinations were more frequent than reinforcing ones. This is likely due to coding differences, as the criteria for disambiguating gestures were not restricted to deixis, pronominals, or attention-directing expressions. Instead it was formulated as "identify[ing] the precise referent of a verbal utterance" (O'Neill *et al.*, 2005 p. 355) conceivably including the majority of combinations classed as reinforcing under the alternative coding system. The authors account for the increased gesture rate by hypothesising that English mothers use an increasingly didactic interaction style.

Taken together these three studies do indicate that adults adapt their gestures when interacting with young children. Gesture becomes less frequent, is almost entirely used with speech and reinforces the verbal modality. Gestures tend to be deictic, conceptually simple and are tied to the immediate context of the interaction. Such changes do not seem to be sensitive to developmental changes in the child's age or linguistic ability.

The second line of inquiry concerns the role of gesture in labelling and naming. Namy *et al* (2000) investigated parents' use of verbal and gestural labelling to their 15 month old children. They recorded mother child dyads in two conditions; a picture book task and free play. The book consisted of pictures of objects likely to be unfamiliar to the child, half with stereotypical actions associated with them, the other without. Parents preferred to use verbal labelling through out the task, but gestural labelling increased on objects with associated stereotypical actions. Gestures were accompanied by speech. In the free play condition verbal and gestural labelling were used in approximately equal amounts. However the coding system included object manipulation. Empty handed gestures accounted for only 1% of all instances of labelling.

Schmidt (1996) considered the role of deictic gestures to direct attention in naming events with children at three different ages (10, 15 and 18 months). Three gestures were considered, DISPLAY (holding an object up to draw attention to it) which indicated objects, DEMONSTRATION (representational gesture) which focused on actions, and POINTING which referred to locations or an object. Contact points referred to part of the object (e.g. the jack in a jack-in-the-box) and distal points to the whole object. In this study an effect of age was found. Mothers tended to name objects to the youngest children by using display gestures, but demonstrated actions whilst naming to the older age groups. Pointing was rarely used with the youngest children.

These two studies show that gesture combines with words to both direct the child's attention and to provide an alternative form of labelling. Thus it seems that adults not only adapt gestures when interacting with a child but also use them to scaffold naming acquisition.

## 2.3 The child's gestural system

There is a complex interplay between speech and gesture in adults. The development of this system will now be presented, commencing with the comprehension of gesture in young children. This will be followed by a review of gesture development in the first two years of life. The section concludes with a discussion of the relationship between developing gesture and cognition.

### 2.3.1 Gesture comprehension

The study of gesture comprehension is a difficult problem. Gesture is rarely presented without speech, making it extremely difficult to determine if the child truly understands the gesture, or is reliant on the verbal modality. On the other hand, if gesture is divorced from speech, as is often the case in experimentation, the resulting tasks are so removed from natural communication that, at best it does not reflect the true ability of the child, and at worst taps into a different ability altogether. It will require an ingenious experimental design to ascertain the extent to which gesture contributes to meaning for young children. The following is a review of the studies which have been brave enough to tackle this problem thus far.

A few researchers have considered comprehension of iconic gestures. Striano *et al* (2003) used a forced choice design to test the effects of modelling on children aged 1;8 and 2;2 years. The children were presented with four common items. In one condition the items were used functionally (e.g. a hairbrush stroked along the head); in the second they were indicated and named but not used. The children were then asked for one of the objects by substituting an empty handed gesture depicting the action associated with that object into the linguistic frame (e.g. please give me the object that does BRUSH HAIR). At the younger age the gesture was associated with the action of the object, but was not symbolic of the object itself, whereas by 2;2 years the children did understand the naming gesture.

There are two ways in which these gestures can be modelled; either with a body part as the object (BPO); a clawed hand running through the hair to represent the bristles of the brush, or as an imagined object (IO); the hand depicts the action of hair brushing as if it is holding a brush. O'Reilly (1995) had shown that children aged three find BPO gestures easier to understand than IO gestures. By the age of five this difference had disappeared. The Striano study used IO gestures alone. Taken together, the results of these two studies indicate that iconic gestures depicting actions are difficult for children to understand without speech.

The comprehension of emblems was the focus of investigation for Smith and Bryson (2007). The mean age for the group of twenty participants was 6;6 years. They checked that each child could name six gestures, before presenting the child with three drawings showing the gesture in an appropriate context; e.g. waving as somebody leaves the house, as an inappropriate communicative gesture in the same context and a movement that was not a gesture. The child was required to select the correct picture. Although this task eliminates any verbal element it does rely on considerable social knowledge and thus would be difficult to replicate with younger children. All children showed good comprehension of emblems.

Deictic gestures lend themselves more readily to comprehension experiments, perhaps due to their increased autonomy from speech. Baron-Cohen (1989) investigated comprehension of pointing gestures with 27 typically developing children, mean age 4;5 years. The children were asked to paraphrase the experimenter's gesture. Imperative (to obtain an object) and declarative (to share experience) pointing were included. A full discussion of imperative and declarative pointing is given in Section 2.3.2.2. The child was deemed to understand the gesture if they provided a verbal response, translated the point or acted upon the request. Baron-Cohen found that all children could interpret both imperative and declarative pointing correctly (however see Chapter 3, Section 3.5.1 for a critique of this study). Kelly (2001) used semi-structured interaction to investigate comprehension of indirect requests. During the course of the interaction he presented six indirect requests in three conditions; speech and gesture, speech alone or gesture alone. Gesture was found to facilitate speech.

There is some debate over the relationship between comprehension and production of pointing gestures. Carpenter *et al* (1998) found that comprehension marginally precedes production, however Desrochers *et al* (1995) found the opposite but only considered declarative pointing. Camaioni *et al* (2004) used a larger sample and tested imperative and declarative pointing separately. They also found that comprehension preceded production for both functions of gesture. Butterworth (2003) has shown that comprehension of proximal points (to objects nearby) precedes distal points (objects further away).

Morford and Goldin-Meadow (1992) considered the comprehension of speech and gesture. During interactive play they presented several requests to the child in three conditions, speech without gesture, reinforcing cross-modal combinations and supplementary cross-modal combinations. All children were producing only single words, and were aged between 1;2 and 2;4 years. They found that gesture facilitated comprehension with both the reinforcing and supplementary combination conditions showing significantly more correct responses from the child than the speech alone condition. Increased success rate on the supplementary condition demonstrates that children integrated information across modalities. Deictic gestures were the most beneficial for comprehension. Action words were understood, but the corresponding iconic gestures were not; it seems for this age group, iconics hinder comprehension.

### 2.3.2 Gesture development

This section will consider gesture in terms of social and communicative development from birth to school age. Firstly the discussion will concern the emergence of joint attention behaviours and pointing. Language begins to develop in the second year, accordingly the focus shifts to the relationship between emerging verbal and gestural systems. Two main themes will be discussed, firstly the relationship between iconic gestures and first words, and secondly how gesture supports the acquisition of linguistic structures. Finally there will be review of the continuing development of gesture after the age of two years.

#### 2.3.2.1 The development of joint attention

Joint attention refers to the ability to attend to an object, whilst being aware of another's attention on the same object. This forms the core of social interaction in humans, and is considered necessary for language acquisition (Tomasello, 1992). There are several methodological issues concerning the identification of joint attention in children. Firstly each must be aware that the other is attending and therefore an element of monitoring the other person should be displayed. Nor is it sufficient for one person to be watching another playing with an object, as the actor is not monitoring the attention of the observer. In adult-child interaction it is commonly assumed that the adult is engaged in joint attention, but it is not so easy to decipher the child's behaviour.

Triadic interaction refers to the ability of the child to attend to both another person and an object. This is not synonymous with joint attention, as triadic interaction does not include the stipulation that both participants must monitor the other. Sensitivity to triadic interaction occurs at an early age in children. This is most often tested by the following of the experimenter's eye gaze to an object. There are several levels of complexity within this paradigm, including conservative or liberal coding criteria, location of object and the use of multiple or single objects. In the simpler versions of this experiment children as young as three months have been found to follow eye gaze (D'Entremont, 2000). This is a developing ability; by six months children can follow the direction of eye gaze, but focus on the first object in their path, regardless of the object that the adult is looking at. By 12 months the correct target is identified, and by 18 months the children can also locate an object placed behind them (Butterworth & Jarrett, 1991). Butterworth (2001) has named these three phases as ecological, geometric and representational. Moll and Tomasello (2004) used barriers to block the child's line of sight to the object. At twelve months children crawled around the barrier to find the object that the adult was looking at.

#### 2.3.2.2 The development of pointing

Another indicator of joint attention skills is pointing. Pointing first emerges between 8 and 15 months, with the majority of children pointing at 11 months (Butterworth, 2003; Camaioni *et al.*, 2004). In a review of the gestures used by apes, apes raised by humans, children with ASD and typically developing children, Tomasello and Camaioni (1997) found triadic distal pointing differentiated the apes from humans. There are two main types of pointing gesture. The first, imperative pointing, is used to obtain a desired object. As such it requires the understanding of others as causal agents capable of making things happen. Imperative pointing is believed to develop out of reaching and grasping behaviours (Carpendale & Lewis, 2006). The second type of pointing gesture is declarative. Declarative gestures are used to direct another's attention to an interesting object or event, and require the understanding of another as having intentions and attitudes which can be shared (Tomasello & Camaioni, 1997). Declarative pointing may have grown out of finger tip exploration.

Imperative pointing develops prior to declarative pointing (Camaioni *et al.*, 2004). In a series of experiments Liszkowski and colleagues (Liszkowski, 2005; Liszkowski *et al.*, 2004; Liszkowski *et al.*, 2006) suggest other pointing functions including points to repair misunderstandings in proto-conversational turn-taking, to provide information to help others and to self-direct.

In linking pointing to joint attention, the ability of the child to assess the effect of their point on their interlocutor is vital. This is done by visual checking; the alternation of gaze between the interlocutor and referent. In a longitudinal study Desrochers *et al* (1995) found that the onset of pointing is 12 months, whereas pointing with visual checking occurs at 15 months. In a further cross sectional study by Franco and Butterworth (1996) visual checking was found to increase with age. In the 12 month old group children looked at the adult after performing the point, at 14 months old the point and visual check were performed together, and at 16 months the children looked at the adult immediately prior to pointing. The developmental progression of visual checking was not replicated in a longitudinal study (Haynes *et al.*, 2004) with monthly sampling.

#### 2.3.2.3 Interpreting joint attention behaviour

Other joint attention skills include social referencing and imitative learning. Social referencing refers to the ability of the child to take emotional cues from a parent when faced with new experiences. Imitative learning involves using a strategy modelled by another to solve novel problems. Both of these appear developmentally at around nine months to one year of age. Tomasello and colleagues (Tomasello, 1995) offer a rich interpretation of these behaviours. They argue that many joint attention behaviours appear simultaneously in development (competent gaze following, pointing gestures, social referencing, and imitative learning amongst others) which corresponds to an underlying revolution in the understanding of the intentions and attitudes of others. They present an analogue argument; the child understands its own intentions and attitudes and through this applies the knowledge to others. Such a view naturally leads to dissent. Similar behaviours can also be interpreted in terms of a lean view, as that taken by Carpendale and Lewis (2006). They point to the evidence for a gradual development of gaze following, from three months onward, similarly for the gradual development of pointing combined with visual checking. Moore (1998) criticizes the central tenet of the rich interpretation claiming that whilst nine month old children are intentional, it does not lead to the assumption that they are aware that their actions are intentional. There is little conclusive evidence for either position. A conservative conclusion is that the evidence is not substantial enough to justify assumptions of conceptual leaps when gradual development can lead to similarly large changes.

Joint attention is vital for the acquisition of language (Tomasello, 1992). In a series of experiments Baldwin (1995) examined the sensitivity of children to joint attention situations in the context of language learning. Children ignored decoupled word learning (e.g. parent talking on phone whilst the child is playing), discrepant labelling (parent labelling a different object to the one the child is looking at), and children were able to differentiate between referential and non-referential tasks. Joint attention forms a valuable resource in the acquisition of language, which will be considered next.

#### 2.3.2.4 Indications of an early link between vocalisation and hand movement

Children begin a period of canonical babbling between the ages of six and nine months. Canonical babbling consists of reduplicated sounds identifiable as consonants and vowels within a syllabic structure ([bibi], [dada]). Canonical babbling is considered a major milestone for language development, but can also be seen as one of a family of rhythmically organised, stereotyped movements (such as movements of the limbs). There is some evidence that there is a link between speech and gesture even at this young age, as the onset of canonical babbling coincides with a marked increase in arm shaking occurring simultaneously to the vocalisation (Iverson *et al.*, 2007). This argument is strengthened by findings from a previous study (Iverson & Fagan, 2004), namely that vocal-manual co-ordination is more likely with one arm rather than both, that index-finger extension is related to babble (Masataka, 1995) and that manual movements either slightly precede or are temporally synchronous to the vocal counterpart, similar to the distribution found in adult speech and gesture (Nobe, 2000). Thus by the onset of the first words and gestures the link between the hand and mouth is well established.

#### 2.3.2.5 The first words and gestures

In pioneering studies Bates and colleagues (Bates *et al.*, 1979; Bates *et al.*, 1975) documented early gestural behaviour. The repetition of behaviours which have gained the child attention in the past is one of the first manual means of communication to emerge. This precedes requests and protests. Requests include reaching for something, ritualised requests (opening and shutting the fingers of the hand whilst reaching) and physical prompts (moving the adult's hand to an object to achieve an action). Protests include turning, pushing or pulling away, hitting and kicking or head shaking (Blake *et al.*, 2005). Such gestures emerge at around 9 to 10 months old.

Other common early gestures are showing (lifting an object up and showing it to someone), giving (handing an object to another person), raising arms to another as a request to be picked up and emotive gestures (Blake & Dolgoy, 1993.). Emotive gestures include bouncing, flapping arms and clapping or clasping hands. Emotive and reaching gestures tend to decline from around 11 months (Blake & Dolgoy, 1993.; Blake *et al.*, 2005) as pointing gestures increase. As discussed previously pointing gestures begin to emerge around 9 months and are well established at a year old.

Children produce their first words at around 10-12 months. After a relatively slow start their vocabulary undergoes rapid expansion at approximately 18 months. About the time the first words appear, so too do the first representational gestures. These early iconic gestures are generally strongly stereotyped and include flapping arms to represent a bird, or using the arm as an elephant's trunk. The emergence of symbolic labelling in either modality is dependent on underlying cognitive abilities also developing at this time. Symbolic labelling in the gestural modality appears to marginally (but significantly) precede the verbal modality (Goodwyn & Acredolo, 1998).

The two modalities do not remain equivalent in terms of labelling. In a series of studies Namy and Waxman (1998, 2002) introduced children aged 18 months and 26 months to object categories using novel words or gestures (e.g. blik and a dropping motion for fruit). They found that at 18 months children accepted both gestures and words as novel names for the categories, but at 26 months gestures were no longer accepted as names. In considering their spontaneous production gestures were found to be used referentially at 18 months, but non-referentially at 26 months. In contrast words were used referentially through out. The authors claim that their results indicate that gesture moves from a stand-alone representational system to an augmentative form of communication. This interpretation has been extended (Namy *et al.*, 2004) with the discovery that four year old children once again accepted gestures as referential. They conclude a U-shaped developmental function, where children pass through a period of rigid expectations on symbolic reference forms, before appreciating the communicative intent behind non-conventional means of representation. The use of event-related potentials (epochs of neural activity time-locked to a particular event) has shown that at 18 months gesture and words activate shared neural systems, but at 26 months these have diverged (Sheehan *et al.*, 2007) with only words showing the congruency effect.

#### 2.3.2.6 Transition from one to two word speech

The transition from one- to two-word speech has been the focus of numerous studies. Children's vocabularies undergo a rapid expansion from 18 months onwards, and shortly after this two word combinations begin to occur, also increasing rapidly from onset. Iverson *et al* (1994) recorded 12 Italian children in spontaneous play at 16 and 20 months. They found several differences in the use of speech and gesture between these two ages. At 16 months half the children had more gestures than words. Yet there was minimal lexical overlap between words and gestures. Gestures were primarily deictic. At 20 months despite an overall gestural increase, the use of gesture had declined with respect to speech. Growth in gesture was attributed to increased frequency of pointing gestures, rather than an expansion of the gestural repertoire.

These results were corroborated by a later study (Capirci *et al.*, 2005) which followed 3 Italian children, recorded monthly, from 10-23 months old. Gesture without speech was found to be the most frequent communicative act prior to the age of 14 months. Single words and cross-modal combinations appeared approximately simultaneously for all participants. They emerged around 12 months, although age of onset varied. Words and cross-modal combinations increase in frequency at a similar rate to each other. They become the favoured communicative form at 15-17 months old. Once single words and cross-modal combinations form the majority of the communicative acts, two word combinations emerge. This leads to three different relationships between gesture and speech; 10-14 months gesture is preferred, 15-17 months gesture and speech are equally distributed, and post 17 months words are preferred. Gestural levels remained steady throughout the study, but verbal levels increased.

Returning to the 12 participants recorded at 16 and 20 months, the research team reanalysed the data, focusing on combinations of gesture and speech (Capirci *et al.*, 2005). They conclude that cross-modal combinations are more prevalent than uni-modal combinations[2] for children at 16 months. Capirci *et al* (1996) extended the terms (reinforcing, disambiguating and supplementary) to include uni-modal combinations. All three types were present at 16 months. Most frequently deictic gesture was combined with a representational word. Whilst iconic gestures were much less frequent than deictic gestures, the Italian children produced far more than similarly aged American children (Morford & Goldin-Meadow, 1992). The authors attribute this to the gesture-rich Italian culture.

Similar studies have also been undertaken with American children. Butcher and Goldin-Meadow (2000) followed six children from the age of 12 to 27 months, recorded (in most cases) fortnightly. As with previous studies gesture without

[2] For the sake of clarity, combinations will be referred to as reinforcing, disambiguating or supplementary regardless of the various terms employed by different research groups

speech, though initially dominant, declines in favour of cross-modal combinations. Additionally they found that temporal synchronicity within cross-modal combinations improves over time. The point at which synchronised cross-modal combinations became more frequent than gesture without speech also coincided with the first gesture and meaningful word (as opposed to vocalisations) combination and is termed the convergence point. All gesture-meaningful speech combinations were reinforcing. Supplementary combinations emerged later and, in turn, predicted two word combinations.

McEachern and Haynes (2004) replicated these findings with ten children, aged 15-21 months, recorded monthly. Two word combinations increased from 18 months, but were preceded by an increase in supplementary combinations. At an individual level supplementary combinations either preceded or were recorded simultaneously with two word combinations for each child. Pizzuto and Capobianco (2005) also provide corroborative evidence. They report an increase in two word combinations from 18 months, based on six children followed monthly from 12-24 months. Initially high, reinforcing combinations start to decline at approximately 16-17 months, and subsequently remain low. Supplementary and disambiguating combinations increase from 15 months, only to plateau at 18 months, as two word combinations appear. In line with other studies they found that most combinations consist of a deictic gesture and representational word.

Butcher and Goldin-Meadow (2000) provide an interesting interpretation for these results. They suggest that speech and gesture are initially separate systems and that the convergence point reflects integration of these two systems. Post-integration both modalities are available to a single utterance hence the increase of supplementary combinations where a single semantic idea is spread across two modalities. Eventually two elements are combined on a single modality (two word speech).

The second part of the argument seems irrefutable. It is easier to encode a single idea across two modalities, in preference to encoding on one. To point at a book and say "mine" is easier to process than the phrase "my book". Sharing across modalities lightens the cognitive load as elements can be synchronised without recourse to hierarchical structure and less strain is placed on memory due to the reduced conventionality of gesture compared to words. The ability to combine components on a single modality arrives with the onset of two word speech. Indeed

Ozcaliskan and Goldin-Meadow (2005) provide evidence that such a strategy is replicated with the acquisition of syntax. They show that three structures (argument+argument(s), predicate+argument(s) and predicate+predicate) all appear in cross-modal distribution prior to the verbal modality alone.

The proposal that the gesture-speech systems integrate deserves further exploration. Butcher and Goldin-Meadow (2000) claim that the convergence point reflects a fundamental organisational change in the gesture and speech systems. It is at this point that a single, adult-like system is formed. Supporting evidence is drawn from the increasing temporal synchronicity and developing semantic coherence of cross-modal combinations. Unlike reinforcing combinations, in supplementary combinations both the gesture and speech must contain meaning, in order for two elements to be combined semantically. Therefore supplementary combinations are not possible prior to the onset of first words. Butcher and Goldin-Meadows' hypothesis predicts that words and gestures will emerge approximately together (but see Goodwyn & Acredolo, 1993 for possible onset advantage for gesture) but independent of the other. Non-synchronous reinforcing combinations will emerge first, and become synchronous prior to the emergence of synchronous supplementary combinations. This leads to testable claims, firstly that words will appear appreciably before reinforcing combinations, secondly the first reinforcing combinations will be non-synchronous and thirdly the first supplementary combination will be temporally synchronous from onset.

The results from Capirici *et al* (2005) lead to alternative conclusions. These results suggest that independent gesture use precedes independent word use, and that words and cross-modal combinations emerge at approximately the same time. In effect the child is using any and all resources for communication, combining both words and gestures as soon as they become available. This indicates there is some integration between speech and gesture from the outset. The significant change is not integration, but the ability to combine two *separate* components of a single idea across modalities. This interpretation leads to the prediction that firstly gesture will appear without speech, secondly that there will be no appreciable difference between the onset of words and of cross-modal combinations. It should however be noted that these children were recorded monthly (as opposed to fortnightly) so slight differences between the onset of words and cross-modal combinations may have been missed. Further discussion of the processing architectures underlying speech and gesture will be returned to in Section 2.3.3.3.

#### 2.3.2.7 Gestures after 2 years old

Gesture continues to develop after the age of two years. At three years old most iconic gestures are produced as Body Part as Object (BPO), but by five years children spontaneously produce Imagined Object (IO) gestures (O'Reilly, 1995). A young child's gesture is more exuberant than that of an adult. Initially gestures exist in three dimensions, to the utmost reach of the child, in contrast to adults' two dimensional gestural space, limited to the upper torso area (McNeill, 1992). Children become more adept at using the gesture space and gestures move from being highly pantomimic, to becoming more refined and abstract. Before reaching school age beat gestures emerge (Nicoladis *et al.*, 1999). These gestures do not carry semantic information, but mark emphasis, and manage conversational interaction.

| Age (months) | Social | Gesture | Language |
|---|---|---|---|
| 1-6 | Rudimentary gaze following | | |
| 6-8 | | Increase in rhythmic arm movement | Canonical babbling |
| 9-10 | Social referencing<br>Imitative learning | Comprehension of pointing (proximal precedes distal)<br>Requests and protests<br>Pointing without visual checking (imperative precedes declarative)<br>Emotive gestures | |
| 10-14 | Gaze following to second object, or crawl around barrier<br>Social referencing | Decline of reaching and emotive gestures<br>Iconic gestures<br>Gesture and speech independent<br>Reinforcing combinations | Production of first words |
| 15-17 | | Naming gesture and words in equal distribution<br>Supplementary combinations begin to increase<br>Convergence point possible | |
| 18-20 | Gaze following to location behind the child<br>Joint attention established | Visual checking used with pointing<br>More naming words than gestures<br>Convergence likely to have occurred | Rapid expansion of vocabulary<br>Two word combinations |
| 21-24 | | Iconic gestures no longer interpreted as referential | |
| 2-5 years | | Iconic gestures develop from BPO to IO<br>Iconic gestures re-interpreted as referential<br>Gesture space becomes more restricted<br>Beat gestures emerge | Development of syntax |

**Table 2.1: social and communicative development**

#### 2.3.2.8 Summary

This has been an extensive discussion of the development of gesture relating it to social and language development. Main points are summarised in Table 2.1.

During the first year gesture and social development are most closely aligned. The child begins to interact with others by following their gaze and begins to assign intentions to others. Early gesture is characterised by emotional displays, requests and protests and the emergence of pointing. In the second year gesture becomes increasingly related to language. First words and iconic gestures emerge, both used to refer to objects, although gestures lose this function by the second year. Cross-modal combinations emerge, and by two years the child is combining semantic elements in the verbal modality alone. In the pre-school years the child's iconic gestures become more abstract and once again take on a referential meaning. Beat gestures, associated with emphasis and pragmatic ability emerge.

### 2.3.3 Gesture and cognition

This section will discuss research linking gesture to other cognitive domains. First to be considered is gesture as a predictor of language ability and secondly gesture as an indicator of the child's potential to learn. These separate accounts will be united through a discussion of the processing architecture of speech and gesture in the developing child. Finally gesture's role in language intervention will be considered.

#### 2.3.3.1 Gesture as a predictor of language development

Gesture has long been known to be an indicator of later language development. Late talkers featuring high levels of iconic gestures, and who use gesture to answer questions, are likely to catch up with their peers (Thal & Tobias, 1992). Children who do not show compensatory strategies in gesture remain delayed at follow up. The use of sequences of symbolic gesture also differentiates children who catch up from those who do not.

It is now well established that supplementary gestures predate the onset of two word speech (Butcher & Goldin-Meadow, 2000; McEachern & Haynes, 2004). Iverson and Goldin-Meadow (2005) raised the question of whether supplementary gestures not only predate but also predict two word speech. They found that onset of supplementary combinations was significantly correlated to onset of two word speech, whereas the onset of reinforcing combinations was not. They conclude that it is the ability to combine two different elements within a single communicative act that predicts the two word stage, and not the ability to produce gesture and speech together. Iverson and Goldin-Meadow (2005) found a mean of 2.3 months between onset of supplementary combinations and onset of two word speech, which may be reassuring when taking a clinical view but has limited applications for therapy.

Capobianco *et al* (2007) addresses the issue of prediction over a longer time span. Cross-modal combinations were assessed statistically for ten participants at three age points (12, 15 and 18 months). Language development was measured at 2;0 years in three ways, onset of two word speech, verbal complexity (frequency of multi-word utterances) and word repertoire. Both reinforcing and supplementary combinations predicted language development. Reinforcing combinations at 12 and 18 months predicted verbal complexity and word repertoire, whilst supplementary combinations, as expected, predicted the onset of two word utterances. This line of research has interesting potential and deserves to be investigated further. It implicates the use of deictic gestures, more frequently observed in the child's production than iconic gestures. It would be interesting to determine the predictive power of gesture, particularly if the correlations persist beyond the two year mark.

#### 2.3.3.2 Gesture as an indicator of the potential to learn

Thus far three different combinations between speech and gesture have been discussed; reinforcing, disambiguating and supplementary. There is a theoretical fourth combination; speech and gesture contrast each other, providing conflicting semantic information. Such combinations do exist, and have been termed mis-matches (Goldin-Meadow, 2003). Mis-matches occur when children are asked questions about problem solving tasks. Problems which have been studied include Piagetian conservation tasks (Church & Goldin-Meadow, 1986), mathematical equivalence sums of the sort 7+2+3=?+3 (Goldin-Meadow *et al.*, 1993), and symmetrical and asymmetrical balance beams (Pine *et al.*, 2004). Children can be either concordant or discordant (Alibali & Goldin-Meadow, 1993). The concordant group are characterised by complementary words and gestures, the discordant group by contrasting words and gestures. For example in the balance beam task, the fulcrum will change depending on length and weight. Children may give a verbal response indicating that beams balance in the middle, whilst gesturing about weight or distance. These children are believed to be simultaneously accessing two different representations about balance (Alibali & Goldin-Meadow, 1993); one expressed verbally and the second expressed through gesture. Mis-matches indicate a potential to learn, discordant children respond better to instruction than concordant children (Goldin-Meadow, 2003; Pine *et al.*, 2004). Gesture speech mis-matches are not restricted to children, with appropriate tasks they have been found in adults (Alibali *et al.*, 1999) although the generalisability of this is in some doubt (Addison Stone *et al.*, 1992).

All previous studies rely on dual representations arising from the participants' degree of knowledge. Thurnham and Pine (2006) extended this research by inducing dual representations in their participants. They assigned children (aged five years) into one of three conditions each of which narrated a story, the first a false belief, the second a true belief, and the third an extended true belief in order to control for the added complexity of the false belief story. In the false belief story Suzie left her cat in her bedroom then left the room. While she was gone the cat left the bedroom for the kitchen. On Suzie's return she is surprised to find the basket empty. In the true belief story Suzie returns to her bedroom to find the cat, and in the extended version they play in the garden. In the false belief condition participants were expected to hold two representations; one corresponding to the true belief that the cat was in the kitchen and the second to the false belief that Suzie thought the cat was in the bedroom. Few instances of gesture-speech mis-match were found, but dual representations did lead to a significant increase of gesture.

One way that gestures may ease the cognitive burden is by reducing pressure of the working memory (Goldin-Meadow, 2000). Gesture has been found to facilitate counting (Alibali & DiRusso, 1999) by invoking visual-spatial memory which removes some of the loading on verbal memory, thus freeing this resource for the processing of more complex syntactic structures. By analogy a similar process could account for the increased levels of gesture found in the children holding dual representations.

#### 2.3.3.3 Development of the processing architecture of speech and gesture

From the discussion of the development of gesture and its role in cognition there are two main research findings that the processing architecture must be able to incorporate. The first concerns the assumption of integration prior to the onset of supplementary gestures and the second is gesture-speech mis-matches. Each will be discussed in turn.

The assumption that speech and gesture are initially two systems which integrate to form a unified whole is intuitively pleasing, but requires a single, substantial and fundamental change in the communication and processing of the child. If, as discussed previously, it is hypothesised that speech and gesture are a single system from much earlier in development this large fundamental shift in the underlying processing architecture is no longer required. Instead gradual development of all the components of the system leads to large overall changes. At the earliest stage the repackaging of thought for communication (as occurs in the conceptualiser) is basic, resulting in global representations which are directed to either the formulator, resulting in verbal output, or the gesture generator, resulting in gesture. This corresponds to the observed period when gesture and words are used independently.

The emergence of reinforcing combinations corresponds to the conceptualiser sending the repackaged communication to both the formulator and gesture generator simultaneously. Exactly how this process unfolds is still in some doubt. If, as shown by Butcher and Goldin-Meadow (2000), reinforcing combinations are initially temporally non-synchronous this indicates that the links between the conceptualiser, formulator and gesture generator take time to fully develop. Once these links are fully established cross-modal combinations become synchronised. The data reported in Capirci *et al* (2005) indicates that full links between the three components are established from the start, resulting in synchronous cross-modal combinations from onset.

The developing ability of the conceptualiser to repackage thought into segments most appropriate for the verbal or gestural modality leads to a single semantic idea shared across modalities: a supplementary combination. These are temporally synchronous from onset as the links between the formulator and gesture generator are previously fully formed (as demonstrated by synchronised reinforcing combinations). Gesture is now available as a means to express constructions currently beyond the scope of the language. The appearance of two word speech is due to development within the formulator and the beginning of competence with the hierarchical structure of syntax.

Gesture-speech mismatches are often interpreted in light of the windows on the mind metaphor. At the conceptualisation stage the child has access to two representations applicable to the resolution of the problem. The speaker may betray the less well-formed representation through their gesture, as semi-formed representations appear in the less conventionalised, spontaneous and idiosyncratic modality. As discussed previously whilst gestures are less conventionalised and more global when compared to speech, they may not be entirely spontaneous and idiosyncratic. Furthermore gesture can represent semi-formed ideas without invoking the window on the mind metaphor. Despite the added (possibly implicit) levels of complexity inherent in the alternative architecture, the gestural modality lends itself to the expression of impressionistic ideas. For example a gesture can represent the importance of weight to locate the fulcrum of a balance beam, without full understanding that weight is also related to distance.

Supposing a discrepancy between the levels of understanding of dual representations, two predications can be formed. Firstly one representation will be limited solely to gesture, whilst the other may be expressed through any modality, and secondly, the less understood representation will be expressed through gesture. The first is confirmed as more representations are expressed through the gestural modality alone compared to the verbal or combined modalities (Goldin-Meadow *et al.*, 1993). The second prediction was addressed by testing the implicit knowledge of the child (Garber & Goldin-Meadow, 2002). When presented with different strategies to solve maths problems, participants accepted most answers as correct if they had previously expressed that strategy in both speech and gesture, fewer if they had expressed the strategy in the gestural modality alone, and fewest as correct if they had shown no previous evidence of that strategy. Thus gesture can reveal implicit knowledge. It seems that the reduced conventionality of gesture does lend itself to the expression of semi-formed representations.

#### 2.3.3.4 Does gesture have a role in language intervention?

The absence of spontaneous gesture production in young children is known to be an indication of possible later language difficulties (Olswang *et al.*, 1998) especially if it is coupled with a word comprehension delay (Bates & Dick, 2002). As previously reviewed there is considerable evidence that speech and gesture are closely related from the very early stages of language acquisition. The reduced conventionality and visible (thus imitable) nature of gesture makes it an attractive option for use in intervention.

Deictic gestures are known to help word learning in joint attention contexts. In a recent study (McGregor, 2008) this relationship was considered in light of informing speech and language therapy practices. Four different deictic gestures were used when introducing a novel object to children aged between 28-31 months old. The four gestures were eye gaze towards the object, eye gaze and point, eye gaze and touch (pointing finger makes contact with toy), and eye gaze and manipulation (finger moves toy). The control group received no gesture when naming the novel object. Knowledge was tested by providing different objects and requesting the named object (give me the koobs). All children who received gestural input performed above chance, with a large increase between eye gaze alone and eye gaze combined with other deictic gestures. Deictic gestures help direct children's attention so that they can more readily map words to referential categories.

It is more usual to consider how iconic gestures may facilitate word learning. Goodwyn *et al* (2000) investigated the effects of a gesture-rich environment on language production. Over a hundred 11 month old children were divided into three groups: sign training, no intervention, and verbal training. Parents in the no intervention group were not aware of the researchers interest in either gesture or language development, parents in the sign training group were asked to model eight target gestures daily, the third group were asked to verbally model eight target words daily to control for any effects arising from intervention. The children were tested at 15, 19, 24 and 30 months on a range of language measures. No effects were found between the two control groups. The children in the sign training group were significantly better in terms of language comprehension, verbal production, and had higher Mean Length of Utterance (MLU) scores, although no significant difference was found in terms of the longest utterance. The effects were strongest at the younger ages, and by 36 months the difference was no longer significant. Symbolic gesturing fast tracks children into language, even if the effects are not long term. This study relied on parents modelling gestures to their children, but similar improvement on word learning by using gestural modelling has been found in an experimental training and test design (Capone & McGregor, 2005), and in an gesture-based intervention for at-risk quadruplets (McGregor & Capone, 2004).

It is important to note that in all cases gesture is used with speech to reinforce language. This is a consistent feature of child-directed gesture, Iverson *et al* (1999) suggests that the processing of gesture without speech may be difficult for the child. Gesture as intervention appears most relevant pre-linguistically and during acquisition of first words. Once children begin to use symbolic gestures they will elicit further verbal modelling from the adults as the adult elaborates on the child's communicative attempts. Likewise the child has more control over topic selection, thus creating favourable opportunities for word learning. The advantage observed in language measures may be due to these factors, which arise as a consequence of increased use of gesture. It does not seem likely that gestural based communication will compete with conventional manual sign systems (such as

Makaton and Sign Supported English) which are currently employed for older children and adults.

## 2.4 Summary

This chapter sought to introduce current research in the area of gesture studies. Firstly a definition and the scope of gesture were discussed. It was argued that gesture is primarily communicative, and three different classifications of gesture were presented. These were a consideration of the form of gesture, the functions of gesture and arguments for a degree of conventionality in gesture, even though this moves away from pioneering work on gesture analysis.

The second part of the chapter was devoted to a discussion of gesture in the communication of adults. The extremely close links between gesture and speech were discussed, with particular attention to the temporal synchronicity and semantic coherence of gesture and speech. Cross linguistic studies were reported, which demonstrated linguistic influences on the form of gesture. This review led to a discussion of the underlying processing architecture of speech and gesture, and arguments for the Unified Architecture were provided, alongside the influential windows on the mind metaphor of gestural processing.

Attention then switched to the child with a consideration of the gestural changes in adult-child interaction. It was argued that, comparable to speech, systematic changes can be identified in the gestural system, which are subsumed under the term "gesturese". These changes include restricted levels of gesture, primarily used to reinforce speech, large amounts of deictic gesture, and an emphasis on concrete, contextually tied, conceptually simple gestures. The role of gesture in naming was also considered.

The final section looked at the development of gesture in children. Firstly the problems of assessing gestural comprehension were laid out, with a brief discussion of studies which have attempted to measure gestural comprehension. A detailed description of the development of social awareness, language and gesture in the first two years of life formed the core of this section. The first gestures to appear developmentally are emotive gestures, requests and protests, showing gestures and pointing. Iconic gestures appear alongside first words. Cross-modal combinations are initially reinforcing, and possibly non-synchronous. Supplementary combinations precede two word combinations. There was some discussion of the proposal that the speech and gesture systems integrate prior to the two word stage.

The role of gesture as a predictor of later language abilities, and gesture-speech mis-matches were discussed. All current knowledge of the development of gesture was brought together in a discussion of processing architectures, and the Unified Architecture was adapted to a developmental situation. Current gaps in knowledge were indicated, and predictions made based on the architecture. Finally the role of gesture in intervention was considered, in light of its close and supporting relationship to speech. It was concluded that gesture is most likely to be of benefit in young children, prior to the two word stage of language acquisition.

Chapter 3

# A Review of Autistic Spectrum Disorders

This chapter aims to provide an introductory overview of ASD as it is currently understood, as opposed to a detailed critique of the body of research in this area. As the behavioural traits of ASD are so crucial to diagnosis, these will be described first, followed by a discussion of cognitive processes believed to underpin these behaviours. Attention then turns to current intervention methods before a comprehensive review of gesture in ASD is undertaken.

## 3.1 The triad of impairments

Individuals with ASD do not form a homogenous group. ASD is diagnosed when individuals show abnormalities in the three core areas of socialisation, communication and imagination. There is a great range of abilities within this, and each component of the triad may vary independently from the others. Recognition of this heterogeneity led to the reclassification of ASD into a spectrum of disorders. As ASD is a complex disorder, it is current practice to include in the research design two control groups; one of typically developing children and one of developmentally delayed children. This allows the behavioural traits which are specific to ASD to be distinguished from those which may be expected through developmental delay. The three main impairments associated with ASD, social, communicative and imaginative, are discussed below.

### 3.1.1 The socialisation impairment

Despite reliable diagnosis occurring from the age of two or three years, it is likely that social difficulties have a much earlier onset. Attempts have been made to trace pre-diagnosis behaviours either through retrospective parental report or analysis of home videos. Neither method is immune to criticism; with time parents' memories of behaviour becomes distorted, as it is unavoidably clouded by hindsight. The second method relies on the quality and quantity of video recording available (Chawarska & Volkmar, 2005). Osterling and Dawson (1994) controlled for variability in video recording by only analysing tapes of first birthday parties. They discovered that a lack of eye contact and joint attention skills combined with reduced orienting to speech distinguished children with ASD from typically developing children at one year of age. A third methodology is to screen at risk children with later follow up assessments. These studies reveal that in the first year of life children with ASD are less likely to anticipate being picked up compared to typically developing children, and show little interest in interactive games (Chawarska & Volkmar, 2005).

By eighteen months of age joint attention is clearly established in typically developing children. In contrast joint attention is delayed in children with ASD; they tend not to look at objects held by others, use limited social referencing, and little visual checking (Carter *et al.*, 2005). The absence of joint attention forms part of the basis of the Checklist for Autism in Toddlers (CHAT) designed to identify children with autism at 18 months (Baron-Cohen *et al.*, 1992).

Imitation of body movements constitutes an early form of interpersonal communication. It is well established that imitation is delayed in children with ASD, and that this is specific to ASD and not due to developmental delay (Williams *et al.*, 2004). In this extensive review Williams *et al* conclude that goal oriented or object oriented imitation is not as impaired as imitation of meaningless actions. Children with ASD did not behave differently to controls on tasks of imitating an adult's goal, imitating in a mirror fashion, or imitation of hand grasps in a motor planning task (Hamilton *et al.*, 2007). The deficit in elicited imitation is not observed in spontaneous imitation as echolalia and echopraxia are common, albeit divorced from context.

Social difficulties continue into later life (Williams White *et al.*, 2007). At school age mutual or co-operative play is limited, children with ASD initiate interaction less with peers, respond to the approaches of others less, and appear content when on their own (Koning & Magill-Evans, 2001). Adults and adolescents are unlikely to form friendships when friendship is defined as involving varied, mutually responsive and reciprocal activities outside of an organised setting (Lord *et al.*, 1994). The recognition of emotion in others is also impaired, which may fit within a broader impairment of facial recognition (Carter *et al.*, 2005). This naturally has implications on the development of empathy which in turn impacts on the ability to read the social cues of others leading to restricted social relationships.

### 3.1.2 The communication impairment

A language delay is a common, but not universal in children with ASD. It is generally accepted that if no speech occurs by the age of five, the outlook is bleak. Current estimates are that between 20-50% of children will be nonverbal by middle childhood (Goldstein, 2002). Figures are decreasing which may be due to earlier diagnosis, which leads to earlier intervention, or to the increased diagnosis of high functioning autism. Around 25% of children with ASD will produce first words and then regress in both language and social skills (Bernabei & Camaioni, 2001). This regression is unique to ASD.

There is evidence that children with ASD do categorise first words, although this knowledge may not be used in lexical retrieval tasks (Tager-Flusberg & Anderson, 1991). As a group they are noted for the few mental state terms in their lexicon, although other words may be extremely rich (Tager-Flusberg, 1992). They often use neologisms or odd phrases. Whilst this occurs in typical development it is persistent in ASD, and may be a result of ignored social feedback which prevents the remapping of object-word relationships. Children are reported as being pedantic or bookish in their speech.

Syntax and morphology is similar to typical development. The children score well on Mean Length of Utterance measures, but show a lack of varied syntactic structures on other measures (Scarborough *et al.*, 1991). A well known feature of autism is pronoun reversal; the use of *you* instead of *I* or *me* in such sentences as *you want a cookie* or *tickle you*. This may reflect difficulties in distinguishing between the self and others (Lee *et al.*, 1994). Echolalia is the exact repetition of words and phrases including intonation. Echolalia may be immediate or delayed. Although first considered an undesirable behaviour, it has since been shown to fulfil six different functions: turn taking, assertions, affirmative answers, requests, rehearsals to aid processing and self-regulation (Rydell & Prizant, 1995).

The comprehension of first words is delayed compared to the production of words, however in absolute terms more words are understood than used (Charman *et al.*, 2003). The lack of social interaction, expressed through symbolic play, has a negative impact on receptive language. It seems that these children do have social knowledge which they can use to support the emerging knowledge of linguistic structures. These children find it hard to integrate non-verbal cues (smiles, touch, tone of voice) with the accompanying language, although prosodic cues are a relative strength (Jarvinen-Pasley *et al.*, 2008).

The social aspects of language, pragmatics, are most impaired. Children are more likely to interact with adults than peers, but the initiation of spontaneous conversation is rare (Stone & Caro-Martinez, 1990). These children have a higher rate of conversational errors than other atypically developing children, these are especially apparent in the use of gaze and intonation (Landa, 2000). Conversations are difficult. Individuals with autism take literal over intended meaning, and tend to assume greater knowledge for the interlocutor than is the case. As a result presenting new information and clarifying old is problematic (Tager-Flusberg & Anderson, 1991). In short all aspects of reciprocity are impaired, leading to difficulties in the ability to engage in mutually co-operative social dialogue (Capps *et al.*, 1998). Narration may be strangely organised, and show a lack of cohesiveness (Tager-Flusberg, 2000).

### 3.1.3 The imaginative impairment

In typically developing children at around 18 months symbolic play begins to appear. Symbolic play is the use of objects in ways in which they were not intended, for example using a brick as a mobile phone. Prior to this play has been either sensorimotor play such as banging, sucking or waving objects or functional play which uses the object in the intended way. There is a paucity of spontaneous symbolic play in ASD, and for those individuals who do attain symbolic play it is repetitive and stereotypical.

It was originally hypothesized that the absence of symbolic play linked into a larger symbolic deficit, also evident in the language delay (Rogers *et al.*, 2005). Further research showed that children do understand symbolism in symbolic play but experience difficulty in generating novel play schemes (Lewis & Boucher, 1995). Thus impoverishments in symbolic play are ascribed to a lack of generativity of ideas and difficulty in shifting attention from one behaviour or play scheme to a new one. A closer examination of functional play, originally believed to be developing normally in children with ASD also revealed similar patterns. Children organised their play behaviours to show more repetition, less novelty, less diversity of play schemes and more immature patterns of play when compared to typically developing peers (E. Williams *et al.*, 2001). If children are not engaging in the social world they are unlikely to replicate such experiences in their play. The limited and repetitive play behaviour may be in part attributable to a lack of social knowledge.

Around the age of three years restricted, repetitive and stereotypical motor movements begin to emerge (Chawarska & Volkmar, 2005). Children may also show unusual sensory behaviours, including observing with a close attention to detail. They may be hyper sensitive to noise and the taste of food, but show little attention to their parents' voices. These early behaviours become more pronounced as the child grows older. As the child approaches school age they adopt rigid routines and become distressed if the routine or environment changes. They may develop obsessive and restricted interests, with apparently little social relevance. They may show a preference for facts, over experiences and this continues into later life (Happé, 1994).

## 3.2 Explaining the triad

This behaviour profile of ASD can be summarised as avoidance, or rare initiation of social contact, and difficulties in forming and maintaining relationships. Both expressive and receptive language shows difficulties, particularly in pragmatic and semantic aspects. The third area of impairment leads to restrictive and repetitive behaviours, stereotypical motor actions, problems with generalisation and integrating ideas, a close attention to detail, preference for remembering facts over experiences and a good rote memory, a need for routine and structure, limited imagination and perseveration in play activities.

Three proposals are currently believed to underpin these behaviour patterns. They are theory of mind, executive functions and weak central coherence. Although independent, there is evidence to suggest that the three systems are located in the frontal lobe area of the brain (Baron-Cohen & Swettenham, 1997). Each will be discussed in turn.

### 3.2.1 Theory of mind

The ability to understand the mind of another has been termed theory of mind. This refers to the understanding that someone's mental states, including beliefs, desires, intentions, imagination, emotion etc, may differ from your own and that such beliefs may be false, that is do not correspond to the actuality of the real world. The exact formulation and interpretation of theory of mind varies across researchers (Carpendale & Lewis, 2006) yet all formulations share a common core which will be discussed here. Precursors to theory of mind begin to appear in the first year as children begin to understand animacy, and that people have emotions and desires which are not apparent in inanimate objects (Wellman & Lagattuta, 2000). Before the age of eighteen months children understand that people are intentional, which results in an array of joint attention skills, as reviewed in Chapter 2. By the age of three children understand that thoughts can be subjective, and they can distinguish thinking from doing (Wellman & Lagattuta, 2000). Yet they do not distinguish a person's subjective thought from objective reality. It is this step which is believed to mark the beginning of a full understanding of another's mind.

Children acquire a theory of mind around the age of four. They understand that other people may have different beliefs and desires to themselves and that behaviour and actions are direct consequences of individual's perception of the world. As a consequence of this increasing social knowledge people's actions become predictable; in effect children learn to mind read. Without a theory of mind it is impossible to entertain the thought that other people can hold different knowledge, emotion, thoughts and beliefs to oneself. This affects empathy, the ability to deceive and prohibits many social interactions. The social deficits of ASD can be explained through a failure to develop a theory of mind.

The most common form of testing theory of mind is false belief tasks. There are two main paradigms: the unexpected transfer test and the deceptive container test. The first hinges around a character who leaves the room and during their absence a target object is moved. On their return the character will hold a false belief of the location of the object. The child is asked where the character thinks the object is located. To pass the test the child must give the original location, giving the new location results in a fail. The second paradigm is similar. Children are presented with a familiar box, such as a tube of Smarties, and are asked what they believe it contains. The tube is then opened to reveal unexpected contents, for example pencils. When asked what they first thought was in the box children under three generally respond with pencils, and also claim that a new person, who has not seen inside the box will also believe that it contains pencils. During the course of twenty years research the two main paradigms have been extensively investigated and refined. It is perhaps surprising that such a body of research rests on a single test.

Moreover a test which is not easily replicable within the same participant, as once the novel aspect is revealed the child cannot be tested again.

False belief tasks and a range of other theory of mind tests have been investigated with children with ASD. Such tests include appearance-reality distinction, recognition and production of mental state words, pretend play, intentions, deception and pragmatics (Baron-Cohen, 2000). All children are delayed, although 15 to 45% do pass first order false belief tasks, as described above (Plaisted, 2000). This number decreases substantially when tested with second order false beliefs (John thinks that Mary thinks), understanding of irony and sarcasm is similarly impaired.

The recently proposed broken-mirror hypothesis links the mirror neuron system to theory of mind. It is hypothesised that mirror neurons form the underlying base for the social nature of human kind (Gallese *et al.*, 2004). The neurons activated during the observation of meaningful actions or emotions means that the observer experiences in a small part the actions and emotions of the agent. It is this which gives us empathy and the ability to predict the actions of others. The broken-mirror hypothesis simply states that the mirror neuron system is dysfunctional in individuals with ASD.

The investigation of mirror neurons in ASD has concentrated on the area of imitation. The pattern of strengths and weaknesses shown by individuals with ASD in these tasks does not confirm the simple version of the hypothesis which would predict that all imitation is impoverished. Individuals with ASD show no impairment on goal or object orientated tasks, yet do on the spontaneous copying of non-goal driven tasks (Hamilton *et al.*, 2007). Based on a review of recent studies Hamilton (2008) suggests two components of the mirror neuron system, each with a distinct pathway in the brain. The first is emulation and planning, required for goal driven tasks. This is not impaired in ASD. The second is activated for low level mimicking tasks, which is impaired. Mimicking, when not used to excess, can establish a social bond. Hamilton speculates that the dysfunction may be located in high level processes which control when and to what degree imitation is socially acceptable. This would predict that individual's with ASD may imitate too little or too much.

Whilst theory of mind accounts for the social deficits, other aspects of ASD remain unexplained. Namely, a restricted repertoire of interests, an obsessive desire for sameness, remaining islets of ability, an excellent rote memory, perserveration and preoccupation with parts of an object (F. Happé, 1994). Theories of central coherence and executive functions account for these.

### 3.2.2 Executive functions

Executive functions form the cognitive underpinning of goal-directed, future oriented behaviours. They include planning, organisation, flexibility, the ability to inhibit behaviours, self-monitoring, goal setting and the use of working memory (Ozonoff *et al.*, 2005). Executive dysfunction is implicated in ASD. Some of the early studies investigated executive functions in ASD by means of the Wisconsin Card Sorting Test (Prior & Hoffman, 1990). In this test participants must sort cards according to changing rules given by verbal feedback. Thus they must be both flexible in order to change strategies, and also be able to inhibit earlier correct strategies. Children with ASD made significantly more perseverative errors than matched controls.

More recently investigations have turned to component analyses of executive functions. The Wisconsin Card Sorting Test requires multiple skills, namely the ability to recognise and classify stimuli, inhibit previous strategies, sustain attention to the abstract properties of the stimuli, and to react to verbal feedback provided in a social interaction. It is not possible to determine which of these factors prevents the ability of the participant to complete the task. Component analysis attempts to devise experiments which test single functions. Such division is not easy to achieve when behaviours are so closely related (Ozonoff *et al.*, 2005). Despite these problems experiments have been devised. Individuals with ASD do not differ from controls on tests of inhibition (Brian *et al.*, 2003; Ozonoff & Strayer, 1997) but do on tests of flexibility; both conceptual (Ozonoff *et al.*, 2004) and attention shifting (Rinehart *et al.*, 2001). There is mixed evidence for working memory to be an impaired component of executive functions (Ozonoff *et al.*, 2005). The main impairment appears to be flexibility.

The development of executive functions is an area which is receiving increased interest. No differences between children with ASD and developmentally delayed controls have been found in children under the age of four years (Dawson *et al.*, 2002; Griffith *et al.*, 1999) although both groups were delayed compared to typical development. This suggests that delay in executive functions is not specific to ASD in pre-school children, but more research is necessary to fully understand these relationships.

Executive function has been found to correlate with joint attention skills in pre-school children (Griffith *et al.*, 1999), and to false belief tasks (Perner & Lang, 1999) Executive function is often used to account for repetitive actions and behaviours due to perseveration of behaviour, lack of inhibitory control, and impaired generalisation.

### 3.2.3 Weak central coherence

Central coherence (Frith, 2003) refers to local and global processing of stimuli. Typical individuals have a strong drive for coherence (Noens & van Berckelaer-Onnes, 2005) which leads to global processing, or understanding and extracting the gist of the stimulus. It is proposed that individuals with ASD have weak central coherence which tends towards local processing and a preference for details. Since its proposal weak central coherence has been investigated in numerous ways. Individuals with ASD do well on the Weschler Block Design test which presents a global geometric design; the participant must replicate the design using different combinations of coloured blocks. Presenting the design in a segmented fashion noticeably improved performance for two control groups (typically developing and intellectually impaired) but not for the ASD group (Shah & Frith, 1993). Children with ASD also show a great ability on the Embedded Figure Tests; locating a hidden geometric figure within a larger line drawing (Jolliffe & Baron-Cohen, 1997).

Many of the studies only investigate the enhanced processing of details, but ignore global processing. Weak central coherence, as formulated by Frith (1989) does not claim that global processing is impaired. Instead individuals with ASD prefer local to global processing but can switch when explicitly requested. There is evidence that this is the case. When drawing a house typically developing children draw the outline first then fill in details such as doors and windows. Children with ASD begin with the details, but the resultant picture is globally coherent (Happé & Booth, 2008). Individuals with ASD do not rely on context to decipher meaning and pronunciation of homographs (words with a single spelling but pronounced differently dependent on meaning) (Jolliffe & Baron-Cohen, 1999). However when instructed to read for meaning, homographs were correctly pronounced (Snowling & Frith, 1986).

Interpreting the evidence Plaisted (2001) suggests that individuals with ASD demonstrate enhanced discrimination and reduced generalisation. Features which are common to multiple objects are not easily processible, whereas unique features are. This is the reverse of typical individuals. She illustrates this with the analogy of a moth camouflaged on a tree. There are many features common to both tree and moth which make the moth almost invisible, yet an enhanced processing of the few unique features would lead to easier recognition of the moth. This accounts for categorisation differences demonstrated by individuals with ASD as perception of similarities is difficult. Conversely the obscure and seemingly irrelevant details are noticed as these will often be the unique features which do not contribute to the process of assimilation.

### 3.2.4 High level processing: a unifying theme?

Links between the three proposals are not currently understood. It increasingly appears as though high level processing is dysfunctional in ASD. Executive functions rely on high level processing. If Hamilton's (2008) refined broken mirror hypothesis of theory of mind is verified this also points to high level processes which control when and to what extent imitation occurs. Too little imitation may account for the pattern of weaknesses reviewed in the section on imitation, too much imitation may play a part in the presence of echolalia and echopraxia. Central coherence can also be accommodated with high level processes as they control the preference of processing globally or locally (Happé and Booth, 2008). This may be emerging as a new direction for research in this area.

## 3.3 Summary

ASD is a developmental disorder, characterised by three impairments in the area of socialisation, communication and in repetitive stereotypical motor actions and deficits in imagination. Social impoverishment is explained by impairments in the theory of mind, possibly related to the mirror neuron system. Executive functions and weak central coherence explain the non-social impairments. There is still a long way to go fully understand the disorder, and to reconcile the complex interplay between these three accounts.

## 3.4 Interventions for ASD

There are a range of interventions currently in use for children with ASD, including nutritional, pharmacological, behavioural and educational approaches. Many treatments have been claimed to have a large impact on the condition, or to effect a cure, although in the majority of cases these claims are not substantiated by the empirical evidence (Howlin, 1997). It is more realistic for an intervention to aim to mediate at the individual level, understanding the possible causes for the problem behaviour in each child and providing alternative strategies for self-expression (Howlin, 1998). It seems that the most effective intervention programmes are those which begin at an early age, both involve and provide support for parents, and take a gradual approach, setting small achievable targets and effecting change one step at a time (Howlin 1997). This section is not intended as a critical review of behavioural interventions, but introduces methods which will be referred to throughout the thesis.

### 3.4.1 Behavioural Interventions

Traditional behavioural interventions are structural, also referred to as discrete trial training. More recently naturalistic behavioural interventions have arisen to address some of the criticisms levelled at the structural approach. These methods will be described in turn.

#### 3.4.1.1 Structured behavioural interventions

Modern structured behavioural intervention has evolved from Applied Behaviour Analysis (ABA), developed in the 1960's. This is a common form of therapy and is based on repetition with reinforcement of the targeted behaviour. Sessions are highly structured and teacher controlled. Targeted skills are subdivided and taught in terms of achievable goals. Resources are constant through out repeated trials until the child meets the pre-selected criteria. For example to teach emotional recognition the child may be asked to point to the happy face. The same target and distractors will be presented each trial. Behaviour will be targeted over successive sessions and the trial repeated until the child meets the required criteria (Delprato, 2001). On successful completion of the trial the child is given positive reinforcement, such as playing with a favourite toy. The reinforcer is typically unrelated to the task.

ABA has found success as a mainstream intervention in ASD. It is effective in specific behaviours, and has led to significant gains in intellectual and educational skills (Schreibman & Ingersoll, 2005). However it has been criticised on several fronts. The main research (Lovaas, 1987) on the effectiveness of the programme has not been replicated, and the original study has several methodological flaws including lack of random assignment of participants and questionable outcome measures (Mesibov, 1993). The tightly controlled environment prevents spontaneous use of the taught behaviour and generalisation to every day life. The interactions induced by this approach are not typical adult-child interactions (Schreibman & Ingersoll, 2005).

#### 3.4.1.2 Naturalistic behavioural interventions

Naturalistic behavioural intervention aims to facilitate language through short teaching episodes initiated by the child and embedded into play sessions. Various techniques are used to introduce teaching into the play; two main approaches are incidental teaching (McGee *et al.*, 1983) and the interrupted behaviour chain method (Schreibman & Ingersoll, 2005). Incidental teaching occurs when the child demonstrates interest in an object or event, allowing the therapist to elaborate on it. As a result teaching episodes vary and are opportunistic both in targeted behaviour and use of resources. The natural interaction is ended by explicit praise from the therapist and the initial object of interest is used as a reinforcer. In the second method the therapist interrupts the child's behaviour, for example by removing marbles from a marble run. The child enters into an interaction to retrieve the toys, which becomes the reinforcer, in order to continue playing.

Due to the less structured environment naturalistic behavioural intervention leads to increased spontaneity from the child and reflects natural adult-child interactions (Kaiser *et al.*, 1992). Increased generalisability is gained through the increased naturalness of the teaching, by the provision of multiple exemplars and the direct linking between reinforcer and interaction (Charlop-Christy & Carpenter, 2000).

There are many difficulties with effectively evaluating behavioural approaches to intervention. There are few easily measurable outcomes as often quite subtle changes in behaviour are targeted. The therapy will be tailored to the specific needs of each child, making a homogenous group virtually impossible to achieve. Despite this lack of an evidence base, such approaches are common in the intervention provision for ASD.

### 3.4.2 The Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) programme

The Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) programme (Mesibov *et al.*, 2004) emphasises structured teaching and provides a learning framework for the particular curricula. The underlying tenet is that the strengths should be developed and adapted to support deficits within the individual. This is achieved through four major components.

Firstly the physical organisation of space is considered. The class room should be clearly separated into visually distinct areas for play, work, snack etc. Situating an activity in the same place provides continuity for the child. Visual distraction should be minimised.

Timetables form the second component. These give structure to the session and aid in transition from one activity to the next minimising the chances of disruptive behaviour. Timetables are on a group or individual level. The form of the timetable is child dependent; they may be based on objects, colours, pictures, numbers or words. Abstraction should increase as the child develops linguistically. To aid transition the child takes the representation of the task to the designated area and returns it to the timetable on completion of the task.

The third component comprises individual work systems, a set of tasks individually tailored to each child's needs. All tasks are in view of the child, and when completed are moved into a different box. Through this system the child knows how much work is expected and can monitor progress through tasks. The final part of the TEACCH structure concerns the way tasks are presented to the child. This should be increasingly abstract with decreasing support. Instructions should clarify task requirements, sequences and relevant concepts. In addition to the structured environment further support is given through direction, prompts and reinforcers.

The TEACCH system can help improve work-related skills and reduce inappropriate behaviour (Howlin 1998). In order for improvements to be maintained for the long term the support given by TEACCH should gradually be reduced.

### 3.4.3 The Picture Exchange Communication System (PECS)

The Picture Exchange Communication System (PECS) is designed to enhance communication, specifically amongst children with ASD (Frost & Bondy, 2002). The system consists of a series of pictures, or symbols, which form the vocabulary of the child. These are flexible, and adaptable to the child's needs. There are several levels to the system. The first is to establish an exchange. The child is allowed to play with a motivator, before the adult removes it. In order to regain the toy the child hands the adult a blank symbol. Physical prompts are used to direct the child to the symbol and away from the motivator. Secondly the child is taught to discriminate between symbols through the use of a motivator and deterrent. The child receives the same toy as the picture used in the exchange.

Once the child is discriminating phrases are introduced, usually with "I WANT". The symbols are placed on a velcro strip in the correct order and the child is encouraged to verbalise during the exchange. The strip is not accepted if the elements are in the wrong order. Phrases are expanded with adjectives (attributes) forming the sequence I WANT + ATTRIBUTE + OBJECT (e.g. I want triangle crisp). The child can be expected to travel to the adult, thus they are not only practicing communication, but also social skills such as initiation and requests.

Using augmentative systems appear to support, rather than hinder spoken language (Howlin 1997). Pictorial based systems place least demand on the child's cognitive, linguistic and memory skills (Layton & Watson, 1995). In a recent study Howlin and colleagues (Howlin *et al.*, 2007) attempted a randomised controlled trial to investigate the effectiveness of PECS. Despite inherent methodological constraints, PECS was shown to be successful in terms of rate of initiation and frequency of PECS exchanges, but spoken language did not increase. These improvements were lost when intervention ceased.

### 3.4.4 Summary

This section has reviewed some of the main intervention approaches to ASD, although some evaluation of these was attempted it is extremely difficult to measure the efficacy of behavioural intervention for children with ASD. The programmes discussed were structured behavioural intervention, in the form of Applied Behaviour Analysis (ABA), naturalistic behavioural interventions, the TEACCH programme and PECS as a form of augmented communication.

## 3.5 Gesture in ASD

The final section in this chapter focuses on providing a review of research into gesture in individuals with ASD. Comprehension will be discussed first, followed by spontaneous and imitated production.

### 3.5.1 Comprehension

Several studies have assessed the comprehension of imperative and declarative pointing gestures in children with ASD. In a seminal study, Baron-Cohen (1989) tested twenty children with ASD (aged 6-16 years) with two control groups; a developmental delay control of fourteen children with Down Syndrome and twenty seven typically developing children. The verbal mental age of all children was above 3 years. Comprehension of imperative pointing was assessed by sitting the child in an array of toys in front, to the side and behind them. The experimenter then pointed to one of the toys. Children were rated as passing if they correctly paraphrased the gesture or handed the indicated toy to the experimenter. Similar methodology was used for declarative pointing, except that the experimenter pointed to a location not visible to the child, for example out of the window. Criteria for comprehension were either a correct paraphrase of the gesture, asking what the experimenter could see (e.g. what is it?) or moving to provide a clear line of sight to the referent.

Results indicated no differences between the three groups for comprehension of imperative pointing. However only two children from the ASD group passed the declarative pointing assessment, 10% of the group, compared to 86% of the Down's Syndrome group and 96% of the typically developing controls. Not only was the ASD group significantly different there was a strong dissociation between comprehension of imperative and declarative pointing.

These results were replicated and extended by Camaioni and colleagues (Camaioni *et al.*, 1997). Three children with ASD matched for language ability were followed longitudinally for two years. The children ranged from 25 to 53 months old at the start of the study and were assessed every five months. Comprehension of imperative function was assessed by means of an object with a removable part, such as a puppet driving a car, or drum and drum stick. The experimenter played with the object then handed it to the child, retaining one part. In the example of the car the experimenter would point to the car the child is holding and say "let me put the puppet in the car". The child was rated as passing if they gave or refused to give the object to the experimenter. Comprehension of declarative pointing was through the activation of a distal event, such as a bird figure at the window. The child's attention would be established prior to a point towards the window.

Comprehension of imperative pointing emerged first for all the participants. Only one of the participants showed comprehension of declarative pointing. This study was replicated with a further five participants (Camaioni *et al.*, 2003). They found that all but one child understood imperative pointing, but only two children understood declarative pointing. The two children who demonstrated comprehension of declarative pointing were the children with the mildest impairments, as measured by the Childhood Autism Rating Scale (Schopler *et al.*, 1986).

These studies serve to demonstrate some of the methodological difficulties inherent in assessing comprehension of gestures, discussed in the previous chapter. Gestures are rarely produced without verbal accompaniment in naturalistic interaction. If, like Baron-Cohen's experiments, words are eliminated from the assessment the task becomes much harder for the child. It is doubtful if asking a child to paraphrase a gesture taps the same underlying ability as comprehension of gestures. Alternatively if language accompanies the gesture, following Camaioni *et al*'s methodology, it is hard to judge the extent to which the child is deducing meaning from the verbal modality. The experiments were engineered so that the action could only be inferred from language giving some element of control for this factor. The complete absence of comprehension of declarative function in Baron-Cohen's experiment may be due to the artificiality of gesture being presented with out speech which arguably makes this a harder task than that devised by Camaioni *et al.*

Loveland and Landry (1986) investigated comprehension of attention directing gestures. They considered gaze shifting, pointing, showing, and tapping gestures as well as moving the child's hand to an object. Gestures were presented in two conditions: with or without speech. They studied eleven children with a mean mental age of 5;8 years and a chronological range of 4;10-11;2 years. Children performed best in the gesture alone condition, with 80% giving appropriate responses. This dropped to 70% in the gesture and speech condition. The difficulty in integrating speech and gesture has also been revealed in a recent study which used eye-tracking techniques to assess the comprehension of iconic gestures in adolescents with high functioning autism (Silverman *et al*, 2007). Participants watched videos of an actor describing one of four shapes shown on the computer screen. Descriptions of the shape were verbal or cross-modal combinations. The cross-modal condition facilitated identification of the target for the control group, but hindered the individuals with ASD who were faster in the verbal condition. This implies that individuals with ASD have cross-modal processing difficulties which significantly impede integrated speech and gesture comprehension. There was no condition which presented gesture in the absence of speech.

The study of comprehension of emblems (Smith and Bryson, 2007) as described in Chapter 2, Section 2.3.1 also contained an ASD group of twenty children aged 7 to 18 years old. The methodology remained the same. The experimenter modelled one of six gestures and asked what it meant. If the child did not provide a response they were given three choices, for example OK, GOODBYE, or BE QUIET. For the gestures that were named the child was asked to choose the appropriate social setting for the gesture from a series of three pictures. Children with ASD tended to have difficulty in naming the emblems, but performed similarly to the controls on the verbal and pictorial choice tasks.

These studies of comprehension are summarised in Table 3.1.

| Researchers | N | Age | Summary of Main Findings |
|---|---|---|---|
| Loveland and Landry 1986 | 11 | 4;10-11;2 years | Comprehension of cross-modal combinations is more difficult than comprehension of gesture alone |
| Baron-Cohen, 1989 | 14 | 6-16 years | No difference with control groups for comprehension of imperative pointing, but ASD group impaired in comprehension of declarative pointing. |
| Camaioni *et al* 1997 | 3 | 25-53 months Assessed at 5 month intervals | All three participants understood imperative pointing. Only one participant understood declarative pointing. |
| Camaioni *et al* 2003 | 5 | 3;3-4;10 Assessed at four month intervals | 4 of 5 participants understood imperative pointing, 2 understood declarative pointing. Understanding of declarative pointing was associated with the milder impairments. |
| Smith and Bryson 2007 | 20 | Mean 11;4 yrs 7-18;5 | More difficulty naming emblems compared to control groups, but verbal and pictorial selection same as controls |
| Silverman *et al* 2007 | 19 | Mean 15;6 yrs | Comprehension of cross-modal combinations is slower than comprehension of speech alone |

**Table 3.1: Research into gesture comprehension in children with ASD**

### 3.5.2 Production

Much of the focus of research into gesture production in children with ASD has focused on deictic gestures. These studies will be reviewed first, followed by a discussion of representational gestures including iconics and emblems.

#### 3.5.2.1 Deictic gestures

The first observations regarding gesture production in children with ASD are generally attributed to Curcio (1978). This study used teacher report and classroom observations on twelve children, aged between 4 to 12 years old. The children were found to have deficits in declarative pointing and showing gestures. Imperative pointing and requests and protests were not impaired. This pattern was replicated in interactions at home (Wetherby and Prutting 1984) and in the laboratory (Loveland & Landry, 1986). Baron-Cohen (1989) assessed the production of ten children with ASD aged 2;6 to 5;0 years, in group interaction with two control groups. No differences were apparent between groups for imperative pointing however none of the ASD group produced declarative pointing, a significant difference to the control groups.

A similar pattern is reported in longitudinal studies (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003). Toys were selected to elicit either imperative pointing by being proximal and manipulable, or declarative pointing in the case of distal and unexpected events. All participants were assessed individually at five monthly intervals and all produced imperative function, either requests or pointing gestures. Only a three of the participants produced declarative pointing. In all cases this emerged after imperative pointing. The researchers concluded that only the participants with mild autism produced declarative pointing. It appears that deictic gestures develop in a similar sequence to typical development. Request and protests give way to imperative pointing, declarative pointing, if it emerges, is last to appear.

Stone and colleagues (1997) used a similar methodology to investigate deictic gesture in fourteen children aged between 27 and 38 months old. Participants were individually matched to children with developmental delay and/or language impairment on the basis of chronological age, mental age, and expressive vocabulary. The ASD group was found to communicate less than the control group. They also used more requesting (imperative) gestures, and fewer commenting (declarative) gestures. Reaching gestures were equally prevalent in both groups, but the control group preferred distal gestures such as pointing whereas the ASD group showed a preference for contact gestures, such as manipulating the adult's hand. The ASD group was less likely to use eye gaze and vocalisations when commenting. In an interesting finding only those children who used distal pointing were found to use the declarative function. This study agrees with previous research that the declarative function is impaired in children with ASD. In contrast to previous studies very few children used pointing gestures (only 2 of 14) and those two produced imperative and declarative pointing with equal facility. Only the children who used the declarative function used pointing gestures. The authors suggest the ability to use communicative pointing rests on an underlying social requirement in which the child has the knowledge that a point will direct another's attention.

The difficulty of declarative pointing for children with ASD is part of the general impoverishment of joint attention skills. In addition to imperative pointing, self-directed pointing is also observed (Goodhart & Baron-Cohen, 1993). Thus the lack of the declarative pointing is a consequence of the social impairment and has been linked to theory of mind deficits (Baron-Cohen, 1995; Tomasello & Camaioni, 1997). Alternatively Stone *et al* (1997) suggest that the impairment lies with the ability to monitor, rather than direct the attention of another. This invokes the executive functions account as children cannot shift attention between the referent and the interlocutor. This also explains the preference for contact gestures, as monitoring becomes irrelevant with direct manipulation of another's hand. Regardless of the underlying cause, the lack of joint attentional behaviours and declarative pointing is so well attested in young children with ASD that it has been used as part of an early diagnostic for autism (Baron-Cohen *et al.*, 1992), with promising results (Baron-Cohen *et al.*, 1996; Charman *et al.*, 2001).

Other contact gestures such as tapping or holding a relevant object may be used by children with ASD for functions usually performed by gaze. These functions are to display active engagement in the interaction, and to signal preparation for a turn in the interaction (Dickerson *et al.*, 2007). This work is a timely reminder that in clinical speech the primary function of a gesture may not be the same as that of typical speech. Any behaviours which first appear non-communicative should be carefully assessed for interactional content before being summarily dismissed.

#### 3.5.2.2 Iconics and emblems

In comparison with the interest in deictic gesture, other gesture forms have been less vigorously researched. Emblems and iconics are known to be limited in both quantity and quality (Wetherby *et al.*, 2004). Emblems have been reported in studies where the primary focus was deictic gesture (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003; Stone *et al.*, 1997) but these are infrequent, restricted to certain individuals and are mainly imitative learnt during social routines.

Global assessments of gesture use in children with ASD tend to use instruments designed to assess early communication. Wetherby *et al* (1998) tested twenty two children diagnosed with Pervasive Developmental Disorder with the Communication and Symbolic Behaviour Scales (CSBS) (Wetherby & Prizant, 1993) which contains a gestural component. Although the distinction between deictic gestures and emblems are somewhat blurred in this assessment, the children with ASD produced fewer conventional gestures (emblems), fewer distal gestures (pointing) and fewer utterances which combined gesture and vocalisations compared to controls.

Also in this line of research the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI) (Fenson *et al.*, 1993) was used to measure early language development of 134 pre-school children with ASD (Charman *et al.*, 2003). The CDI measures vocabulary and early gestures. As with the CSBS distinctions between deictic gestures, emblems and play schemes are blurred, and iconic gestures are entirely absent. Gesture production was found to be relatively in advance of word comprehension compared to typical development, but communicative gestures were significantly more delayed than play schemes. Gestures may help to bridge the gap between word comprehension and production. This implies that gesture could be legitimately targeted in intervention programmes.

In an earlier study Stone and Caro-Martinez (1990) investigated the spontaneous communication of a group of thirty children with autism, aged between 4-13 years (M=8.4, SD=2.7). The children were observed for up to three hours in unstructured activities. Their spontaneous communication only was recorded, and coded for form and function. There were four categories for form: vocalisations, speech, motoric acts and gesture. Motoric acts were non-symbolic actions, directly manipulating either an object or person. Gesture was defined as symbolic actions, including pointing and signing. Motoric acts formed the majority of the children's communication at 51.5% of all acts, but gesture in comparison was used the least (12.8%) and by less than a third of the children. Motoric acts were significantly correlated to the functions of requesting, protesting, getting attention and social routines. In comparison gesture was only significantly correlated to commenting.

Table 3.2 summarises the studies discussed in this section. The rare instances of emblems which have been reported raise interesting questions over the nature of gesture imitation. The imitation of emblems is more inaccurate with children with ASD then with control groups (Smith & Bryson, 2007). The production of emblems was more problematic when the participants were given a verbal ("show me with your hands how to say X") as opposed to a concrete visual cue (modelling of the gesture).

| Researchers | N | Age | Summary of Main Findings |
| --- | --- | --- | --- |
| Curcio 1978 | 12 | mean 8 yrs. range 4 to 12 yrs | Absence of declarative pointing and showing gestures. Some use of request, refusal and greeting gestures |
| Wetherby and Prutting 1984 | 4 | range 6 to 12 yrs | Absence of declarative function |
| Loveland and Landry 1986 | 11 | mean 8;6 yrs range 4-11 yrs | Absence of gestural and verbal joint attention behaviours |
| Baron-Cohen, 1989 | 10 | 2;6 – 5;0 yrs | No difference across groups on imperative function<br>No declarative function produced by ASD group, significantly different to control groups |
| Stone and Caro-Martinez 1990 | 30 | mean 8;5 yrs range 4 to 13 yrs | Reliance on motoric communication, deficits in symbolic and declarative gestures |
| Camaioni *et al* 1997 | 3 | 25-53 mths assessed at 5 month intervals | Ritualised requests more frequent than reaching<br>Reaching preceded pointing.<br>All participants used imperative function, only two used declarative function<br>A few emblems produced, but rare |
| Stone *et al* 1997 | 14 | 27-38 mths Mean 32.8 mths SD 3.5 | Compared to controls, ASD group:<br>Communicate less<br>More likely to use imperative than declarative function<br>Use more contact and fewer distal gestures<br>Use less eye gaze, less gesture co-ordinated with eye gaze and vocalisation |
| Wetherby *et al* 1998 | 22 | 17-60 mths mean 35;9 mths SD 11.72, | Large differences between ASD and controls:<br>Use of emblems and distal hand gestures<br>Co-ordination of gesture and vocalisations<br>Also large effect size for gestural cluster score and communication composite score |
| Camaioni *et al* 2003 | 5 | 3;3-4;10 Assessed at 4 month intervals | Reaching preceded pointing.<br>All participants used imperative function, only one used declarative function (in participant with mild impairments)<br>A few emblems produced, but rare |
| Charman *et al* 2003 | 134 | Mean 3;2 yrs Range 1;6-7;4 SD 1;2 | Word and gesture production is ahead of word comprehension<br>Actions on objects are less delayed than communicative gestures |
| Dickerson *et al* 2007 | 2 | 16 yrs | Tapping gestures are used to:<br>Display active engagement<br>Project forthcoming talk |

**Table 3.2: Research into gesture production in children with ASD**

Selected deictic, iconic gestures and emblems with appropriate verbal responses have been taught to children with ASD (Buffington *et al.*, 1998). All four participants increased use of these gestures during discrete trial training. This study had promising results but was limited in several ways. Firstly the children were taught specific gestural responses, and any generalisation from this is unknown. Secondly the children responded to specific stimuli and so teaching would not affect their spontaneous use of gesture, there was also no follow up measure so long term benefits are unknown.

Ingersoll (2007) attempts to resolve these issues by using naturalistic behaviour intervention to teach iconic gesture through imitation. Five participants increased imitation and spontaneous gesture from baseline, and there was limited generalisation to untrained environments. Frequency of gesture only was recorded therefore it is not known if the children learnt a few gestures which were repeated frequently, or if they developed an extensive repertoire. The authors tentatively conclude that targeting gesture imitation is a useful intervention strategy, especially for children with limited language skills.

### 3.5.3 Summary

Children with ASD have predominantly deictic gestures in their repertoire. These gestures progress from requests and protests, such as reaching, ritualised requests, manipulating the adult's hand and rejecting behaviours, to pointing. Preference seems to be shown for contact gestures, such as manipulating the adult's hand and touching objects. The declarative function, as realised through pointing and showing gestures is an area of difficulty. The use of emblems is limited and appears restricted to those learnt by imitation of social routines (such as waving, nodding and shaking the head). Iconic gestures have not been demonstrated to be spontaneously produced. Preliminary findings indicate that teaching gesture through imitation may be a viable form of intervention.

# Chapter 4

# METHODOLOGY

This chapter aims to describe the project undertaken for this thesis and is divided into four main parts. Firstly the research questions will be presented, followed by a discussion of the relevant methodologies. The project will then be described and the coding system introduced. The final section concerns the participants and reports the assessments undertaken during the course of the project.

## 4.1 Exploring gesture development

Chapter 2 reviewed current research on gesture development in typical children. Whilst there have been many advances in this area, there has been little comparative work with disordered language development. This project aims to contribute to this area by exploring the nature of the gesture system in children with ASD. The specific research questions are generated from the approach to development outlined in Chapter 1, and will correspond to the three strands of development, input and interaction.

### 4.1.1 Defining the research questions

As a point of reference it would be beneficial to obtain a reasonably accurate overall measurement of the gestural abilities of a child. This would allow atypical development, such as that likely to occur in autism, to be compared to typical development. Further it would then be possible to ascertain if the communicative impairment associated with autism affects the gestural modality to the same extent as the verbal. Currently no such assessment exists, thus the development of a checklist focusing on gesture is a necessity. This leads to the formulation of the first research question, concerned mainly with the secondary strand of gesture's place in intervention:

Is gesture in autism delayed compared to typical development?

Returning to the three main strands of interest, research questions may also be defined for each:

Development: a. What is the gestural profile of children with autism and how does it develop?

b. Can the Unified Architecture be applied to children with autism?

Input: Do adults adapt their gestures when talking to children with autism, and if so how?

Interaction: How is interaction collaboratively achieved between the adult and child?

Assembling the information gleaned from these questions will form a coherent picture of the both the child's predisposition to development and the social and communicative environment within which learning is situated. Understanding the profile of gestural strengths and weaknesses inherent in autism is the first step in devising an intervention programme to support emerging skills. Furthermore by considering input and interaction successful communication strategies on the part of the adults can be identified and incorporated into such a programme. Thus by appreciating the links between development, input and interaction a fully comprehensive programme of intervention may be devised. This leads to the final, more speculative, question:

Can the findings be translated to a clinical setting?

In all this provides five different research questions, each focusing on a different aspect of gestural development, and each requiring a different methodology in order to achieve a comprehensive answer.

### 4.1.2 Choosing an appropriate methodology

The use of multiple methodologies allows gesture to be considered from many different viewpoints resulting in the fullest possible understanding of the gestural system. Each methodology provides different insights into gesture use, creating a rich tapestry of interpretation and analysis. In the following sections each of the chosen methodologies will be discussed.

#### 4.1.2.1 Assessing gesture: Quantitative measures

From an applied viewpoint it is important to know how gesture in children with autism compares to gesture in typically developing children. One diagnostic of ASD is the language delay. It is possible to hypothesise that a language delay would also mean a gestural delay for these children. Questions of this nature are best answered by quantitative measures. An assessment form provides a snapshot of the child's current ability. This is compared against a database of other children, and the target child can be placed in relation to their peers. By repeating the assessment at different time intervals changes in the gestural system can be identified.

A quantitative analysis provides macro level information. The behaviour under investigation is considered static; categories are pre-determined and imposed on the data by the investigator. Each category is assigned a numeric code which enables statistical calculations to be performed on the data. The enumerative base allows data to be easily summarised, following the conventions of descriptive statistics. In addition, provided that the chosen sample is representative of the larger population, inferential statistical tests may also be applied. When this requirement is met generalisations can be identified and predictions made regarding future behaviour. Representative samples lead to reliable and easily replicable results. Thus large numbers of participants are required which creates a bias towards cross-sectional, structured designs.

The advantages of a quantitative analysis are that reliable and generalisable patterns of behaviour can be identified at the group level. It is based on enumerative methods; studies are easily replicable increasing confidence in the patterns of behaviour identified. A single case study can be compared to group as a whole and strengths and weaknesses within an individual's profile can be discovered. However this methodology can not inform on the individual experiences of the participants. Longitudinal studies are difficult to administer. Repeated cross-sectional studies can be used, but this provides a series of snapshots of development. A representative sample is difficult to attain with atypical groups due to the large number of participants required.

In view of these difficulties this methodology will be used to assess the participants' gestural ability at two time points; on commencement and completion of their participation in the project. These assessments will be compared to normative data gathered from typically developing children.

#### 4.1.2.2 Development of gesture: longitudinal design

Although it is possible to chart the development of behaviours of interest using cross-sectional designs, for example by recruiting groups of participants at different ages, this is not desirable as there is no control for differences in the group characteristics. Instead a longitudinal design should be employed which performs repeated measures on the same participants during the course of a pre-determined time span. This ensures that the group remains consistent across the measures at each assessment, thus changes in behaviour, corresponding to development, can be identified.

Longitudinal designs often focus on group trends resulting in long time intervals between measures. The emphasis on group trends also biases such designs towards quantitative analyses, as described in the previous section (Section 4.1.2.2). This study will employ a longitudinal design in the repeat measures of gesture development taken when the participants join and leave the project.

#### 4.1.2.3 Development of gesture: the Micro-Genetic Method

In order to investigate change whilst it occurs, it is necessary to follow participants whilst they undergo the transition in behaviour which is the focus of the study. A close analysis of change in the gestural system will include a number of factors (Siegler, 2006). The nature of the change could be quantitative or qualitative; it could be rapid or slow. When considered developmentally change could be domain specific, or could be traced across various domains. Individual variation can also affect change. By collating such information it may be possible to extrapolate back and suggest possible underlying causes of the observed changes. The Micro-Genetic Method (MGM) is designed to study change.

Studies designed to conform to an MGM analysis vary from both cross sectional and longitudinal studies. In repeated cross sectional designs change can be identified but not described, in traditional longitudinal designs the focus is on group trends and the time between measures is often large. In contrast MGM places the focus on the individual and repeat measures are frequent. This provides a much finer-grained analysis of change which leads to a richer interpretation of the factors at play. It means that individual differences and group behaviour can be studied, although group trends are more constrained when compared to traditional designs as the group size is necessarily smaller for MGM designs.

There are three principles central to MGM (Flynn *et al.*, 2006). Firstly the time of transition must be identified prior to data collection. Data should be collected over the transition period, thus careful planning is required from the researcher. Secondly the density of the observations must be high in relation to the rate of change. The frequency of data collection must be balanced against time consuming analysis. Too much data and the nature of the change will be hard to extract. Too little and the process of change will be lost. Finally the data thus generated are analysed intensively to throw light on the underlying processes driving the change. Inter-participant comparisons are also possible which may identify different transition processes dependant on each participant.

The method is not without disadvantages. Frequent repeated measures with children may lead to boredom and loss of motivation, or introduce practice effects on experimental tasks, although this becomes irrelevant in an observational study. The high frequency of data collection generates a large amount of data, which is time consuming to prepare and complex to analyse.

The participants will be video-recorded weekly during their involvement with this study. The resulting data will be subjected to a MGM analysis. It is anticipated that change will occur across the duration of the study, but not during each individual recorded session. Although this method allows the changes in the gestural and speech systems to be analysed at a micro level, there are still omissions in the overall picture. As with quantitative measures the coding is done *a priori* and is externally imposed upon the data. MGM can track individual differences and gestural changes, but cannot capture the collaborative nature of communication. Therefore to understand how children with ASD interact with others through gesture and language requires a third methodology.

#### 4.1.2.4 Interacting with gesture: Qualitative Analysis

In order to capture the characteristics of each participant's interaction a qualitative approach must be used, allowing a micro level analysis. Unlike the previous two approaches no constraints are placed upon the data. Interesting behaviours emerge during analysis and are explored further. No hypotheses are pre-devised, nor are external categories imposed upon the data. The behaviour under investigation is considered dynamic and is co-constructed by the interacting participants. This methodology is particularly suited to a small group of case studies. Due to the in depth analysis of individual behaviour results are not replicable but will change dependent on the participants of each study. There are many different qualitative approaches, but the methodology will be loosely based upon Conversation Analysis (CA), drawing on Discourse Analysis (DA) when appropriate.

The central tenet of CA is that by closely analysing the directly observable properties of the interaction, underlying patterns can be discerned which structure contextualised interaction. By studying only that which is directly observable CA is inherently empirical and analysis is closely tied to the data. By examining the sequential unfolding of the interaction the collaborative construction of the communication is revealed. By emphasising the sequential aspects of small units, patterns of use can be discerned, which in turn lead to an overall picture of interaction (Hutchby & Wooffit, 1998). The CA approach will form the main analysis tool, but Discourse Analysis will also be woven into the analysis. CA is restricted to the directly observable components of the interaction. DA seeks to link the interaction to the wider social context in which it is situated. Such concepts as power and status become relevant, as are the expectations and knowledge that each participant brings to the interaction. DA proceeds by unpicking the text or conversation to re-construct underlying themes and categorise the data (Coulthard, 1992). Maintaining the balance between pure description and true analysis can prove difficult yet DA can throw light on another dimension of the data which CA perforce excludes.

## 4.2 Description of project

Participants were identified by the local Autism Service. To be eligible for the project the children were firstly diagnosed with ASD by the clinical team working for the Autism Service, and secondly had accepted a place on an intervention programme (the Explorers programme) run by the Service. The programme aims to facilitate socialisation and communication skills; details of the therapy methods are given in Section 4.2.3. The children enter the programme aged between 2;0 and 3;6 years old, and attend the programme for between six to ten months. Provided that the above criteria were met there were no other exclusions. Two distinct varieties of data were obtained: assessment and video footage.

### 4.2.1 Materials

Children were assessed at three monthly intervals during the course of the Explorers programme by Explorers staff members. This is an integral component of the monitoring system provided by the Autism Service. In addition assessments specific to the project were completed by the parent when the child commenced and completed the programme.

Three assessments are used at Explorers, none of which are standardised. *The Checklist for providing baseline of levels for socialisation/communication development (early years) non school environment*, (the socialisation checklist) has been developed in-house and assesses the child's communication and behaviour, covering adaptability to rules and routines, socialisation, communication and learning independence (Ryegate Children's Centre, 2006).

The second assessment is *The Living Language Detailed Profile*, developed by Anne Locke for atypically developing children (Locke & Beech, 1991). This covers physical, social and linguistic development through an assessment of physical skills, self help and independence, eye and hand co-ordination, play and social development, listening and understanding and expressive skills. For each category twelve skills age appropriate for typical development are listed.

The final assessment, *The Surrey Speech Language and Communication Profile*, is a detailed assessment of the linguistic abilities of the child. This is non-standardised, relying on the scorer's judgement of age specific skills (McGregor & Cave, 1996). The assessment covers receptive skills, expressive skills, speech production, the impact the language and speech production has on communication, interaction skills and behaviour.

On the commencement and completion of their child's participation on the Explorers programme the parents were also asked to complete two parental report forms. The first, *The Oxford University Babylab Communicative Developmental Inventory* (OCDI) is a measure of vocabulary (Hamilton *et al.*, 2000). It is the British version of the MacArthur-Bates Communicative Developmental Inventory, a prestigious and comprehensive assessment of early words and actions. The OCDI does not include gesture therefore parents were asked to complete an additional report form focusing on gesture development. *The Gesture Checklist* (GC) has been specifically devised for this purpose, full details are given in Chapter 5.

### 4.2.2 Video recording

The participants were video recorded throughout the programme. Each participant was recorded weekly, alternating between the Explorers and home environments. Recordings ceased during school holidays. The recordings are of 20 minutes duration and consist of the child interacting with staff members or their mother, capturing spontaneous interaction whilst engaged in their normal activities. For the recordings at home this comprised play activities with their mother. No attempt was made to control the range of toys available to the child as it was felt that more communication would be achieved if the children played with their favourite toys. These included, but were not restricted to, jigsaws, books, playdough, trains and animal toys. At Explorers children were recorded during all activities, with the time of recording staggered across the sessions for each child. Such activities included playing with similar toys as listed above, PECS training, snack time and one-on-one focused activities with a staff member (such as craft activities, or naming activities). The decision not to constrain the context or activity led to variation in communication and gesture use across the recorded sessions. Recording finished when the participant left the Explorers programme.

The video footage was first transcribed following Computer Human Access Transcription (CHAT) conventions, then accessed via the Child Language Analysis (CLAN) software (MacWhinney, 2000). This allowed a quantitative description of the gestural repertoire. Passages of further interest were identified, transcribed in detail and analysed qualitatively.

### 4.2.3 Characteristics of the data

The data collected for this study can be divided into three main groups; firstly the measures used by the children's centre for the assessment of ASD, secondly the assessments completed by the parents when their child joined and left the project, and thirdly the video data recorded whilst the child was a participant in the project. Each of these groups of data have different characteristics, which will influence the way in which they are regarded (Table 4.1).

| Data source | Completed by | Objectivity |
|---|---|---|
| The Socialisation Checklist | Staff member | Non-standardised |
| Living Language Detailed Profile | Staff member | Non-standardised |
| Surrey Speech, Language and Communication Profile | Staff member | Non-standardised |
| The Oxford University Babylab Communicative Developmental Inventory | Parent | Standardised (n=547) |
| The Gesture Checklist | Parent | Standardised (n=54) |
| Video Recordings | Recorded by researcher | Inter-coder reliability |

**Table 4.1: characteristics of the data**

Although routinely administered by the children's centre, none of the measures used for assessing ASD are standardised. This makes it difficult to assign the degree of severity of the social, communicative and imaginative impairments for each participant. However it was felt that as the majority of the analysis would be based on the individual level a homogenous group of participants was not an essential criteria, as such no additional measures of autism were used. Although it is not possible to give absolute measures for the impairments associated with autism, the non-standardised assessments do allow relative judgments to by made between the participants.

The second group of data comprises that completed by the parents to assess their child's vocabulary and gestural repertoire. These consist of two measures, the OCDI and the GC. The OCD is fully standardised, and attempts were made to standardise the GC (see Chapter 5 for full details). Some variability on these measures may be expected due to the reliance on parent reporting. The third set of data is the video data, this comprises the largest data set and forms the basis of the analysis of gesture undertaken in this study. Objectivity for this data has been obtained through the use of inter-coder reliability measures.

### 4.2.4 The Explorers programme

Children attend the Explorers programme three days a week. Each session lasts two and a half hours. There are five permanent members of staff and an additional short term member. Of the five permanent members four are support teachers and one is a speech and language assistant. The children on the programme regularly see a speech and language therapist who is attached to the centre. Therapy is a combination of a structured environment following TEACCH principles and naturalistic behaviour based intervention. In addition PECS is used to facilitate communication.

The four main TEACCH principles are used in the programme. The centre consists of four rooms, each of which has a distinct purpose. Two of the rooms interconnect, the others are reached by a corridor. Furthest down the corridor is the light room. This is a room dedicated to sensory stimulation. It has large soft mats on the floor, and padding around the walls. There are various toys and fibre optic light equipment in this room. A mirror runs the full length of one of the walls. This room is used for twenty minutes in each session for physical, undirected play. Room three is used for PECS training and other directed tasks. This has the least visual stimulation on the walls and contains a table and a few chairs. The emphasis is on direction and compliance. The room is also used for group work, such as singing or watching videos.

The interconnecting rooms (one and two) are the main rooms used during Explorers sessions. Initially these rooms were interchangeable, with work, activities and free play occurring in both. This was revised at the start of 2007 with room one becoming the play room. The children remain here until called for specific one on one tasks. In room one there is no direction, the children are free to choose between permanent activities (such as soft play and sticking) and other toys which are included on a rotation basis. The walls have mirrors and beads, and other tactile stimulatory objects. Room two is used for activities and work stations. Reinforcement with PECS also occurs in this room. As with room three the emphasis is on direction and compliance, but to a lesser degree. The walls are covered with visually stimulating scenes, often the product of the children's previous craft activities.

Each child has a visual timetable using PECS symbols, located in room two. The child removes the symbol, and takes it to the appropriate table or room. On completion of the activity the symbol is taken back to the timetable and placed in a box at the bottom of it. The procedure is then repeated with the topmost symbol on the timetable.

The individual work systems are referred to as work stations. Each contains individual activities designed to target the specific requirements of the child. Tasks are placed in a green box and, when completed, moved to a red box. Usual activities are hand and eye co-ordination tasks, the learning of vocabulary, matching objects, and completion of jigsaws.

Therapy shifts to a more naturalistic behaviour based model during the time spent in room one and the light room. At these times the children drive the interaction; they are free to play with any of the provided toys and may request others. The staff members play alongside the children, providing commentary on their actions, thus providing a language rich environment. Much use is made of explicit praise, physical prompts and reinforcers.

The third component at Explorers is the use of PECS. Each child is provided with a PECS book and receives training in its use. PECS is incorporated further into the nursery by its use on the visual timetables. During snack time the children are also required to use PECS to request food and drink.

## 4.3 Coding gesture

The video data were transcribed, then coded for communicative acts. Communicative acts were defined as intended acts which have the potential to, or do, initiate or prolong a meaningful interaction between the communicator and at least one other person. Communicative acts were preferred over linguistic utterances as this term includes communicative bids from the non-verbal participants, in addition to possible atypical attempts at communication. Thus no communicative behaviour from the child was unanalysed. In the case of the adults communicative acts tended to coincide with linguistic utterances which constituted a conversational turn. Gestures produced by both adult and child were identified then coded for four aspects: the relationship of the gesture to speech, the function of the gesture, the form of the gesture, and temporal synchronicity with speech. Each of these is described more fully below.

In all approximately 35 hours of video recording was transcribed. Sections of transcripts were selected blind for second coding comprising five per cent of the data. These were spread longitudinally for each participant and included both environments. The second coder, a speech and language therapist, received training in the coding system. Together both observers identified 358 communicative acts and identification overlapped in 233 cases (65.1% agreement). Both observers identified 204 gestures, and overlapped in 154 cases (75.5% agreement). Although not possible to check the reliability of these agreements statistically, the inter-coder reliability is high for naturalistic data. Further analyses of reliability were calculated solely on the gestures identified by both observers.

### 4.3.1 Cross-modal combinations and relationship between gesture and speech

The identified gestures were firstly judged to occur alone or accompany speech. Coders agreed in 150/154 cases (97.4% agreement, significant and very strong Cohen's kappa=.93, p<.001). In cross-modal combinations the gesture can reinforce, disambiguate or supplement speech. Definitions for each of these are given in Figure 4.1. There was 100/116 (86.2%) agreement regarding the relationship between gesture and speech. This was significant and strong agreement (kappa=.62, p<.001). Finally cross-modal combinations were coded for temporal synchronicity (Table 4.2). Observers agreed in 109/116 instances (94.0%), this agreement was significant and strong (kappa=.66, p<.001).

| Code | Definition |
|---|---|
| GA | Gesture alone |
| GX | Non-synchronised cross-modal combination |
| GS | Synchronised cross-modal combination |

**Table 4.2: coding the temporal relationship between gesture and speech**

### 4.3.2 Functions of gesture

Function codes were derived from the data in an iterative process. It was found to be problematic to disentangle speech and gesture in a naturalistic setting, therefore for reinforcing and disambiguating cross-modal combinations the whole combination was coded for function. If the gesture clearly had a separate function to accompanying speech, as in supplementary combinations and gesture with no accompanying speech, then this function superseded the combined function and was coded independently.

Some functions proved exclusive to adults, others to the child. These preferences are shown in Figure 4.1 which also provides definitions for each code. The gestures divide into three groups; organisational gestures, facilitative gestures and emotional displays. Organisational gestures are used to initiate or end an activity or task.

They are also used to regulate a child's behaviour or recall attention on to a task. The majority of functions falls into the second group. These gestures facilitate the current activity and can be further divided into questions, direction, marking interest, feedback, questions and answers, immediate needs and socially motivated gestures. The distinction between organisational and facilitative gestures borrowed heavily from the categorisation of types of talk occurring during speech therapy sessions devised by Letts (1985). The final group of gestures are emotional gestures. These are body movements which reflect an inner emotional state and are primarily used by the child only. Inter-coder reliability was 143/154 (92.9%) agreement for the three main functions. This agreement was significant and strong (kappa=.63, p<.001). For the subgroups of facilitative functions observers agreed in 119/132 instances (90.2%) agreement, significant and very strong (kappa=.87, p<.001).

### 4.3.3 Forms of gesture

Coding form of gesture borrowed from the taxonomy developed by McNeill (1992). Gestures were split into three main groups: deictic and representational gestures and Makaton signs. Full details of the gesture codes for form are given in Figure 4.2 and Figure 4.3. Although Makaton signs are not gestures, as defined in Chapter 1, it was felt that they should be included as they were relatively frequent in the communication between the Explorers staff and the child. Self-adaptors (mannerisms such as stroking hair, or touching the face) were not coded or analysed further as these fell outside of the definition of gesture for the purposes of this study. Perhaps surprisingly, although the staff members used beat gestures amongst themselves, neither they nor the parents used beat gestures with the participants. This may have arisen as a way of simplifying communication directed to young children. In consequence these gestures are also excluded from the study. It should be noted that when adults used physical prompts this was a much stronger request compared with the child's use of such gestures. The two coders agreed for 146/154 gestures (94.8%). This was significant and very strong agreement (kappa= .89, p<.001).

### 4.3.4 Additional codes

Finally the onset of first words and two word combinations was examined. Only productive words were considered. The following criteria were used to determine words:

1) non-echolalic – the word must clearly be seen to be independent from, or a different response to, the previous utterance
2) no unanalysed chunks
3) socially and linguistically appropriate - the word must be used appropriately and with apparent understanding of the meaning of the word
4) stable phonological form

and additionally for two word combinations

5) syntactically combined – thus excluding repetition (jump jump jump) or lists/ counting (one two three)

Where possible parental report forms (Oxford Babylab CDI) were used to determine onset of first words. For two word combinations and first words which appeared during filming two independent coders examined the data, differences of opinion were resolved through discussion.

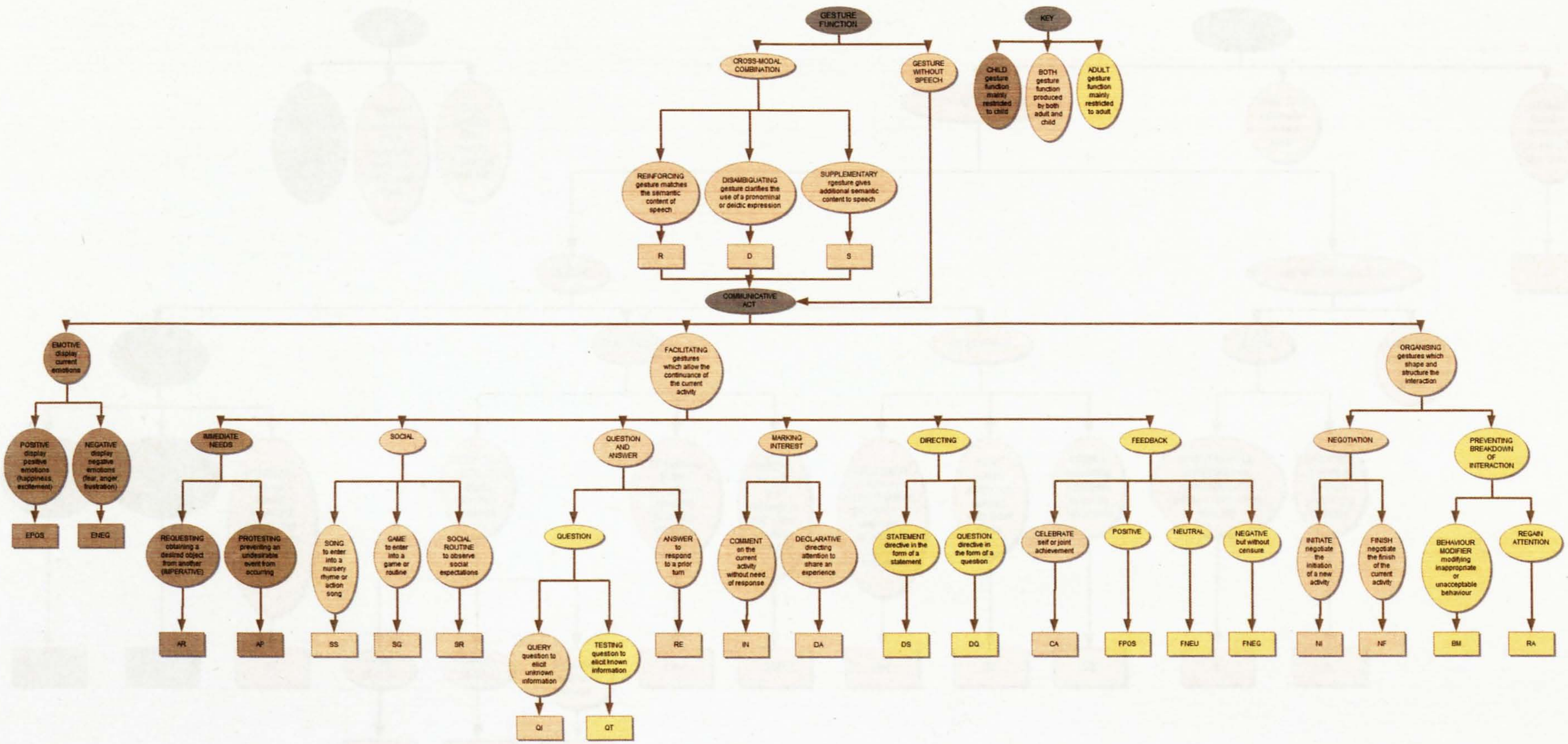



**Figure 4.1: Coding system for gesture function and relationship to speech**

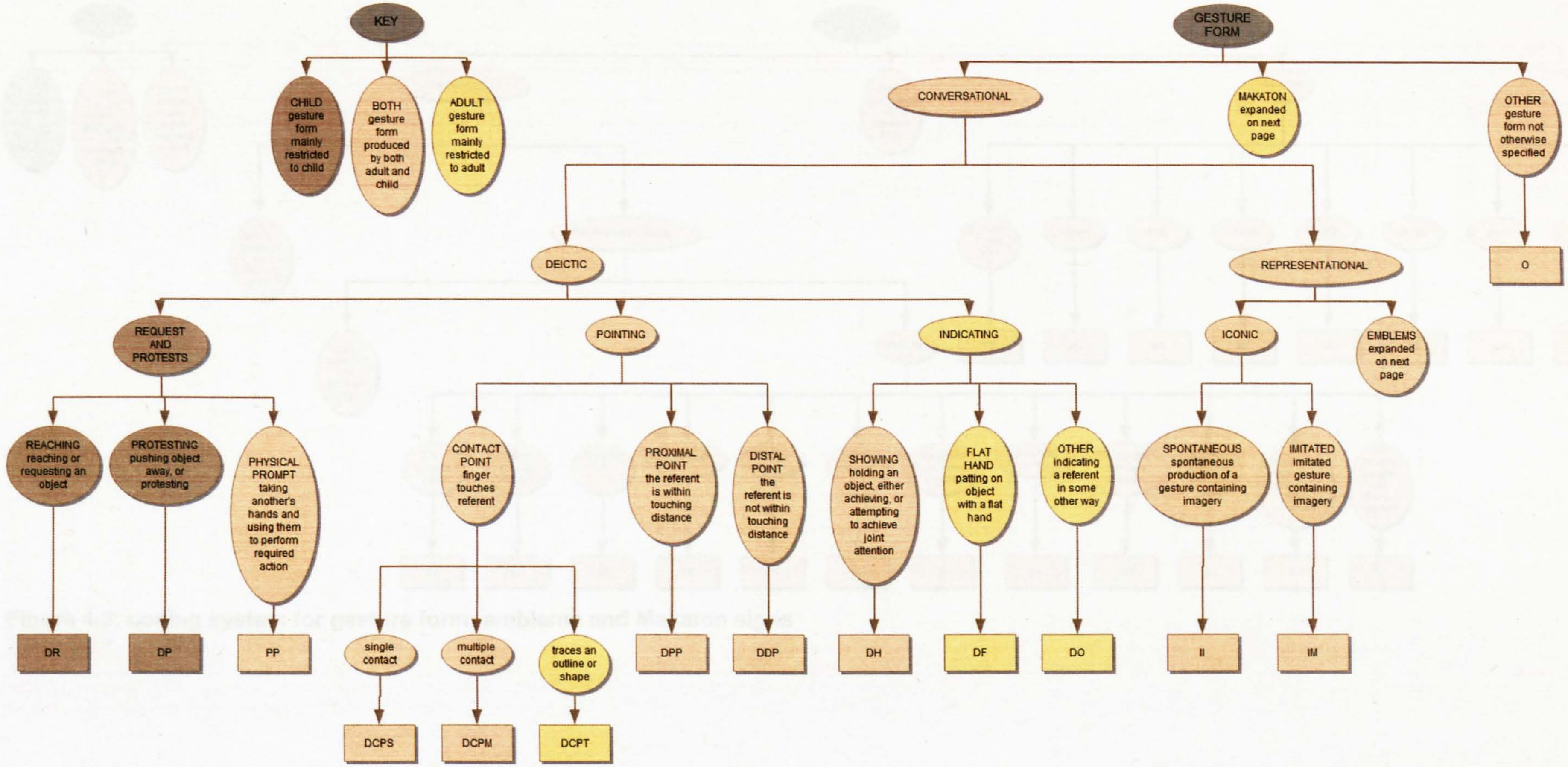



Figure 4.2: coding system for gesture form: deictic and iconic gesture

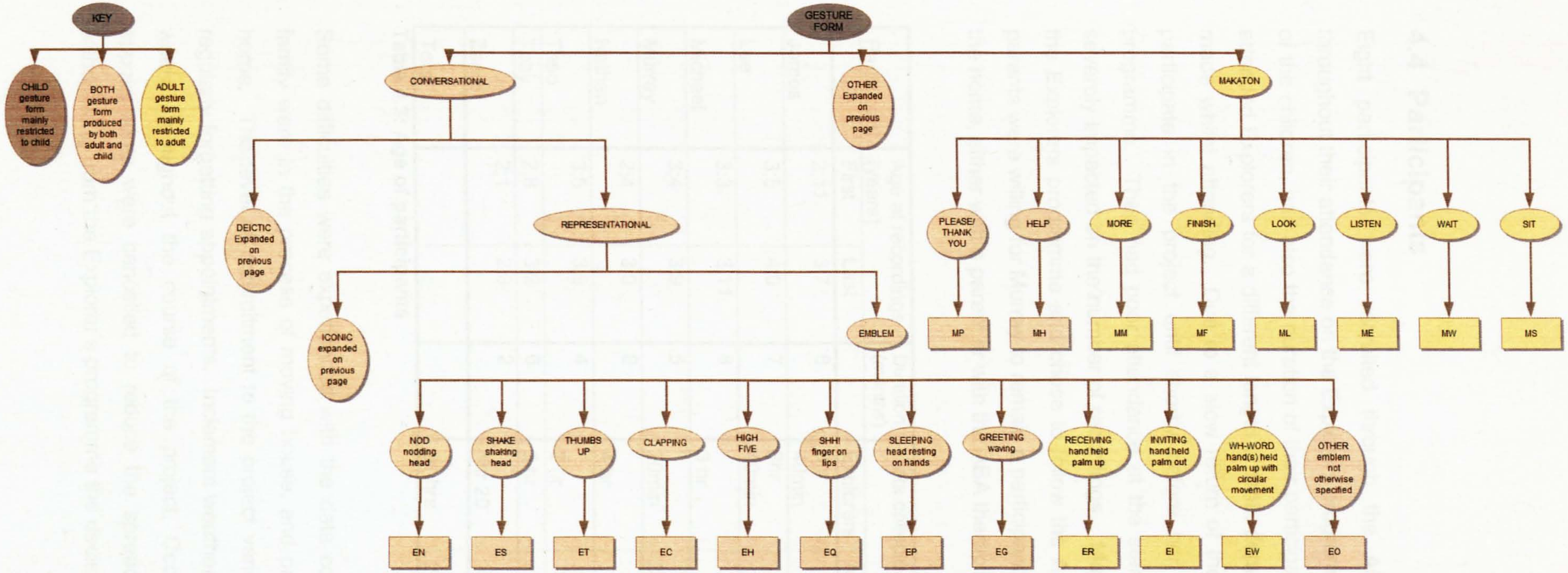



**Figure 4.3: coding system for gesture form: emblems and Makaton signs**

## 4.4 Participants

Eight participants were recruited through the Autism Service, and followed throughout their attendance on the Explorers programme. Table 4.3 shows the ages of the children, and also the duration of their participation in the project. Each child attended Explorers for a different length of time, dependent upon the progress they made whilst attending. Due to a slow return of the consent form Zaara did not participate in the project until shortly before her completion of the Explorers programme. Theo had poor attendance at the start of the programme, and this severely impacted on the number of recordings. Murray's parents decided against the Explorers programme and chose to follow the ABA programme at home. His parents were willing for Murray to remain a participant. All further recordings were in the home, either with a parent or with the ABA therapist.

| Participant | Age at recordings (years) | | Duration (months) | Data collected | | | |
|---|---|---|---|---|---|---|---|
| | First | Last | | Explorers | ABA | Home | Total |
| James | 2;11 | 3;7 | 8 | 3hr 40min | | 2hr 20min | 6hr |
| Lee | 3;5 | 4;0 | 7 | 3hr 40min | | 2hr | 5hr 40min |
| Michael | 3;3 | 3;11 | 8 | 3 hr | | 3hr 40min | 6hr 40min |
| Murray | 3;4 | 3;9 | 5 | 20min | 2hr | 1hr | 3hr 20min |
| Nathan | 2;4 | 3;0 | 8 | 4 hr | | 2hr 40min | 6hr 40min |
| Theo | 3;5 | 3;9 | 4 | 2 hr | | 40min | 2hr 40min |
| Toby | 2;8 | 3;2 | 6 | 3 hr | | | 3hr |
| Zaara | 2;1 | 2;3 | 2 | 1hr 20 | | | 1hr 20min |
| Total | | | | 21 hrs | 2 hrs | 12hr 20min | 35hr 20min |

**Table 4.3: Age of participants**

Some difficulties were experienced with the data collection in the home. Toby's family were in the process of moving house, and preferred not to be recorded at home. The level of commitment to the project varied across parents, with some regularly forgetting appointments. Inclement weather prevented travelling for some weeks throughout the course of the project. Occasionally a child was ill, or appointments were cancelled to reduce the spread of infections. With Murray withdrawing from the Explorer's programme the decision was made to continue with fortnightly visits to the home, in order not to place too high a burden on the family. This reduced opportunities for collecting data with both parents and therapist.

The following sections report the assessments repeated every three months on the Explorers programme. As the assessments are not standardised a traffic light system will be used; red indicating a severe delay, and green correspondingly mild. Full scores for all assessments are given in Appendix A. A vocabulary assessment, completed by the parent at the beginning and end of participation on the project is also reported.

### 4.4.1 The Socialisation Checklist

The checklist assesses behaviour and communication. Table 4.4 shows the children's profiles, at the first and final assessment. Taking the children as a group, communication and socialisation are the most impaired. Learning independence and adaptability to rules and routines seem relative strengths. Each child increases their score, or remains steady at the second assessment, none regress.

| | Age (years) | Adaptability to rules and routines | Socialisation | Communication | Learning Independence |
|---|---|---|---|---|---|
| James | 2;9 | red | red | red | red |
| | 3;6 | amber | amber | red | amber |
| Lee | 3;2 | red | red | red | red |
| | 4;0 | green | amber | amber | green |
| Michael | 3;0 | amber | amber | amber | amber |
| | 3;10 | green | green | amber | green |
| Murray | 2;9 | amber | amber | red | amber |
| | 3;4 | green | amber | red | amber |
| Nathan | 2;3 | amber | amber | red | amber |
| | 2;11 | green | green | green | green |
| Theo | 3;0 | amber | amber | amber | amber |
| | 3;8 | amber | amber | amber | amber |
| Toby | 2;7 | red | amber | red | amber |
| | 3;2 | green | amber | amber | green |
| Zaara | 1;9 | red | red | red | red |
| | 2;3 | amber | amber | amber | amber |

**Table 4.4: Socialisation checklist**

NB: colour calculated by taking range of possible scores and dividing by three:

red: bottom third of possible scores
amber: mid third of possible scores
green: top third of possible scores

James, Lee and Zaara all present with serious delays in all aspects measured by the Checklist, their scores fall into the red zone across the board. However the outcomes are very different. Within six months Zaara is scoring in the amber zone in all categories. James's final assessment occurs nine months after the first. In this time his scores fall into the amber zone, with the exception of communication skills, which remains red. In ten months Lee also increases his scores for socialisation and communication, from red to amber. He shows the greatest progression in adaptability to rules and routines and learning independence, increasing these scores from red to green.

Toby initially has grave problems with adaptability to rules and routines and communication. By the final assessment his profile has changed and it is socialisation and communication which are the weakest areas, communication showing some improvement. At this final assessment he is scoring in the green range for both learning independence and adaptability to rules and routines.

At the first assessment Murray and Nathan are both consistently within the amber range, with the exception of communication which proves difficult for them both. Unfortunately within seven months Murray does not manage to significantly improve any of his scores, except for adaptability to rules and routines. More worryingly his language remains problematical. In contrast at age 2;11 years Nathan is scoring in the green range across all four categories, showing most improvement in his language.

Michael and Theo were both initially assessed to fall within the amber range. Theo shows no difference on the final assessment, eight months later. Michael has improved in all areas, with the exception of communication.

### 4.4.2 Living Language Detailed Profile

The Living Language Detailed Profile is a checklist of development, aimed at atypically developing children. Not surprisingly language skills once again prove difficult for the participants as a group. Also problematic is self help and independence. The group strengths are physical skills and hand and eye co-ordination. The majority of the participants do show development between assessments, however in some cases the development is not at a comparable rate to typically developing children resulting in increased delays.

Murray initially scores poorly on this assessment, in all five categories he is delayed by more than 12 months. This improves slightly by 2;11 years when physical skills and hand and eye co-ordination delays reduce.

Once again Lee and James present in a similar way. Both have a delay of over 12 months for all aspects except for physical skills (between 6 and 12 months) on the first assessment. James's development is slow and consequently by the final assessment he is delayed by more than 12 months in all sections. Lee maintains his development in all areas, and reduces the delay for eye and hand co-ordination and play and social development to between 6 and 12 months.

Michael and Toby both initially have a delay of more than 12 months in all areas, except for physical skills and hand and eye co-ordination. Michael shows uniform development, reducing the delay to between 6-12 months for all sections, and reducing eye and hand co-ordination to less than 6 months delay. In contrast Toby does not continue to develop at a rate comparable to typical children, resulting in a final assessment delay of over a year for hand and eye con-ordination. The other aspects of the assessment remain as they were at the first assessment.

| | Age (years) | Physical skills | Self-help and independ-ence | Eye-hand co-ordination | Play and social develop-ment | Listening and understa-nding | Expressive skills |
|---|---|---|---|---|---|---|---|
| James | 2;5 | amber | red | red | red | red | red |
| | 3;6 | red | red | red | red | red | red |
| Lee | 3;1 | amber | red | red | red | red | red |
| | 4;0 | amber | red | amber | amber | red | red |
| Michael | 2;11 | amber | red | amber | red | red | red |
| | 3;10 | amber | amber | green | amber | amber | amber |
| Murray | 2;9 | red | red | red | red | red | red |
| | 2;11 | amber | red | amber | red | red | red |
| Nathan | 2;2 | green | amber | green | amber | red | red |
| | 2;11 | amber | red | green | amber | amber | green |
| Theo | 3;4 | green | amber | amber | amber | amber | amber |
| | 3;8 | green | amber | amber | green | amber | amber |
| Toby | 2;1 | amber | red | amber | red | red | red |
| | 3;1 | amber | red | red | red | red | red |
| Zaara | 1;7 | amber | red | amber | amber | amber | red |
| | 2;3 | amber | red | amber | red | red | amber |

**Table 4.5: Living Language Detailed Profile**

NB: colour calculated by length of delay:
red: 12+ months amber: 6-12 months green: 0-6 months

The last three participants are all disparate in their scores. Nathan initially shows a mixed profile. He has a delay of less than 6 months for physical skills and eye-hand co-ordination. He is between 6 and 12 months for self help and independence and play and social development, however his language skills are seriously delayed and prove problematic for him. By the second assessment expressive skills are within 6 months of typical development, and receptive skills have also improved. Eye-hand co-ordination and play and social skills remain similar to the first assessment, but the delay in physical skills and self help and independence has increased to 6-12 months and over 12 months respectively.

Similarly to the other assessments Theo shows little change between the first and the last assessment. His strengths are physical skills and play and social development. The remaining categories show a delay of between 6 and 12 months. Zaara has problems with self help and independence and expressive skills at the first assessment. At the second assessment Zaara has managed to reduce the delay in expressive skills to between 6 and 12 months. She has maintained her scores for physical skills and eye-hand coordination, but self help and independence remains difficult. In addition to this the delays in play and social development and receptive skills are increasing.

### 4.4.3 Surrey Speech, Language and Communication Profile

The Surrey Language Profile examines the impairment and the effect it has on the functionality of language. The profile covers receptive and expressive skills, speech production, interaction and behaviour (Table 4.6). Some participants were only assessed once, eliminating the possibility to observe changes. This assessment confirms the already noted difficulties that the participants have with speech and language. All areas assessed by the Surrey Profile are problematic for the participants. Speech production is possibly the least affected, and behaviour scores are also slightly in advance of others. The impact that the speech and language difficulties are having upon the participant's communication is large.

Despite severe problems with receptive and expressive skills, and speech production Lee interacts relatively well, despite a large impact on his communication. For both Michael and Toby all areas prove difficult, although speech production is better than most. For Michael the behaviour section is a relative strength. Theo presents a more mixed profile, speech production is good, and interaction and expressive skills are better than his receptive skills and behaviour. However the combined difficulties do have a large negative impact on his communication.

| | Age (years) | Receptive | Expressive | Speech Production | Impact | Interaction | Behaviour |
|---|---|---|---|---|---|---|---|
| James | 2;9 | Red | Red | Red | Red | Red | Red |
| | 3;6 | Red | Red | Red | Red | Red | Red |
| Lee | 3;8 | Red | Red | Red | Red | Amber | Amber |
| Michael | 3;10 | Red | Red | Amber | Red | Red | Amber |
| Nathan | 2;4 | Red | Red | Amber | Red | Red | Amber |
| | 2;11 | Amber | Amber | Green | Amber | Red | Amber |
| Theo | 3;9 | Red | Amber | Green | Red | Amber | Red |
| Toby | 2;8 | Red | Red | Amber | Red | Red | Red |
| Zaara | 1;10 | Red | Red | Red | Red | Red | Red |
| | 2;3 | Amber | Amber | Amber | Red | Red | Amber |

**Table 4.6: Surrey Speech Language and Communication Profile**

NB: colour calculated by taking range of possible scores and dividing by three:
red: bottom third of possible scores
amber: mid third of possible scores
green: top third of possible scores

Both James and Zaara were assessed twice. At the first assessment they are in the red zone across all five categories. By the second assessment this has not changed for James. Zaara has developed her receptive and expressive skills, in addition to speech production and behaviour. The culminating effect of the difficulties is still large, and interaction is problematic.

Nathan was also assessed twice. At first his speech production and behaviour are relatively in advance of the other sections, all of which fall into the red zone. The second assessment shows development in all areas with the exception of interaction and behaviour. Interaction proves to be the biggest difficulty for Nathan, the only section which remains in the red. His speech production continues to be good and his score reaches the green range. Murray's speech and language was not assessed.

### 4.4.4 Oxford Communicative Development Inventory

The Oxford Communicative Development Inventory (OCDI) measures both comprehension and production of over 400 words common to early development in a parental report format. The OCDI has normative data available for over 500 children. Parents were asked to complete this assessment at the start and end of the project. No assessments were returned for Zaara.

James was only assessed on his entry to the project. At this time he had a comprehension delay of 15 months. As James was pre-verbal on entering the programme it was impossible to quantify the productive vocabulary delay. The assessment for Lee occurred towards the end of the project. His vocabulary is the most delayed at 32 months for comprehension and 28 months for production.

| | Chronological Age (years) | Comprehension Age (years) | Comprehension Delay (months) | Production Age (years) | Production Delay (months) |
|---|---|---|---|---|---|
| James | 2;11 | 1;0 | 11 | <1;0 | >23 |
| Lee | | | | | |
| | 4:1 | 1:5 | 32 | 1;9 | 28 |
| Michael | 3;3 | 1;7 | 20 | 1;10 | 17 |
| | 4;0 | 2;0 | 24 | 2;1 | 23 |
| Murray | 3;3 | 1;7 | 20 | 1;10 | 17 |
| | 3;10 | 2;0 | 22 | 2;1 | 21 |
| Nathan | 2;4 | 1;1 | 15 | 1;6 | 10 |
| | 2;11 | 1;4 | 19 | 1;9 | 14 |
| Theo | 3;4 | 1;10 | 18 | 1;10 | 18 |
| | 3;9 | 1;11 | 22 | 1;11 | 22 |
| Toby | 2;7 | 1;4 | 15 | 1;0 | 19 |
| | 3;4 | 1;7 | 21 | 1;9 | 19 |

**Table 4.7: Oxford Communication Development Inventory scores**

The remaining participants were assessed twice. In all cases the development of vocabulary was slower than that of typical children, resulting in the measured delay increasing with time. Michael, Murray, and Nathan all appear to have more difficulty with comprehension of language than with production. Michael has a comprehension delay of 20 months on commencement of the project, increasing to 24 months at the end. The delay for production is less, 17 months at first, increasing to 23 months by age four. However it should be noted that due to his interest in Thomas the Tank Engine Michael has acquired many words which are not listed on the OCDI. Murray maintains a delay of just under two years through out the duration of the project for comprehension. Although the production delay is initially smaller at 17 months, this also increases to just under two years by the end of the project.

On commencement of the programme Nathan scored an age equivalent score of 1;1 years for comprehension, resulting in a 15 month vocabulary delay which increased to 19 months by the end of the project. However his production scores were higher, giving him a delay of 10 months initially, increasing to 14 months at the end of the programme.

At the first assessment Toby's scores also resulted in a 15 month comprehension delay and a 19 month production delay. Over the course of the programme Toby continued to develop his expressive vocabulary, maintaining the 19 month delay. However the comprehension delay increased to 21 months on the second assessment. Theo, uniquely, has an equal delay for both comprehension and production. At the commencement of the project this delay was 18 months, increasing to 22 at age 3;9 years.

### 4.4.5 Summary

By combining the information given from the four assessments it is possible to describe a profile for each participant. The core areas of physical skills, independence, socialisation and communication will be considered and progress during the programme will be reviewed.

James scores consistently low across all four areas. His physical skills are his strength. He shows little progress in any area during the programme. He is one of the younger participants and whilst experiencing serious delays these may reduce in time.

Lee also scores quite poorly at the beginning, yet during the course of the programme he improves in all areas. His physical skills are strongest, but changes within communication allow more interaction despite low scores for receptive and expressive skills. Lee is amongst the oldest participants, the low scores are increasingly worrying for his future.

Michael showed astonishing development during the course of the programme. His physical skills remain a strong point, but independence, socialisation and communication all rapidly developed during his attendance. Communication remains his weakest area of the four.

Murray did not remain in the project long, therefore the assessments were administered close together. Despite this all four areas developed from the first assessment, although independence and socialisation remain low. Communication is also problematic for Murray.

Nathan showed development in all areas during the programme. Socialisation and physical skills improved the most. Nathan has difficulties with independence, but his communication skills were developing quickly at the end of the programme. Despite being one of the youngest children, Nathan was consistently scoring highly on the assessments.

Theo showed little change over the programme. He remained competent in all four areas through out the programme.

Toby is best at physical skills. Communication and independence are weak. His social skills appear to not be developing at the same speed as a typically developing child, thus increasing the delay in these skills. Communication also does not appear to be developing during the programme.

Zaara is the youngest child as reflected in the low scores at the first assessment. Her physical skills develop during the course of the programme. There is slight improvement on her independence, although she still relies on staff members. Social and communication skills develop during the programme.

On the basis of these assessments a disparity can be seen between the majority and James and Lee who consistently score below the other participants. In the next chapter a gestural assessment will be developed, which will then be used to assess each child's use of gesture.

Chapter 5

# THE GESTURE CHECKLIST: AN ASSESSMENT OF GESTURE DEVELOPMENT

This chapter firstly reviews existing gesture assessments, and considers the strengths and limitations of different assessment techniques. The Gesture Checklist (GC) is then presented, and the initial pilot data reported and discussed. The final section returns to the participants with ASD and uses the GC to assess their gesture on commencement and completion of the project.

## 5.1 Assessing gesture

As discussed in Chapter 2, gesture is amongst the first meaningful communication of a child. The indications are that gesture, and its combination with speech is a predictor of later language ability. Due to its close links to speech, gesture may be a legitimate target for intervention in communication disorders. It would be extremely valuable to have a reliable means of assessment of gesture in young children. Such an assessment would not only establish normative control data with typically developing children, but could be used as a screening tool for children with disordered language.

A review of the current assessments on gesture reveals that this is a neglected sub area of communication. There is no established battery of tests for assessing gesture. There are a few checklist assessments designed to guide observational sessions which include gestural information, although these contain less detail than the ideal. Assessments can be divided into two categories: those which a therapist completes and those which rely on parental or caregiver response. Each will be described in turn.

### 5.1.1 Assessment in a clinical setting

The direct assessment of children has many benefits. The researcher or therapist can interpret the child's behaviour through their expert knowledge without the need of an intermediary. There are many different assessments and tasks designed to be completed by children of all ages, each tapping into a different ability and including both input and output measures. However despite the advantages of the direct observation this approach has several disadvantages.

In order to provide a comprehensive measure of the child's emerging ability extensive testing may be necessary resulting in large demands on the child's attention. It may be necessary to split the testing over several sessions. The time taken for the assessments may also impact on the sample size, as resources of the researcher's time and laboratory time may prove prohibitive. Finally very young children may not wish to co-operate with the testing, and may be reluctant to interact with an unfamiliar adult. Repeat measures on a similar test may induce practice effects. Despite these limitations this approach has been successfully adapted to the study of gesture in young children.

#### 5.1.1.1 Assessments of communication which include gesture

There are many assessments which target the developing communication of a child. Some of these assessments also include sections on gestural communication. The Living Language Detailed Profile (Locke & Beech, 1991) covers the age from birth to five years (as described in Chapter 4). It is aimed at children with significant language learning difficulties as a means of monitoring progress and setting targets. The assessment provides an overview of many different areas of development. This discussion will be restricted to the first two checklists which conclude at two years. The profile takes a broad view of communication, using sections as diverse as physical skills, play and social development as well as receptive and expressive language skills. The checklists are divided into six month age ranges with twelve milestones listed for each skill in each range. Children under the age of six months are not expected to use gesture, therefore this is not included at this level. The assessment is completed by a professional, through observation and direct testing of abilities.

Gesture, as a form of communication, features most heavily in the six-twelve month age range. Gesture forms included are deictic, emblems and iconics such as those found in nursery rhymes and action songs. Imperative and declarative functions are included. There is no definition of gesture given, and in many cases the required behaviour could be realised through numerous means, inclusive of gesture. Thus it is not always possible to ascertain if the child is using all the gestures listed on the profile.

The Preverbal Communication Schedule (PVCS) (Kiernan & Reid, 1987) is designed for individuals of any age, who have not developed spoken language. The form is designed to be completed by a professional (therapist or teacher) and is assessed through a combination of observation and direct testing of the child's abilities. The assessment is a comprehensive profile of early communicative behaviours including vision, hearing, motor skills, emotion and social behaviour, singing, imitation non-verbal communication and comprehension. The assessment is divided into three sections: pre-communicative behaviours, informal communicative behaviours and formal communication skills. The section on gesture falls into the second section.

The PVCS defines gesture as a response in which the student expresses meaning through a movement without physical contact. Such gestures as an affirmative nod, or negative shake of the head are included, as is waving. Simple iconic gestures are included, both as a request (DRINK) and naming (CAT). Perhaps as a result of the targeted population, which may include older children exposed to sign training, the form also notes any gesture sequences of action depiction. Early gestures such as reaching towards an adult to be picked up and physical prompts are included. There is a separate section on pointing, including contact and distal pointing, and imperative and declarative function.

The PVCS provides an extremely informative and comprehensive profile of the child's early communicative behaviours. However there are some omissions in the gestural information. Responses are scored as occurring usually, rarely or never. Therefore for iconic gestures it is not possible to know the repertoire of gestures that each child has, whether the child responds often with various gestures, or whether the response is limited to a small set of often repeated gestures. As the form is targeted at non-verbal individuals there is also no assessment of gesture's changing relationship to speech.

The Communication and Symbolic Behaviour Scales (CSBS DP) (Wetherby & Prizant, 2002) was developed specifically to screen for autism or pervasive developmental disorders at an early age. The CSBS requires a trained examiner and relies on direct observation of the child, with both structured and unstructured sampling procedures. The CSBS measures across twenty two scales, and results in seven cluster scores, including communicative functions, gestural, vocal and verbal communicative means, reciprocity, social/affective signalling and symbolic behaviour. Within the gestural measures three distinctions are made. Conventional gestures approximately equate to emblems. Such gestures include giving, showing, rejecting, pointing, waving and nodding. The second group of gestures are distal gestures, these are defined as communicative acts where the child's hand does not touch a person or object. The gestures included in this category overlap with that of the previous section. The final measure corresponds to co-ordination of gesture and vocal acts; acts where the gesture and vocalisation overlap in time.

Despite the detail of gestural information incorporated into this assessment, there are still some areas which need to be further developed. Due to the focus on screening for ASD there is little distinction between gesture forms, with emblems and deictic gestures subsumed under the category of conventional gestures. Iconic gestures are not listed. Although there is some information collected on the relationship between gesture and speech this is at a very basic level. It is not possible to link specific gesture forms to speech, to know the cross-modal relationship between gesture and speech, nor to know if gesture and vocalisations are synchronised.

The Prelinguistic Communication Assessment (PCA) (Stone *et al*, 1997) was also designed specifically for children with autism. It consists of sixteen situations designed to elicit either imperative or declarative communication. The PCA claims to cover a wider variety of eliciting situations, all sharing common instructions for the provision of prompts to the child. Situations for eliciting declarative behaviour include a balloon deflating and flying across the room, picture books and unexpected noises. Situations targeting imperative behaviours include giving the child a jar with tempting contents but a tightly screwed on lid, playing catch or batting a balloon backwards and forwards then holding the ball or balloon out of reach, and playing with a wind-up toy which is handed to the child when it has stopped. Similar prompts are used in each situation, increasing through three different levels of explicitness. The resulting communicative acts are coded for function (imperative, declarative and rejecting) and gestural form (give, show, touch, manipulate examiner's hand, reach, contact point and distal point).

This assessment is tightly focused on non-verbal communication which achieves the imperative or declarative function. It is highly structured and so may not reflect the true range of non-verbal behaviour of the child. It is also developed for children with autism, thus may not be generalisable to all communication disorders.

### 5.1.2 Assessment using parental report

Using parental report as a means of assessment has several advantages (Feldman *et al.*, 2000; Hamilton *et al.*, 2000). Firstly a questionnaire has the potential to reach a large number of children. Secondly for young children interaction with an unfamiliar experimenter is a significant difficulty which is avoided by using parental reporting. Thirdly a questionnaire is inexpensive to administer. It requires no specialised equipment and is quick to score. Finally parental report is particularly suited to gesture development as responses are drawn from multiple observations over a long time span. This gives a better representative idea of the child's true development.

Assessments following this methodology are open to criticism. Although they have been used successfully to report productive language they are less reliable on comprehension measures. The problem is two fold (Tomasello & Mervis, 1994). In child directed talk gestures rarely occur without accompanying speech. Thus in a naturalistic setting it is not possible to tease apart whether the child is attending to gesture or speech, and as a result, gesture comprehension is over reported. Additionally no parent report form requires that a word is no longer context-bound, nor is it possible to see how it could easily do so. This too leads to over reporting, which results in inflated measurements of comprehension (Harris & Chasin, 1999). It follows that comprehension scores obtained by parent report forms should be treated with caution.

Parental report has been used successfully to both assess children's communication, and to asses gesture in particular.

#### 5.1.2.1 Assessments of communication and gesture using parental report

The Children's Communication Checklist–Revised (CCC-R) (Bishop, 2002) is designed for children who are already speaking in simple sentences and aids diagnosis of autism and pragmatic language disorder. It is completed by parent or caregiver and consists of 70 statements of behaviour, 50 focusing on areas of difficulty and 20 on areas of strengths. The respondent is asked to judge the extent to which the statements apply to their child, following a four point scale (less than once a week, through to several times a day). Of the 70 statements only one refers to gesture and is subjective and vague in its context: "*Makes good use of gestures to get his/her meaning across*". As this assessment is focused on children who are already communicating primarily through speech, gestural information is not central to this assessment.

In comparison Volterra and colleagues have developed several parental questionnaires focusing on deictic gestures including imperative and declarative pointing, referential gestures, words and combinations of words and gestures (Camaioni *et al.*, 1992 cited in Camaioni *et al.*, 1997; Perucchini & Camaioni, 1999 cited in Camaioni *et al.*, 2004). Unfortunately the results of these assessments have not yet been published in English (but note Camaioni *et al.*, 1991). The more comprehensive of the two has been found to distinguish between typically developing children and those with autism (Camaioni *et al*, 1997).

Justifiably the most influential assessment of early language development is the MacArthur-Bates Communicative Development Inventory (CDI)(Fenson *et al.*, 1993). This has been translated from the original American English into many other languages and has been extensively tested. The CDI has two versions, one for infants, and another for toddlers. This discussion will focus on the first of these forms, Words And Gestures, designed for eight to sixteen month old children. The first part of this form is a vocabulary list, the second concentrates on actions and gesture.

The form is comprised of six sections, divided into two main components; early and late gestures (Table 5.1). The early gestures comprise sections A and B, "first communicative gestures" and "games and routines". This first section has specific reference to twelve different gestures ranging from nodding and shaking the head, through pointing to shrugs. This is a good, but by no means comprehensive list. Section B covers games such as peek-a-boo and chasing. These are not gestures which are closely linked to the prediction of language ability, nor to the cognitive underpinnings of communication and understanding.

The second component, late gestures, includes sections C-F. These sections are more closely allied to the development of play, than to communication. They include "actions with objects", "pretending to be a parent" and "imitating other adult actions". For all of these sections the listed test items are actions or play schemes and not gesture. This is also true of the final section which inquires concerns imaginative play. Grouping these as late gestures disguises the differentiation between gesture and play schemes. This issue has not been resolved on the CDI.

| Component | Section | Name | No. of test items |
|---|---|---|---|
| Early Gestures | A | First communicative gestures | 12 |
| | B | Games and routines | 6 |
| Late Gestures | C | Actions with objects | 17 |
| | D | Pretending to be a parent | 13 |
| | E | Imitating other adult actions | 15 |
| Others | F | Pretend objects | n/a |
| | G | Other comments | n/a |

**Table 5.1: Structure of the CDI**

The majority of the assessments reviewed here have a broad focus on the development of communication, resulting in imprecise or limited gestural information. There is a need for a focused and reliable assessment of early gesture.

### 5.1.3 Objectives for the development of an instrument to assess gesture

The ultimate aim would be to create an assessment for gesture as well conceived, robust and reliable as the CDI. However due to the nature of gesture there are a number of problems which must be overcome. Parental report appears to be the best means of assessment to gain a true impression of the child's communicative ability. After all it is to communicate in every day environments that prompts the child to use gesture. Consequently the methodology should be able to capture the spontaneous nature of gesture.

Deictic gestures occur around 10 months of age, and children are beginning to reach the two word stage by about 20 months, the ideal age range for an assessment would be from 8 to 24 months. As the assessment is to be completed by the primary care-giver the layout should be simple, user friendly and require no prior knowledge of gesture. A clear distinction should be maintained between gesture, baby sign or other sign language, and play schemes or actions. As it is conceivable that a child may gesture rarely, yet have an extensive early vocabulary any assessment of gesture should be used in conjunction with an assessment of early language ability, so that the child which communicates mainly in the verbal modality is not penalised in their communicative ability.

Any assessment should include both the form of the gesture produced by the child, but also the function of the gesture or speech-gesture combination. A section focusing on speech-gesture combinations and the relationship that the two components hold to each other would be beneficial as both reinforcing and supplementary combinations can predict later language ability. Whilst it is extremely unlikely that children of this age will have developed hand preference, information pertaining to the change from double handed gestures to single handed gestures, or the dominance of a single hand in double handed gestures could be assessed and would be invaluable.

A measure of comprehension would be extremely informative, yet it is difficult to see how this could be included in any meaningful way. Perhaps a subjective measure is the closest that can currently be achieved, for example asking the care-giver if they believe that using a gesture would aid the child's comprehension in a number of situations. However this would need to be validated independently in an experimental design with a subset of children in order to have any confidence in the accuracy of the results.

Despite numerous problems in the creation of an assessment for early gestural ability such a task should be undertaken. It appears overdue in the light of the new knowledge that is currently being accumulated regarding the nature of gesture, and the important role it plays in the development of language.

## 5.2 Method

This section describes the design of the Gesture Checklist, and the procedure and participants for the pilot study. The coding system developed for the GC is also described.

### 5.2.1 Materials

The Gesture Checklist (GC) is designed to be both user friendly and comprehensible to someone with no experience of gesture research. Language is informal, instructions brief and summarised on each page. The format is kept as constant as possible across all seven sections of the form. The use of tick boxes facilitates completion through increasing speed of response and minimising instruction. The GC is divided into seven sections, the first five of which target a different gesture function (Table 5.2). These sections are Pointing, Communicating, Naming, Actions, and Describing. The sixth section records hand choice, and the final section is open for individual comments from the parents. Items for the GC were decided upon through a review of the literature on early gesture, the item's inclusion on previous gesture assessment instruments and personal observation of the communication of young children.

The first five sections all share the same tabular format. There are three sections; a description of each gesture, receptive skills (headed by 'understands') and expressive skills (headed by 'uses'). The penultimate section of the assessment includes seven different hand choices for each gesture function. In the final section the parent is invited to make any relevant comments, and to explain decisions taken when the form restricted their immediate response, thus hopefully minimising constraints resulting from the form filling process (Fawns & Ivanic, 2001).

| **Section** | **Name** | **No. of test items** | |
|---|---|---|---|
| | | Comprehension | Production |
| A | Pointing | 7 | 8 |
| B | Communicating | 12 | 14 |
| C | Naming | 9 | 9 |
| D | Actions | 4 | 4 |
| E | Describing | 5 | 5 |
| F | Hand Preference | Hand choice in the performance of gestures | |
| G | Comments | Room for explanations/ other comments. | |

**Table 5.2: Structure of the Gesture Checklist**

Two questions gather background information on the child. The first controls for any factors arising from bilingual acquisition, or cultural factors influencing gesture. The second targets the child's general development in an open question to ascertain if there were developmental delays due to medical causes. The full Gesture Checklist is given in Appendix B.

### 5.2.2 Participants and Procedure

Respondents (the parents) were recruited from twenty nurseries in the Sheffield area, UK, and from Sheffield University staff. In all there were fifty four returned forms. The children (participants) were divided into three age groups each of six months duration, and balanced for gender (Table 5.3). Socio-economic status was not assessed as previous research has shown this not to be a factor (A Hamilton *et al.*, 2000).

| | No. of participants | | |
|---|---|---|---|
| Age (mths) | Boys | Girls | Total |
| 6-11 | 10 | 8 | 18 |
| 12-17 | 9 | 10 | 19 |
| 18-23 | 7 | 10 | 17 |
| Total | 26 | 28 | 54 |

**Table 5.3: Breakdown of Participants**

The respondents were approached by the researcher, either in person at their child's nursery, or via email through the university. Respondents were given some background information on the study and were then asked to fill in two forms, the Gesture Checklist (GC) and the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI), Part 2 (Actions and Gesture). The CDI was included in order to provide some validation of the newly devised GC. The forms were optionally returned in paper or electronic format.

### 5.2.3 Coding

The CDI measures production of gestures and actions. In section A parents are required to respond with 'not yet', 'sometimes' or 'often' to describe how their child performs that gesture. These were coded on a ranked scale of 0 (not yet) to 2 (often). In subsequent sections merely whether the child does or does not perform the gesture is recorded. The child scored 1 for each gesture produced.

The GC follows a similar format. Each of the four measurement variables (comprehension, gesture production, word production, combined gesture and word production) uses a similar ranking scale (Table 5.4). For comprehension parents are prompted to a three-way decision: 1) their child does not understand the gesture, 2) their child would understand the gesture if it was accompanied by speech, 3) the gesture would be understood in the absence of speech. Gesture production (the 'uses' section) also uses a three point scale: the gesture is not used, is used sometimes, or is used often. There are definitions for each of these cases given in the main instructions. Word use is assessed by a further choice of 'has a word' for the children who express that particular function through the verbal modality.

The final measure, combined production, attempts a global measure of the child's speech and gesture. The assumption that gesture will appear developmentally before verbal items was built into the coding system. The use of a word was given a stronger weighting in combined production than gesture used occasionally. A gesture produced often and using a word instead of a gesture were scored equally. Those children who used both words and gesture interchangeably for the same test item scored more highly (Table 5.4). It should be noted that the limited piloting revealed no inconsistencies with this assumption for typically developing children, but this may not be the case for atypically developing children who may have a gestural deficit when compared to first words. However such a case should be revealed through the separate production measures.

| Code | Comprehension | Gesture Production | Word Production | Gestural and Verbal Production |
|---|---|---|---|---|
| | | | | |
| 1 | Doesn't understand | Not yet | No word | Not yet |
| 2 | Understands with speech | Sometimes | Uses word | Sometimes |
| 3 | Understands without speech | Often | n/a | Often OR has a word |
| 4 | n/a | n/a | n/a | Both word AND gesture used |

**Table 5.4: Coding Scheme for the Gesture Checklist**

## 5.3 Results

This results section will fall into two main parts: the results for the CDI will be discussed before the results for the GC. The GC section will be further divided into a section reporting on the reliability and validity of the assessment, and a second section reporting on the participants' performance on the assessment.

### 5.3.1 The MacArthur-Bates Communicative Development Inventory

This section comprises the analysis undertaken of the data collected by parents' responses to the CDI. The responses were analysed by section of the form, age and gender of the participants.

#### 5.3.1.1 Describing the groups

By standardising (converting to proportional scores) the scores for each section a comparison of the different sections of the form can be made (Figure 5.1). It can be seen that in each section some children are scoring at both floor and ceiling. However for sections A and B the medians are both quite high at about 0.7. Likewise the inter-quartile range for these two sections is also comparable. As these two sections group together to form Early Gestures it makes sense that they are patterning in a similar way, and also that the children are consistently achieving the highest scores for these two sections.

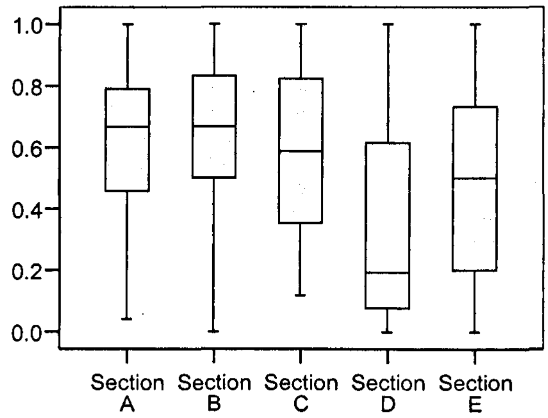



**Figure 5.1: Box Plot to show Standardised Section Scores**

The remaining three sections group together to form Late Gestures. Section C can almost be seen as a transition from early to late gestures, as the median remains high, yet the inter-quartile range is greater, showing that more children are scoring at the lower end of the section. A similar, but slightly more pronounced pattern can be observed in section E. Section D shows a different composition of the group. The median is far lower than for the other sections, below 0.2. Furthermore the inter-quartile range is not equally distributed, the lower quartile having a much smaller range than the upper quartile. In general it can be seen that the children score higher on the early gestures sections of the form compared to the late gesture sections.

Returning to the raw scores, each section can be split into age and gender groups. Overall on the form it can be seen that there is a steady increase in scores across the three age groups for both boys and girls (Figure 5.2), however the boys do consistently score slightly lower than the girls. A greater range can be seen in the scores of the younger children. This reduces as the children grow older.

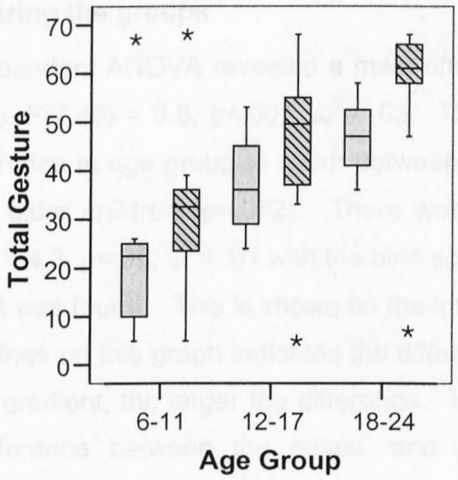



**Figure 5.2: Box Plot showing Total Gesture scores**

A similar pattern is evident in the scores for the late gestures. These show a gradual increase in scores with age, girls tending to score slightly higher than the boys. However the range of scores remains fairly constant through all groups for both age and gender. The picture is rather different for the scores on early gestures. As might be expected, the majority of the children are scoring highly in this section. The older children score slightly higher than the middle children, and also have less range in their scores. Interestingly the youngest girls show very little changes to their adjacent group counterpart, unlike the youngest boys who are scoring much lower than the other age groups. There is a large difference between the youngest and middle age group of boys.

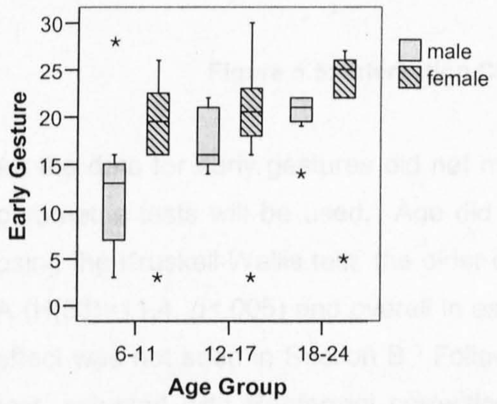



**Figure 5.3: Box Plot showing early gesture scores**

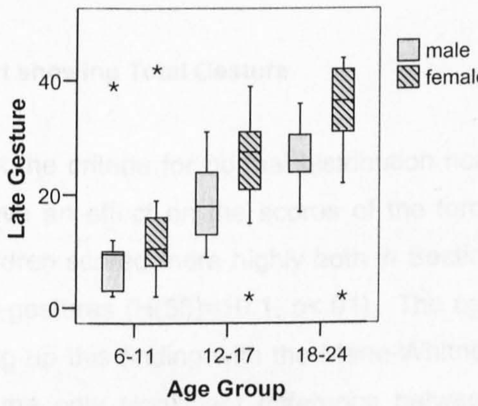



**Figure 5.4: Box Plot showing Late Gesture Scores**

### 5.3.1.2 Comparing the groups

A two-way independent ANOVA revealed a main effect of age considered over the form as a whole, $F(2,48) = 9.8$, $p<.001$, $\omega^2= .03$. The Games-Howell test showed the largest difference in age group to occur between the younger children ($p=.042$) rather than the older children ($p=.072$). There was also a main effect found for gender, $F(1,48) = 4.3$, $p<.05$, $\omega^2= .01$ with the girls scoring higher than the boys. No interaction effect was found. This is shown on the interaction chart (Figure 5.5) The gradient of the lines on this graph indicates the difference between the age groups, the steeper the gradient, the larger the difference. The distance between the lines indicates a difference between the sexes, and parallel lines indicate similar interaction effects. As can be seen there is a larger difference between the younger children compared to the older, girls are scoring consistently higher than the boys, yet the profile of both lines are very similar.

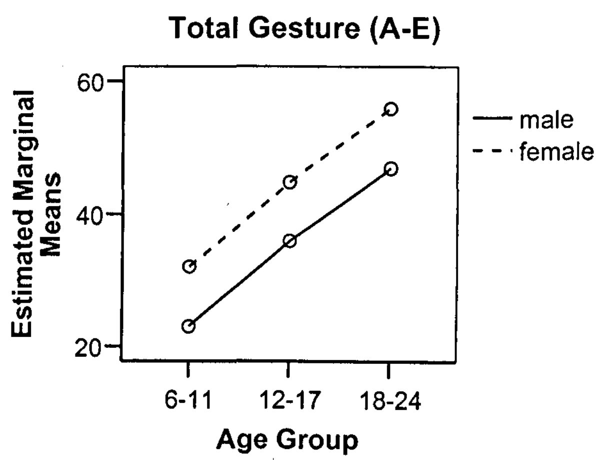



**Figure 5.5: Interaction Chart showing Total Gesture**

As the data for early gestures did not meet the criteria for normal distribution non-parametric tests will be used. Age did have an effect on the scores of the form, using the Kruskall-Wallis test, the older children scored more highly both in Section A ($H(53)=11.4$, $p<.005$) and overall in early gestures ($H(53)=10.1$, $p<.01$). The age effect was not seen in Section B. Following up this finding with the Mann-Whitney test, adjusted with Bonferroni correction, the only significant difference between adjacent age groups was found in section A between the middle (*Mdn*= 16) and older (*Mdn* = 18) age groups $U = 88$, $p<.05$, $r = .32$.

There was also an effect for gender, with the girls scoring higher than the boys. Section A showed the greatest difference with the girls (*Mdn* = 17.5) scoring higher than the boys (*Mdn* = 12), $U = 208.5$, $p<.005$, $r= .37$. There was a similar effect for Section B: (girls *Mdn* = 4.5, boys *Mdn* = 4), $U = 227$, $p<.01$, $r= .33$, and for early gestures: (girls *Mdn* = 22, boys *Mdn* = 16), $U= 187.5$, $p<.005$, $r = .42$. These effects can be seen on the interaction chart (Figure 5.6).

A main effect for age was also found in the late gestures by means of a two-way independent ANOVA, $F(2,48)=12.3$, $p<.001$, $\omega^2= .05$. Follow up with the Games-Howell test showed this to be significant between the younger and middle children ($p <.05$) and the middle to older children ($p<.05$). A similar effect was tested non-parametrically in Sections C and D (Kruskall-Wallis test), and using parametric tests (two-way independent ANOVA) in Section E. The age effect was found in all sections (Section C: $H(53)=17.1$, $p<.001$; Section D: $H(53)=15.0$, $p<.005$; and Section E: $F(2,48)=13.7$, $p<.001$, $\omega^2= .36$). In the follow up to these tests it was shown that the difference was between the younger and middle children in Sections C and D (C: younger children *Mdn* = 5.5, middle children *Mdn*=11, $U$=69, $p<.005$, $r = .42$; D younger children *Mdn* = 0.5, middle children *Mdn*= 4, $U$=85, $p<.01$, $r=.36$) and between the middle and older children in Section E (Games-Howell, $p<.01$).

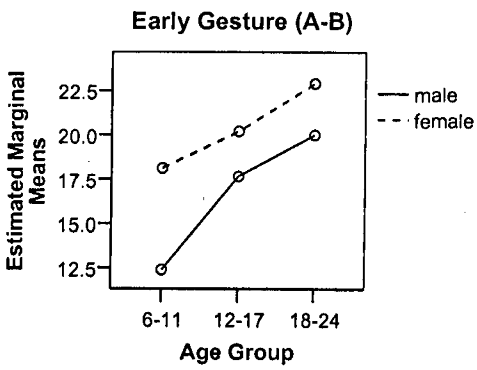



Figure 5.6: Interaction Chart showing Early Gestures

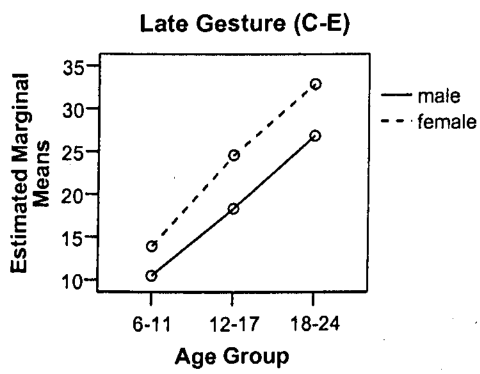



Figure 5.7: Interaction Chart showing Late Gestures

Although an effect for gender was found to be only approaching significance overall in late gestures ($F(1,48)=3.4$, $p=.07$) a gender effect was found in sections C and D. In each case the girls (Section C *Mdn* = 11.5, Section D *Mdn* = 7) scored higher than the boys (Section C *Mdn* = 8, Section D *Mdn*= 1.5). In both cases the Mann-Whitney test was used, in Section C $U$=256, $p< .05$, $r= .26$, and in Section D $U$=198.5, $p<.005$, $r = .39$.

As expected gesture use increases with age across the whole of the form. Similar effects are also found in early and late gestures. There is a tendency for girls to score more highly than boys; this reaches significance for some sections of the assessment.

### 5.3.2 The Gesture Checklist: assessing the form

This section first considers the internal reliability of the GC, and assesses validity when compared to the CDI, Words and Gestures assessment. Normative data in the form of percentiles is given, based on the 54 participants.

#### 5.3.2.1 Reliability and Validity

Within each section the reliability of each test item was analysed by means of internal consistency, using Cronbach's alpha test. This method uses an average inter-item correlation by pairing items and calculating correlations. For an item to be reliable the resulting correlation should be greater than 0.3. These correlations are then averaged across the all section items to provide a correlation for the section, which should be around eight for a reliable test. Finally the last correlation is repeatedly recalculated, dropping one test item each time. If the correlation score increases it follows that the assessment is more reliable with that item excluded. This test was carried out on all test items for both comprehension and combined gestural and verbal production.

The results for this test are shown in Table 5.5. From the table it can be seen that for section A only two items decrease the reliability of the section as a whole, these are reaching out as a request for an object and a contact point. Reaching out is marked both for comprehension and production. It also has a low item correlation score. Contact points are only unreliable on the comprehension side.

Section B has no outstanding test items for comprehension, however three items are marked in production; raising arms to be picked up, rubbing your tummy to show that something tastes good and physical prompts. Of these the first two are also low in the item correlation score. Section C and D both score differently on the last item "other" in Section C in comprehension only, in Section D for both comprehension and production. In Section C the only production test item to have a correlation score above the threshold is "dummy". Section D shows consistency except for the final item "other".

| Section A | Item | Item-Total Statistics | | | |
|---|---|---|---|---|---|
| | | Comprehension | | Production | |
| (Cronbach's Alpha) | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Comprehension 0.826 | Reach out | 0.244 | 0.841 | 0.383 | 0.860 |
| | Request | 0.509 | 0.813 | 0.553 | 0.844 |
| Production: 0.856 | Self-point | | | 0.597 | 0.839 |
| | Contact point | 0.325 | 0.845 | 0.609 | 0.838 |
| | Imperative point, proximal | 0.729 | 0.776 | 0.615 | 0.837 |
| | Imperative point, distal | 0.712 | 0.777 | 0.658 | 0.831 |
| | Declarative point, proximal | 0.726 | 0.773 | 0.680 | 0.829 |
| | Declarative point, distal | 0.753 | 0.770 | 0.691 | 0.827 |

| Section B | Item | Item-Total Statistics | | | |
|---|---|---|---|---|---|
| | | Comprehension | | Production | |
| (Cronbach's Alpha) | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Comprehension: 0.914 | Hold for attention | 0.550 | 0.911 | 0.597 | 0.867 |
| | Lift up | | | 0.243 | 0.882 |
| Production: 0.878 | Wave bye bye | 0.643 | 0.907 | 0.604 | 0.867 |
| | Shake head | 0.816 | 0.899 | 0.638 | 0.865 |
| | Nod head | 0.697 | 0.905 | 0.461 | 0.875 |
| | Blow kiss | 0.597 | 0.909 | 0.684 | 0.863 |
| | Smack lips | 0.579 | 0.910 | 0.501 | 0.872 |
| | Rub tummy | 0.457 | 0.914 | 0.288 | 0.880 |
| | Finger on lips | 0.630 | 0.908 | 0.534 | 0.870 |
| | Shrug | 0.714 | 0.904 | 0.582 | 0.868 |
| | Clap | 0.730 | 0.903 | 0.630 | 0.866 |
| | Palm up, open hands | 0.724 | 0.903 | 0.710 | 0.861 |
| | Blowing something hot | 0.689 | 0.905 | 0.724 | 0.860 |
| | Physical prompt | | | 0.329 | 0.880 |

**Table 5.5: Reliability of test items**
N.B. grey indicates an item that is not reliable.

| Section C | Item | Item-Total Statistics | | | |
|---|---|---|---|---|---|
| | | Comprehension | | Production | |
| (Cronbach's Alpha) | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Comprehension: 0.925 | Songs | 0.753 | 0.915 | 0.809 | 0.882 |
| | Animals | 0.789 | 0.913 | 0.772 | 0.892 |
| Production: 0.902 | Vehicles | 0.754 | 0.915 | 0.840 | 0.878 |
| | Dummy | 0.575 | 0.925 | 0.488 | 0.905 |
| | Book | 0.836 | 0.909 | 0.745 | 0.892 |
| | Food | 0.730 | 0.917 | 0.803 | 0.890 |
| | Toy | 0.800 | 0.912 | 0.864 | 0.885 |
| | Hat | 0.788 | 0.913 | 0.800 | 0.888 |
| | Other | 0.525 | 0.928 | 0.518 | 0.902 |

| Section D | Item | Item-Total Statistics | | | |
|---|---|---|---|---|---|
| | | Comprehension | | Production | |
| (Cronbach's Alpha) | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Comprehension: 0.805 | Sleep | 0.744 | 0.689 | 0.575 | 0.706 |
| | Drink | 0.691 | 0.719 | 0.620 | 0.684 |
| Production: 0.766 | Eat | 0.741 | 0.692 | 0.776 | 0.583 |
| | Other | 0.331 | 0.863 | 0.341 | 0.807 |

| Section E | Item | Item-Total Statistics | | | |
|---|---|---|---|---|---|
| | | Comprehension | | Production | |
| (Cronbach's Alpha) | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Comprehension: 0.884 | Big | 0.710 | 0.864 | -0.060 | 0.260 |
| | Small | 0.772 | 0.855 | 0.313 | 0.042 |
| Production: 0.206 | Thin | 0.844 | 0.857 | 0.000 | 0.212 |
| | Fat | 0.844 | 0.857 | 0.000 | 0.212 |
| | Square | 0.846 | 0.854 | 0.295 | 0.141 |
| | Round | 0.792 | 0.858 | 0.295 | 0.141 |
| | More | 0.397 | 0.932 | 0.121 | 0.370 |

**Table 5.5 continued.**
N.B. grey indicates an item that is not reliable.

For comprehension there is only one poor correlation score in Section E, for the test item "more". Section E shows the most variability in terms of production test items. This may be a consequence of the floor effects found in this section (see Section 5.3.2.2). The correlation scores for the entire section are extremely low, and no confidence can be placed in the reliability of this section to assess the production of describing gestures. It seems that children of this age range do not routinely use gesture to describe the attributes of objects. Once again "more" can be seen to be behaving very differently to the other test items in this section.

Despite being included with attributes "more" does not describe an attribute of an object in quite the same way as the other test items. Moreover the parents will often use it as a question rather than a description; likewise it is commonly used by children as a request not description. For these reasons it may be considered that "more" would fit in Section B rather better than its present inclusion in Section E. This idea was tested and proved a better fit for production than comprehension. For comprehension the inclusion of "more" in Section B slightly lowered the section correlation to .910. The discrepancy is smaller for Section B, so although "more" is not a perfect fit in section B it is better than categorising it with attributes. The other test items in Section B are unaffected by its inclusion. For production including "more" in Section B increases the section score to .881. "More" falls within this range at .878 indicating that its function is more communicative than descriptive. Other test items are not affected.

Validity of the GC was checked by correlations with the gesture section of the CDI. Since the GC conforms to a tighter definition of gesture it was assumed that the strongest correlations would be found between the GC and the early gestures component on the CDI (Section A and B) as these sections also adhere to the narrower definition. Correlations were carried out for gesture production scores using Spearman's Rho test. The results are shown in Table 5.6. Unfortunately there were no means to test the validity of the comprehension measures.

| | | Gesture Checklist, by section | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | All |
| The CDI, by section | A | .53*** | .83*** | .67*** | .65*** | .34* | .79*** |
| | B | .32* | .56*** | .43** | .55*** | .30* | .53*** |
| | C | .61*** | .84*** | .79*** | .79*** | .39** | .86*** |
| | D | .54*** | .81*** | .75*** | .72*** | .39** | .81*** |
| | E | .65*** | .84*** | .73*** | .70*** | .38** | .84*** |
| | Early | .52*** | .85*** | .71*** | .70*** | .36** | .81*** |
| | Late | .64*** | .88*** | .81*** | .78*** | .40** | .88*** |
| | All | .63*** | .90*** | .81*** | .78*** | .41** | .89*** |

**Table 5.6: Correlation of the GC to the CDI**

1. *** sig <001, **sig <01 *sig<05
2. dark shading very strong correlation (0.8 and above)
3. lighter shading strong correlation (0.5-0.79)

There is very strong to moderate agreement across all sections of the CDI and GC, resulting in good validity for the GC as an assessment. Sections A, B, C and D of the GC correlate strongly with all sections of the CDI. This is also true of the overall scores for the GC. The strongest correlations can be found in Section GC B (from 0.56 to 0.90, all at the $p<.001$ level) and overall scores of the GC (from 0.53 to 0.89, all at the $p<.001$ level). Section E on the GC has consistent moderate strength correlations with the CDI. All but two of these are significant at the $p<.01$ level. Section B on the CDI also has correlations ranging from moderate to strong.

#### 5.3.2.2 Normative Data

The GC is designed to mirror development; hence the earlier sections should yield higher scores for both comprehension and production than the later sections. This hypothesis was tested for both comprehension and combined production by using dependent t-tests. Table 5.7 shows the means and standard deviation for each section. These standardized scores (calculated by taking the score per section and dividing by the maximum score obtainable for that section) show that performance tends to decline over the later sections of the form, and also that comprehension consistently scores higher than production, again an expected finding.

| Section | Comprehension | | Production | |
|---|---|---|---|---|
| | Std. Mean | Std. Deviation | Std. Mean | Std. Deviation |
| A | 0.72 | 0.18 | 0.56 | 0.15 |
| B | 0.68 | 0.20 | 0.50 | 0.13 |
| C | 0.50 | 0.19 | 0.36 | 0.13 |
| D | 0.56 | 0.20 | 0.39 | 0.15 |
| E | 0.40 | 0.11 | 0.28 | 0.04 |

**Table 5.7: standardised mean and SD by section of the GC**

For both comprehension and production, each section decreases its mean score from the section before, with the sole exception of Section D: Actions which increases from C: Naming. This indicates a better ability on this section by the children. The differences between each section were tested for significance by using dependent t-tests, the results are shown in Table 5.8. This shows that each section is significantly different in terms of scoring than the one before, with the exception of sections A-B for comprehension and C-D for production.

| | | t | df | Sig. (2-tailed) | R |
|---|---|---|---|---|---|
| **Comprehension** | A-B | 1.58 | 53 | 0.121 | n/a |
| | B-C | 7.06 | 53 | 0.000 | 0.70 |
| | C-D | -2.55 | 53 | 0.014 | 0.33 |
| | D-E | 6.76 | 53 | 0.000 | 0.68 |
| | | | | | |
| **Production** | A-B | 4.27 | 53 | 0.000 | 0.51 |
| | B-C | 10.47 | 53 | 0.000 | 0.82 |
| | C-D | -1.37 | 53 | 0.175 | n/a |
| | D-E | 5.73 | 53 | 0.000 | 0.62 |

**Table 5.8: Differences between sections**
N.B. Significance is shown in grey.

Due to the smallness of the sample, and limited age effects (see Section 5.3.3) it seemed theoretically sound to continue to treat the participants as one homogenous whole for the purposes of creating norms. Norms, based on percentile ranks, were created for comprehension, combined production and verbal production. Table 5.9 shows the resulting data, it can also be seen in chart form in Section 5.5.1. The asymmetrical patterning for comprehension in Section A shows that the scores for this section are heading towards ceiling, although there is not a ceiling effect. This is support for the supposition that Section A may be close to ceiling, hence the lack of differentiation in the scores between Sections A and B. Section B also shows no floor or ceiling effects. Sections C, D and E all show floor effects, with this being particularly strong in Section E, the most difficult section.

For combined production both sections A and B tend towards slight floor effects. Sections C and D both show stronger floor effects, and Section E shows a very strong floor effect. As expected this is an indication that production follows comprehension, supporting the finding in Table 5.7 showing the consistently higher means for comprehension compared to production. There are no ceiling effects in the norms for production.

Perhaps not unexpectedly, given the age of the children, every section shows strong floor effects for verbal production. Section C shows both floor and ceiling effects. This apparent paradox may be explained by the coding system. For gesture production it is possible in this section to score higher dependent on the number of gestures produced per item. A corresponding sliding scale for words is not available on the form. Words have a binary measurement. It would be possible for a child who uses words to score at ceiling, and one who does not to score at floor, thus creating the profile seen in Table 5.9.

| | Section | Percentiles 0 | 5 | 25 | Median | 75 | 95 | 100 |
|---|---|---|---|---|---|---|---|---|
| Comprehension scores | A | 7 | 9 | 12 | 15 | 18 | 20 | 21 |
| | B | 12 | 12 | 20 | 26 | 30 | 34 | 36 |
| | C | 9 | 9 | 10 | 12 | 17 | 24 | 27 |
| | D | 4 | 4 | 4 | 7 | 8 | 11 | 12 |
| | E | 7 | 7 | 7 | 7 | 9 | 14 | 21 |
| | Overall | 39 | 41 | 56 | 69 | 79 | 98 | 117 |
| Verbal production scores | A | 8 | 8 | 8 | 8 | 8 | 12 | 16 |
| | B | 14 | 14 | 14 | 14 | 15 | 20 | 28 |
| | C | 9 | 9 | 9 | 9 | 12 | 17 | 18 |
| | D | 4 | 4 | 4 | 4 | 5 | 7 | 8 |
| | E | 7 | 7 | 7 | 7 | 7 | 8 | 4 |
| | Overall | 42 | 42 | 42 | 43 | 48 | 63 | 74 |
| Combined production Scores | A | 8 | 9 | 14 | 19 | 22 | 24 | 32 |
| | B | 14 | 15 | 23 | 28 | 34 | 38 | 56 |
| | C | 9 | 9 | 9 | 10 | 16 | 22 | 35 |
| | D | 4 | 4 | 4 | 6 | 8 | 10 | 16 |
| | E | 7 | 7 | 7 | 7 | 9 | 10 | 28 |
| | Overall | 42 | 44 | 60 | 73 | 88 | 100 | 167 |

**Table 5.9: Normative data by percentiles**

The GC was found to have good internal reliability, with the exception of production measures for Section E. Validity was also good, with mainly strong correlations with the CDI. It was not possible to obtain validity scores for the measure of comprehension. Normative data was presented for the whole group, and most sections showed some floor effects.

### 5.3.3 The Gesture Checklist: analysing participants

The four measures of comprehension, gesture production, verbal production and combined production were analysed with respect to section of the assessment and the participants' age and gender.

#### 5.3.3.1 Describing the groups

As for the CDI, scores for each section were standardised, by dividing the score by the total score achievable for each section. These are then represented on the box plots. The black line shows the minimum score possible for each section. Taking comprehension first (Figure 5.8), Sections A-D show a good range of scores. Despite some children scoring near maximum on Section C, this section does show some floor effects, and more so in Section D. As expected from earlier analysis

Section E shows the strongest floor effects, with few children scoring above minimum.

There is a similar profile for gesture production (Figure 5.9). Sections A and B show an even range of scores, from the minimum to maximum available. The floor effects are more evident for gesture production in Sections C and D. Section E revealed the most serious floor effects, with only outlying children managing to score.

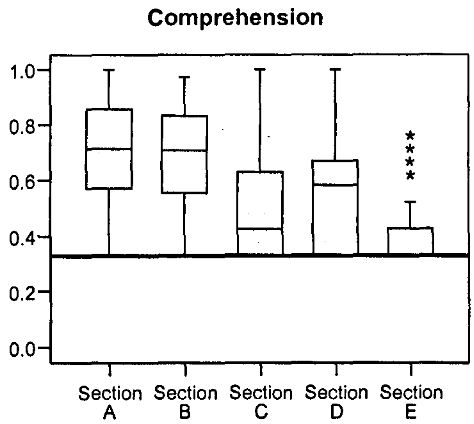



**Figure 5.8: Box Plot showing standardised section scores**

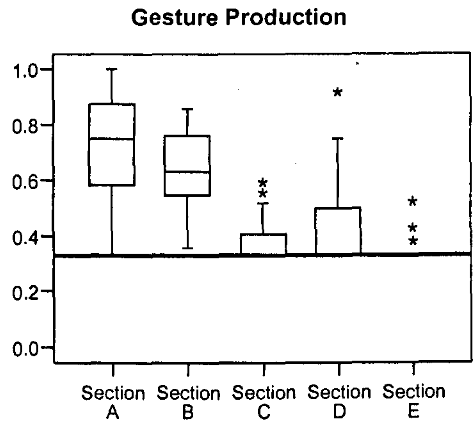



**Figure 5.9: Box Plot showing standardised section scores**

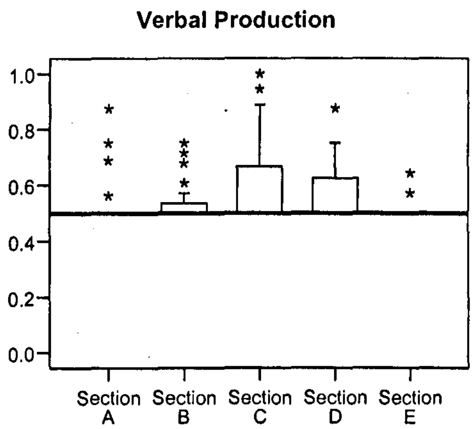



**Figure 5.10: Box Plot showing standardised section scores**

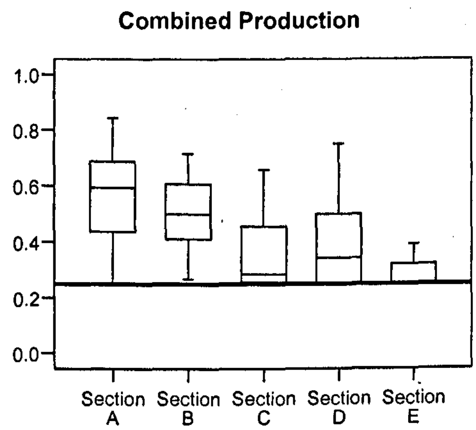



**Figure 5.11: Box Plot showing standardised section scores**

Turning to verbal production (Figure 5.10), again the only scores in Sections A and E are outlying children. Words are used more frequently in Sections B-D, but again these show large floor effects. When combining the two forms of production (Figure 5.11) the floor effects remain, with lessened effect in Sections C onward. As for comprehension Sections A and B show a greater range of scores. However, the scores for production are consistently lower than those for comprehension, with no child obtaining the maximum score.

Turning to age and gender differences for comprehension, the box plot (Figure 5.12) shows that overall comprehension does increase with age for both boys and girls, although at a greater rate for the youngest children. The range of the girls' scores is consistently greater than that of the boys.

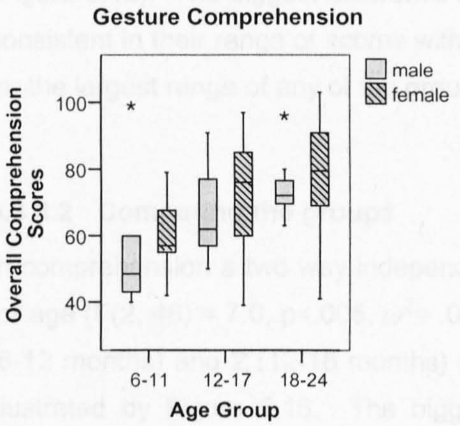



**Figure 5.12: Box Plot showing comprehension scores**

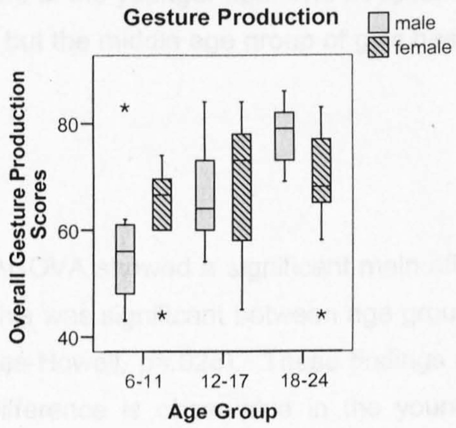



**Figure 5.13: Box Plot showing gesture production scores**

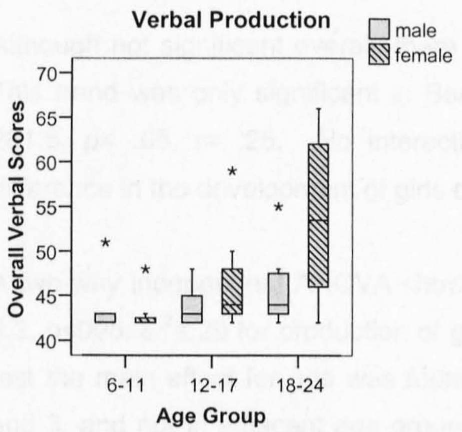



**Figure 5.14: Box Plot showing verbal production scores**

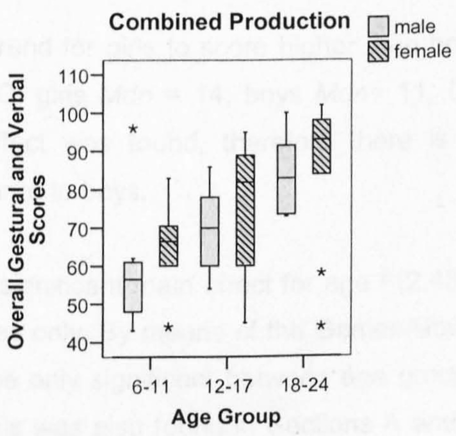



**Figure 5.15: Box Plot showing combined production scores**

Differences also exist in gesture production (Figure 5.13). It can be seen that boys steadily increase their use of gestures with age. The range of scores remains fairly constant throughout. The girls' scores on the other hand do not increase but remain level, particularly in the older age. The middle age group has a far larger range of scores, encompassing both that of the younger and older children. The youngest children, as expected, use very few words (Figure 5.14). There is an increase in word use from the age of 12 months, but this dramatically increases for the girls from the age of 18 months. The range of scores also increases greatly.

However for combined production, the increase seen in the scores is more gradual (Figure 5.15). The biggest difference appears at the younger age. The boys remain consistent in their range of scores with age, but the middle age group of girls has by far the largest range of any of the groups.

#### 5.3.3.2 Comparing the groups

In comprehension a two way independent ANOVA showed a significant main effect for age ($F(2, 48) = 7.0$, $p<.005$, $\omega^2 = .05$). This was significant between age group 1 (6-12 months) and 2 (12-18 months) (Games-Howell, $p=.028$). These findings are illustrated by Figure 5.16. The biggest difference is observable in the younger children, indicating rapid development of comprehension at a younger age. This finding was corroborated at the section level, with Sections B, C, and D showing a similar finding. Section A and E did not show an effect for age.

Although not significant overall, there is a trend for girls to score higher than boys. This trend was only significant in Section C: girls *Mdn* = 14, boys *Mdn*= 11, $U$ = 261.5, $p< .05$, $r= .25$. No interaction effect was found, therefore there is no difference in the development of girls compared to boys.

A two-way independent ANOVA showed a significant main effect for age $F(2,48) = 6.3$, p<005, $\omega^2=.29$ for production of gestures only. By means of the Games-Howell test the main effect for age was found to be only significant between age group 1 and 3, and not in adjacent age groups. This was also found in Sections A and B. Overall the difference between the younger to middle age groups was approaching significance ($p=.088$), and this did become significant in Section C (young group *Mdn*= 9, middle group *Mdn* = 10, $U$= 101.5, $p<.01$, $r= .32$).

Although there was no significant gender effect, either overall, or by section, there was an interaction effect which approached significance $F(2,48) = 2.6$, $p = .088$, $\omega^2=.23$. This relates to the fact that the older boys continue to increase their gesture production scores, whereas the girls' scores plateau at around 18 months (Figure 5.17). It is clear that there is a difference in the development of gesture production over time for both boys and girls. This difference became significant in Section B only $F(2,48)=3.3$, $p< .05$, $\omega^2= .12$.

Due to large floor effects in the verbal production data non-parametric tests have been used in the analysis. This means that there can be no formal analysis of the interaction over time between girls and boys in terms of their verbal production.

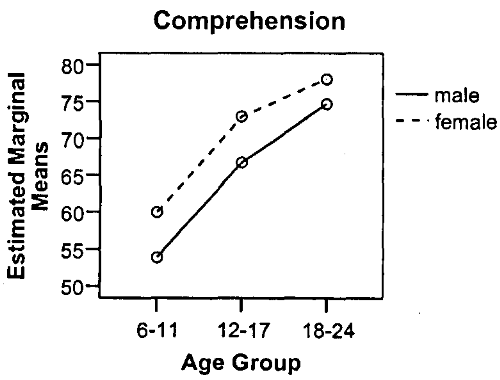



**Figure 5.16: Interaction chart showing comprehension**

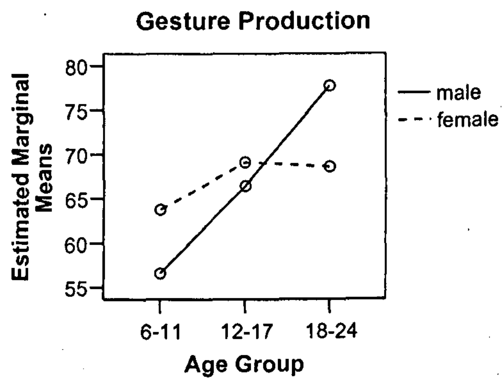



**Figure 5.17: Interaction chart showing gesture production**

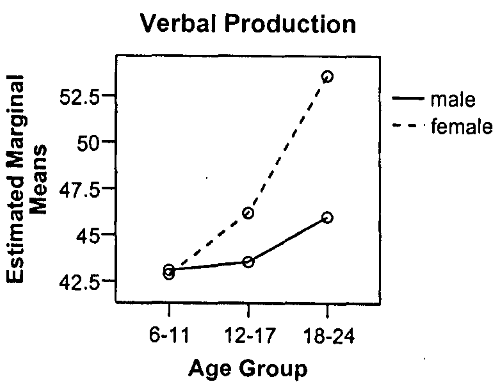



**Figure 5.18: Interaction chart showing verbal production**

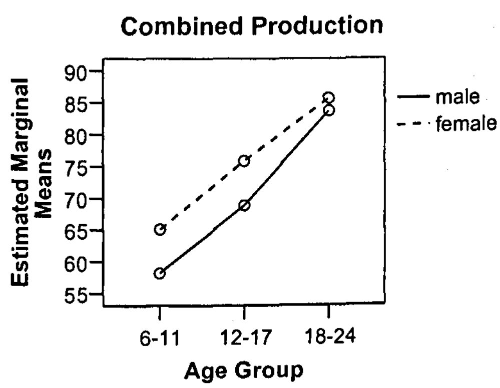



**Figure 5.19: Interaction chart showing combined production**

Effects resulting from age were tested using the Kruskal-Wallis test. Age was found to be significant overall $H(52) = 15.3$, $p<.001$. In a further analysis it was found that the difference between the younger (*Mdn* = 42) to middle (*Mdn* = 43) age groups was significant $U = 91$, $p<.005$, $r = .43$, as was the middle to older (*Mdn* = 48) age groups $U = 86$, $p<.05$, $r = .37$. Section D was the only section not to show age effects.

There was no overall difference between girls and boys in their verbal production. However some differences did become apparent when analysed by section using the Mann-Whitney test. In Section C the girls (*Mdn*=10.5) scored significantly higher than the boys (*Mdn* = 9), $U = 238$, $p< .05$, $r = .30$, and also in Section D (girls *Mdn* = 4, boys *Mdn* = 4) $U=253$, $p< .05$, $r= .31$. No other effects were found relating to gender.

An informal account of the interaction of gender over time can be gained from Figure 5.18, if treated with caution. This confirms that the youngest girls and boys have a very similar profile in terms of word use. Between 12-18 months of age girls increase their verbal production more rapidly than boys. From 18 months and older word use increases rapidly for both genders.

Finally turning to combined gestural and verbal production a two-way independent ANOVA showed a main effect of age $F(2,48) = 10.1$, $p<.001$, $\omega^2 = .05$ and this approached significance in all adjacent age groups; both for the younger age groups (Games-Howell, $p = .053$), and for the older children ($p = .060$). This finding can be explored further by looking at the section results. Section A showed an age effect between the youngest (*Mdn* = 15) and middle children (*Mdn* = 19) $U=100$, $p<.05$, $r = .29$, whereas Sections B and C show differences between all adjacent age groups at the $p<0.05$ level. No effects were found in Sections D and E.

Overall there was no significant main effect for gender, however there was in Sections B (girls *Mdn* = 30, boys *Mdn* =24 $U = 259$, $p< .05$, $r= .25$ ) and D (girls *Mdn* = 7, boys *Mdn* = 4, $U = 237$, $p<.01$, $r= .32$ ). No interaction effect was found overall or by section.

The interaction graph (Figure 5.19) shows this increase in scores with age. It also shows that the girls tend to score higher, though not significantly, and by the final age group the boys have caught up and eliminated this trend.

In summary, girls have a trend to use more gesture than boys prior to the age of 18 months. At this point girls switch from gestural communication to verbal with a rapid increase in their vocabulary. In contrast from 18 months boys continue to communicate gesturally, with a much slower increase in verbal vocabulary. When combining gesture and verbal production little difference can be seen in the overall scores between girls and boys at 24 months.

#### 5.3.3.3 Hand Choice

Section F asked the respondent to rate the hand choices of their child for each of the gestures used by section. There were seven options on the assessment, subsequently coalesced into four groups for analysis (Table 5.10). Further, as the analysis was interested in the hand preferences shown by the children, the category "Not yet" was excluded from the data.

| **Category on form** | **Retained for analysis** | **Abbreviated code** |
|---|---|---|
| Does not do gestures yet | Does not do gestures yet | Not yet |
| Left hand | One hand | One hand |
| Right hand | | |
| One hand only but no preference | | |
| Both hands doing same movement | Both hands | Both hands |
| Both hands doing different movement | | |
| One or two hands used interchangeably | One or two hands used interchangeably | One or two hands |

**Table 5.10: Re-coding of hand preference for analysis**

It may be that age of the child has an affect on their hand choice for performing gesture. This supposition was tested by means of Pearson's Chi-square. There was found to be a significant difference with age as regards hand choice ($\chi^2(2)=14.5$, $p<.01$) and, on follow up, a significant difference was found between the middle and older aged children ($\chi^2(1)=7.9$, $p<.05$), but not between the middle and younger group. Figure 5.20 shows the frequency of each hand choice at each age group. In the youngest children the most popular hand choice is the single hand. Both hands accounted for almost a third of the gestures, whilst the interchangeable use of one or two was quite low. A similar profile is seen in the middle age group, except that the frequency of single hand use has increased dramatically. This increase of the single hand remains in the older children, but the use of both hands diminishes and is replaced by the more flexible strategy of using one or two hands dependent upon the context.

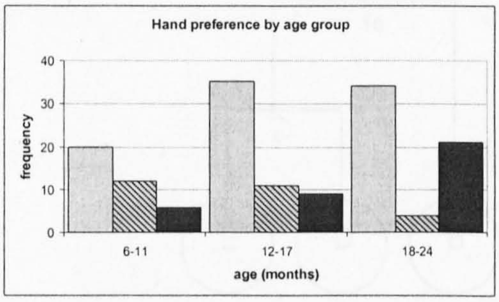



**Figure 5.20: Hand choice by age group**
One hand
Two hand
One or two hand

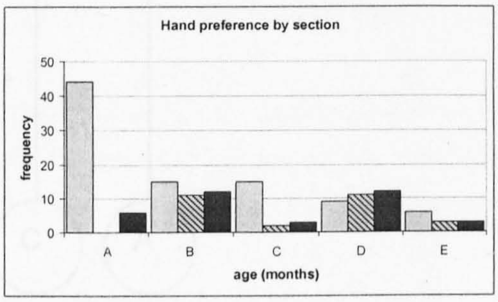



**Figure 5.21: Hand choice by section**
One hand
Two hand
Either one or two hand

Each section on the gesture checklist refers to a different gesture family: pointing, communicating, naming, actions and describing respectively. Each of these functions may impact on the hand choice for the gesture. This is shown in Figure 5.21. As can be seen each section has a different profile of hand use. Most striking is Section A where 44 respondents claimed that their children used a single hand for pointing gestures. The use of only one hand was seen throughout all the sections, and was the most frequent hand choice in Sections A, B and C, and E. The use of two hands was not seen at all in Section A, but formed almost a third of the gestures in Section B, and just over a third in Section D. They were hardly seen at all in Sections C and E. The optional use of one or two hands was also reported for all sections, maximising in Sections B and C, with low reported usage for the other sections.

A hierarchical tree cluster analysis was conducted to group hand choice by gesture family. Distance was measured using the Euclidean Squared measure, and complete linkage was stipulated. The results are shown in Figure 5.22. Sections D and E formed the first cluster, with a correlation of 4. At the next level Section B joined with these to form a larger cluster. At the third level Sections A and C join to form a cluster, joining the other three sections at the final level.

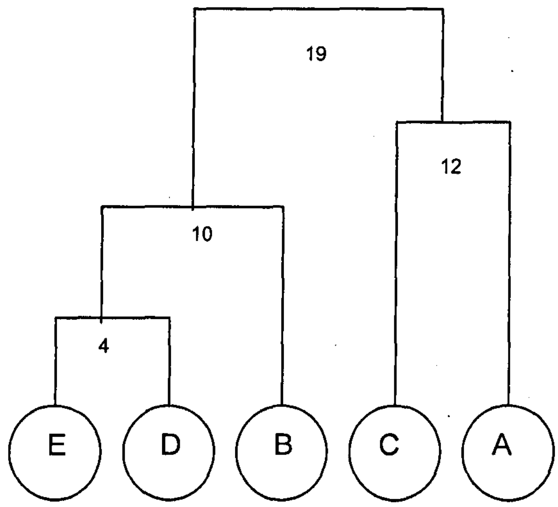



**Figure 5.22: Relationships from the hierarchical tree cluster analysis**

There is a trend for girls to score higher than boys but generally this is not significant across the four measures. The fastest rate of development in comprehension of gestures is in the younger children, both gesture production and comprehension develops with age. From 18 months girls have a higher proportion of words to gestures compared to boys, but from the same age boys continue to use gestures proportionally more than words. This results in no overall difference in combined production for the older boys and girls. Hand choice also develops with age, with children becoming more flexible in gesture performance as they grow older.

## 5.4 Discussion

This discussion will follow the same format as the results section. The CDI will be discussed firstly, followed by the GC, both in terms of participants and reliability and validity of the assessment.

### 5.4.1 The Communicative Development Inventory

The effect of age appears to be quite a robust finding as, despite the small sample size, it appears across all sections of the form, except for Section B. Overall there is a significant difference between the younger and middle age group. However when examined by section further differences can be ascertained.

The grouping of early gestures does not show any age effects for adjacent groups, but does between the youngest and oldest children. Section A does however reveal a difference between the middle and older children, showing that communicative gestures are used more by the older children. Section B does not show any age effects. A possible explanation is that parents enter into games and routines with children of all ages, thus reducing the chances of an age effect being found.

Within late gestures all adjacent age groups were found to be significantly different from each other. In Section C: "actions with objects" this difference was between the children aged 6 months to 12 months and 12 to 18 months. The older children have begun to engage in imaginative play, reflecting the object's intended use. Section D also shows a significant difference between the young and middle age groups. This is likely to result from the same underlying cognitive change which leads to the more imaginative play. A further change is not evident the older children. However the opposite is true of section E: Imitating other adult actions. This result may reflect older children moving from pretending to be a parent to copying more generalised adult actions.

The effect of age is well attested in the data. Although overall on the form there is only a difference between the younger and middle children from adjacent groups a fuller picture can be seen by taking each section individually. Early gestures only show difference in communicative gestures and these are also between the youngest two age groups. Late gestures makes distinctions between all three groups; Sections C and D between the youngest groups and Section E between the middle and older children. This has been argued to be linked to cognitive changes in the children and is expressed through play.

Despite gender difference being significant overall on the form, by section the effect was only picked up by non-parametric tests. Therefore on effect of gender was found in Sections A, B, C, D and early gestures but not in Section E or late gestures. In every section where an effect was found the girls consistently scored higher than the boys. This is a common finding in early language acquisition research. It may be that with a larger sample size this effect would become stronger and be picked up by the parametric tests also. Certainly in the larger grouping of late gestures this is approaching significance (p=.07) as opposed to the smaller Section E. The effect sizes of the non-parametric tests show the gender difference to be of medium size.

To summarise the findings, girls tend to score higher than boys, this trend becomes significant with non-parametric tests. The more robust finding was that scores increase with age, the differences being found between all adjacent age groups on different sections of the form.

### 5.4.2 The Gesture Checklist

This section on the gesture checklist discusses two aspects of the assessment; firstly the validity of the form and secondly a discussion of the participants in terms of age and gender.

#### 5.4.2.1 Assessing the form

The Gesture Checklist was designed to give a more detailed assessment of gesture development in young children than is currently available. Although the CDI is an extremely good and robust measure of first words and gestures, there are some omissions on this form which the GC seeks to address. Specifically these are a consideration of context as relates to gesture, a tighter definition of gesture, a measurement of gesture comprehension and a measurement of the early development of hand choice.

Reliability of individual test items was tested by means of internal consistency. In Section A two test items appeared problematic: reaching out and a contact point. The discrepancy of understanding the reaching gesture can be easily explained. Reaching out is not something the parent will often do. It seems more likely that if an object is out of reach they will either move to it, or request it with a pointing gesture. As such the gesture is rare in input, this may impact upon the reporting of understanding this gesture. It is more difficult to explain why the reaching gesture is also problematic with production as it is a well attested and recognised early child's communicative gesture. One suggestion may be that the older children no longer use this strategy when requesting things, thus lowering the score overall.

The second gesture, a contact point, may show an anomaly as a result of the loose formulation on the checklist. Rather than making it clear that this is a pointing finger, which makes contact with the object of interest, it is formulated as "Touch the thing being pointed at". This is open to several interpretations by the parent, not least that they are pointing and the child responds by touching the object of interest. Such different conceptions of this test item may lead to diverse responses, thus lowering the correlation score for the item.

In Section B the less reliable items include raising the arms as a request to be picked up, similarly a well attested early communicative gesture. The other two items are not so surprising. The test item of rubbing your tummy to show that something tastes good was generally disregarded, with the optional gesture of smacking the lips to indicate this being recorded by more of the respondents. The final test item; physical prompts, was included on the form as a possible distinguisher between typical developing children and children with ASD. It was not expected that the typical children would garner high scores on this test item, as has been shown to be the case.

Many participants noted that their child did not use a dummy; therefore this test item was not applicable in Section C. This would create a difference in scoring between this and the other test items. As "other" is a vague construct it is not surprising that it scores lower in both Section C and D.

Whilst comprehension was shown to be reliable for Section E, the converse was true of the production items. With extremely low correlation scores the production of gestures conveying attributes appears to emerge later in children's development.

The test items within each section appear to be tapping in to similar underlying processes, with the exception of "more" in section E. Moving this test item into section B appears advantageous. Few test items are marked for both comprehension and production, and for most an explanation is readily available. The exceptions to this are found in the expressive scores, particularly for the items, "reach out", and "lift up", both of which are well attested elsewhere.

The GC showed good validity with extremely close agreement to the CDI. The strength of the correlations ranged from very strong to moderate, with the majority being strong or above. The expected outcome, that the GC would correlate most strongly with Sections A and B of the CDI was not observed. This may be an indication that the distinction between gesture and functional acts may not be clear cut in early language development, and may be a prompt to researchers to consider all forms of non-verbal communication in an assessment of early language ability.

Section E of the GC was a section which correlated least strongly with the CDI. It was marked as the correlations were consistently moderate strength. The section comprises gesture relating to attributes and does not have corresponding test items on the CDI. It is also noticeable that Section B: Games and Routines, on the CDI does not correlate very strongly with any part of the GC. It may be that this is a more structured form of communication than that measured by the GC. Overall however the strength of the correlations gives great confidence in the GC as an accurate measure of gesture development.

The assessment met with reliability requirements, each section (with the exception of Section E) showing good internal consistency. It also showed good validity with close agreement to the CDI.

It was expected that the assessment would get progressively more difficult by section. For comprehension it was found that Section A and B were not significantly different to each other. There are two possible explanations for this. Either both sections are conceptually similar in terms of comprehension or that children are scoring at ceiling in Section A, and/or at floor in Section B. By consulting Figure 5.8, no ceiling or floor effects can be found in either section, therefore the second hypothesis can be discounted. It seems that the two sections must be conceptually similar, providing an argument to conflate these sections into one.

It is interesting that Section D scores higher than Section C for both comprehension and production. This indicates that gestures for verbs will develop before that of nouns which runs counter to accepted knowledge of language acquisition. It may be that the action/object distinction is not so wide in gesture. Many objects are represented by enactive gestures, a gesture which refers to an object by depicting the action most closely associated with it. This would be an interesting point to pursue. However this result could also be a confound arising from the design of the assessment. Only four test items are used in Section D, allowing a large variation in the resulting scores. Furthermore the items chosen could equally well be interpreted as nouns (sleep, drink and eat/food).

The differences between all other sections are significant, with large effect sizes and all are in the expected direction, indicating that the form does mirror development, with later sections corresponding to later development. Where differences between the sections exist, the effect size is large. There is some concern over the interpretation of the results for Section D, and a surprising result in that the comprehension of sections A and B appear to be conceptually similar.

Turning to the normative data, floor effects were found in the later sections which pervaded across all measures of ability. The floor effect in Section E is of the magnitude that the assessment would benefit from the entire removal of this section. It appears that using gesture for attributes is not demonstrated until after the age of twenty four months.

The above analysis shows that the assessment has validity, as compared to the CDI. That for the most part each section has internal consistency as measured by an inter-item correlation. From this analysis it arose that the item "more" could probably do better in Section B, and that the item "dummy" could be removed. There is evidence for the removal of the item "lift up" although this is well attested elsewhere, and also for the item "physical prompts" which was an expected result. There is also a possibility of the amalgamation of Sections C and D for production, and Sections A and B for comprehension. Floor effects have been found in the later sections on the assessment, especially in verbal production.

In general terms the gesture checklist seems to be a reliable and valid instrument for assessing gesture comprehension and production, but has serious floor effects when assessing verbal production. The correlation analysis indicates that the tight distinction maintained between gesture and functional acts may not be as clear cut in language use as it would appear theoretically.

#### 5.4.2.2 Analysing participants

Looking at the box plots for standardised scores it can be seen that, for production at least, Section E is evidently too developmentally advanced for children at this age. The finding that only a few children scored in verbal production in Section A is not a problematic finding. As this section is assessing pointing gesture, it would be unusual for a child to produce a word instead of a point.

Comprehension increased with age for both genders. However it increased most rapidly in the younger children, showing that whilst gesture comprehension continues to expand, this occurs most dramatically prior to eighteen months of age. No gender difference in the comprehension of gestures was found, neither was there an interaction effect.

Not unexpectedly gesture production is also linked to age, with the older children having both a larger gesture repertoire and producing gestures more frequently in their communication. However the effect size of this finding is small. There are interesting indications that boys and girls do not develop gesture in the same way with regards to age. It appears that whilst boys steadily increase their gesture repertoire, girls cease to do this at around eighteen months old.

The scores for verbal production showed severe floor effects. However given the age of the children this is to be expected. This measure gave valuable information, thus it does not seem advisable to ignore this variable altogether. On weighing the evidence, despite the floor effects, it seems best to continue to include a measure for verbal production on the form. Unsurprisingly all the children produced more words as they grew older. The form covers children aged from six months to two years and so captures a moment of accelerated vocabulary development. An interesting gender difference was found in the children from eighteen months upward. At about this age the girls' vocabulary scores increased dramatically, whilst gesture scores remained level. The boys also increased their spoken production at this age, but not so rapidly and without the corresponding slowing of the rate of acquisition in the gestural system.

The sub sections of the form which experienced this change most were Sections C: Naming and D: Actions. The preference for girls to change from a gestural representation for an object to a verbal counterpart (the target gestures of Section C) ties in with the findings of Iverson *et al* (1994) and Namy and Waxman (1998) that children move from gesture to words by twenty eight months. It is more surprising that this effect has also shown up in Section D, but may be a consequence of a verbal vocabulary making specific food requests, rather than the generic gesture for food.

Considering combined production the overall scores for both girls and boys continue to increase with age at a similar rate to the development before eighteen months. Therefore acquisition is not slowing, but the nature of the communication system is changing, from a gestural to verbal base. As there are no differences in the combined production scores of boys compared to girls, this indicates that both genders have the same repertoire of production test items. However, considered in the light of previous findings, it can also be demonstrated that the boys rely more on gesture, with a higher proportion of test items using this channel of communication.

Girls have a proportionally higher verbal component in their communication. By the age of twenty four months, the girls continue to use verbal strategies, but the boys increase their scores through extensive use of gesture, and also begin to use more words. The combination of increased gesture use and the beginnings of spoken language means that for the first time the older boys perform on a par with the older girls. The trend that girls out perform the boys no longer holds true.

It is interesting that the onset for a switch to verbal language occurs at a different time depending on gender, a finding which may have been obscured by the cross-sectional designs which have so far been used to investigate these phenomena. There is certainly a case for a longitudinal design to identify and investigate other possible discrepancies attributable to gender relating to the change from gestural to verbal labelling.

Hand choice was found to change with respect to age. At the younger age children tended to use either one or both hands for all the gestures in each section. The preference for a single hand developed in the middle age group. However the most striking difference was the increased flexibility that the older children used in that they could tailor the form of the gesture to the context, happily switching between single and double handed gestures within a gesture function.

The cluster analysis revealed a split between Sections A and C on one hand, and Sections B, C and D on the other. It is clear that identifying objects uses different forms of gesture to describing and communicating. Both section A and C identify objects, one by referential pointing, the other by representational gestures. Within the other cluster, Section B: communicating was shown to be different to the other categories of describing and actions. Indeed Sections D and E were the most similar, and the first sections to be clustered together. Both sections can be thought of as descriptive: Section D restricted to dynamic attributes and Section E to static ones. It may be that the iconic representation of these attributes is similar which leads to the relatedness of hand choice evident in these sections.

### 5.4.3 Evaluation

Regarding the design of the form, it proved extremely useful to split the production measures into three different variables: gesture production, verbal production and combined production. This led to an interesting discovery, namely that girls make the switch from gesture to words at an earlier age than boys. Although based on current data this can only be claimed to be an indication, it may be that with a larger sample size a significant difference between the genders will be revealed. This seems probable as the gender differences reported for the CDI are far greater than those found on the GC. By analogy, due to the close agreement between the forms, it may be true that a larger data set would also confirm the difference between the genders found in the GC, and may also give greater confidence in the effect sizes found for age factors. If so this would add to our present knowledge about the acquisition of both gesture and language.

A form which measures comprehension, verbal and gestural production is by default complex. The wealth of information received from such a design is at the expense of ease of completion. It is important that this balance is maintained, so that the information returned is of good quality and accurate. The response rate for the current study was extremely low for recruitment at the local nurseries. Response rates improved with the option of completing the form electronically, thus eliminating the need for postage, yet the highest response rate was from university staff, a group who may be more willing to participate in research. The complexity and low response rate outside of the university are indications that, in its present form, the GC is not suited to parent report form format. However due to nature of gesture, it is invaluable to have parental input on order to gather the fullest information possible. Certain gestures on the form are strongly contextualized, resulting in limited opportunities for some gestures to arise. If the GC is to be developed further as an assessment it may be appropriate to consider it being administered through a structured interview. Such a methodology retains the parental input, but also has the added advantages of the researcher's detailed knowledge of language development, coupled with a growing familiarity with the form. Based on the current study some revisions to the form and procedure are necessary, but the foundations of a new tool in the assessment of gesture have been successfully laid.

The Gesture Checklist stands as a first attempt to assess a complex and dynamic component of interaction. There are many other changes which could be incorporated into a revised version of the checklist, in order to discriminate even more fully between the different uses of gesture. Some suggestions for the further development of the GC are given below:

1. Reliability

   Internal reliability has been calculated for the GC by means of Cronbach's alpha test. In addition to this test-retest reliability should also be carried out, to ensure consistency in the parent's ability to make decisions regarding their child's use of gesture. It is not possible to ascertain at the moment how reliable repeat measures may be.

2. Validity

   Validity has been sought by correlating the GC to the corresponding parts of the CDI. This does not provide validity for all sections of the GC (and would become less so if suggestions 5 and 6 below are incorporated). An alternative method is to record a group a children interaction with their mothers and score the children on the GC based on these observations. The resulting profile could then be checked against the GC completed by the parents and correlations calculated.

3. Comprehension measures

   Parental report is known to be flawed when reporting on comprehension. This is also the case for the GC. It would be best to omit comprehension measures from the GC entirely. This would have the added benefit of simplifying the completion of the form, making it more user-friendly and thus increasing response rate.

4. Verbal measures

   It is essential to measure vocabulary in conjunction with gesture use, yet it is probably better not to try to incorporate both measures on one instrument. By omitting the direct measurement of vocabulary on the GC the instrument is greatly simplified, hopefully resulting in increased response rates, and also eliminating the need to build assumptions regarding word and gesture use into the coding system.

5. Form and function distinction

   In contrast to the current approach, of dividing the instrument into sections based on perceived families of gesture, it may be beneficial to take a stricter form/function distinction. By using observational data common early gestures can be included on the checklist. This follows existing research. An interesting addition would be to incorporate a section on the functions of gesture use, without tying functions to a particular gesture. On a superficial level such an approach could inform on whether a child uses gesture in the formulation of questions or requests for example.

6. Relationship between speech and gesture
   Currently ignored on the assessment is the relationship of gesture to speech. This is crucial information which is extremely difficult to access. In order to understand speech and gesture combinations it is necessary to have some meta-knowledge which can be used to break the combinations into the constituent components. Although difficult to see how this could be achieved through parental reporting, one possibility is to describe a gesture situation (such as the child pointing to a favourite toy) and provide a list of words which may combine with that gesture. The list should include reinforcing, supplementary and disambiguating combinations. Such an approach would side-step the need for meta-knowledge, but has not, as yet, been piloted.

Not withstanding these future challenges, the piloting of a detailed assessment of gesture has provided a wealth of rich information about the early development of gesture in young children and has demonstrated the GC to be a firmly laid stepping stone in the development of a reliable assessment of gesture in young children.

## 5.5 Assessing gesture in children with ASD

The Gesture Checklist was developed for this project and normative data has been collected for 54 typically developing 6-24 month old children. This section returns to the eight participants with autism, and compares them as a group on the three measurement variables, a discussion of their hand preferences is followed by individual profiles by section. No assessments were returned for Zaara.

### 5.5.1 Group comparisons

The results for comprehension are mixed, possibly a reflection of the methodological limitations of the parental report format. As a group the participants range from the 05 percentile rank to the 95 percentile rank (Figure 5.23). Surprisingly, Murray, Theo, Toby, and Nathan are reported to understand fewer gestures at the second assessment.

Toby, Nathan, James and Lee consistently score in the lower quartile compared to typically developing children. Theo has the greatest discrepancy between first and second assessment, making an accurate placement difficult. Michael scored in the

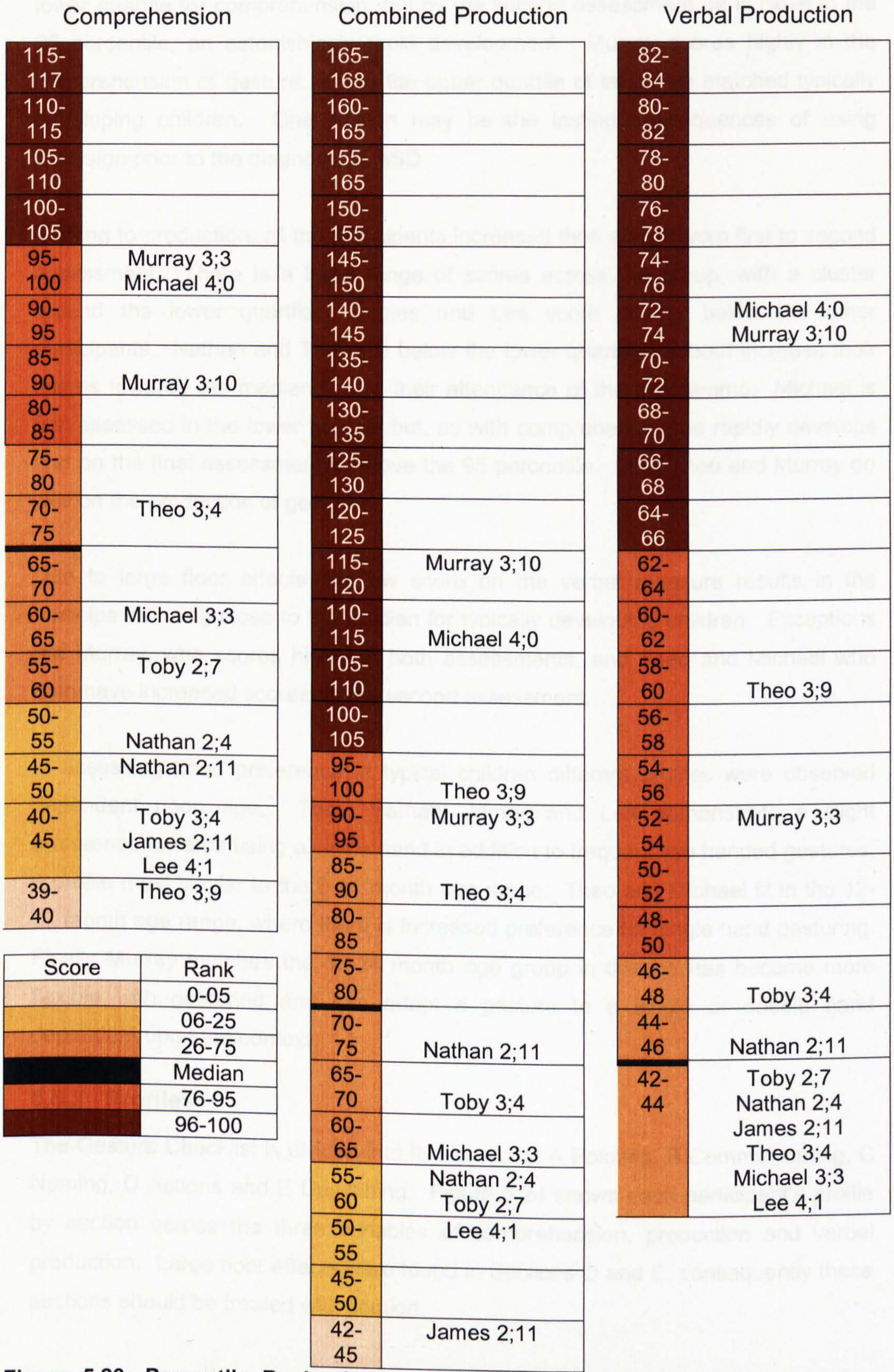



**Figure 5.23: Percentile Ranks for the measurement of comprehension, combined production and verbal production**

NB. the number on the left is the score, the colour shows the percentile rank for typically developing children. The thick black line shows the median. Age in years.

lower quartile for comprehension, but by the second assessment he is close to the 95 percentile, an astonishingly rapid development. Murray scores highly in the comprehension of gesture; above the upper quartile of language matched typically developing children. One reason may be the lasting consequences of using Babysign prior to the diagnosis of ASD.

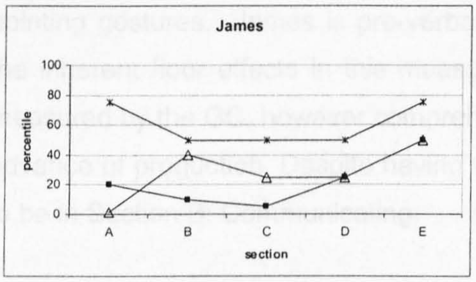
Turning to production, all the participants increased their scores from first to second assessment. There is a large range of scores across the group, with a cluster around the lower quartile. James and Lee score slightly below the other participants. Nathan and Toby are below the lower quartile but both increase their scores towards the median during their attendance of the programme. Michael is first assessed in the lower quartile but, as with comprehension he rapidly develops and on the final assessment is above the 95 percentile. Both Theo and Murray do well on the production of gestures.

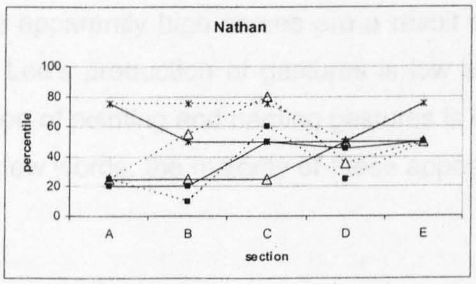
Due to large floor effects the low score on the verbal measure results in the participants being close to the median for typically developing children. Exceptions are Murray, who scores highly at both assessments, and Theo and Michael who both have increased scores on the second assessment.

In assessing hand preference in typical children different profiles were observed dependent upon age. Toby, Nathan, James and Lee demonstrate a slight preference towards using a single hand in addition to frequent two handed gestures, a profile most similar to the 6-11 month age range. Theo and Michael fit in the 12-17 month age range, where there is increased preference for single hand gesturing. Finally Murray matches the 18-24 month age group in that he has become more flexible with gesturing and can adapt a gesture to a single or double hand dependent upon the context.

### 5.5.2 Profiles

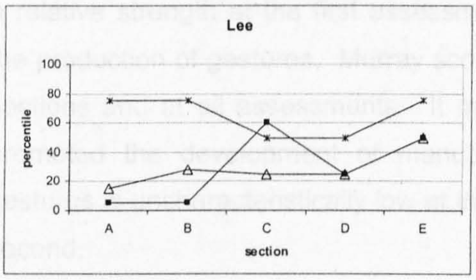
The Gesture Checklist is divided into five sections: A Pointing, B Communicating, C Naming, D Actions and E Describing. Figure 5.24 shows each participant's profile by section across the three variables of comprehension, production and verbal production. Large floor effects were found in Sections D and E, consequently these sections should be treated with caution.

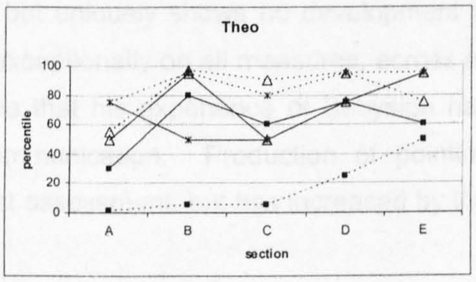



1st assessment: 2;11
2nd assessment: n/a

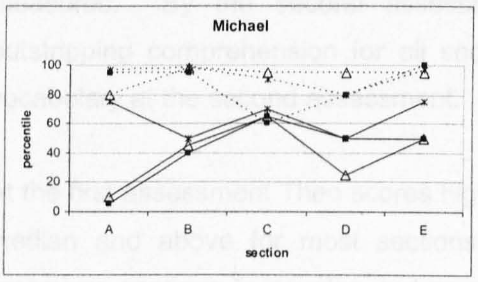
1st assessment: 2;4
2nd assessment: 2;11

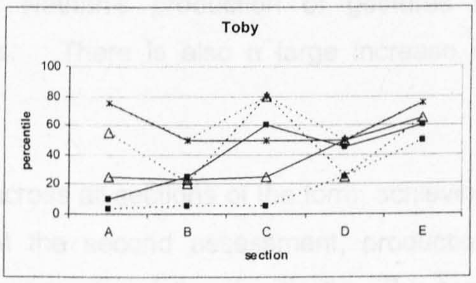



1st assessment: 4;1
2nd assessment: n/a

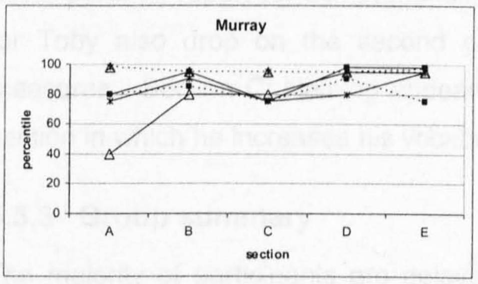
1st assessment: 3;4
2nd assessment: 3;9




1st assessment; 3;3
2nd assessment: 4;0

1st assessment 2;7
2nd assessment 3;4




comprehension of gesture
production of gesture
verbal production
first assessment
second assessment
age in years

1st assessment: 3;3
2nd assessment: 3;10

**Figure 5.24: Participant Profiles for the Gesture Checklist**

James's comprehension scores are generally lower than production scores. This is different in Section A, where comprehension is more developed than production of pointing gestures. James is pre-verbal; the apparently high scores are a result of the inherent floor effects in this measure. Lee's production of gestures is low as measured by the GC, however comprehension of pointing and naming gestures is in advance of production. Despite having very few words, the majority of these appear to be in Section B: Communicating.

Michael shows clear development. In the first assessment he often scores at or below the median, by the second close to ceiling. Interestingly Section C: Naming, is a relative strength at the first assessment, but uniquely shows no development in the production of gestures. Murray scores exceptionally on all measures, across all sections and at all assessments. It may be that his experience of Babysign has promoted the development of manual communication. Production of pointing gestures is uncharacteristically low at the first assessment, but has increased by the second.

At the first assessment Nathan is scoring in the lower inter quartile range for all measures. By the second assessment Nathan's production of gestures is outstripping comprehension for all sections. There is also a large increase in vocabulary at the second assessment.

At the first assessment Theo scores highly across all sections of the form, achieving median and above for most sections. At the second assessment, production measures continue to develop, but comprehension has fallen drastically. This may be due to regression or may in part be a consequence of the known limitations of using parental report for comprehension. Similar to Theo, comprehension scores for Toby also drop on the second assessment, despite improvement on other measures. Section C: Naming appears to be a strength for Toby, as it's the only section in which he increases his vocabulary from the first to the last assessment.

### 5.5.3 Group summary

The majority of participants are delayed in their gesture use and comprehension compared to language matched typically developing children. Within the participants there is a large distribution of scores, as would be expected as the participants have not been matched on the severity of their impairments. No section appears consistently more problematic than the others on any measure. The profile of the participants appears to follow that of typically developing children; Sections D and E are most difficult for all measures, and show serious floor effects. Due to the lack of test-retest reliability information, the differences in scores found at follow-up may be a consequence of poor reliability. This is likely to be the case for comprehension measures, which show the most variance.

In Chapter 3, based on measures of communication, socialisation and general development it was concluded that the participants could be split into two groups. Consistent with the earlier finding James and Lee form one of these groups as they score lower than the other participants in terms of gesture use. Nathan and Toby form a second as they are both firmly in the lower quartile on gestural measures. In terms of gesture use there is a third group as Murray, Michael and Theo consistently score within or above the inter-quartile range.

The Gesture Checklist has provided a snapshot of gestural development. It has revealed delays compared to typical development but also identified changes in the gestural system. The investigation of these changes will be the focus of the following chapter.

# Chapter 6

# THE GESTURAL REPERTOIRE OF CHILDREN WITH ASD

Previous research has shown that the communication difficulties experienced by children with ASD also affect the gestural modality. Deictic gestures form the core repertoire, both emblems and iconic gestures are extremely rare. There is a dissociation between imperative and declarative function. Although imperative function is used regularly declarative function is rare, or completely absent (Baron-Cohen, 1989; Camaioni *et al.*, 1997; Camaioni *et al.*, 2003; Stone *et al.*, 1997). This has been linked to the absence of theory of mind in children with ASD: gestures are used to communicate to others as causal and not attitudinal beings (Baron-Cohen, 1995; Tomasello & Camaioni, 1997). The role of gesture in the transition to two word speech has been well documented in typically developing children. The results presented here will be the first attempt to analyse gesture's role in children with ASD as they change to two word speech.

This chapter will provide a detailed description of the children's gestural development by environment, Explorers followed by home. Within each environment the frequency and nature of the child's communication will first be assessed, before turning to a closer examination of gestures themselves. The development of the form and function of gesture will be traced. The co-development of speech and gesture will then be the focus of attention. The final section of the chapter will consider the similarities and differences between the two environments.

## 6.1 The Explorers environment

The eight participants were recorded fortnightly, excepting holidays, during their attendance on the Explorers programme. Each recording is approximately twenty minutes long, and consists mainly of one on one interaction between the child and a staff member. For each session the child's communicative acts and gestures were identified and gestures were further coded for form, function and relationship to speech. It should be remembered that Murray attended only one Explorers session before changing to an ABA programme implemented by a single therapist at his home.

Any sessions with less than five identified gestures were discarded from further analysis as these introduced a large bias due to the proportional representation. If there are less than five gestures in the session, each individual gesture accounts for over 20% of the production making accurate interpretations impossible.

Cohort 1:

| Child | Explorers Session | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| James | 16 | 23 | 6 | 20 | 12 | 18 | 13 | 9 | | 32 | 15 | 17 | |
| Nathan | | 38 | 27 | 6 | 16 | 28 | 3 | 42 | 35 | 2 | 38 | 13 | 17 |
| Toby | 16 | 19 | | 7 | 9 | 11 | 15 | 4 | 16 | 1 | | | |
| Zaara | | | | | | | | | | 13 | 8 | 44 | 18 |

Cohort 2:

| Child | Explorers Session | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Lee | 7 | 6 | 10 | 5 | 8 | 10 | 26 | | 19 | 27 | 25 | 5 |
| Michael | 0 | | | 6 | 20 | 20 | 41 | 11 | 5 | 5 | 18 | |
| Murray | 20 | | | | | | | | | | | |
| Theo | | 3 | | 20 | 7 | 24 | 34 | | 32 | | | |

| Child | ABA session (occurring between numbered Explorers sessions) | | | | | |
|---|---|---|---|---|---|---|
| | 15-16 | 16-17 | 19-20 | 20-21 | 21-22 | 22-23 |
| Murray | 15 | 4 | 37 | 31 | 32 | 28 |

**Table 6.1: number of gestures per Explorers session by child**
NB: grey cells indicate sessions excluded from analysis.

### 6.1.1 Communicating

This section considers the communicative profile of each participant. Firstly the number of communicative acts made by each child is reported. The proportion of communication which is gestural is then calculated.

#### 6.1.1.1 Communicative acts

Communicative acts are calculated as the number of acts per minute, which allows for comparison across sessions of varying length (Figure 6.1). Despite an initially low frequency of communicative acts, James quickly settles to between 2-4 communicative acts per minute. Lee produces few communicative acts until the age of 44 months when they almost double to between 2 and 4 per minute. Zaara's communicative acts steadily increase from 1.5 per minute to approximately 3 per minute.

For many sessions Toby consistently averages 2 acts per minute. From 36 months this increases to 4 a minute, but remains an uncorroborated rise due to the lack of further data. Michael shows little change; communicative acts remain between 2-4 acts per minute. Murray shows a similar profile for the Explorers session but increases to between 6 to 8 communicative acts per minute with the ABA programme.

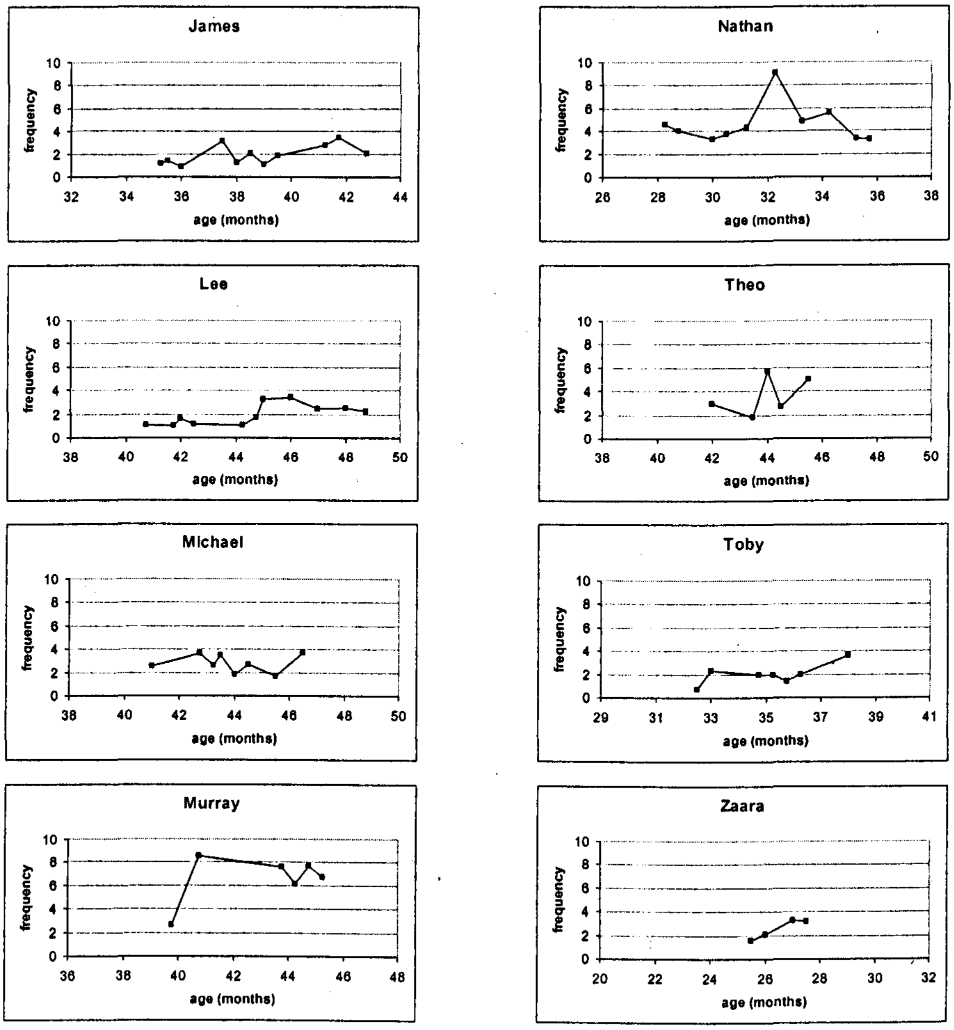



**Figure 6.1: Communicative acts at Explorers**

For the majority of the sessions Nathan produces between 3-6 acts per minute, but communicative acts peak at 32 months, before returning to original levels. Theo stays within a 2-6 acts per minute range, but varies considerably session to session.

Theo may be gradually increasing his communicative attempts, although this is not entirely clear.

In the Explorers environment the majority of participants average between 2-4 communicative acts per minute over the course of a session. Most participants consistently maintain these levels across sessions. A change of environment and therapy methods appears to promote communicative acts.

### 6.1.1.2 Gestural communication

In typical development the proportion of gesture used in communication may differ across children but remains relatively stable within the individual. Gestural communication scores are expressed as communicative acts containing gesture as a proportion of all communication acts regardless of gestural content (Figure 6.2).

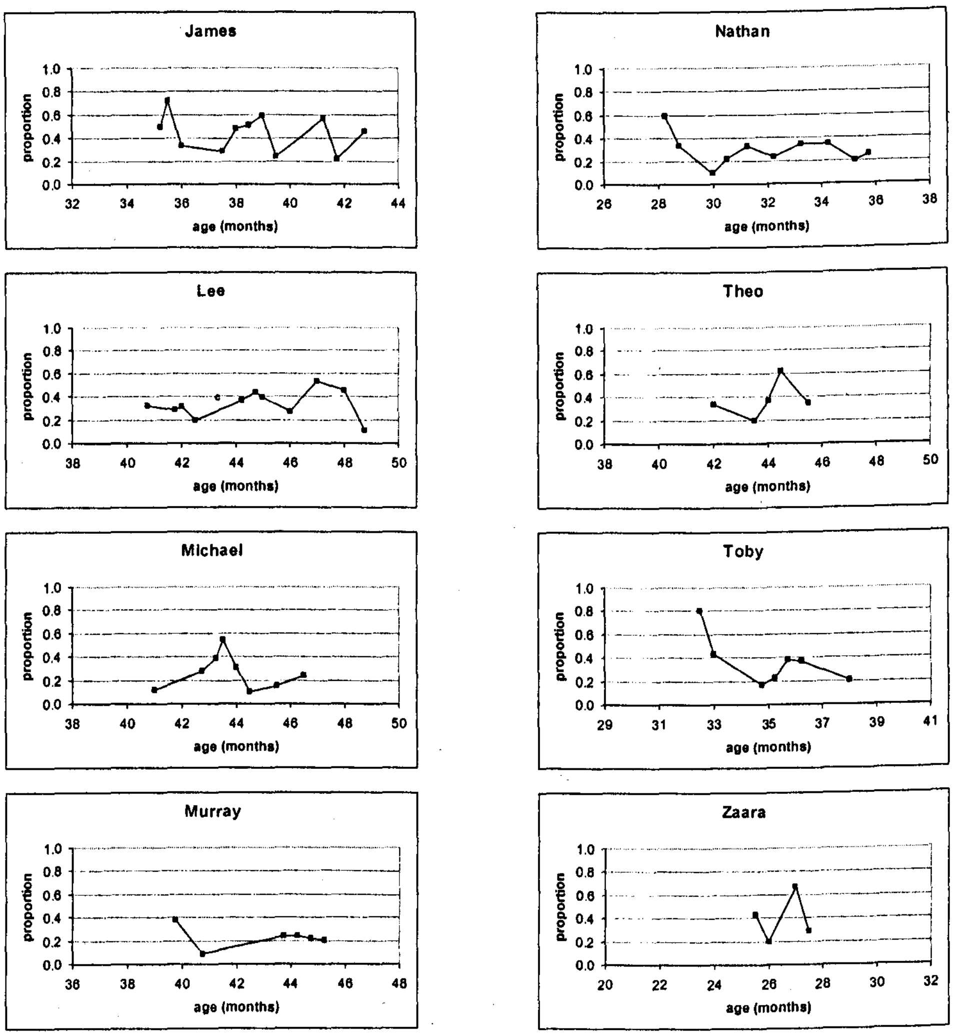



**Figure 6.2: Gestural communication at Explorers**
NB: gesture expressed as a proportion of all communicative acts

Zaara and James show divergent levels of gestural communication even in adjacent sessions. For both, gestural levels range from 20% to over 60% of their total communication. Initially about a third of Lee's communication uses gesture. Gesture levels gradually increase over time, until at 48 months old gesture accounts for close to half of his communication, although falling in the last session.

At Explorers Murray uses a large proportion of gesture at 40%. However this drops to 10% with the change to ABA. From the age of 44 months Murray's use of gesture becomes consistent, at 20% of his communication. Both Nathan and Toby show similar profiles: gesture accounts for a high proportion of communication which falls, and remains consistently between 20-40%.

Michael rapidly increases his gesture use, from around 10% at age 41 months old, to over 50% at 43 months. This rapid increase is followed by an equally rapid decrease, then a gradual increase until at 46 months gesture accounts for 20% of communication. For most sessions gesture accounts for between 20% and 40% of Theo's communication, yet this peaks at 60% at 45 months old, before dropping to previous levels again.

Although difficult to generalise from these results it seems that gesture accounts for between 20% and 40% of total communication for the majority of the participants.

#### 6.1.1.3 Summary

As a group the participants were fairly consistent in the production of communicative acts per minute. This ranged between 2-4 communicative acts per minute across all the participants. With the change to the ABA programme Murray's rate of communication increased to 6-8 acts per minute. There was more variation found in the levels of gestural communication, though in terms of the group gestural communication accounts for 20-40% of all communication.

### 6.1.2 Form and function

The form of gesture will be presented for each individual, followed by the development of deictic gestures and imperative and declarative pointing. In terms of gesture function, the three main groups of emotional display, facilitating and organisational gestures will be examined developmentally. The internal composition of the facilitating gestures will then be considered for each individual.

#### 6.1.2.1 Form of gesture

The literature predicts that in ASD deictic gestures form the majority of the gestural system, with the occasional iconic or emblem gesture. The use of physical prompts is more frequent in children with autism than in typically developing children. Gestures were coded either as deictic (including physical prompts), iconic, or emblems. An additional category (other) was used for communicative gestural actions which did not fit into any previous category. As there was little change over time in the participants use of gesture forms the data was analysed without reference to the longitudinal dimension. Figure 6.3 shows the overall proportions of gesture use based on all recorded sessions for each participant.

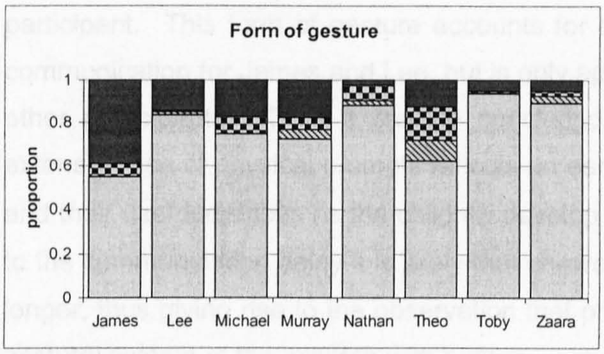



**Figure 6.3: Form of gesture**
N.B. Expressed as a proportion of all gesture
Deictic Iconic
Emblem Other

With the exception of James deictic gestures dominate the gesture form repertoire for all the participants. As expected iconic gestures are rare, and of these 90% are imitated gestures. Emblems are used by all participants and often more frequently than iconic gestures. Gestures used to display emotions (such as jumping, spinning, or banging the table) were recurrently coded as "other". This may explain the high levels of "other" gestures for James, thus forcing the lower levels of deictic gestures. In short there is surprisingly little variation in the gesture forms seen across the participants, and the pattern follows that predicted in the literature.

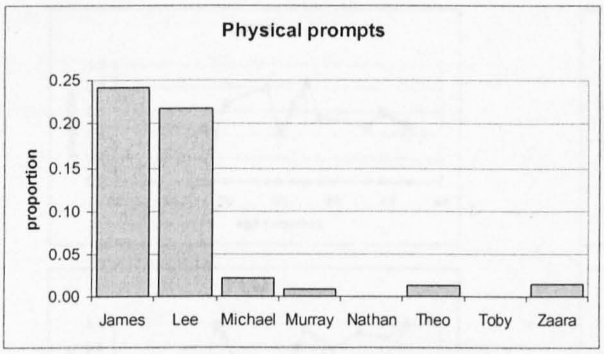



**Figure 6.4: Physical prompts at Explorers**
N.B. expressed as a proportion of all communication containing gesture

The second claim, that children with ASD make greater use of physical prompts was investigated. Figure 6.4 shows the proportion of physical prompts for each participant. This form of gesture accounts for almost a quarter of the all gestural communication for James and Lee, but is only apparent in negligible amounts for the other participants. Thus it can be concluded that, just as for typical children, extensive use of physical prompts reflects an early period of language development, and their use decreases as the children develop other competencies. However due to the communication delay it is likely that children with ASD remain at this stage for longer, thus giving rise to the observation that physical prompts are a feature of the gestural system of the children with autism.

### 6.1.2.2 Deictic development

Deictic gestures are some of the first gestures to appear developmentally. In typical development gestures such as reaching, rejecting, or requesting occur before pointing. These have been classed as requests and protests. Scores are calculated as a proportion of the gestural communication (Figure 6.5).

For James deictic gestures account for just over half of his gesture repertoire, the other half being made up of emotional displays. Within the deictic gestures all gestures are requests and protests, James has not yet begun to point. For the first four months Lee also follows this pattern. By 45 months of age pointing gestures appear. All deictic gestures increase to over 80% of his gestural communication. Within the deictic gestures requests and protests still predominate over pointing gestures which account for less than 20%.

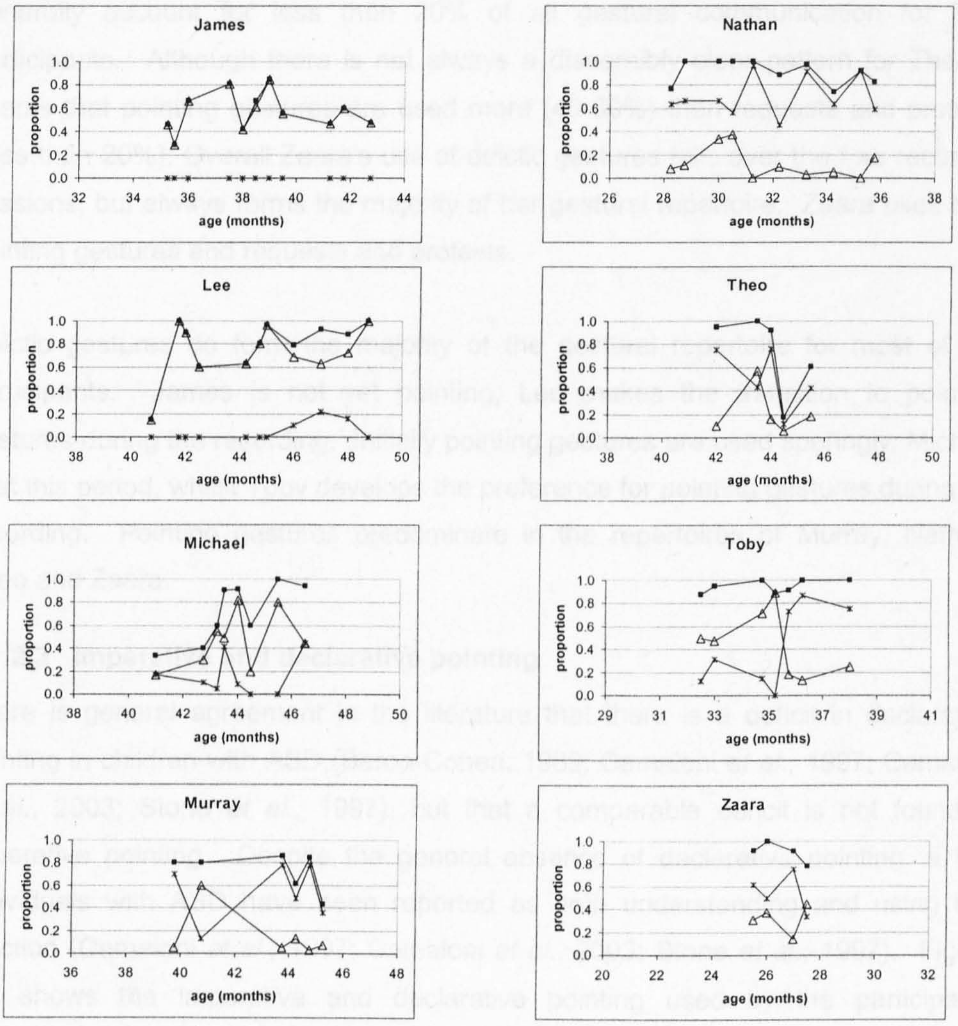



**Figure 6.5: development of deictic gestures**
NB: gesture expressed as a proportion of communication containing gesture
■ Deictic gesture
△ Request and protests
✳ Pointing

The amount of deictic gesture in Michael's gestural communication increases over the duration of the Explorers programme from close to 40% to over 90%. The majority are requests and protests, pointing gestures accounting for less than 40% of gestural communication. Deictic gestures form the vast majority of Toby's gestural repertoire, in each session they account for between 90-100% of his total gesture. Prior to the age of 36 months Toby used more requests and protests. Subsequently pointing gestures are preferred.

Nathan and Murray both have a predominantly deictic gestural repertoire. For both, pointing gestures account for 40-70% of gestural communication, excepting Murray at age 41 months when this drops to 10% for one session. Requests and protests generally account for less than 20% of all gestural communication for both participants. Although there is not always a discernibly clear pattern for Theo, it seems that pointing gestures are used more (40-80%) than requests and protests (less than 20%). Overall Zaara's use of deictic gestures falls over the four recorded sessions, but always forms the majority of her gestural repertoire. Zaara uses both pointing gestures and requests and protests.

Deictic gestures do form the majority of the gestural repertoire for most of the participants. James is not yet pointing, Lee makes the transition to pointing gestures during the recording. Initially pointing gestures are used sparingly, Michael is at this period, whilst Toby develops the preference for pointing gestures during the recording. Pointing gestures predominate in the repertoires of Murray, Nathan, Theo and Zaara.

#### 6.1.2.3 Imperative and declarative pointing

There is general agreement in the literature that there is a deficit in declarative pointing in children with ASD (Baron-Cohen, 1989; Camaioni *et al.*, 1997; Camaioni *et al.*, 2003; Stone *et al.*, 1997), but that a comparable deficit is not found in imperative pointing. Despite the general absence of declarative pointing, a few individuals with ASD have been reported as both understanding and using this function (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003; Stone *et al.*, 1997). Figure 6.6 shows the imperative and declarative pointing used by the participants (expressed as a proportion of all gestural communication).

As James does not yet use pointing gestures, imperative and declarative function cannot be analysed. From the age of 46 months Lee uses imperative function only in his pointing gestures. Prior to this age pointing was not in his gestural repertoire. Michael also only produces imperative function in his pointing gestures.

Nathan, Toby, Theo and Zaara use both imperative and declarative function, with approximately equal ability. Murray only uses the declarative function in pointing gestures. It may be that the imperative function has not been captured in the data sample, rather than the alternative interpretation that Murray does not use this function with pointing gestures.

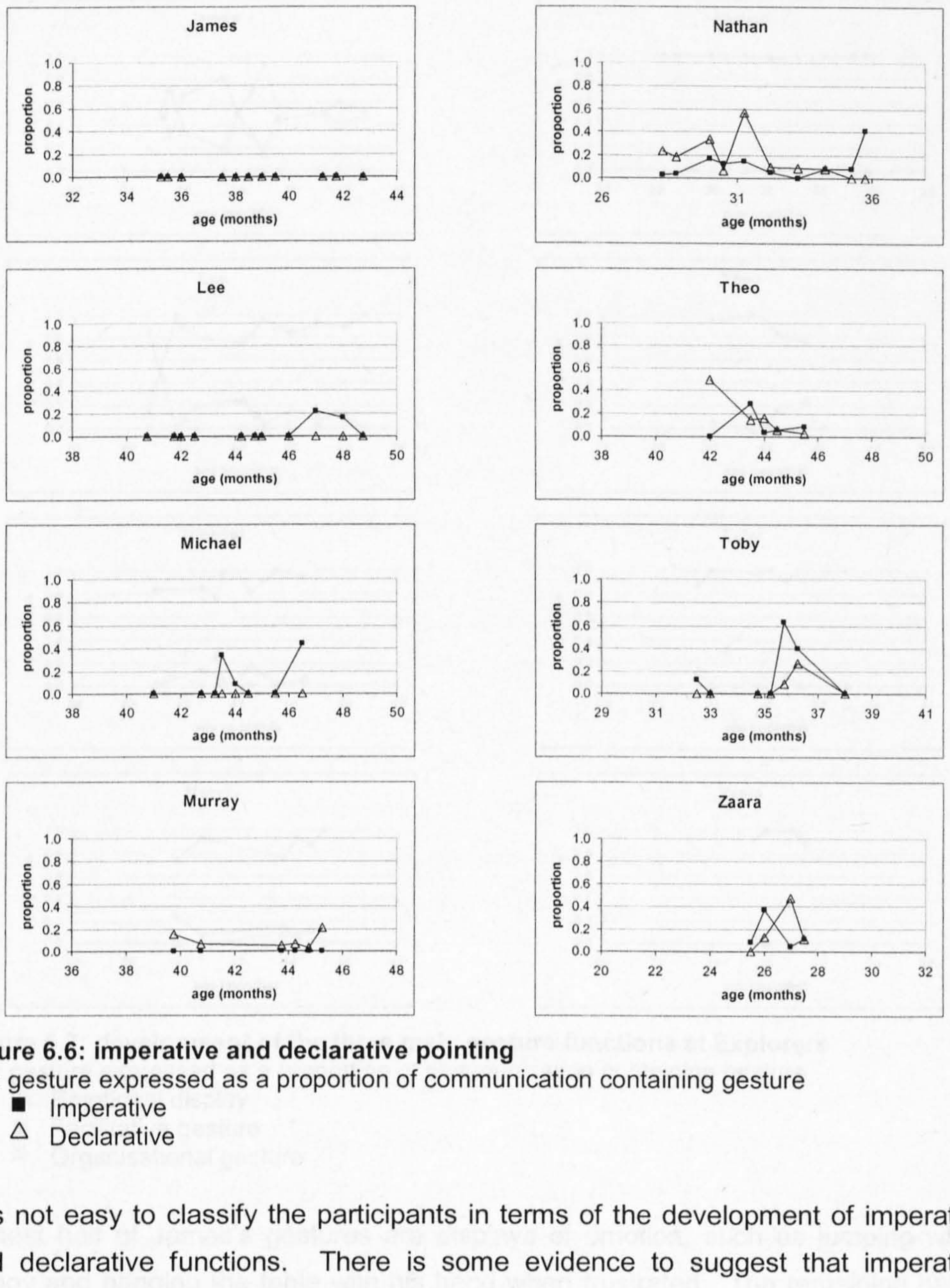



**Figure 6.6: imperative and declarative pointing**
NB: gesture expressed as a proportion of communication containing gesture
■ Imperative
△ Declarative

It is not easy to classify the participants in terms of the development of imperative and declarative functions. There is some evidence to suggest that imperative function may be the first to develop.

### 6.1.2.4 Functions

Three main functions can be identified; they are emotional displays, facilitative gestures which help the current activity and organisational gestures which negotiate a change of activity. Scores are expressed as a proportion of all gestural communication (Figure 6.7).

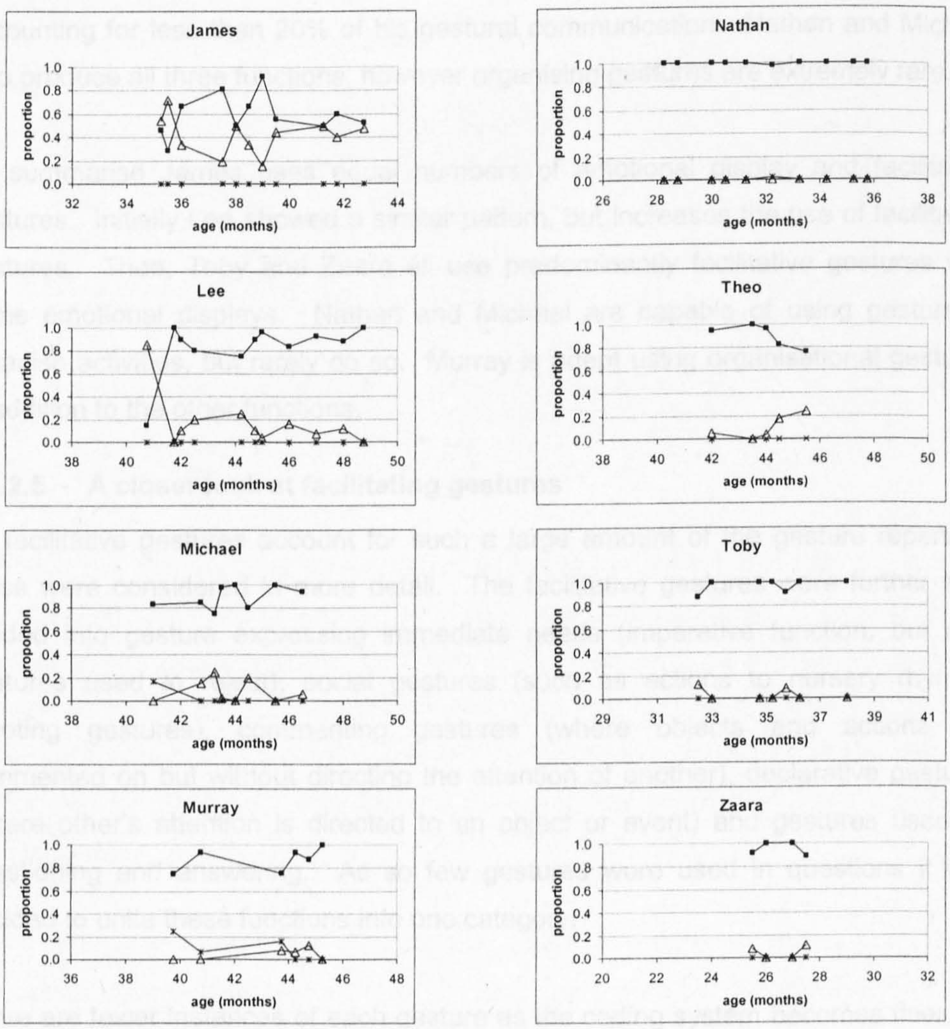



**Figure 6.7: development of the three main gesture functions at Explorers**
NB: gesture expressed as a proportion of communication containing gesture
△ Emotional display
■ Facilitative gesture
✳ Organisational gesture

Almost half of James's gestures are displays of emotion, such as jumping when happy and banging the table with his hand when frustrated. The remaining half is facilitative gestures, mainly requests or protests. James does not show any organisational gestures. Initially Lee shows a similar profile to James. By 44 months old the preponderance of emotional display gestures have been replaced with facilitative gestures, only a few emotional displays remain.

For Theo, Toby and Zaara facilitative gestures account for over 80% of all gestural communication, with the remaining gestures being emotional displays. Murray shows the most flexibility with his gestures; the dominant function is facilitative but emotional displays and organisational gestures are used in similar amounts, both accounting for less than 20% of his gestural communication. Nathan and Michael also produce all three functions, however organising gestures are extremely rare.

To summarise James uses equal numbers of emotional display and facilitative gestures. Initially Lee showed a similar pattern, but increases the use of facilitative gestures. Theo, Toby and Zaara all use predominantly facilitative gestures with some emotional displays. Nathan and Michael are capable of using gesture to organise activities, but rarely do so. Murray is adept using organisational gestures in addition to the other functions.

#### 6.1.2.5 A closer look at facilitating gestures

As facilitative gestures account for such a large amount of the gesture repertoire these were considered in more detail. The facilitative gestures were further sub-divided into gesture expressing immediate needs (imperative function, but also gestures used to reject), social gestures (such as actions to nursery rhymes, greeting gestures), commenting gestures (where objects and actions are commented on but without directing the attention of another), declarative gestures (where other's attention is directed to an object or event) and gestures used for questioning and answering. As so few gestures were used in questions it was decided to unite these functions into one category.

There are fewer instances of each gesture as the coding system becomes finer. In view of this it was decided to amalgamate all data sessions to provide a repertoire of gesture function over the course of the recordings as opposed to tracing the development of these functions. It was felt that such a course of action was further justified by there appearing to be little change with time in the use of gesture functions. Figure 6.8 shows the different sub-functions of facilitating gestures, as a proportion of all facilitating gestures.

The participants divide into three different subgroups. In the first are James, Lee and Michael. Their facilitating gestures are dominated by gestures expressing immediate needs which account for over three quarters of the facilitating gestures, and over 90% for James. Other types of facilitating function for these participants are question and answers, and commenting gestures for Lee and Michael. Michael also occasionally uses the declarative function.

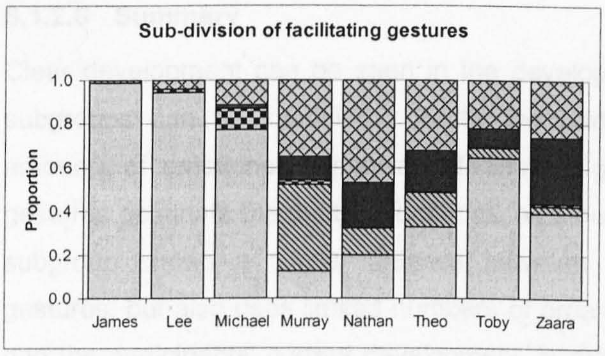



**Figure 6.8: Sub-division of facilitating gestures at Explorers**
NB: all gestures expressed as a proportion of facilitating gestures

- Immediate needs
- Commenting
- Questions and answers
- social
- declarative

Although it is not as clear to separate the remaining participants into two groups, one possible combination is that Theo, Toby and Zaara comprise a second group. The immediate needs gestures for these three participants all account for between one to two thirds of the overall facilitating gestures, further question and answer gestures account for around a quarter of the gestures. Compared to the previous group more use is made of declarative gestures, and social gestures are seen for the first time.

The final group consists of Nathan and Murray. Following the general trend immediate needs gestures are much lower (less than 20%) and question and answer gestures appear more frequently (around half of all facilitating gestures). The remaining gestures are mainly declarative.

To summarise, the subgroups of functions which come together as facilitating gestures were not traced developmentally, but instead were presented individually. Three subgroups were found in the participants, which indicated a developmental pattern which unfolded over a larger time span than had been recorded for each participant. Thus gestures which express immediate needs initially dominate (James, Lee, and Michael), reducing in favour of question and answer gestures. Declarative and social gestures also increase (Theo, Toby and Zaara). These trends continue into the final group (Murray and Nathan) where question and answer gestures account for half the facilitating gestures, and immediate needs for approximately a fifth.

#### 6.1.2.6 Summary

Clear development can be seen in the development of gesture functions. Three subgroups can be identified. Firstly the participants use approximately equal amounts of emotional display and facilitative gestures. Secondly the facilitative gestures dominate the gesture functions, as emotional displays decrease. The third subgroup shows a similar balance between facilitative and emotional display gestures, but also uses limited numbers of organisational gestures. This trajectory, and the participants' current development, is represented visually in Figure 6.14 (p 155). Changes also occur within the facilitating gestures. Initially gestures expressing immediate needs predominate. Gestures used to respond (and to form questions) gradually increase, as do social gestures and commenting and declarative gestures.

As expected deictic gestures dominated the form of gesture. Emblems were slightly more frequent than the extremely rare iconic gestures. Most of the iconic gestures were imitations of gestures used by the adults. The use of an adult's hand was only used with any frequency by James and Lee. Within deictic gestures, requests and protests precede, but decline in favour of pointing gestures. There is some evidence that the imperative function develops before the declarative function but both are used in the interactions. The development of deictic gestures begins with the use of requests and protests prior to pointing gestures. The development of imperative and declarative function in children with ASD remains unresolved. There is conflicting evidence, but it appears that imperative function develops first. Once again this trajectory is represented visually, with the participants' relative placing along it in Figure 6.14.

### 6.1.3 Speech and gesture

The relationship between speech and gesture has received a lot of attention in recent years (see Chapter 2, Section 2.3.2.6). With this in mind the transition from one- to two-word speech was followed in the participants. In addition cross-modal combinations were examined. The implications of these findings are then briefly discussed.

#### 6.1.3.1 Gesture without speech, non-synchronised and synchronised cross-modal combinations

In typically developing children communicative acts comprising gesture without speech or non-synchronous cross-modal combinations predominate before declining in favour of temporally synchronised gesture-speech combinations. Gestures may reinforce, supplement or disambiguate the speech they accompany. A combination of the appearance of supplementary gestures and regular use of synchronised speech and gesture combinations indicate integration of the two modalities.

All participants were found to use reinforcing cross-modal combinations yet individual variation amongst the participants was large. Three participants, (James, Lee and Toby) did not use any other type of cross-modal combination in their communication. Figure 6.9 shows the development of gesture and speech for each participant.

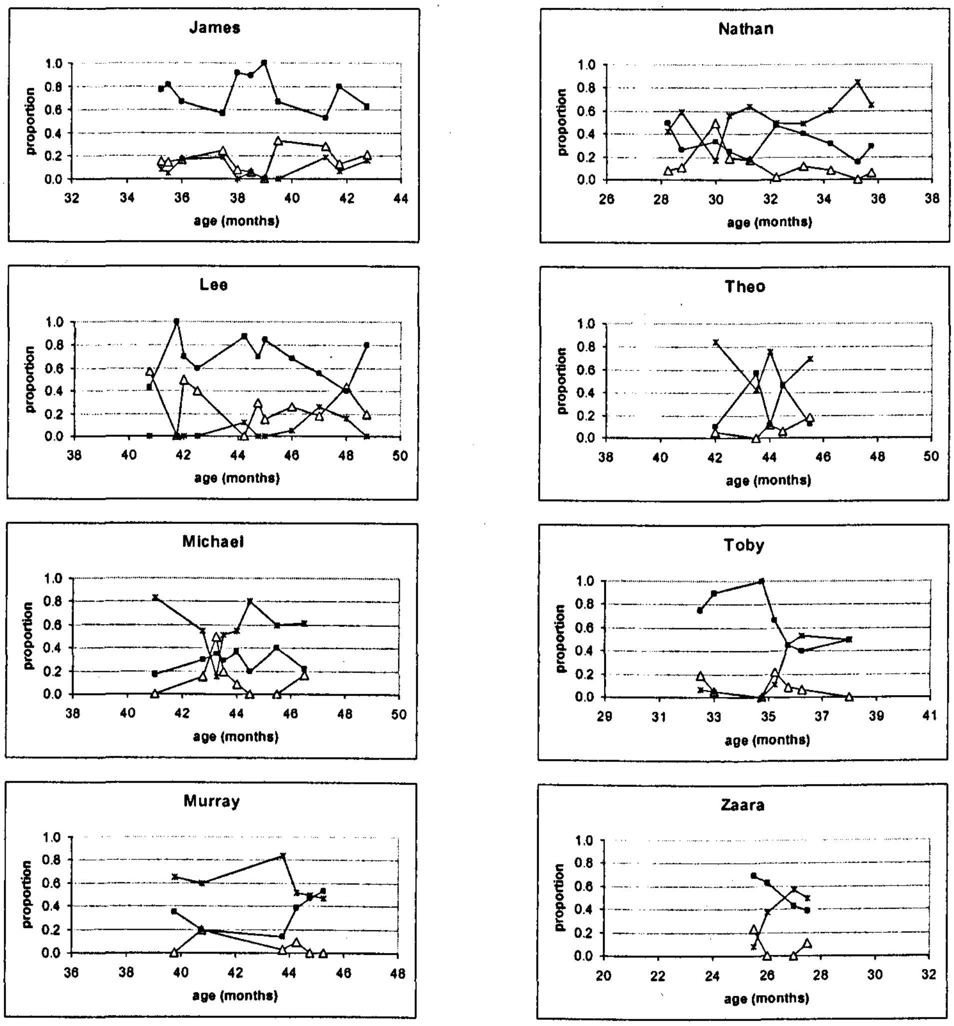



**Figure 6.9: gesture without speech, non-synchronous and synchronous cross-modal combinations**

NB: gesture expressed as a proportion of communication containing gesture

- ■ Gesture without speech
- Δ Non-synchronised cross-modal combinations
- ✳ Synchronised cross-modal combinations

James shows little evidence of either gesture used without speech or non-synchronous cross-modal combinations decreasing. Gesture without speech accounts for 60-100% of his gestural communication, whereas cross-modal combinations account for up to 20%. Non-synchronous combinations are slightly more prevalent than their synchronised counterparts. Lee shows a similar pattern to James until the age of 44 months when gesture used without speech begins to decrease. Likewise non-synchronous combinations decline from approximately 50% of gestural communication to around 20%, whilst synchronous combinations increase, only to diverge in the final session.

Both gesture without speech and non-synchronous combinations are low throughout the sessions for Michael. Murray also has low levels of both gesture alone and non-synchronous combinations, but gesture alone scores increase notably in the final sessions. This can be explained by an increasing number of action songs in the data; Murray performs the actions without the accompanying singing. Nathan shows a slight decrease in both gesture without speech and non-synchronous combinations; most obviously in the latter which fall from 50% to less than 10% by 36 months of age. All three participants show high levels of synchronised combinations. Each participant is also producing supplementary combinations, the first emerging at 42 months for Michael, 41 months for Murray and 28.5 months for Nathan.

Toby and Zaara use fewer cross-modal combinations than gesture without speech. For both gesture alone falls rapidly. Over the course of the programme gesture without speech and synchronised cross-modal combinations converge to approximately 50% of total gestural communication for both. The first supplementary cross-modal combination occurs at 27.5 months old for Zaara, but none are recorded for Toby. It is difficult to decipher a coherent pattern for Theo. Non-synchronous cross-modal combinations are consistently low, yet scores for gesture without speech show great variability ranging from 60% to 10% of all gestural communication. There is little distinction between synchronised cross-modal combinations and gesture without speech, yet it is generally true that the synchronous combinations form the majority of gestural communication. The first supplementary gesture is recorded at 43 months old.

Three distinct periods of development can be identified within the eight participants. Firstly the gestural system comprises mainly gesture without speech with negligible numbers of synchronised cross-modal combinations. James falls within this period. Lee too falls within this period, yet displays some indications of a transition. The second identifiable period of development is characterised by decreasing levels of gesture without speech and increasing levels of synchronised combinations. By the end of the data collection Toby has entered into this second period, as has Zaara. In the third period gesture and speech are predominantly synchronised and can be used to convey a single meaning shared across both modalities. The remaining four participants fall into this group, although the interpretation of Theo's results remains difficult.

### 6.1.3.2 Onset of gesture and speech

The proposed underlying processing architecture makes some predictions about the onset of words and gestures. In order to find the most accurate onset of behaviour the Explorers and home data were combined, this gave weekly recordings for most participants. The onset of gesture was first examined, notably the first use of gesture without speech, reinforcing combinations and supplementary combinations. The participants fell into two groups (Figure 6.10, Figure 6.11), the first group, comprising James, Lee and Toby did not produce any supplementary combinations. For all of these participants gesture alone was used prior to non-synchronised reinforcing combinations. Eventually these too gave way to synchronised reinforcing combinations (Figure 6.10).

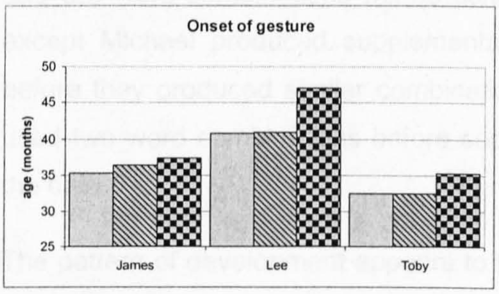



**Figure 6.10: Onset of gesture at Explorers for the first subset of participants**
Gesture without speech
Non-synchronised reinforcing cross-modal combination
Synchronised reinforcing cross-modal combination

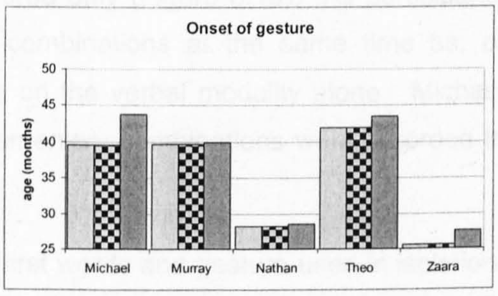



**Figure 6.11: Onset of gesture at Explorers for the second subset of participants**
Gesture without speech
Synchronised reinforcing cross-modal combination
Synchronised supplementary cross-modal combination

The second group (Michael, Murray, Nathan, Theo and Zaara) all produced synchronised reinforcing combinations in the first session, therefore it is not possible to ascertain if they also went through a stage of non-synchronisation. These five participants also produced supplementary combinations. All supplementary combinations were synchronised from the onset (Figure 6.11).

Similar groups were also found in the onset of words and gestures. Three participants (James, Lee and Toby) did not produce two word combinations (Figure 6.12). Lee and Toby were producing gestures and first words before combining the two together. James did not produce his first word until after he was using synchronised reinforcing gesture-vocalisation combinations.

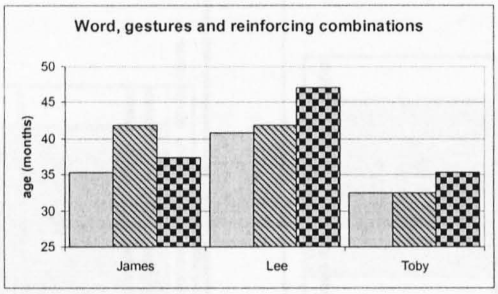



**Figure 6.12: onset of words and gestures at Explorers for the first subset of participants**
Gesture without speech
Single words without gesture
Synchronised reinforcing cross-modal combination

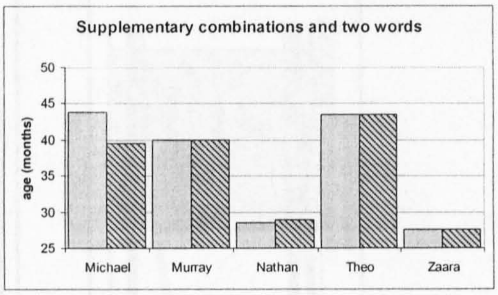



**Figure 6.13: Onset of words and gestures at Explorers for the second subset of participants**
Synchronised supplementary cross-modal combinations
Two word combinations

All the remaining five participants used gesture, words and synchronised reinforcing combinations in the first session, therefore the onset of supplementary combinations and two word combinations will be considered only (Figure 6.13). All participants except Michael produced supplementary combinations at the same time as, or before they produced similar combinations on the verbal modality alone. Michael used two word combinations before supplementary combinations were recorded in the data.

The pattern of development appears to be first words and gesture used in isolation, followed by reinforcing gestures which gradually become temporally synchronised. Supplementary combinations appear after synchronisation is achieved, which are followed in turn by two word combinations.

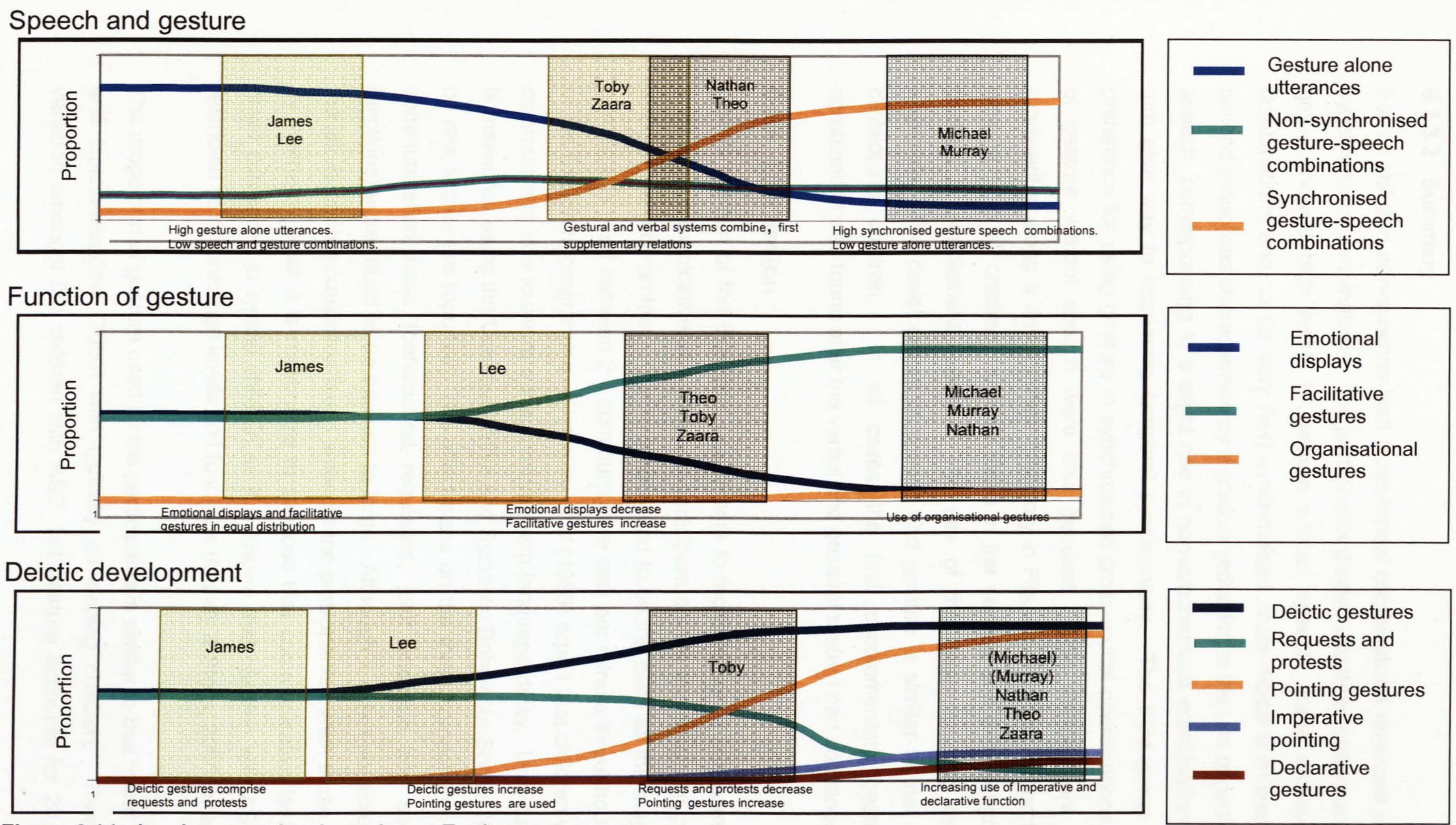



**Figure 6.14: developmental trajectories at Explorers**

NB: Visual representation of developmental trajectories, plotted as proportional use of gestures over time.
Shaded boxes represent each participant's development during the Explorers programme.

#### 6.1.3.3 Summary

For all children non-synchronised cross-modal combinations emerged sooner than synchronised combinations. The participants divided into three subgroups. The first group showed high levels of gesture without speech, some non-synchronised combinations and no (or very few) synchronised cross-modal combinations. The second group was characterised by a gradual reduction in the use of gesture without speech, corresponding to a slight rise in non-synchronous combinations, which in turn give way to increasing temporal synchronicity. The third group showed a preference for using gesture in synchronised cross-modal combinations, instances of gesture without speech were less frequent. This development is visually represented along a development trajectory in Figure 6.14. The reinforcing relation was found in all children, but only those in the second and third subgroups used gesture to supplement speech. The use of the disambiguating relation was negligible. The development of speech and gesture is similar to that of typically developing children. In all cases the first supplementary gesture-speech combination was found after the verbal and gestural system had combined.

### 6.1.4 Discussion

Due to the aim of the Explorers programme to facilitate social and communicative abilities, communicative acts for each participant should increase with progression through the programme. This was not found to be the case as the majority of the participants used between 2-4 communicative acts per minute throughout the whole of the Explorers programme. Wetherby *et al* (1998) report that children with autism communicate at a lower rate than children with language delay. Unfortunately, this is measured using the Communicative and Symbolic Behaviour Scales (CSBS) and no raw scores are reported. The effect sizes on the three components measuring communication rates (behavioural regulation, joint attention and sociability of functions) were found to be medium to large. Although it is not possible to verify if the levels of communication found amongst the participants match those discovered by Wetherby *et al*, it is reasonable to suppose that communicative levels may be lower compared to typical children as it is known that children with ASD do have restricted communication levels and functions (Mundy & Stella, 2000 for a review).

The proportion of gesture used by the participants is similar to that found by Butcher and Goldin-Meadow (2000) with typically developing children. There is more variation amongst the children with ASD, but gesture accounts for 20-40% of all communication. Butcher and Goldin-Meadow found that gesture accounted for approximately 20% of communication, except for one participant were it accounted for approximately 40%. The slightly elevated levels in the children with autism may be in part due to the inclusion of emotional displays as gestures, behaviour which was excluded from the typical children.

The reduction in gesture without speech is not as dramatic as that seen in the typically developing children (Butcher & Goldin-Meadow, 2000). Whilst it is possible to trace the growing preference for gesture to be used with speech this occurs at a slower pace than that seen in the typically developing children. The pattern is more erratic, with more increases in gesture used without speech alongside great reductions. In taking an overview, despite this large variation the overall trend is for gesture without speech to decline, albeit slowly and not always surely. Final levels of gesture without speech are approximately 30% of gestural communication, compared to the 20% seen in typical children. Non-synchronised cross-modal combinations remain consistent throughout the data collection, at approximately 20% for those participants with high levels of gesture used without speech, and lower for those where gesture is more often combined with synchronised vocalisations and words.

Synchronised cross-modal combinations were seen to rise in some of the participants. At the most extreme this rise was from 10% of all gestural communication to 70%, and much less in many participants. As with the decline in gesture without speech this rise occurs much more slowly and less completely than that seen in typical children (Butcher & Goldin-Meadow, 2000). However this may be an artefact of the methodology as the proportional scores are calculated differently. The relationship of gesture to speech in cross-modal combinations for all the participants is predominantly reinforcing.. The first supplementary cross-modal combinations always occur after a possible integration point, similar to typically developing children (Butcher & Goldin-Meadow, 2000).

The onset of gesture and speech broadly follows a similar path to that seen in typically developing children (Butcher & Goldin-Meadow, 2000; Capirci *et al.*, 2005; Capirci *et al.*, 1996; Capobianco *et al.*, 2007; Iverson *et al.*, 1994; McEachern & Haynes, 2004). All participants show the same development of gesture from using gesture in isolation, to non-synchronised reinforcing combinations. As synchronicity is achieved the first supplementary combinations appear. The development of speech also goes from single words to two words, however there is more individual variation in the relationship between speech and gesture than seen in typically developing children. First words would be expected to emerge prior to speech and gesture combinations, and two words combinations would be expected to emerge after the first supplementary cross-modal combination. Most participants do follow this path, the exceptions being James and Michael.

James combines vocalisations and gestures together, and synchronises them before he begins to use words. His first word emerges just prior to 42 months at which point he has been using synchronised reinforcing combinations for four and half months. This may provide evidence that his speech is more delayed than his gestural system. In a remarkably similar fashion Michael also produces two word combinations four and a half months before he produces supplementary combinations. This may also indicate discrepancies between the gestural and speech system, but it seems less likely as he produces synchronised reinforcing cross-modal combinations regularly. It may be resulting from the selective sample of data recorded. Discussion of the implications of these results for the processing architecture of speech and gesture will be taken up in Chapter 9 (Section 9.1.4).

Other than the pervasive imperative and declarative distinction found throughout much of the communication in children with autism, little is known about the functions of gesture used by this group. The participants all used emotional display gestures, although these declined as the child developed communicatively. Overwhelmingly facilitative gestures dominate the functional repertoire, accounting for over 80% of all gestures. Emotional display gestures decline from approximately 50% to less than 20% of all gestures. Organisational gestures are extremely rare, although Murray uses more than most. This may be in part due to his use of Babysign, where he has been explicitly taught signs for FINISH, which he consistently uses.

In terms of gesture form the results reported here agree with earlier studies on the types of gesture used by young children with autism (Camaioni *et al.*, 1997; Stone *et al.*, 1997). Deictic gestures dominate and iconic gestures and emblems are rare. The finding that physical prompts are used extensively only in the early stages of language development (Wetherby *et al.*, 1998) is borne out as James and Lee make the most use of this gesture form. Deictic gestures follow the predicted sequence of requests and protests preceding pointing gestures (Capone & McGregor, 2004), perhaps due to pointing relying on further understanding of the other (Franco & Butterworth, 1996).

Both imperative and declarative pointing was observed in the data, although there is evidence that imperative pointing develops first. This agrees with the observations of Stone *et al* (1997), but goes against the seminal finding of Baron-Cohen (1989). Camaioni *et al* (2003) found a similar profile to the one reported here. Whilst declarative pointing was observed the instances were somewhat rare, and only found in the children with less severe communicative impairments. All participants used the imperative function.

It is interesting that for Lee many changes happen to the gestural system around the age of 44 months. At this time his gesture alone utterances begin to drop, as the synchronised gesture-speech combinations begin to rise, and pointing gestures become established. His communicative acts also increase, and his gestures move to being more task orientated and less emotionally tied. There is also a pivotal point for Toby at 36 months when speech and gesture appear to integrate. This also coincides with a change in the gestural system where pointing gestures predominate for the first time. The fact that multiple changes are occurring throughout the gestural system simultaneously point to an underlying cognitive development which is pervasive to the gestural domain.

## 6.2 The Home environment

Each participant was recorded at home with a caregiver. This was the mother, except Nathan's first session when both parents were present. Due to difficulties in data collection, neither Toby nor Zaara were recorded at home. Each recording lasted around 20 minutes, the numbers of gestures produced by the participant in each session are shown in Table 6.2 below.

Due to the small number of recordings for both Murray and Theo, it is not possible to analyse these data using the microgenetic method. Therefore only James, Lee, Michael and Nathan shall be discussed. The format for this section follows that of the previous. The frequency and nature of the children's communication will be first examined, followed by the development of form and function of gesture and finally speech and gesture.

Cohort 1

| Participant | Recording week | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| James | 9 | 13 | | 22 | 19 | | 11 | 10 | | 14 | |
| Nathan | | 16 | 42 | | 8 | 16 | 11 | 34 | 25 | | 30 |

Cohort 2:

| Participant | Recording week | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Lee | 126 | 59 | 10 | 37 | | 16 | | | 16 | | | | | |
| Michael | 10 | 13 | 7 | | 7 | | 6 | | 15 | 18 | 6 | 3 | 12 | 9 |
| Murray | 13 | 14 | | | | 9 | | | | | | | | |
| Theo | | | | | | 29 | | 26 | | | | | | |

**Table 6.2: gestures produced by session and participant at home**
NB: grey cells indicate sessions excluded from analysis.

### 6.2.1 Communicating

As with the Explorers environment the participants' communication is assessed by means of the number of communicative acts per minute and the proportion of gesture used in this communication.

#### 6.2.1.1 Communicative acts

James's communicative acts remain consistently close to 3 a minute. With initially higher levels Lee also settles to around 3 per minute. Michael and Nathan show more variation. Michael produces between 4-7 communicative acts per minute, occasionally increasing to over 8. Nathan is slightly lower, between 2-6 communicative acts. This is shown in Figure 6.15. Two groups are observed; James and Lee communicate at a lower rate to that of Nathan and Michael.

#### 6.2.1.2 Gestural communication

The patterns for gestural communication closely follow that of communicative acts (Figure 6.16). Most strikingly the proportion of gesture in Nathan's communication remains constant, despite the differing communication rates. This pattern is echoed by James, both between 20 and 40% of communication is expressed through gesture. Lee begins with a high proportion of gesture which falls and settles to around 30%. Michael is the most consistent, but he also uses the least amount of gesture in his communication, at around 10%.

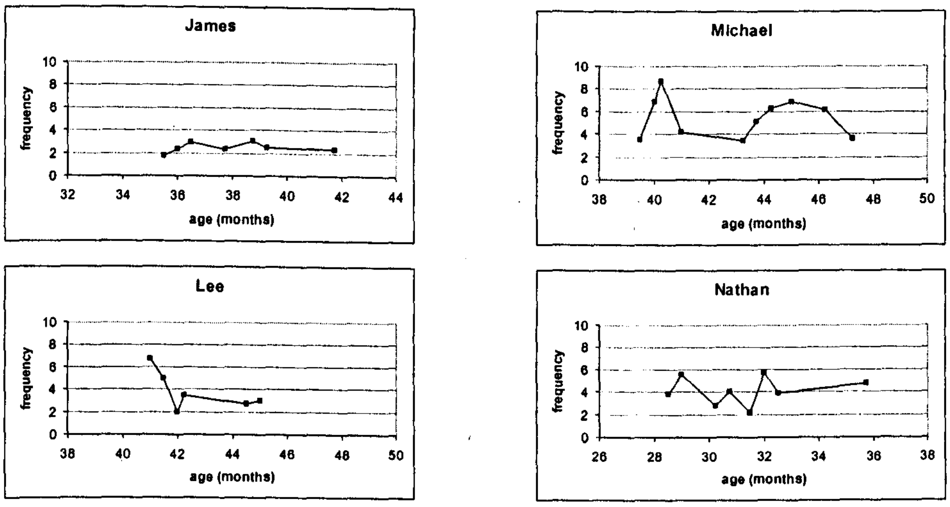



**Figure 6.15: Communicative acts at home**

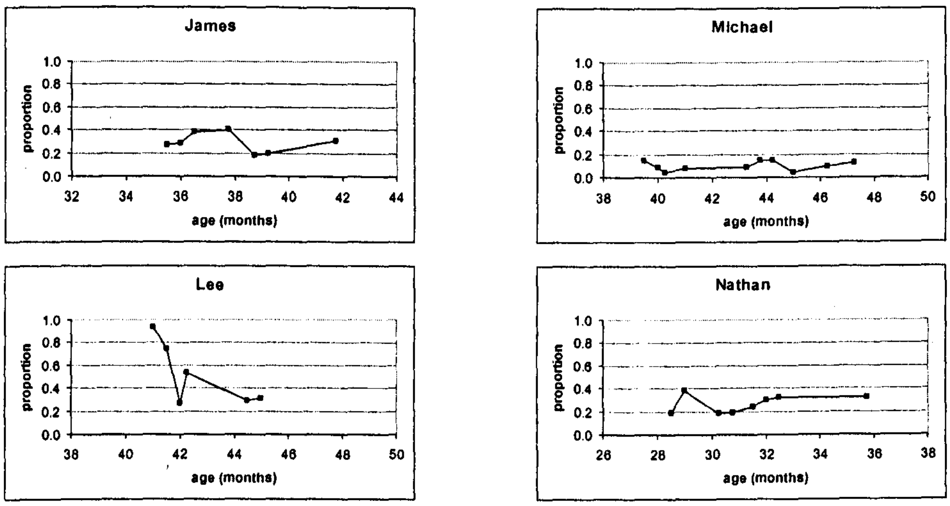



**Figure 6.16: Gestural communication at home**
NB: all gesture expressed as a proportion of all communicative acts

There is great variability in the use of gesture at home. Michael uses the least. For the other participants between 20-40% of all communication is gesture.

### 6.2.1.3 Summary

There is considerable variation amongst the participants both in the levels of communication and the use of gesture. In terms of communicative acts two profiles can be seen. Firstly is the consistent use of approximately 3 communicative acts per minute. The second profile is to have a higher rate of communication (around 5 communicative acts per minute) but to have a much greater range, between 2 and 8 communicative acts per minute. For most of the participants gesture accounts for

20-40% of all communication, but this does vary considerably. Michael is different as he consistently uses gesture for only 10% of his communication.

### 6.2.2 Form and function

This section follows the analysis presented for the Explorers environment. The repertoire of gesture form will be reported first, followed by a developmental analysis of deictic gestures. The three main functions will be considered developmentally, followed by a breakdown of the facilitating gestures.

#### 6.2.2.1 Form of gesture

Many participants showed a general trend of decreasing deictic gestures at home. With the exception of Michael no other changes in the form of gesture was discovered over time. Therefore the forms of gesture repertoire of each participant will be calculated without reference to the longitudinal aspect. This allows the data collected for Murray and Theo to be included in the analysis. Overall proportions for each form of gesture are shown in Figure 6.17. Michael has been included in this analysis, however at 43 months old his use of deictic gesture fell and other forms rose. From this point on no one form of gesture accounted for more than 60% of all communication.

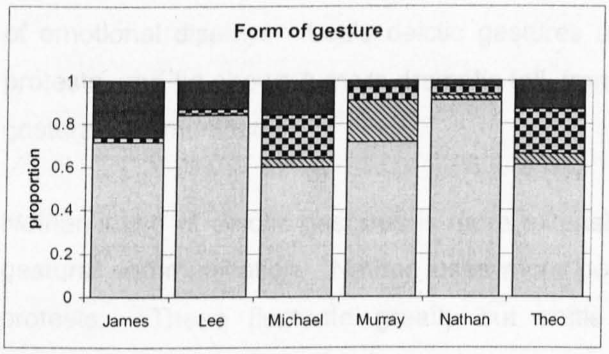



**Figure 6.17: form of gesture at home**
N.B. Expressed as a proportion of all gesture
Deictic  Iconic
Emblem  Other

Deictic gestures are predominant for all participants. Every participant uses some degree of emblems, and all but James use iconic gestures (albeit exceptionally limited, e.g. Lee and Nathan). Imitated gestures account for 29% of all iconic gestures across the participants, however Murray alone accounts for half the spontaneous iconic gestures. Emotional display gestures coincide with the coding of "other" and are used by all the participants

Murray and Theo are the only participants who do not use physical prompts (Figure 6.18). Lee does extensively, and James's use of physical prompts is noticeably higher than that for Michael and Nathan.

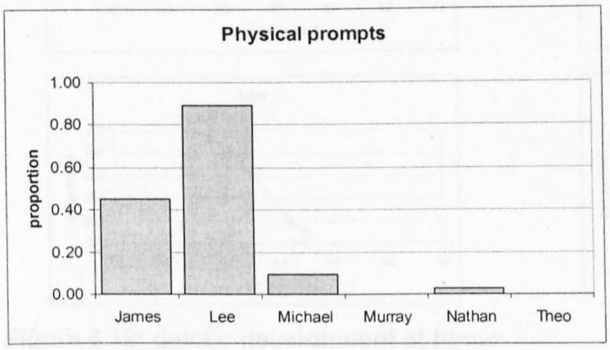



**Figure 6.18: use of physcial prompts at home**
NB. Expressed as a proportion of all communication containing gesture

Gesture form appears relatively stable across participants, however both Lee and James make more use of physical prompts than the other participants.

### 6.2.2.2 Deictic development

As neither James nor Lee use pointing, all their deictic gestures consist of requests and protests (Figure 6.19). For James the overall trend is for deictic gestures to fall from 70% to 50%. This corresponds to the fall of facilitative gestures and increase of emotional displays. Lee's deictic gestures are also made up of requests and protests, and he shows a more dramatic fall, from close to 100% down to 10% of all gestural communication.

Nathan's use of deictic gestures is more extensive, accounting for over 80% of all gestural communication. Nathan uses more pointing gestures than requests and protests. These fluctuate greatly but settle to around half of all gestural communication by the final session. In contrast requests and protests are used less frequently, accounting for 20% of all gestural communication.

Like James, Michael's use of deictic gestures falls over the course of the data collection. Initially Michael uses more requesting and protesting gestures, but at 44 months old pointing gestures become increasingly used and remain the predominate form until the end of data collection four months later.

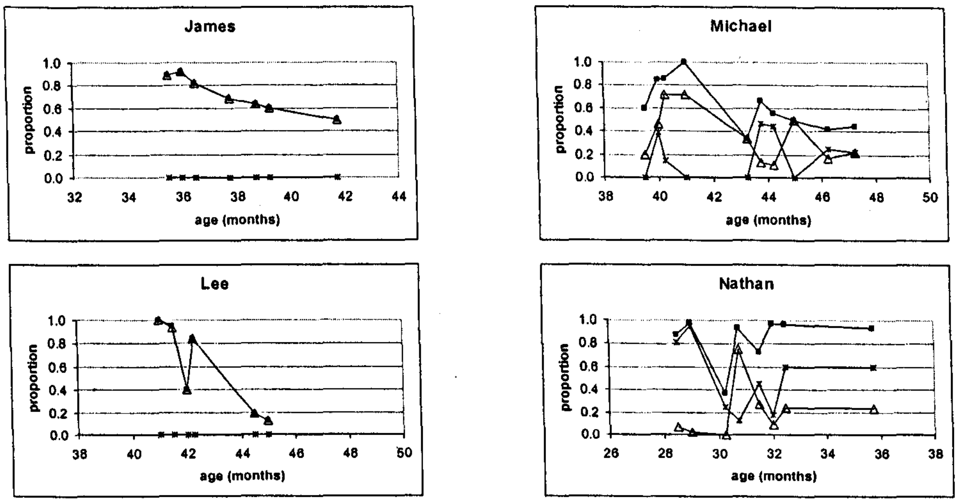



**Figure 6.19: deictic development at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
- ■ Deictic
- △ Requests and protests
- ✳ Pointing

Contrary to expectations of the gestural repertoire of children with ASD, deictic gestures are used less extensively at home. Despite low levels of deictic gestures, as with typical development, requests and protests precede pointing gestures.

#### 6.2.2.3 Imperative and declarative pointing

James and Lee do not use pointing gestures, therefore the use of imperative or declarative function cannot be ascertained. Nathan makes use of both the imperative and declarative function (Figure 6.20). Although neither occur frequently, declarative function is slightly more common than imperative, particularly from 32 months old onward.

Michael uses very few clear imperative or declarative pointing gestures. These only occur in two sessions, just prior to 44 months of age, where the declarative function is used, and at 45 months where both imperative and declarative pointing gestures are produced.

Therefore it seems that both functions are used, although the evidence for this is not substantial.

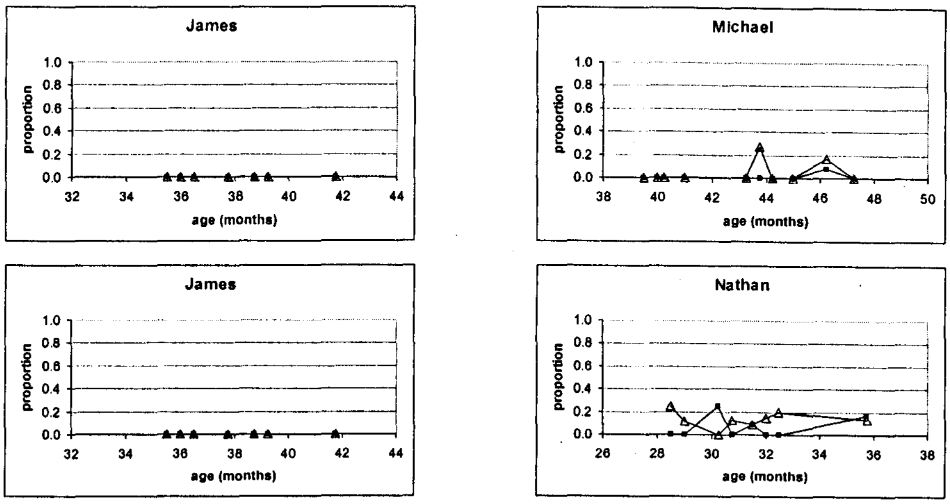



**Figure 6.20: imperative and declarative pointing at home**
NB: all gesture expressed as a proportion of all communicative acts containing gesture
■ Imperative
△ Declarative

#### 6.2.2.4 Functions

Neither Lee nor James produces any organisational gestures, yet both display a change in gesture function over time (Figure 6.21). The initially high levels of facilitative gestures gradually decrease and concomitantly emotional display gestures increase. For James this pattern continues to the final session when both gesture functions are in equal proportions. Until Lee is 43 months old the facilitative gestures remain high. After this age emotional displays become the dominant gesture function whilst facilitative gestures decrease to around 10%.

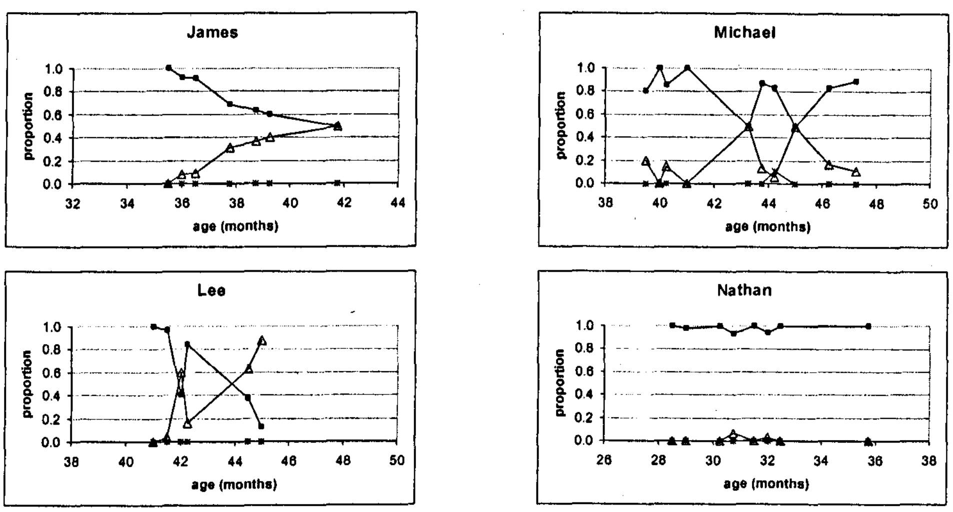



**Figure 6.21: gesture functions at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Emotional displays
△ Facilitative gestures
✳ Organisational gesture

Nathan makes most use of facilitative gestures. These account for 90-100% of all gestural communication. The remaining gestures are emotional displays. Michael's facilitative gestures are around 80% of all gestural communication. Excluding sessions where emotional displays and facilitative gestures are in equal distribution, emotional displays account for less than 20% of the gestural communication. Michael is also the only participant to use organising gestures at home, this occurs at 44 months old.

A familiar pattern emerges; James and Lee being at an earlier developmental stage than Nathan and Michael.

#### 6.2.2.5 A closer look at facilitating gestures

The five subgroups of gesture that make up the facilitating function (immediate needs, social, commenting, declarative and questions and answers) were examined in detail for each participant (Figure 6.22). As this analysis relies on the total data collected, both Murray and Theo were included in the analysis.

James and Lee form one subset, where gestures expressing immediate needs dominate the facilitating gestures. Another subset can be formed with Michael, Nathan and Murray. Both Michael and Nathan show a very similar profile. For both, gestures expressing immediate needs account for about a third of all facilitating gestures, a further third comprises questions and answers. The remaining third is composed of social, commenting and declarative gestures. Murray is different as, although immediate needs do account for a third of all facilitating gestures, question and answer gestures account for another 60%, thus reducing the levels of social, commenting and declarative gestures.

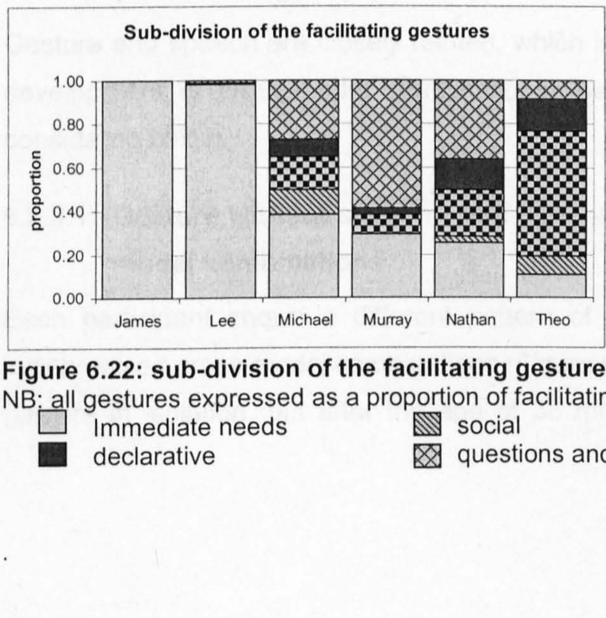



**Figure 6.22: sub-division of the facilitating gestures at home**

NB: all gestures expressed as a proportion of facilitating gestures

Immediate needs — social — commenting — declarative — questions and answers

Theo demonstrates a different pattern. The majority of the gestures he uses are commenting gestures (approximately 60%), with very few instances of gestures expressing immediate needs, or social, declarative or question and answer gestures.

There is a clear distinction between James and Lee on the one hand, who use predominantly gestures expressing immediate needs, and the other participants who show a more even profile of all five sub-types of facilitating gestures.

#### 6.2.2.6 Summary

The divide between the participants can be traced through gesture's form and function. In terms of gesture function James and Lee increase the level of emotional display gestures at the expense of facilitative gestures. In contrast both Michael and Nathan clearly have a preference for facilitative gestures, producing much fewer emotional display gestures. In terms of the form of gesture both Michael and Nathan regularly use pointing gestures, and are able to use both declarative and imperative function. Lee and James do not use pointing gestures, instead they rely on requests and protests, including physical prompts.

These developmental trajectories are idealised in Figure 6.24. There is considerable individual variation, especially in the proportional levels of deictic gesture used, therefore the relative proportions of the trajectories should be seen as a guide only. In addition the participants fall at each end of the trajectory, yielding little information about the changes between the two groups, therefore this is merely a proposal of development.

### 6.2.3 Speech and gesture

Gesture and speech are closely related, which is shown in their development. The development of cross-modal combinations, leading to two word speech will be considered below.

#### 6.2.3.1 Gesture without speech, non-synchronised and synchronised cross-modal combinations

Each participant shows a different pattern of gesture without speech and non-synchronised cross-modal combinations (Figure 6.23). James initially only produces gesture in isolation, but after the age of 36 months the first speech and gesture combinations emerge. Subsequently non-synchronised combinations account for up to half the gestural communication, although he does not use synchronised combinations at home. All combinations are reinforcing.

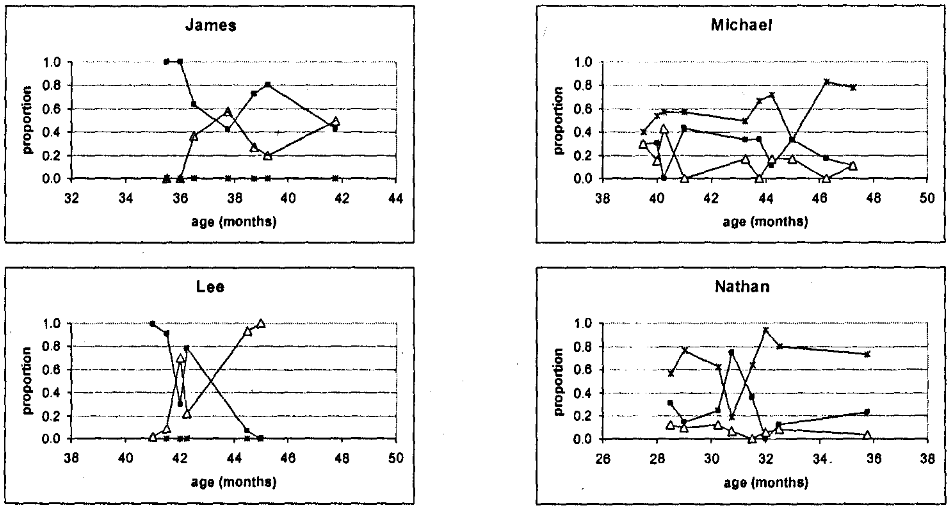



**Figure 6.23: gesture without speech, non-synchronised and synchronised cross-modal combinations at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Gesture without speech
△ Non-synchronised cross-modal combinations
✳ Synchronised cross-modal combinations

Lee has no cross-modal combinations in the first session, but they appear increasingly frequently by 42 months of age. At 44 months gesture alone communications have dramatically fallen whilst non-synchronised combinations increase. There is no synchronisation, and all combinations are reinforcing.

Nathan demonstrates a different pattern. Excepting the session at 31 months of age, the proportion of gesture without speech remains consistently low, around 20% of all gestural communication. Non-synchronised combinations are also consistently low, however synchronised combinations gradually increase. Nathan first uses supplementary combinations in the first session, and subsequently produces both supplementary and disambiguating combinations. Michael uses gesture without speech more frequently than in non-synchronised combination with speech, but gesture alone falls from 30% at age 39 months to 10% at 47 months. The majority of Michael's gestural repertoire is synchronised cross-modal combinations. This distinction becomes more apparent as gesture without speech declines. The first supplementary combination was found just prior to 44 months. Michael does not use disambiguating cross-modal combinations at home.

As before the participants are split into two groups with Lee and James not using any synchronised cross-modal combinations, and Nathan and Michael using both synchronised and supplementary cross-modal combinations.

#### 6.2.3.2 Summary

In the home environment the four participants fall into two subgroups. Lee and James are very similar to each other in many respects; initially high levels of gesture used without speech fall as non-synchronised cross-modal combinations rise, neither use synchronised combinations, nor do they use gesture to supplement or disambiguate speech. By comparison Michael and Nathan have lower levels of gesture without speech and routinely use synchronised gesture-speech combinations. They also produce some limited supplementary combinations in addition to reinforcing combinations. The two subgroups are very distinct from each other which poses problems when trying to ascertain a developmental trajectory. This has been attempted in Figure 6.24, although the path between the subgroups can only be postulated and not confirmed.

### 6.2.4 Discussion

The participants were recorded at home interacting with a parent and their gestures were identified and analysed in terms of the relationship to speech, form and function. Overall levels of communication showed great variation at home. The cause of this is unclear. Some explanation may be found in the context of interaction initiated by the mothers. If this varied considerably this may impact on the communication of the child. This hypothesis will be followed up in Chapters 7 and 8. It is difficult to say how the communication rate compares to typical children. The gestural communication at home is much more consistent. For most of the participants gesture accounts for approximately 30% of the total communication, with the exception of Michael which is 10%. Butcher and Goldin-Meadow (2000) found that for typical children the level is 20% (rising to 40% for one participant). The levels here are comparable, if not identical.

The pattern between gesture without speech and cross-modal combinations is quite complex. Two subgroups can be observed. The first group is characterised by falling levels of gesture without speech (rapid and extensive in the case of Lee, slow and gradual in the case of James), with relatively high levels of non-synchronised cross-modal combinations (approximately 50%) and no synchronised combinations. This differs from typical children in a number of ways. Although Lee's decline in the use of gesture without speech is comparable to that seen in typical children, James's is not. The consistently high numbers of non-synchronised cross-modal combinations is also different to that seen in typical development, as these reduce more rapidly.

The second subgroup show a profile which is similar to typical development. Use of gesture without speech is restricted (approximately 20-30% for both ASD and typical), synchronised cross-modal combinations dominate (approximately rising to 70% for autism, 90% for typical development). The discrepancy between these scores may be explained by the proportion for the autism group being calculated from all gestural communication, and that for the typical group from cross-modal combinations only. The use of non-synchronised combinations is negligible for both groups. Although based on very few participants, this would indicate that in the home environment the trajectory of speech and gesture development varies compared to typical development, even if, post integration, the profile is similar. Reinforcing combinations dominated in every participant, supplementary combinations were rare, and gestures disambiguating speech almost non-existent.

There is considerable variation in the functions of gesture used by the participants at home. As with the communication rate this may tie in with the context of interaction, the focus of the qualitative analysis in Chapter 8. Nathan is the only participant to show a consistent profile at home and at Explorers; facilitative gestures dominate and emotional display and organisational gestures are rare. Emotional display gestures are prevalent in the other participants, at the expense of facilitative gestures. Organisational gestures are rare throughout all the participants. The informality of the home environment appears conducive to emotional display. It remains to be seen which contributing factors (relationship to mother, security of surroundings, less educational expectations etc.) and to what extent these factors, may lead to the increased use of emotional displays.

The form of gesture remains consistent with previous studies. Deictic gestures dominate, with little use of emblems or iconic gestures. Emotional displays have a greater role as shown by the increase in the "other" category. The early strategy of manipulating another's hand is also more prevalent at home, perhaps linking in to similar factors to the increase in emotional display gestures as both of these behaviours are indicators of early development. Deictic development follows the expected route of requests and protests preceding pointing gestures. Again both imperative and declarative pointing gestures are observed.

One final observation is that there appears to be a pivotal point for Michael at around 44 months. From this age there is a gradual increase in communication rate, and synchronised gesture-speech combinations increasingly diverge from gesture alone utterances. Coinciding with this is the recording of the first supplementary gesture-speech combination. Additionally deictic gestures change from predominantly requests and protests to pointing gestures, and the first declarative function is recorded.

## 6.3 Comparing environments

Having considered both Explorers and the home environment as fully as possible, a comparison between the two will now be drawn.

### 6.3.1 Communicating

Generally it appears that the participants have higher communication rates at home than at Explorers. This is true for James, Lee and Michael but not for Nathan. The effect in some cases is quite subtle: for James his communication rate is around 2 per minute at Explorers and 3 per minute at home. For Lee the difference is slightly larger, an increase from 1 per minute at Explorers to 3 per minute at home. Unfortunately home data collection ended at 44 months of age, the point at which he began to increase communications at Explorers. For Michael the difference is considerably bigger: a communication rate of 2-4 per minute at Explorers compared with 4-7 per minute at home. In comparison to the other participants the communication rate for Nathan did not increase. At Explorers his rate was found to be around 4 per minute, at home the rate was more variable, between 2 and 6 communications per minute.

Turning to the level of gesture in the participants' communication, it seems that the environment does not influence the proportion of gestural communication, with the proviso that the levels are more consistent at home. James is a case in point. At Explorers his gestural communication oscillates between 20 and 60% of his total communication. At home gestural levels remain steadier between 20 and 40%. Nathan is slightly more consistent at home but his gestural level in both environments is about 30% of total communication.

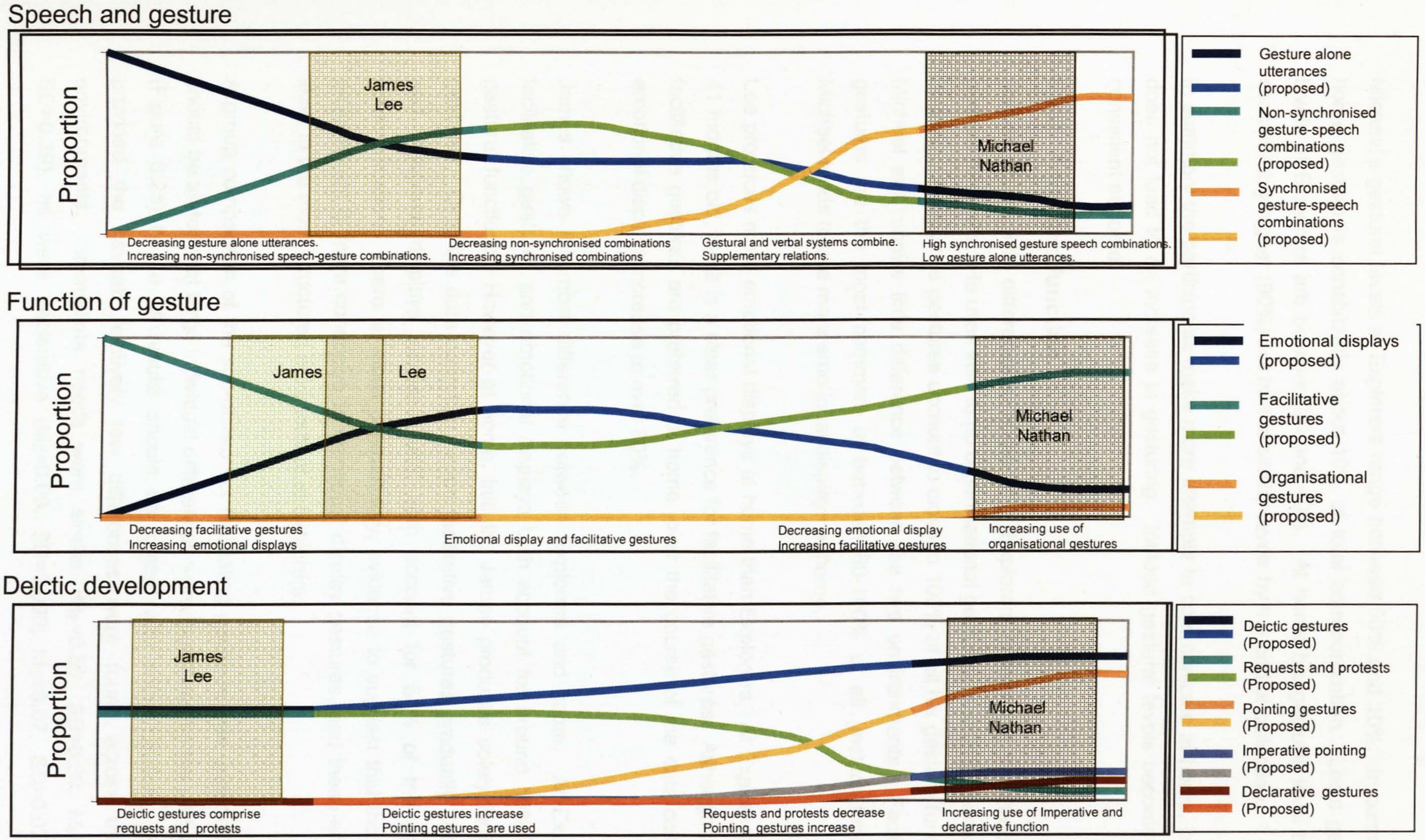



**Figure 6.24: developmental trajectories at Home**

.NB: Visual representation of developmental trajectories, plotted as proportional use of gestures over time.
Shaded boxes represent each participant's development during the data collection.

Michael's gestural levels at Explorers range between 50% and 10%. In contrast at home gesture is consistently about 10% of total communication. Lee's gestural levels at Explorers are between 20 and 40%. At home his gestural level begins considerably higher (90%) but falls to similar levels by the end of collection.

In summary the participants make more attempts to communicate at home, but this does not lead to an increase in gesturing. Instead gestural levels become more consistent at home.

### 6.3.2 Form and function

Nathan shows little difference at home or at Explorers in terms of the three main gesture functions. He uses little to no organisational gestures, and limited emotional displays. Facilitative gestures account to close to 100% of all his gesture functions. Michael also shows little difference between the two environments. Facilitative gestures are the most common, at between 80-100% of all gesture functions. Michael tends to use more emotional displays at home.

Lee produces more emotional displays at home than Explorers. At Explorers, from 41 months old, there is a clear preference for facilitative gestures. Although initially facilitative gestures are preferred at home, over the course of the data collection emotional displays increase to over 80%.

James shows the most difference between Explorers and home. At Explorers facilitative gestures and emotional displays both account for around 50% of the gestural functions. However at home, initially, James produces solely facilitative gestures. Over the data collection period facilitative gestures gradually decrease and emotional displays increase, until both account for 50% of the gestural communication. There is, albeit contradictory, evidence to suggest that the home environment is more conducive to emotional display gestures, and these are less likely in the more structured environment at Explorers.

A group comparison of the sub-division of facilitating gestures was undertaken. It should be stated that large individual differences were found across the participants (Figure 6.25) hence all results should be treated with some caution. Having provided the caveat, relatively few differences were found across the two environments. Immediate needs were similar ($M_E$=0.56, SD=0.39; $M_H$=0.50, SD=0.39), as were declarative ($M_E$=0.09, SD=0.090; $M_H$=0.07, SD=0.07) and questions and answers ($M_E$=0.22, SD=0.19; $M_H$=0.22, SD=0.23). Differences were found in social gestures ($M_E$=0.11, SD=0.15; $M_H$=0.04, SD=0.05) and commenting gestures ($M_E$=0.02, SD=0.04; $M_H$=0.17, SD=0.21). It may be that the group emphasis at Explorers, and the singing of more songs, has led to the increase in social gestures. The increase of commenting gestures at home is probably due to the extensive use which Theo makes of this type of gesture.

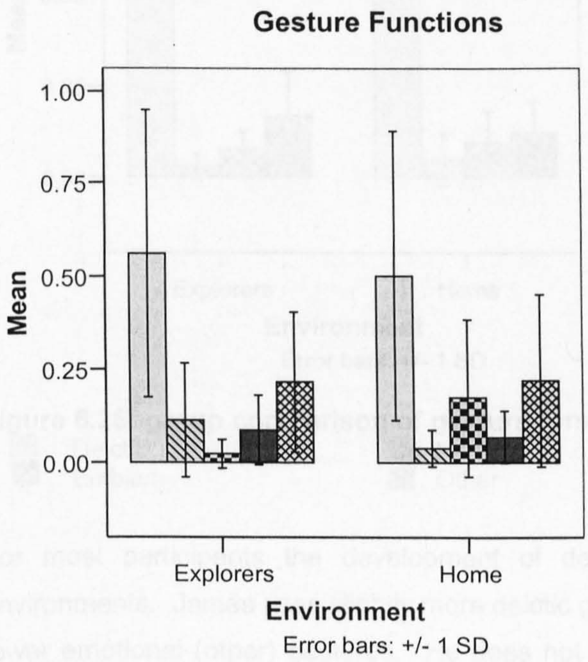



**Figure 6.25: Group comparison of the sub-division of facilitative gestures**

Immediate needs
social
Commenting
declarative
Questions and answers

In a similar comparison of the form of gesture, much less variation was found (Figure 6.26). Deictic gestures dominate in both environments ($M_E$=0.73, SD=0.13; $M_H$=0.73, SD=0.12). Emblems are infrequent, although at similar levels in each environment ($M_E$=0.08, SD=0.05; $M_H$=0.10, SD=0.09), but iconic gestures are similarly rare ($M_E$=0.03, SD=0.04; $M_H$=0.05, SD=0.07). Gestures coded as "other", generally corresponding to emotional displays are relatively frequent ($M_E$=0.17, SD=0.12; $M_H$=0.12, SD=0.09). Variation within the group is large on all measures with the exception of the use of deictic gestures. This may indicate individual difference, but it corresponds to calculations based on small numbers of gesture and may contain inaccuracies resulting from a small sample size.

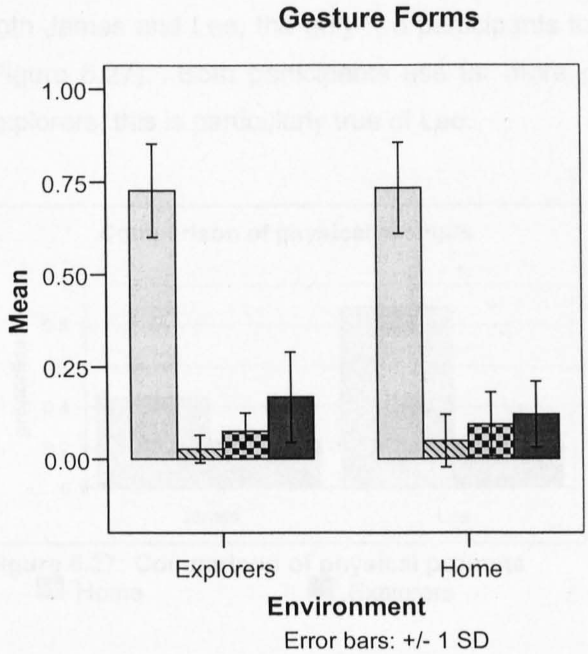



**Figure 6.26: group comparison of gesture form**



For most participants the development of deictic gestures is similar in both environments. James uses slightly more deictic gestures at home and consequently fewer emotional (other) gestures. He does not use pointing gestures and thus is restricted to requests and protests. Lee does not use pointing gestures, data collection at home finishing when he begins to do so at Explorers. Lee shows a remarkable consistent balance of gestural forms across environments.

Nathan's profile in both environments is the same. Deictic gestures account for over 80% of his gestural communication, pointing gestures outnumber requests and protests. Michael uses more iconics (e.g. TRAIN WHISTLE) and emblems at home than at Explorers, but deictic gestures are similar in both environments. Initially the majority of deictic gestures are requests and protests. In both environments pointing gestures increased, and become the preferred option at home.

Murray uses more iconic gestures at home, probably as a result of the action songs recorded. He uses fewer "other" gestures with his mother than during therapy. Theo is fairly consistent in the forms of gesture in both environments.

There is a large difference in the use of physical prompts across environment for both James and Lee, the only two participants to use this gesture form extensively (Figure 6.27). Both participants use far more physical prompts at home than at Explorers, this is particularly true of Lee.

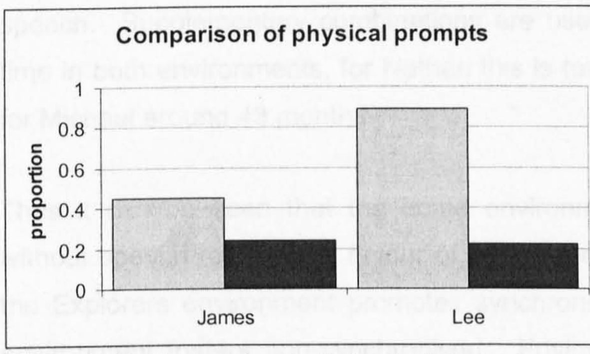



**Figure 6.27: Comparison of physical prompts**

Examining the imperative and declarative functions of pointing gestures no differences can be traced between the two environments for either Nathan or Michael. Therefore in general it seems that deictic development is unaffected by environment.

### 6.3.3 Speech and gesture

The differentiation between the two groups of participants at home is evident in speech and gesture in both environments. James and Lee reduce the amount of gesture without speech to a greater extent at home than at Explorers. For James gesture alone falls from 80 to 60% at Explorers, but from 100 to 40% at home. Similarly Lee's use of gesture alone falls from 100 to 40% at Explorers, but from 100 to 10% at home. Michael and Nathan's use of gesture alone communications is already restricted, and remains at relatively constant levels at home and at Explorers. This is around 20-40% in both environments.

Turning now to non-synchronised cross-modal combinations the divide between Lee and James on one hand and Nathan and Michael on the other remains valid. James and Lee increase their gestural combinations more at home then they do at Explorers. Nathan and Michael do not increase the number of non-synchronised combinations in either environment, non-synchronised combinations count for less than 20% of gestural communication.

Neither James nor Lee produce any synchronised cross-modal combinations at home. However both do at Explorers, with synchronised combinations accounting for around 20% of their gestural communication. They do not produce any supplementary or disambiguating combinations in either environment. Michael and Nathan use synchronised combinations more frequently than gesture without speech. Supplementary combinations are used by both, and appear at a similar time in both environments, for Nathan this is towards the end of 28 months of age, for Michael around 43 months.

Thus it can be seen that the home environment is more conducive to gesture without speech reducing in favour of cross-modal combinations. Yet it seems that the Explorers environment promotes synchronised combinations, whilst the home environment fosters non-synchronised. Environment does not affect participants who have established synchronised combinations. The appearance of supplementary gestures occurs almost simultaneously in both environments.

### 6.3.4 Discussion

The two environments, Explorers and home, were compared to identify any differences arising from the change in environment. Comparisons were made in terms of communication, development of gesture and speech, and the form and function of gesture.

There was a trend for the participants to make more communicative acts at home than at Explorers. For some participants the discrepancy was small, for others quite large. However the proportion of gesture used in the communication did not vary with environment, other than being more consistent at home. It is likely that the choice of activity and the context within which it is situated will be more limited at home, perhaps resulting in the more consistent levels of gesture found. This will be expanded on in Chapter 8. It is not clear why the communication rate increases at home. This may be partly due to the informal environment, the security of a familiar place. It may also be partly attributable to the nature of the data collected, as parent and child are not competing with other children or staff members, or time pressure, All data collected at home was one on one, this varied occasionally at Explorers. Again this will be considered in depth in Chapter 8.

There was considerable difference found between environments in the use of non-synchronised cross-modal combinations, specifically pre-integration. At Explorers gesture used without speech declined as temporal synchronisation improved. At home the decline in gesture without speech was accompanied by a rise in non-synchronised combinations, prior to temporal synchronicity. It seems that the participants are willing to combine gesture and speech more loosely in the more informal environment at home. A qualitative analysis is needed to precisely identify this phenomena and isolate possible contributing factors. Post integration there is little difference between the environments, as both a characterised by large numbers of reinforcing, synchronised cross-modal combinations and limited use of gesture without speech and non-synchronised supplementary or disambiguating combinations.

In terms of the function of gesture both environments are similar in the almost non-existent use of the organisational function. This appears to be developmentally and cognitively too demanding to be used with dexterity by the participants. The most use of organisational function is made by Murray and is likely to be a result of the Babysign (FINISH) that he has been explicitly taught. It should also be remembered that much more time in an interaction is devoted to the ongoing task (facilitative function) than in negotiation of tasks. This imbalance perhaps contributes to the domination of facilitative gestures in the Explorers environment. A different pattern is found at home, where initially dominant facilitative gestures appear to give way to emotional displays, before once again becoming the dominant gestural function. It is not clear why this should be the case. It may be a genuine effect resulting from the more informal home environment, or may resulting from the context of the interaction undertaken in each session. A qualitative analysis (Chapter 8) may help to decide between these options.

There is little difference in the form of gesture between the two environments. Deictic gestures are the most prevalent in both, but most other forms of gesture are slightly increased at home compared to Explorers. This is most notable in the manipulation of another's hand. Despite the increase in emotional displays at home, "other" gestures (often corresponding to this function) decrease. This may be because emotion is displayed via conventional means at home (such as clapping when excited) or that unusual gestural actions are being used communicatively at Explorers but not with the same frequency at home. If the first supposition is true this should lead to an increase in emblem and iconic use. This increase is slight, but is confirmed in the home environment, to a greater degree for iconic gestures. Further corroboration comes from the fact that more of the iconic gestures are spontaneous, as opposed to imitated, at home. The second explanation (that unusual actions are used communicatively at Explorers) cannot be confirmed through this analysis so far.

Taken overall it seems that the home environment is epitomised by behaviours which are associated with an early developmental stage of language and gesture. These include increased levels of non-synchronised cross-modal combinations, fewer supplementary and disambiguating relations, increased levels of emotional display gestures, increased levels of manipulation of another's hand, and fewer instances of declarative pointing (from participants as a group). Yet whilst the Explorers environment yields more complex gesture use, overall communicative levels are reduced.

It is clear that the environment does affect gesture use by the participants. Possible contributing factors have been suggested and these will be examined in more depth in Chapter 8. However it is also possible that staff and parents communicate with gesture in different ways, which will also effect the production of the participants. Therefore the gestural input will be the focus of the following chapter.

# Chapter 7

# GESTURAL CHANGES IN CHILD-DIRECTED COMMUNICTION

Currently there is only limited knowledge about the gestural system in child directed speech. This chapter explores these issues in speech directed to children with autism, in professional and parental interaction. This chapter will consider the nature of child directed gestures in each environment, beginning with the Explorers programme. The gestural levels in communication will be followed by gesture's relationship to speech and concluding with a full description of the gestural repertoire. Finally both environments will be compared on a group and individual basis.

## 7.1 The Explorers environment

The Explorers programme is delivered in a diagnostic centre for children attached to the local children's hospital. The department employs eight staff members of which four or five are present at each Explorers session. The programme is staffed on a rotation basis around additional duties of child assessment, provision of other early intervention programmes, and home, school and playschool visits. In all ten adults were recorded during the course of the study: Jackie, the most senior, manages the Explorers programme. There are five support teachers (Joanne, Kiera, Louise, Diane and Zoe) working either full or part time. Becky is the speech and language therapist based at the centre. Katy is a language assistant. Lucy is a speech and language student, working at the centre through the summer, Jane a visiting speech and language therapist. Table 7.1 shows the total number of gestures in the input during each session by participant.

Cohort 1:

| Child | Explorers Session | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| James | | 28 | 53 | 35 | 18 | 10 | 13 | 43 | 20 | | 13 | 16 | 37 | |
| Nathan | | | 133 | 103 | 74 | 112 | 46 | 5 | 152 | 137 | 29 | 116 | 32 | 50 |
| Toby | 42 | | 95 | | 89 | 69 | 51 | 68 | 83 | 125 | 11 | | | |
| Zaara | | | | | | | | | | | 17 | 75 | 42 | 40 |

Cohort 2:

| Child | Explorers Session | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Lee | 19 | 30 | 33 | 24 | 46 | 51 | 45 | | 62 | 26 | 40 | 63 |
| Michael | 20 | | | 62 | 82 | 67 | 43 | 16 | 69 | 61 | 31 | |
| Murray | 66 | | | | | | | | | | | |
| Theo | | 25 | | 54 | 65 | 86 | 74 | | 119 | | | |

| Child | ABA session (occurring between numbered Explorers sessions) | | | | | |
|---|---|---|---|---|---|---|
| | 16-17 | 17-18 | 20-21 | 21-22 | 22-23 | 23-24 |
| Murray | 49 | 54 | 50 | 31 | 48 | 39 |

**Table 7.1: staff gestures by session for each participant**
NB: grey cells indicate sessions excluded from analysis.

### 7.1.1 Communicating

This section will take an overview of child-directed communication, both verbal and gestural. Communicative acts will be considered first, followed by gestural levels in child-directed communication.

#### 7.1.1.1 Communicative acts

The staff's communication rate was calculated by dividing the number of utterances by the duration of the session, thus allowing for comparison across sessions and participants. It was common for each session to have three or more staff members contributing to the total communication rate. The individual differences between staff members were not considered.

Figure 7.1 shows the communication rate to each participant. As a group the communication varies from 2 to 20 utterances a minute. For the majority of the participants the communication rate falls between 5 and 15 utterances a minute, and appears dependent on the context of the interaction, not the developmental ability of the child.

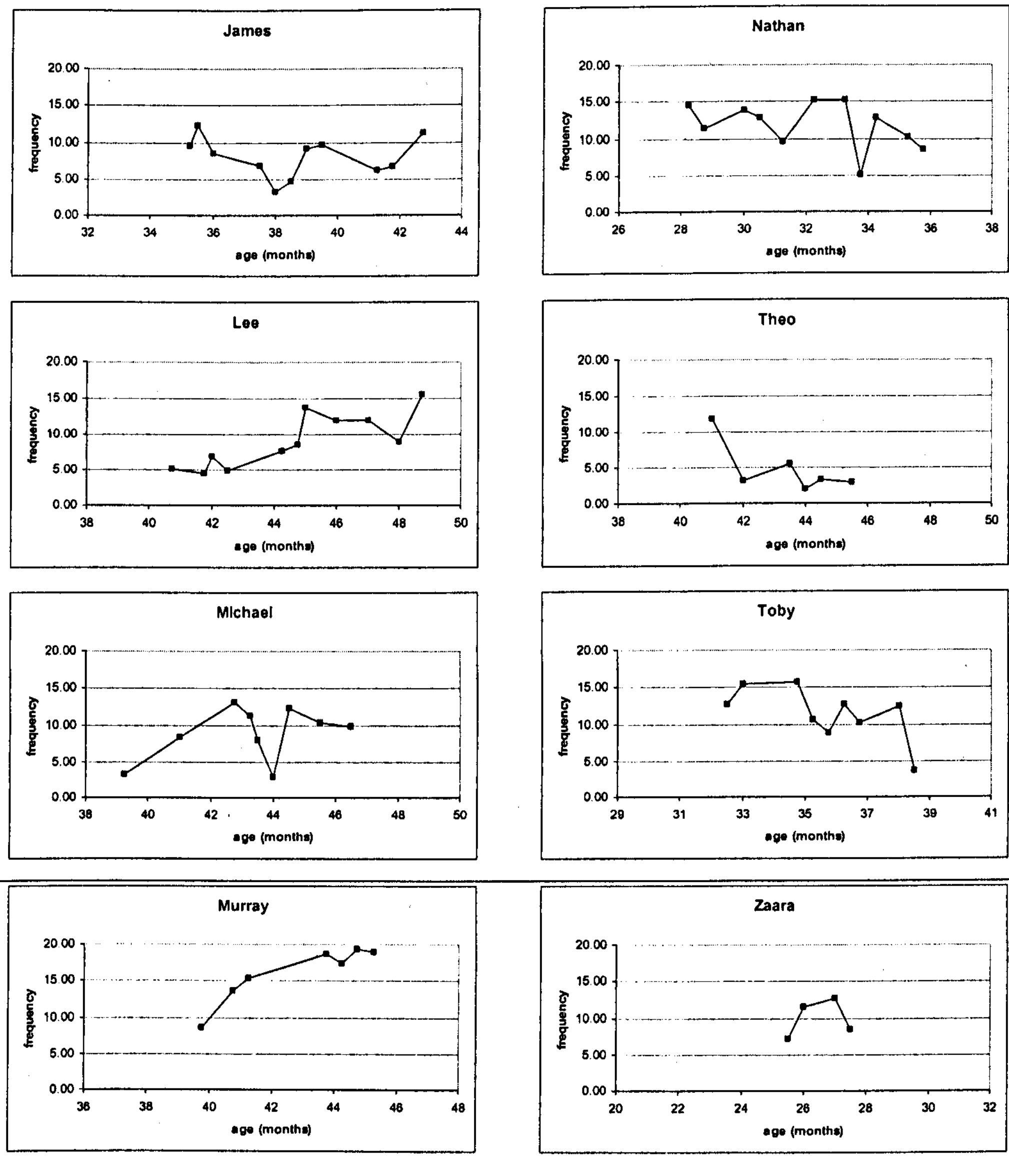



**Figure 7.1: communicative acts at Explorers**

It is noticeable that there is a large rise in communication rate for Lee, Michael and Murray. For the first two this rise in communication coincides with changes in their gestural systems, as reported in Chapter 5. From 41 months old onwards Murray changed from group to individual therapy, perhaps partly explaining the rise in communication rate. Frequency of communication to the other participants remains steady. For Nathan and Toby this is between 10-15 utterances a minute. The communication rate to Zaara is approximately 10 utterances per minute, and is lower for James at 5 per minute. On first glance it appears that the communication rate for Theo falls over the course of the programme. After the first session the communication rate remains steady at less than 5 utterances a minute. It may be that the first session is an anomaly, leading to the appearance of a fall in communication.

To summarise, the communication input the participants receive remains steady between 5 to 15 communications per minute. The exception is Theo who receives less than 5 consistently. There is a rise in communication rate for Lee, Michael and Murray, in the first two cases this corresponds to large changes in the participants' communication, for Murray this may be partly attributable to a change in therapy provision.

#### 7.1.1.2 Gestural communication by staff

At Explorers more than one staff member will be interacting with the participants in each session. In order to isolate any changes over time it is necessary to ignore the individual staff members and use a composite score. This combines all members of staff into one, in effect creating a virtual staff member. For this to be accurate, it is based on the assumption that each staff member uses gesture in similar ways. This is reasonable as each member of staff receives the same training, and works closely alongside their colleagues. It is important to verify before continuing, as the gestural communication is used in the calculation of other scores, and any underlying differences in the staff members will be reflected in the results.

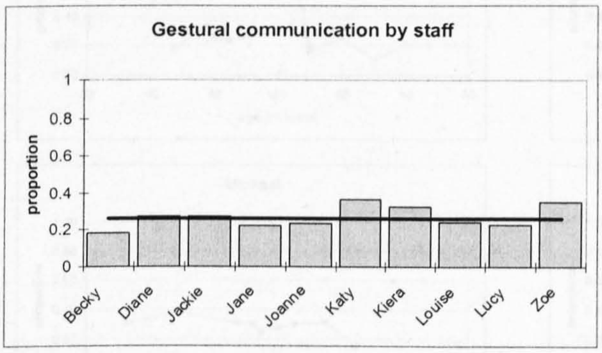



**Figure 7.2: gestural communication by staff**
NB: grey bars represent mean gestural communication for individual staff members, black line represents the group mean

The proportion of gestural communication used by each staff member to each participant, irrespective of session was calculated. These scores were used to calculate a gestural mean for each staff member (shown in Figure 7.2) which were then compared to the group mean (M=0.26, SD=0.08). Only Katy and Zoe differed from the group mean by more than one standard deviation. The individual scores reveal that Katy consistently uses more gesture in comparison to other staff members, whereas Zoe uses large amounts of gesture in a single interaction with

Toby, thus increasing her overall scores. This interaction occurred when Toby was 38 months old and should be remembered in the interpretation of results. Qualitatively Katy frequently uses Makaton to support her verbal communication, thus explaining the increased gestural levels. The effects are likely to be diffuse and therefore, with a few minor caveats, it seems the assumption that staff members are similar in their proportional use of gestural communication is valid.

#### 7.1.1.3 Gestural communication by session

A measure of gestural communication was obtained by identifying communicative acts containing gesture and expressing these as a proportion of all communicative acts. Multiple staff members contribute to each session.

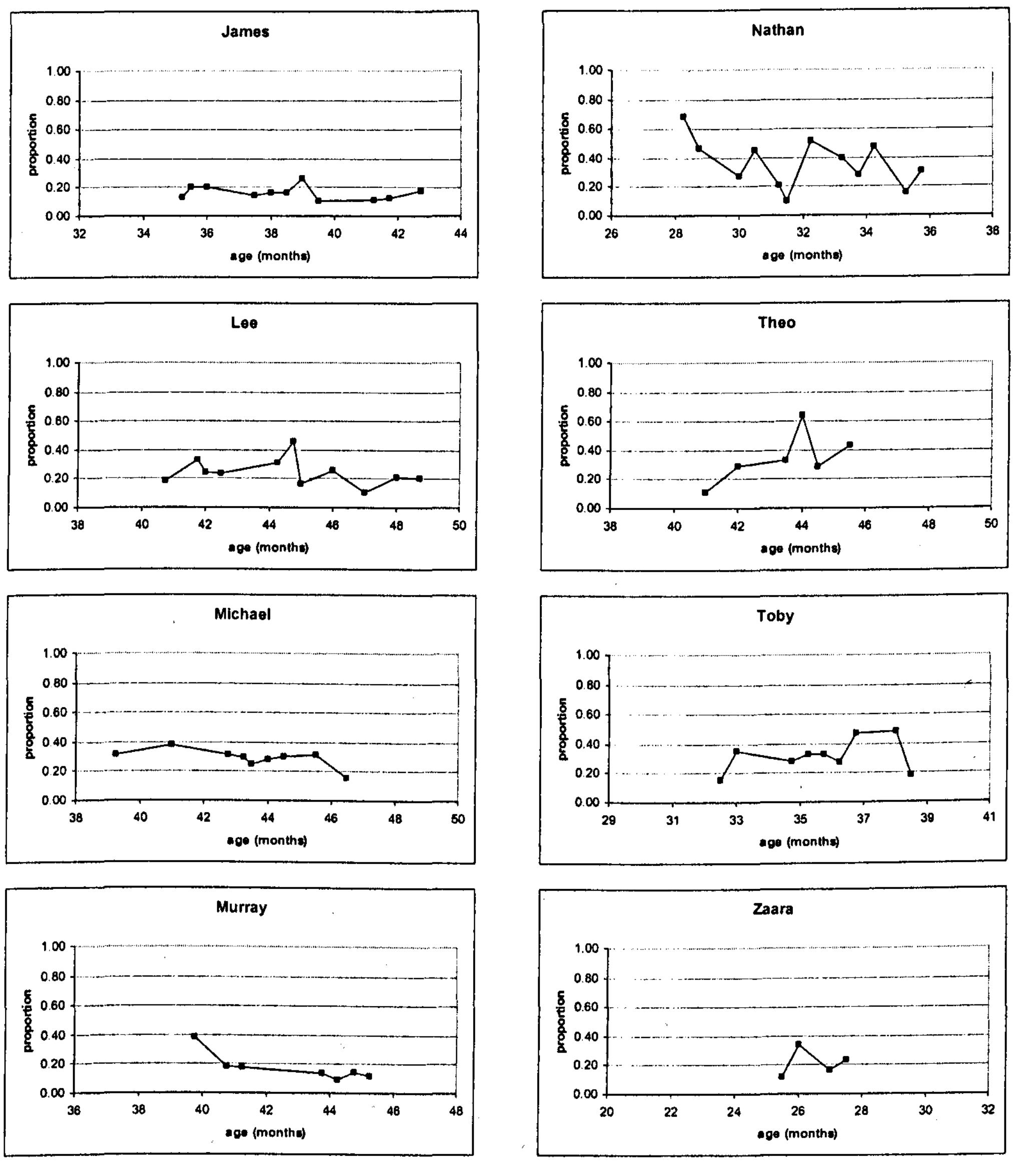



**Figure 7.3: staff gestural communication by participant**
NB: gestural communication expressed as a proportion of all communicative acts

The levels of gestural input remain relatively constant across all the participants at approximately 20-40% of communication (Figure 7.3). There are some exceptions. For James and Murray gestural levels are consistently less than 20%. It is not clear why this may be the case for James, however the gesture levels fall for Murray when he changes to the ABA programme at home. This is delivered by a single therapist, who appears to favour verbal communication, as shown in the rise in communication rate, but the fall in gestural levels.

Though Nathan's gestural input remains steady, it ranges from 20 to 50% of all input and is comparatively high. The gestural input for Theo appears to increase from 10% to just over 40%. It seems that whilst Theo is receiving less input overall as measured by communication rate, the amount of gesture is increasing as he progresses through the intervention.

To conclude the developmental ability of the child does not affect the amount of gestural input provided by staff members, which remains constant at 20-40% of all communication.

#### 7.1.1.4 Summary

In the majority of the interactions, staff members used between 5 and 15 utterances a minute. This seemed dependent on the context of the interaction rather than the development of the child. Gestural levels remained consistent at 20-40% of all communication. Individual variation amongst staff members was minor, causing no impediment to combining staff input into a "virtual" staff member.

### 7.1.2 Form and function

The main gesture forms will be presented, followed by a discussion of gesture function. The facilitative function will be examined in more detail following the general discussion of gesture function.

#### 7.1.2.1 Form of gesture

The majority of gestures used by the staff in child directed communication are deictic. Exact levels vary; for Lee, Michael, Nathan, Theo and Toby deictic gestures account for 40-80% of the input, for Zaara this increases to 60-80% and increases yet again for Murray (60-100%) when he commences the ABA programme. Makaton, emblems and iconic gestures account for around 20% or below for Lee, Theo (with the exception of one session), Michael, Murray and Zaara. Increasing use of emblems and Makaton gestures is evident for Nathan and Toby (20-40%) compared to iconic gesture (around 10%).

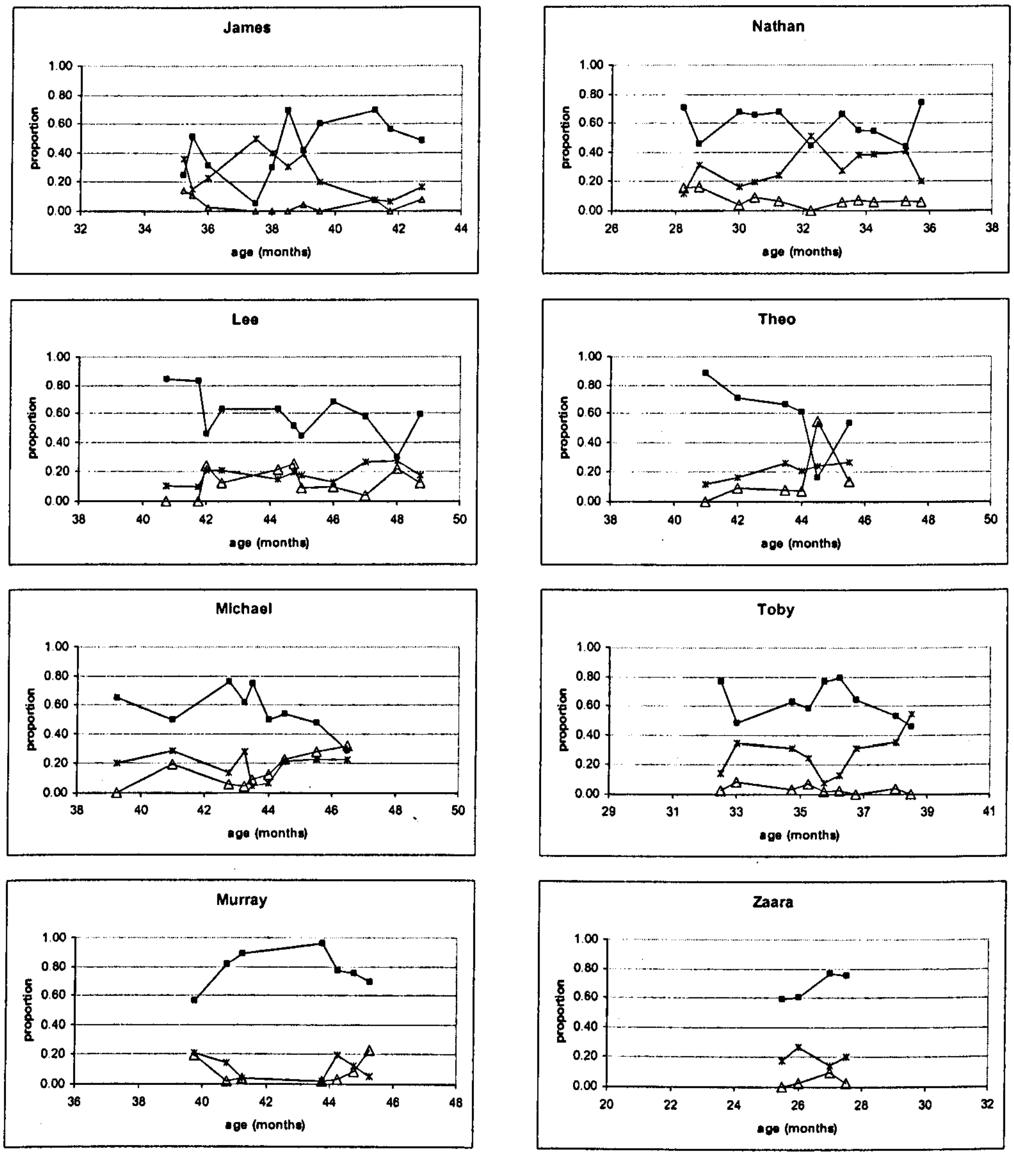



**Figure 7.4: Gesture form at Explorers**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Deictic
△ Iconic
✳ Emblem and Makaton

The input for James does not conform to this pattern. Iconic gestures are seldom used. Prior to the age of 39 months deictic gestures, emblems and Makaton are used in approximately similar amounts. There is a marked change after 39 months when deictic gestures predominate (around 60%) and emblems and Makaton decline to less than 20% of the input. During recording it was observed that the staff members used more physical prompts with James, compared to the other children.

Such instances were too rare in the data to be analysed longitudinally, yet it may be that increased use of this gesture without speech has led to the different profile observed for the interactions with James in terms of the relationship of speech and gesture (see Section 7.1.3.1). This hypothesis was tested by comparing the overall proportion of physical prompts without speech across all sessions for each participant (Figure 7.5).

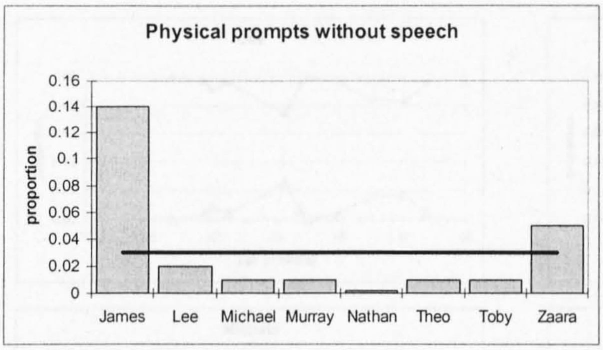



**Figure 7.5: physical prompts without speech**
NB: all gesture expressed as a proportion of communicative acts containing gesture
Grey bars represent proportion of physical prompts in the input for each participant.
The black line represents the group mean.

It can be clearly seen that the staff do use considerably more physical prompts without speech than they do for the other participants. Thus it seems that the higher levels of gesture used without speech may be accounted for by the corresponding increase in physical prompts.

In conclusion, deictic gestures are most commonly used in communication with the participants. Iconic gestures are rarely used, and Makaton signs and emblems are slightly more prevalent than iconics.

### 7.1.2.2 Functions

The staff members use two main gesture functions: gestures facilitating the current activity, and organisational gestures which negotiate the change of activities, or regulate behaviour. Both functions were identified and expressed as a proportion of all gestural input, by session for each child, with contributions from multiple staff members. As with previous measures a clearly identifiable pattern emerges. Regardless of the child's current development, facilitating gestures provide the majority of the input, accounting for over 80% of the gestures used, and organisational gestures for under 20% (Figure 7.6).

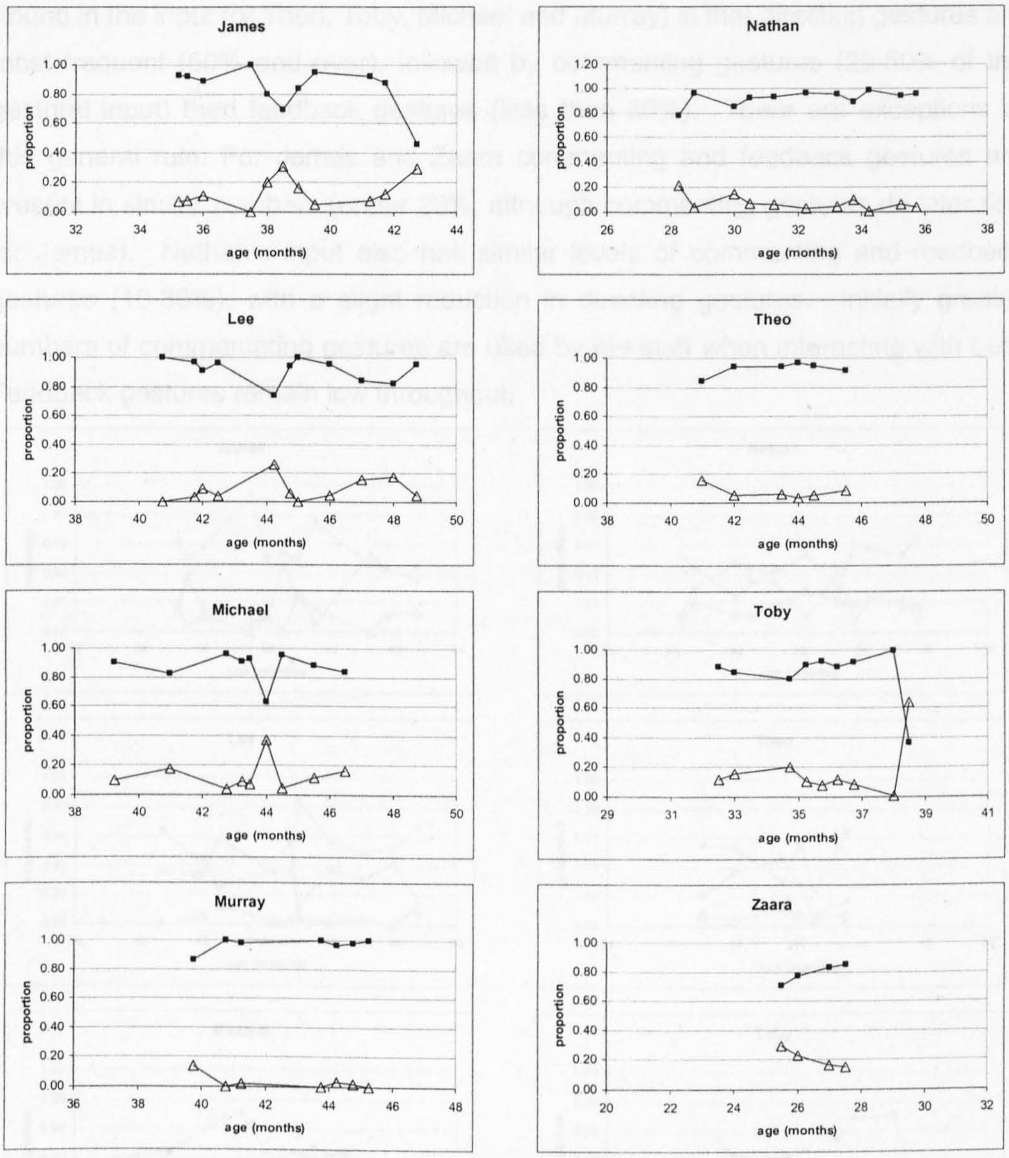



**Figure 7.6: facilitating and organisational function at Explorers**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Facilitative
△ Organisational

### 7.1.2.3 A closer look at facilitative gestures

Facilitative gestures are further divided into gestures giving direction, feedback, or commenting on the current activity. These are shown in Figure 7.7 and are expressed as a proportion of all gestural input, calculated per session for each child, with multiple staff members contributing.

For all the participants the majority of gestures are directing. The distribution of feedback and commenting gestures is not so clear cut. The most common pattern (found in the input for Theo, Toby, Michael and Murray) is that directing gestures are most frequent (50% and over), followed by commenting gestures (20-50% of the gestural input) then feedback gestures (less than 20%). There are exceptions to this general rule. For James and Zaara commenting and feedback gestures are present in similar numbers (under 20%, although commenting gestures do later rise for James). Nathan's input also has similar levels of commenting and feedback gestures (10-30%), with a slight reduction in directing gestures. Initially greater numbers of commentating gestures are used by the staff when interacting with Lee. Feedback gestures remain low throughout.

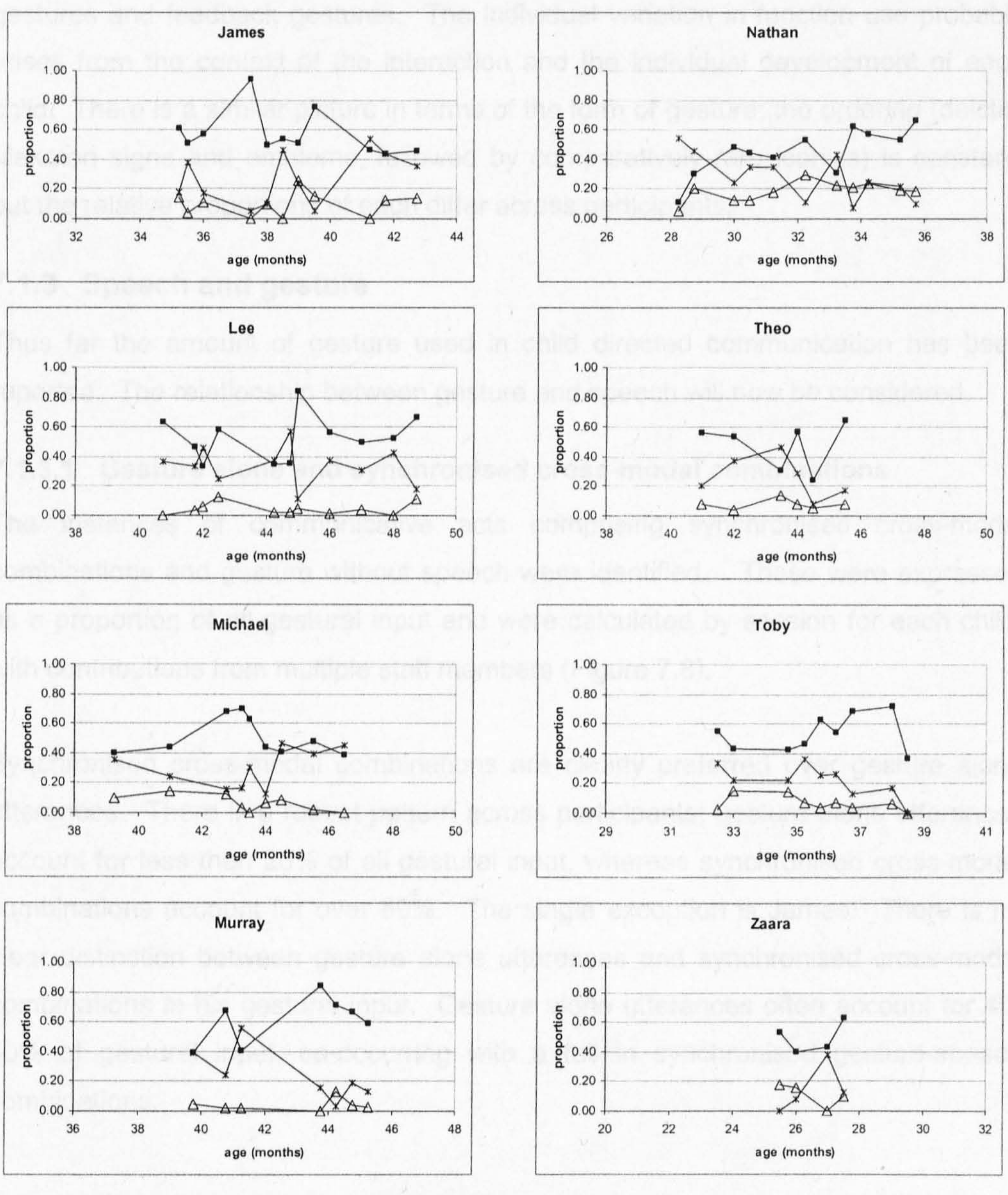



**Figure 7.7: facilitative functions at Explorers**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Directing △ Feedback ✳ Commenting

Considerably more individual variation is present in this measure, yet directing gestures dominate across all participants. Feedback gestures are used the least, with commentating gestures being intermediate between the two.

#### 7.1.2.4 Summary

The majority of child directed gesture has a facilitative function (over 80%), only 20% of gestures are used to organise activities or regulate behaviour. The ordering of the different functions within facilitative gestures is constant across the participants, with directing gestures being most frequent, followed by commenting gestures and feedback gestures. The individual variation in function use probably arises from the context of the interaction and the individual development of each child. There is a similar picture in terms of the form of gesture; the ordering (deictic, Makaton signs and emblems, followed by comparatively rare iconics) is constant, but the relative proportions of each differ across participants.

### 7.1.3 Speech and gesture

Thus far the amount of gesture used in child directed communication has been reported. The relationship between gesture and speech will now be considered.

#### 7.1.3.1 Gesture alone and synchronised cross-modal combinations

The instances of communicative acts comprising synchronised cross-modal combinations and gesture without speech were identified. These were expressed as a proportion of all gestural input and were calculated by session for each child, with contributions from multiple staff members (Figure 7.8).

Synchronised cross-modal combinations are clearly preferred over gesture alone utterances. There is a robust pattern across participants; gesture alone utterances account for less than 20% of all gestural input, whereas synchronised cross-modal combinations account for over 80%. The single exception is James. There is no clear distinction between gesture alone utterances and synchronised cross-modal combinations in his gestural input. Gesture alone utterances often account for 40-60% of gestural input, co-occurring with a fall in synchronised gesture-speech combinations.

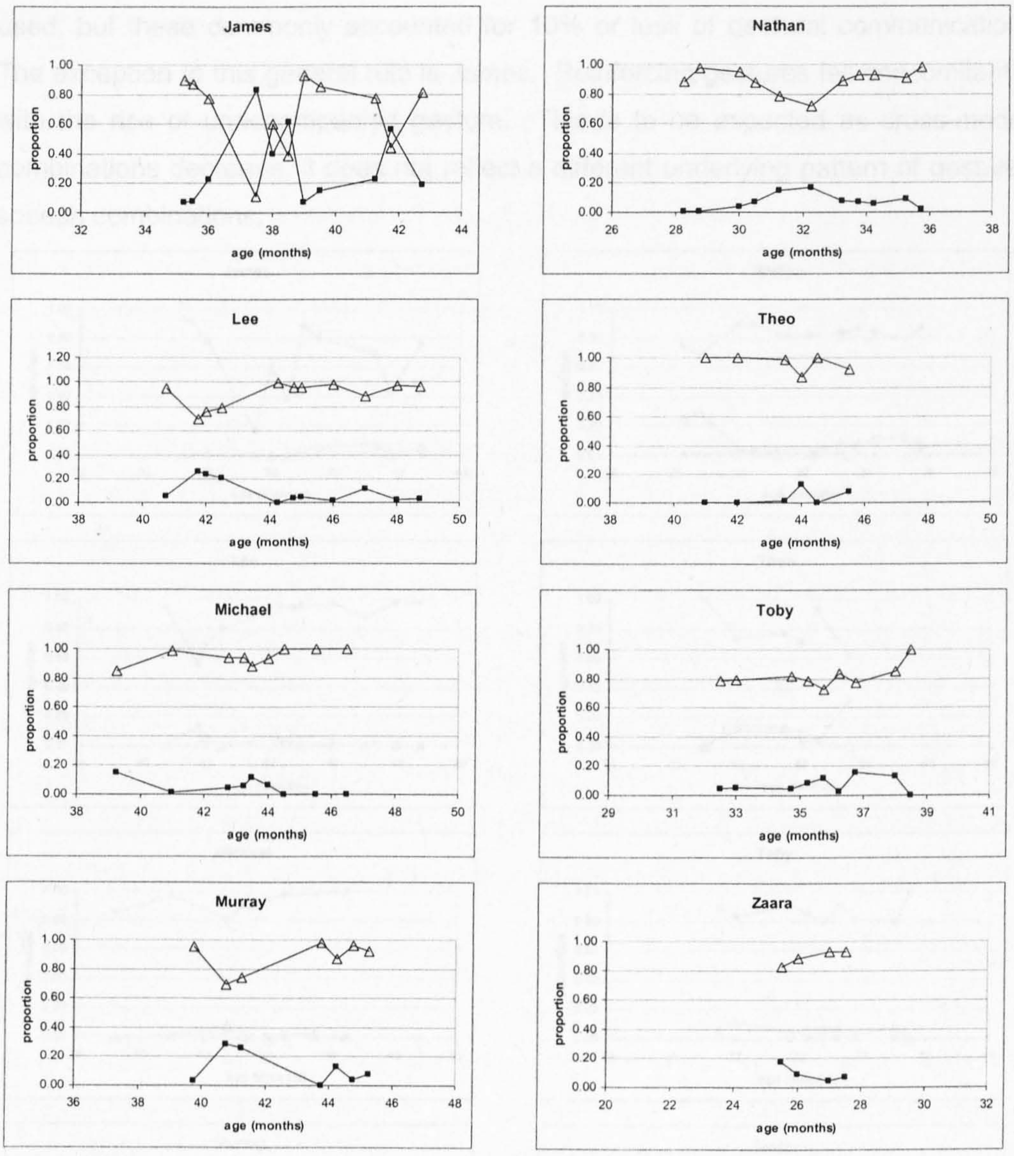



**Figure 7.8: synchronised cross-modal combinations and gesture without speech at Explorers**

NB: all gestures expressed as a proportion of communicative acts containing gesture

■ Gesture without speech

△ Synchronised cross-modal combinations

### 7.1.3.2 Reinforcing, supplementary and disambiguating cross-modal combinations

The cross-modal combinations were coded as reinforcing, supplementary or disambiguating combinations and were expressed as a proportion of all gestural communication. The results are presented by session for each child, with multiple staff members contributing. Little difference was found across participants (Figure 7.9). For most of the participants over 90% of the gestures were reinforcing gestures. Small amounts of supplementary and disambiguating gestures were used, but these commonly accounted for 10% or less of gestural communication. The exception to this general rule is James. Reinforcing gestures fell concomitantly with the rise of unaccompanied gesture. This is to be expected as cross-modal combinations decrease, it does not reflect a different underlying pattern of gesture-speech combinations.

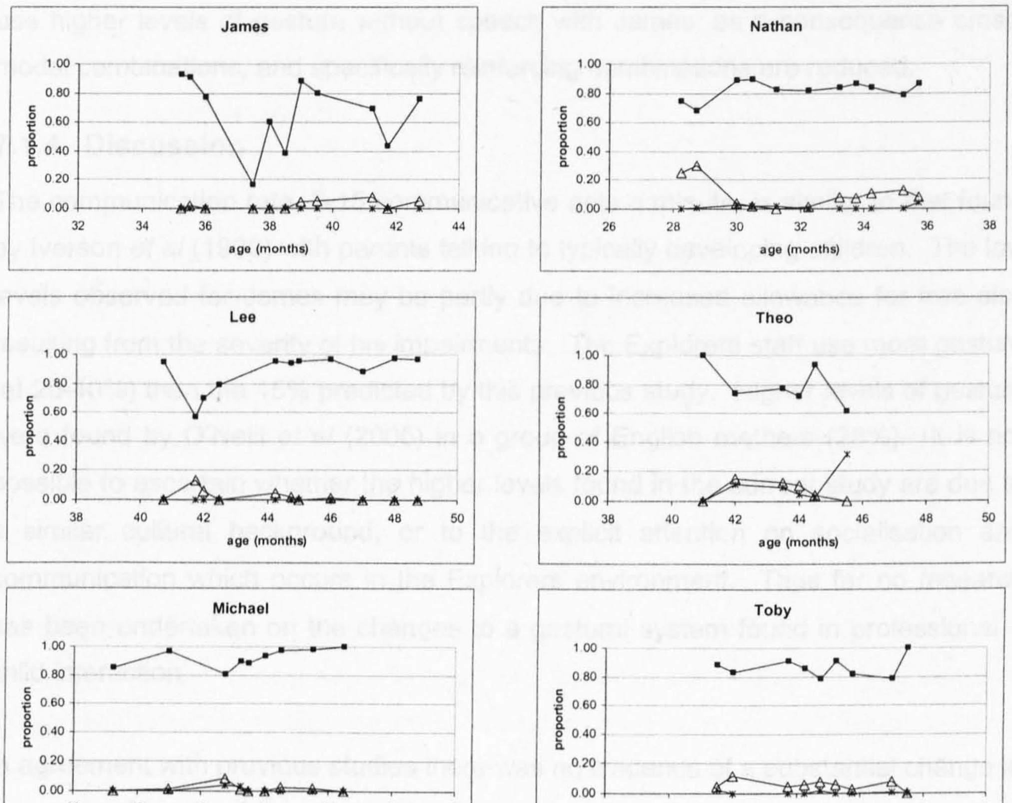



**Figure 7.9: reinforcing, disambiguating and supplementary relation at Explorers**
NB: all gestures expressed as a proportion of communicative acts containing gesture
■ Reinforcing
△ Supplementary
✳ Disambiguating

#### 7.1.3.3 Summary

There is a strong pattern of results in terms of gesture's relationship to speech. Synchronised gesture-speech combinations are preferred and account for 80% of all gesture use. Of these, over 90% are gestures used to reinforce speech, with the remaining 10% either supplementing or disambiguating speech. The staff members use higher levels of gesture without speech with James, as a consequence cross-modal combinations, and specifically reinforcing combinations are reduced.

### 7.1.4 Discussion

The communication rate, 5-15 communicative acts a minute, is similar to that found by Iverson *et al* (1999) with parents talking to typically developing children. The low levels observed for James may be partly due to increased allowance for free play resulting from the severity of his impairments. The Explorers staff use more gesture (at 20-40%) than the 15% predicted by this previous study. Higher levels of gesture were found by O'Neill *et al* (2005) in a group of English mothers (28%). It is not possible to ascertain whether the higher levels found in the current study are due to a similar cultural background, or to the explicit attention on socialisation and communication which occurs in the Explorers environment. Thus far no research has been undertaken on the changes to a gestural system found in professional – child interaction.

In agreement with previous studies there was no evidence of a substantial change in the gestural input relative to the development of the child. In the case of Lee and Michael there does appear to be a corresponding rise in the communication rate of staff to them whilst they are undergoing changes in their gestural systems. Further investigation is necessary to understand if these phenomena are linked and if yes, to determine the causal direction.

The preference for synchronised cross-modal combinations is a strong one. The current result, that gesture with speech accounts for 80% of the gestural input is conservative compared to previous studies. The discrepancy can be explained as previous studies make no distinction between synchronised and non-synchronised combinations. It is interesting that the input for James should have higher levels of gesture without speech, this was shown to be due to the increased amounts of physical prompts used without speech, possibly arising from the severity of his impairments compared to the other participants.

As predicted by previous studies reinforcing cross-modal combinations were found to be most common, with disambiguating and supplementary combinations less frequent. The difference between reinforcing combinations and the others was far greater than expected. Possible explanations may be that the presentation of communication across two simultaneous modalities may reduce comprehension difficulties arising from the communicative impairment associated with autism, or it may be a feature of professional-child interaction resulting from the emphasis on the role of clear communication.

No previous research exists on the functions of gesture in this context. It is clear that facilitative gestures account for 80% of gestural communication. Although the consistency of this result may be surprising, the opportunity for facilitative gestures is far higher, due to time spent on task rather than negotiation. Intuitively, facilitative gestures will dominate. The relative proportion of the different facilitative functions appears to fluctuate dependent on context, and those engaged in the interaction. For example, Nathan receives higher levels of feedback than the other children, possibly due to his constant seeking of reassurance.

The relative frequency of each gesture form agreed with previous research. Deictic gestures were the most prevalent, followed by emblems and Makaton gestures, and iconics were the most rare. As with the function of gesture the relative proportions of each are dependent on the interlocutors and the context of the interaction, thus resulting in individual variation.

In general these results are in line with previous findings. Gestures are most commonly found with speech, and the reinforcing relation is the most frequent of the cross-modal combinations. Deictic gestures are favoured over iconics and emblems. New knowledge has been gained about the function of gestures, the majority of which are facilitating gestures.

## 7.2 The Home environment

Each child was recorded fortnightly in the home interacting with a parent. The sessions lasted twenty minutes. In each case the participant was interacting one on one with their mother, except for Nathan's first recording were both parents were present. Table 7.2 shows the number of gestures in the parental input per session. Due to data collection difficulties Zaara and Toby were not recorded at home.

Cohort 1

| Participant | Recording week | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| James | 53 | 19 | | 47 | 63 | | 69 | 51 | | 63 | |
| Nathan | | 23 | 14 | | 8 | 6 | 7 | 12 | 7 | | 3 |

Cohort 2:

| Participant | Recording week | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Lee | 37 | 26 | 24 | 52 | | 10 | | | 30 | | | | | |
| Michael | 51 | 37 | 41 | | 35 | | 19 | | 27 | 86 | 44 | 11 | 74 | 18 |
| Murray | 20 | 75 | | | | 36 | | | | | | | | |
| Theo | | | | | | 23 | | 34 | | | | | | |

**Table 7.2: parental gestures by session for each participant**
NB: grey cells indicate sessions excluded from analysis

In the following sections Murray and Theo will not be discussed as the data is insufficient for the application of the microgentic method. Therefore the discussion of the home environment will be restricted to James, Lee, Michael and Nathan. As in the previous section, overall communication will be considered, followed by gesture and speech and lastly the form and function of gesture.

### 7.2.1 Communicating

The communication rate for each parent is calculated, followed by the proportion of gesture in each parents' communication to their child.

#### 7.2.1.1 Communicative acts

The rate of communication was calculated as the number of communicative acts per minute. The results are shown in Figure 7.10 below.

Both James's and Michael's mothers have a high level of communication, between 10 and 15 utterances a minute. The communicative acts for Michael remain constant, but those for James gradually increase. The opposite is true for Nathan; his father and mother combine to have a relatively high level of communication at 13 acts per minute in the first session, which slowly falls to approximately 5 utterances per minute. The communicative rate for Lee also falls, more rapidly but less far, from 15 acts per minute to 10.

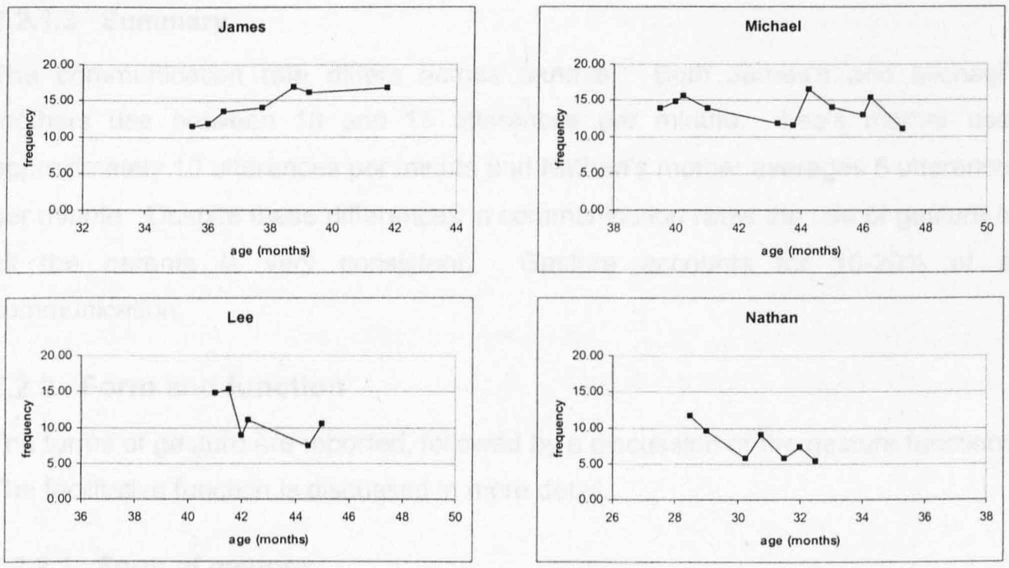



**Figure 7.10: communicative acts at home**

### 7.2.1.2 Gestural communication

The gestural communication for each parent is identical; gesture is used in 10-20% of all communication. This is consistent across sessions and participants as shown in Figure 7.11.

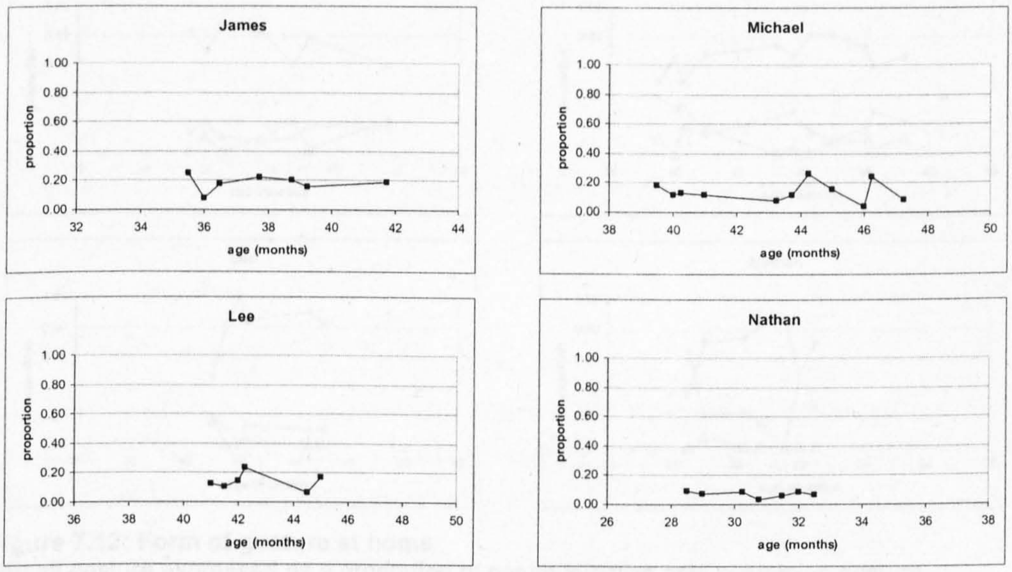



**Figure 7.11: gestural communication at home**
NB: all gesture expressed as a proportion of all communicative acts

#### 7.2.1.3 Summary

The communication rate differs across parents. Both James's and Michael's mothers use between 10 and 15 utterances per minute. Lee's mother uses approximately 10 utterances per minute and Nathan's mother averages 5 utterances per minute. Despite these differences in communication rates the use of gesture by all the parents is very consistent. Gesture accounts for 10-20% of all communication.

### 7.2.2 Form and function

The forms of gesture are reported, followed by a discussion of the gesture functions. The facilitative function is discussed in more detail.

#### 7.2.2.1 Form of gesture

Whilst deictic gestures form the majority of the input, individual variation does exist between the parents (Figure 7.12). Lee's mother uses the most deictic gestures at over 80% of all gestural communication. James's and Michael's mothers use between 60-80% deictic gestures. Nathan's mother has a slightly wider range between 50-80% of her gestural communication is deictic.

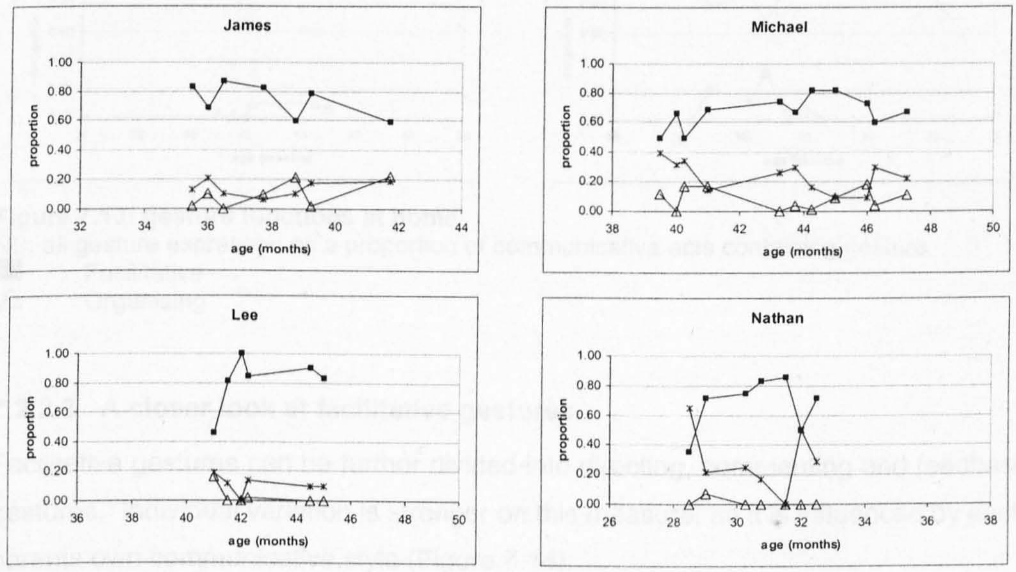



**Figure 7.12: Form of gesture at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Deictic
△ Iconic
✳ Emblem and Makaton

James's and Michael's mothers use iconic and emblematic gestures in approximately equal amounts (less than 20%). Michael's mother tends to use more emblems (up to 30%). Apart from the first session, Lee's mother uses no iconic gestures, but emblems account for 15% of all gestural communication. Nathan's mother uses no, or very few, iconic gestures but makes use of emblems ranging from 20-50% of gestural communication.

#### 7.2.2.2 Functions

The profiles for facilitating and organisational gestures are similar across all parents. Most gestures fall into the facilitative group (80% of all gestural communication). The remaining gestures are organisational. This pattern holds true for each parent and each session as shown in Figure 7.13 below.

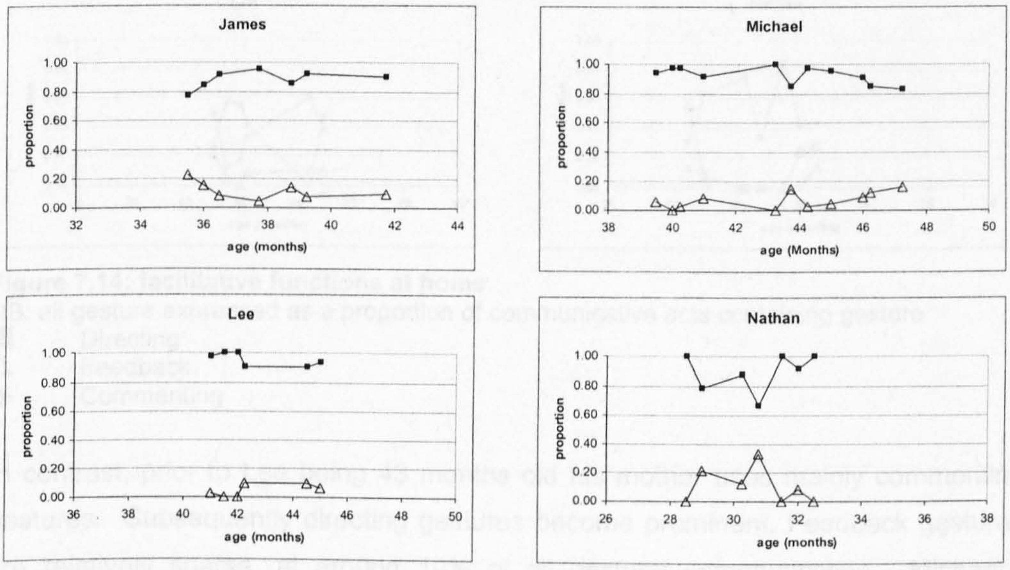



**Figure 7.13: gesture functions at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Facilitative
△ Organising

#### 7.2.2.3 A closer look at facilitative gestures

Facilitative gestures can be further divided into directing, commenting and feedback gestures. Individual variation is stronger on this measure, as it is influenced by each parents own communicative style (Figure 7.14).

James's mother uses directing gestures, increasing from 50 to 70% after the age of 38 months. Previous to this age commenting gestures accounted for 30 to 50% of the input, but subsequently fall to around 10% of all gestural communication. Feedback gestures are rarely used (less than 15% of the gestural input). For Nathan directing gestures account for 40 to 80% of his mother's gestural communication. Nathan's father tends to use more feedback gestures, as can be seen by the higher levels in the first session. Commenting gestures are rarely used, but increase after Nathan is 32 months old.

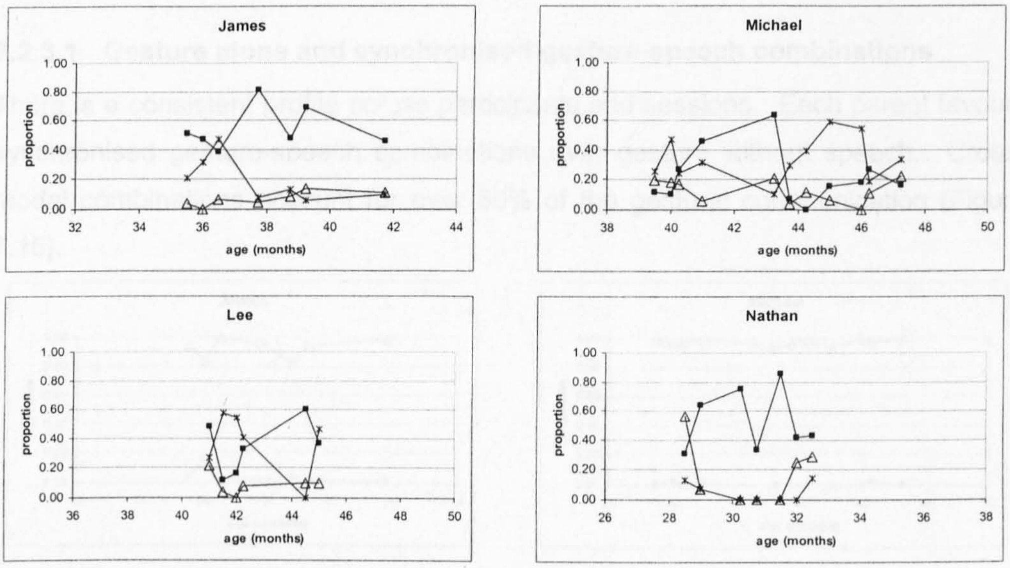



**Figure 7.14: facilitative functions at home**

NB: all gesture expressed as a proportion of communicative acts containing gesture

■ Directing
△ Feedback
✳ Commenting

In contrast, prior to Lee being 43 months old his mother uses mainly commenting gestures. Subsequently directing gestures become prominent. Feedback gestures are relatively sparse, at around 10% of all gestural communication. Michael's mother provides more feedback gestures, at 20% of all gestural communication. Initially commenting gestures are more frequent than directing gestures. Between Michael being 40 and 43 months directing gestures account for over half of all gestural communication, whilst commentating gestures are around 20%. At 44 months commentating gestures increase at the expense of directing gestures.

#### 7.2.2.4 Summary

There is a robust pattern of facilitative gestures forming over 80% of the gestural input, with organising gestures accounting for the remaining 20%. Within the facilitative gestures there is considerable individual variation across parents and no reliable pattern can be ascertained other then feedback gestures are used the least. Deictic gestures are extensively used in the parental input. Use of iconics is rare, and emblems are usually less than 20% of the input.

### 7.2.3 Speech and gesture

Attention turns to the nature of gesture and speech integration, in terms of cross-modal combinations, and the use of gestures without speech.

#### 7.2.3.1 Gesture alone and synchronised gesture-speech combinations

There is a consistent profile across participants and sessions. Each parent favours synchronised gesture-speech combinations over gesture without speech. Cross-modal combinations account for over 80% of the gestural communication (Figure 7.15).

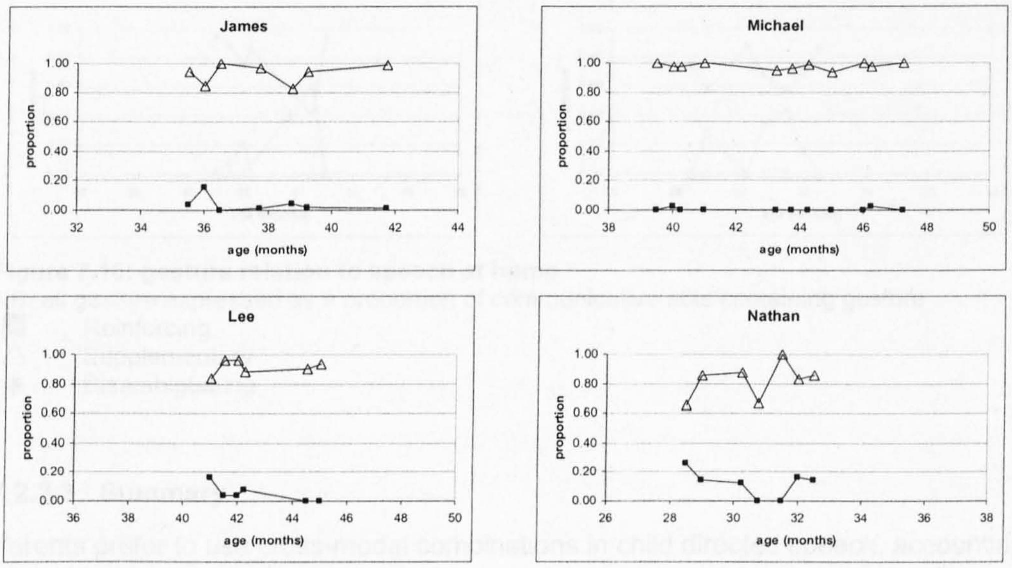



**Figure 7.15: synchronised cross-modal combinations and gesture without speech at home**

NB: all gesture expressed as a proportion of communicative acts containing gesture

■ Gesture without speech

△ Synchronised cross-modal combinations

#### 7.2.3.2 Reinforcing, supplementary and disambiguating cross-modal combinations

All parents use reinforcing cross-modal combinations most frequently, but fall into two subgroups. The first consists of James's and Michael's mothers. For them, reinforcing combinations account for over 80% of all cross-modal combinations. In addition small numbers of supplementary and disambiguating combinations are used. Both mothers tend to use more disambiguating combinations than supplementary. Reinforcing combinations also dominate in the second subgroup, though to a lesser extent. Nathan's and Lee's parents use more disambiguating combinations, accounting for up to half the total cross-modal combinations. Neither parent uses supplementary combinations. This is shown in Figure 7.16 below.

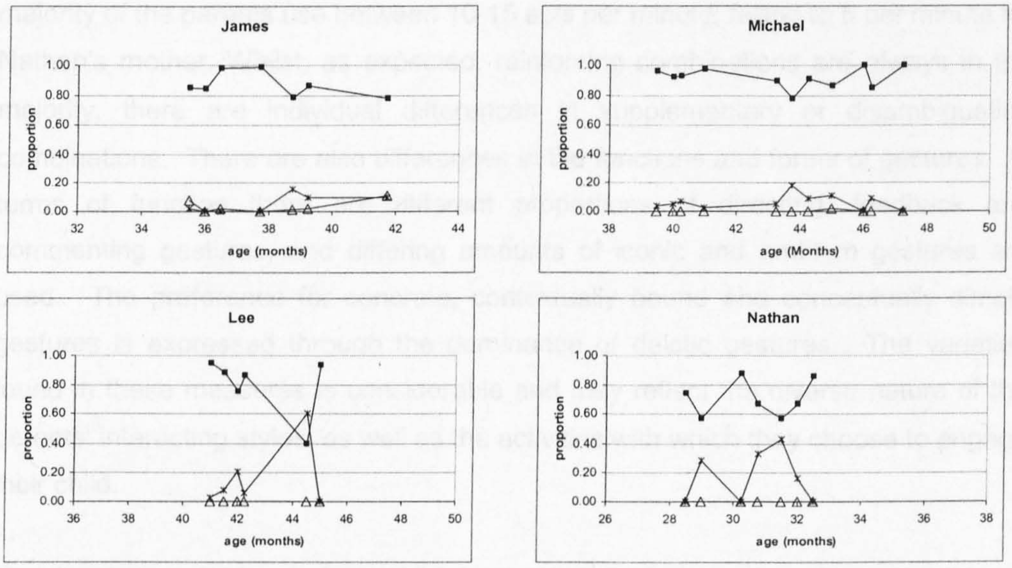



**Figure 7.16: gesture relation to speech at home**
NB: all gesture expressed as a proportion of communicative acts containing gesture
■ Reinforcing
△ Supplementary
✳ Disambiguating

### 7.2.3.3 Summary

Parents prefer to use cross-modal combinations in child directed speech, accounting for over 80% of all communication containing gesture. All parents use reinforcing combinations, followed by disambiguating combinations and very rarely supplementary combinations. There is some difference in the relative proportion of reinforcing and disambiguating combinations, with two of the mothers favouring the latter to a greater extent.

## 7.2.4 Discussion

From the above discussion it is evident that individual variation has a greater role in some measures, and very little in others. The invariant measures include the proportion of gesture used in communication, which appears stable at around 10 to 20%. This confirms the finding in Iverson *et al* (1999) of gestures accounting for 15% of all communication. The preference for cross-modal combinations over gesture without speech is also confirmed, and the balance between the two agrees with that found by Iverson *et al* (1999) and O'Neill *et al* (2005). It also seems that facilitative gestures outweigh organisational gestures, with an 80/20% split, similar to the findings for the Explorers environment.

Variation can be observed in the parent's communicative acts per minute. The majority of the parents use between 10-15 acts per minute, falling to 5 per minute for Nathan's mother. Whilst, as expected, reinforcing combinations are always in the majority, there are individual differences in supplementary or disambiguating combinations. There are also differences in the functions and forms of gestures. In terms of function there are different proportions of directing, feedback and commenting gestures, and differing amounts of iconic and emblem gestures are used. The preference for concrete, contextually bound and conceptually simple gestures is expressed through the dominance of deictic gestures. The variation found in these measures is considerable and may reflect the diverse nature of the parents' interacting styles, as well as the activities with which they choose to engage their child.

The developmental level of the child does not seem to impact on the gestural input that child receives. If this were the case then Lee's and James's mothers would be most similar. Instead it is Michael's and James's mothers that are most like each other. It seems that the mothers' individual interacting styles outweigh the differences due to the different developmental abilities of the child. This is in line with Iverson *et al's* finding that the age of the child, thus the developmental level, did not result in differences in the gestural system of their mothers.

## 7.3 Comparing environments

In many aspects of gesture use no change was discerned over time in either environment. As there are no longitudinal differences it is possible to ignore the chronological dimension and collapse the data to a single collection. This allows direct comparison between the two environments. In addition limited data collected from Murray and Toby can be included in the comparative analysis. A comparison group of six participants (James, Lee, Michael, Murray, Nathan and Theo) will be used. Group means for the whole group of eight participants at Explorers can be found in Appendix C. The group analysis is based on enough instances of gesture to calculate an accurate mean and standard deviation. A large standard deviation was found when basing calculations on fewer instances of gesture (facilitative functions and the form of gesture).

### 7.3.1 Communicating

As a group the parents make more communicative attempts than the staff at Explorers, and there is slightly less individual variation within the parent group ($M_S$=10.98, SD=3.82; $M_P$=12.45, SD=3.14) as shown in Figure 7.17. Individually the exceptions to this rule are Murray, where the communication rate is similar in both environments, and Nathan, where the staff have a considerably higher communication rate than his mother.

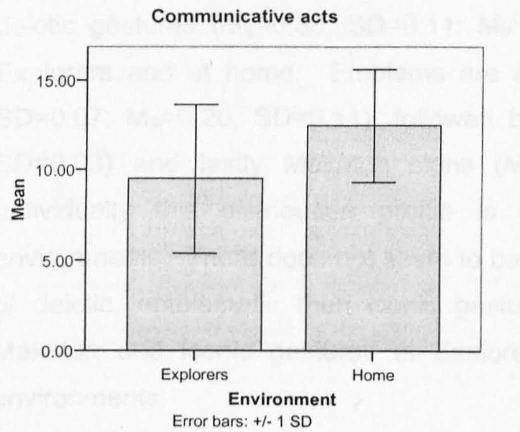



**Figure 7.17: Group comparison of communicative acts**

In terms of gestural communication, the staff at Explorers use proportionally more gesture in their communication ($M_S$=0.20, SD=0.94; $M_P$=0.13, SD=0.04). As a group the parents are more consistent in their gesture use (Figure 7.18). Individually the increased use of gesture by the staff compared to parents is particularly striking for Nathan and Theo. For James and Murray the difference is barely discernable.

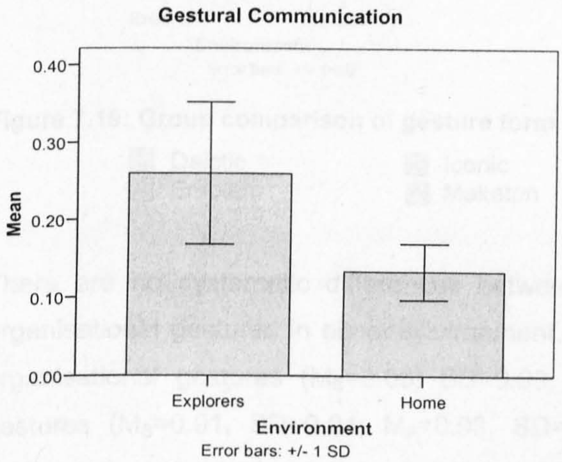



**Figure 7.18: Group comparison of gestural communication**

The general trend indicates that parents talk more to their children, but use less gesture overall in their communication. The staff at Explorers may make fewer communication attempts, but within those communications gesture plays a larger part.

### 7.3.2 Form and function

Turning now to the form of gesture. The group analysis (Figure 7.19) reveals that deictic gestures ($M_S$=0.58, SD=0.11; $M_P$=0.71, SD=0.07) are used most both at Explorers and at home. Emblems are also used relatively frequently ($M_S$=0.17, SD=0.07; $M_P$=0.20, SD=0.11), followed by iconics ($M_S$=0.12, SD=0.04; $M_P$=0.06, SD=0.03) and lastly Makaton signs ($M_S$=0.04, SD=0.03; $M_P$=0.01, SD=0.01). Individually this distribution profile is found across all participants in both environments. There does not seem to be systematic variation beyond the ordering of deictic, emblematic then iconic gestures. Other than an increased use of Makaton and iconic gestures at Explorers there is little difference in the two environments.

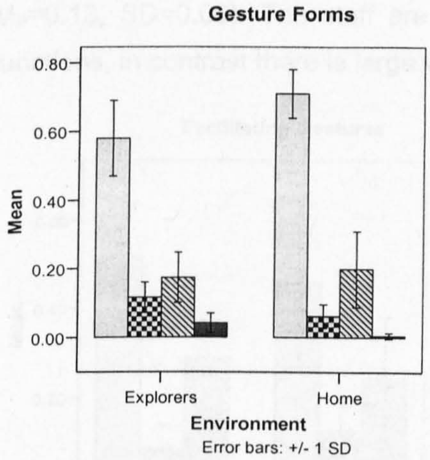



**Figure 7.19: Group comparison of gesture form**

Deictic Iconic
Emblem Makaton

There are no systematic differences between the distribution of facilitative and organisational gestures in either environment. By group the proportional levels of organisational gestures ($M_S$=0.08, SD=0.03; $M_P$=0.08, SD=0.03) and facilitative gestures ($M_S$=0.91, SD=0.04; $M_P$=0.93, SD=0.03) are the same (Figure 7.20). Furthermore individual variation within group is exceptionally small.

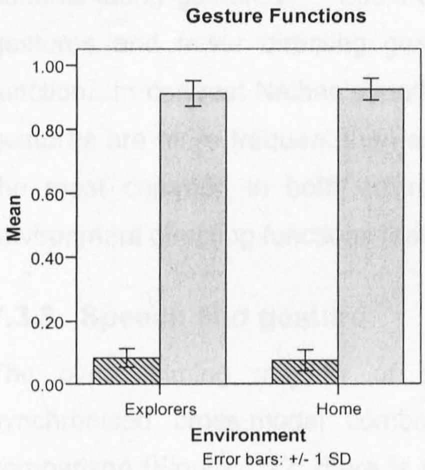



**Figure 7.20: Group comparison of gesture function**

Organising Facilitative

There are few systematic differences by environment for facilitative functions. In a group analysis both staff and parents use directing gestures the most ($M_S$=0.52, SD=0.06, $M_P$=0.46, SD=0.19), followed by commenting gestures ($M_S$=0.29, SD=0.03; $M_P$=0.24, SD=0.14) and feedback gestures the least ($M_S$=0.09, SD=0.05; $M_P$=0.13, SD=0.06). The staff are more consistent in their use of these gesture functions, in contrast there is large variation amongst the parent group (Figure 7.21).

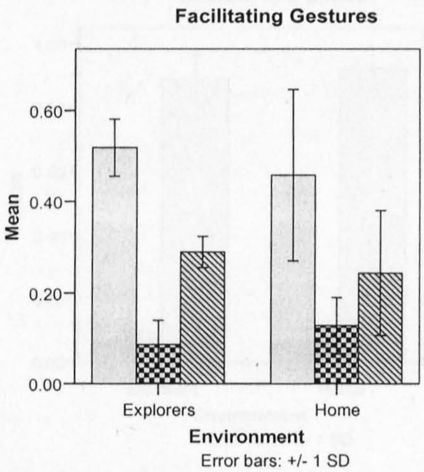



**Figure 7.21: Group comparison of facilitative functions**

Directing Feedback Commenting

Individually the staff profile is to use mostly directing gestures, followed by commentating gestures and feedback gestures are used the least. This pattern is only to be found in the gestures of James's and Murray's mothers. Theo's mother uses a majority of directing gestures, but equal quantities of feedback and commentating gestures. Lee's and Michael's mothers use more commentating gestures and fewer directing gestures, feedback is the least frequent gesture function. In contrast Nathan's mother uses mainly directing gestures, but feedback gestures are more frequent then commentating gestures. Facilitative gestures are the most common in both environments. In the more structured and formal environment directing functions feature more heavily than at home.

### 7.3.3 Speech and gesture

The overwhelming majority of gestural communication occurs in temporally synchronised cross-modal combinations, in both environments. In the group comparison (Figure 7.22) there is very little difference in the levels of cross-modal combinations ($M_S$=0.89, SD=0.08; $M_P$=0.92, SD=0.07) or for gesture without speech ($M_S$=0.10, SD=0.07; $M_P$=0.06, SD=0.05), although there are more instances of the latter at Explorers. Turning to the individuals for Lee, Michael and Theo the pattern of distribution between synchronised cross-modal combinations and gesture alone communications is the same in both environments. For James and Murray gesture alone communications are more frequent at Explorers. The opposite is true for Nathan, the proportion of gesture alone communications is higher at home.

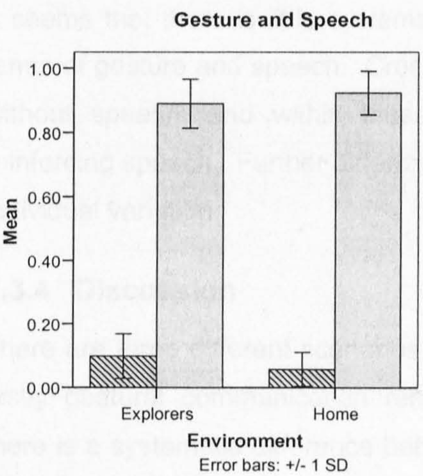



**Figure 7.22: group comparison of gesture without speech and synchronised cross-modal combinations**

Gesture without speech     Synchronised cross-modal combinations

In terms of cross-modal combinations the reinforcing combination is ubiquitous in both environments when compared by group ($M_S$=0.82, SD=0.07; $M_P$=0.85, SD=0.07). A difference can be discerned between supplementary and disambiguating combinations (Figure 7.23). Supplementary combinations are used somewhat more frequently by the staff ($M_S$=0.05, SD=0.04; $M_P$=0.01, SD=0.02) and disambiguating combinations more so by parents ($M_S$=0.03, SD=0.05, $M_P$=0.09, SD=0.03), yet the variation in supplementary and disambiguating use is large. This is confirmed when analysed by individuals. There is little difference evident between staff and parents for reinforcing combinations, yet considerable differences for supplementary and disambiguating combinations.

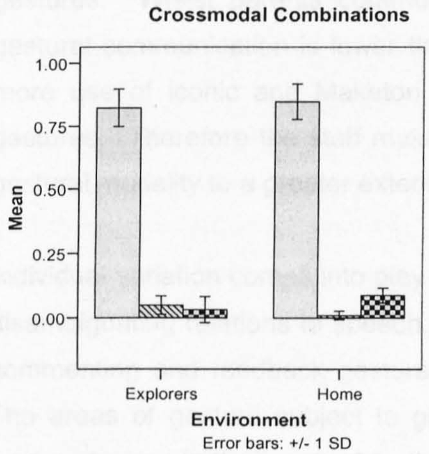



**Figure 7.23: group comparison of gesture relation to speech**

Reinforcing Supplementary Disambiguating

It seems that there is little systematic difference between the two environments in terms of gesture and speech. Cross-modal combinations are preferential to gesture without speech, and within those combinations the most common is gesture reinforcing speech. Further differences are not systematic but appear dependent on individual variation.

### 7.3.4 Discussion

There are three different scenarios to consider in the comparison of gestural input; firstly gestural communication remains constant across environments, secondly there is a systematic difference between the two environments and thirdly a certain amount of individual variation is apparent in gestural communication.

It is constant across environments that temporally synchronised cross-modal combinations comprise over 80% of the total gestural communication. This finding is identical to both the Iverson *et al* (1999) and O'Neill *et al* (2005) studies. The slightly more conservative result can be explained by reporting only synchronised cross-modal combinations. Although obscured by coding differences, reinforcing combinations are likely to be the most frequently observed in all three studies. Also constant is the division between facilitative and organisational gestures. The form of gesture is stable as deictic gestures are common, and iconic gestures infrequent, again a finding replicated across studies.

Systematic differences are seen in the communication profile and the use of deictic gestures. Whilst parents communicate more with their child, the proportion of gestural communication is lower than that of the staff. Additionally the staff make more use of iconic and Makaton gestures, whilst decreasing the use of deictic gestures. Therefore the staff make fewer communicative attempts, yet exploit the gestural modality to a greater extent, both in terms of frequency and form of gesture.

Individual variation comes into play with the exact distribution of supplementary and disambiguating relations to speech. This is also true of the distribution of directing, commenting and feedback gestures, and to a lesser extent, the form of gesture. The areas of gesture subject to greater variation correspond to instances where gesture is rare in the input. An alternative interpretation is that the current sample size is too small to register systematic difference in such fine grained coding. A larger sample size, thus increasing the frequency of these gestures, would either confirm or disprove this interpretation.

The proposal (O'Neill *et al,* 2005) that an increasingly didactic interaction style will affect both overall gesture levels and deictic gestures receives partial support from the results reported here. Gestural levels of the parents were similar to those of Italian mothers (Iverson *et al,* 1999) at close to 15%. The staff members made more extensive use of gesture (20%) but not at the levels reported by O'Neill *at al* (28%). This increase in gesture use did not correspond to an increase in deictic gestures. O'Neill *et al* report English mothers' gestural repertoires as being over 90% deictic. The parents in the present study were high (71%), especially in comparison to the staff (59%) which was closer to that reported by Iverson *et al.* It may be that use of deictic gestures is associated with a didactic style more natural to English parents. The training the staff receive in communication, and the emphasis on non-directive therapy may be factors in the reduction of the use of deictic gestures. The increase in iconic gestures may, in part, be attributable to their knowledge and use of Makaton as both these signs and iconic gestures share an innate symbolism.

It is difficult to accurately state if the differences between this and previous studies are a result of parents adapting to the atypical development of their child, or in the case of the staff, arising from explicit training in communication methods. As there is little evidence of adapting the gestural input to the developmental ability of the child, either by staff members or parents, it seems unlikely that this can have a large effect. There is considerably less variation amongst the staff as a group, than amongst the parents. This indicates that the training the staff have received coupled with their close working relationship, has had an effect on gestural communication.

In general these results are in line with previous studies. Gesture is used in 15-20% of all child-directed communication. Gestures are limited in repertoire, consisting of mainly deictic gestures, and are conceptually simple, concrete and contextually bound. Gesture occurs most often with accompanying speech and usually serves to reinforce that speech. Additionally these results show that the facilitative function is used more frequently than organising, and whilst the subgroups of facilitative functions remain constant the frequency may vary. Potential differences have been suggested in the gesture use of staff working with and the parents of children with ASD.

# Chapter 8

## GESTURE IN ITS INTERACTIONAL CONTEXT

Earlier chapters focused on either the adult or the child, thus ignoring the fact that interaction is a collaborative process. This chapter attempts to redress the balance somewhat by examining how the interlocutors influence the interaction and each other. Unlike previous analyses, gesture does not form the central core of this chapter, instead it takes its place as an ancillary system to speech. This chapter is not intended to be an exhaustive account of the communication of the parents, staff and children recorded during the study, but rather presents a series of observations which may be of use to professionals during moments of critical self–reflection.

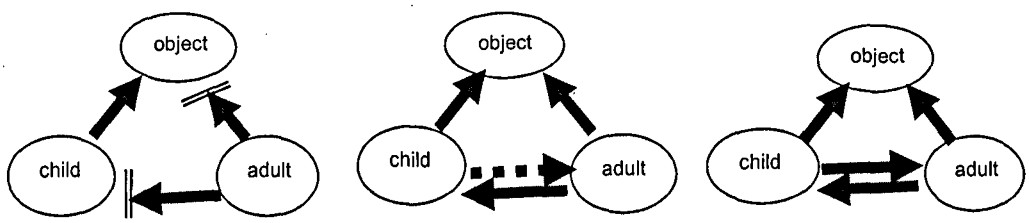
There are three main sections to the chapter, firstly the influence of the child will be considered, chiefly through analysis of joint attention skills. Secondly the adult's influence will be discussed, focusing on the manipulation of structure and directiveness. Finally a series of case studies are presented, illustrating how the child and adult influence each other, and thus affect the resultant shape of the interaction.

### 8.1 The influence of the child on interaction

The importance of joint attention skills as a basis for communication and other social development is well known, and has been discussed in Chapter 2. Joint attention refers to the ability to maintain a triadic interaction, between the child, adult and an object. It is essential that both the adult and child are attending to the object, and, crucially, that they are aware that the other is doing so. On analysis of the data it became apparent that the child's ability to enter joint attention was a large factor in the shaping of interactions with the adult. Therefore all situations were joint attention was possible were identified and analysed.

### 8.1.1 The development of joint attention

The development of joint attention was found to be a gradual process. Three different periods of development will be defined, followed by individual analyses of the participants' interaction. During the first period of development, interaction is predominantly dyadic, secondly there are some elements of triadic interaction and finally full joint attention is established. These three periods are shown schematically in Figure 8.1, and will be discussed more fully below.




**1) primarily dyadic** **2) primarily triadic** **3) sustained joint attention**

**Figure 8.1: three periods in the development of joint attention skills**

*Primarily dyadic:* the child is engaged with the adult or with the object that they are playing with, but cannot co-ordinate attention between the two. They may seem oblivious of the presence of the adult playing next to them, or if the adult encroaches upon either them or their toys, may reject any overtures on the part of the adult. In gestural communication this is realised through the protesting function, or simple deictic gestures to push away the adult's hand, or unwanted object.

*Primarily triadic:* the presence of the adult playing next to the child is accepted, overtures are responded to, and some interaction is initiated by the child. Any periods of joint attention are transitory and brief. The child may demonstrate some joint attention behaviours; they can follow the eye gaze of the adult. The child may use physical prompts or pointing without visual checking. Therefore there will be an increase in physical prompts and deictic gestures (both requests and protests and pointing gestures) as well as a possible increase in the number of communicative acts per minute.

*Sustained joint attention:* joint attention is easily established and often maintained over multiple turns. The child takes an active role and contributes significantly to the interaction. The child is competent in a range of joint attention skills. They will follow cues given by the adult's use of gaze and will also use visual checking (looking between the object and the adult to ensure that the adult is attending) and social referencing (using the adult's reaction to judge their own actions) if appropriate. They will use both proximal and distal pointing, with both imperative and declarative functions. In general more complex gesture functions and forms will be demonstrated (including iconics and emblems) as the interaction is extended over several turns.

### 8.1.2 Individual development of joint attention

The participants fall into three subsets, based on the profile of joint attention skills. The first set comprises James and Lee. The majority of their interaction is dyadic interspersed with moments of triadic interaction. These moments are fleeting and, especially for James, are usually the result of great persistence on the part of the adult. Extract 1 is an example of this.

Extract 1:

| | | |
|---|---|---|
| 1. | JOA: | balls<br>*rolling balls in fingers* |
| 2. | | *James takes balls and plays with them* |
| 3. | JOA: | good boy |
| 4. | JAM: | {vocalisation} |
| 5. | JOA: | balls<br>*Shows two kooshes to James* |
| 6. | | *James plays with balls and doesn't look* |
| 7. | JOA: | you've got balls<br>*plays with yellow koosh* |
| 8. | JAM: | {vocalisation}<br>*plays with sticky balls* |
| 9. | JOA: | are you humming?<br>*Stretches strand of koosh in front of James* |
| 10. | JOA: | pull!<br>*pulls and lets go a strand of koosh* |
| 11. | | *James looks up then tries to move away* |
| 12. | JOA: | pull (0.2) ready: (.) bounce bounce bounce<br>*pulls and lets go a strand of koosh* |
| 13. | | bounce bounce bounce<br>*bounces koosh on a single strand* |
| 14. | | *James pushes koosh away and turns into wall smiling* |

Joanne manages to spark James's interest in the balls, which he takes in line 2. James continues to play with the balls to line 14. Joanne initially lets him play with the balls (lines 3-8) but then attempts to entice him into playing with her by using the koosh, a ball made of multiple thin rubber strands (lines 9-13). Despite James ignoring her she continues to play with the koosh, until he rejects the overture in line 14 by pushing the koosh away and turning into the wall. Despite rejecting Joanne's overtures James appears to enjoy the interaction as he is smiling as he turns away.

At home Lee is more likely to initiate interactions, and also shows more acceptance of an adult, maintaining joint activities for longer, even if the moments of triadic interaction are not sustained. In Extract 2 Lee's mother initiates a game of building towers, using the bricks from a container beside her. She sits Lee on her knee and begins to build the tower in front of them. Lee becomes interested in the tower building and tries to place one of the bricks himself (line 6). From this point on Lee accepts his mother's help to build the tower, letting her choose the bricks, but placing them on the tower himself. Each are confined to their own role, there is no discussion of which brick to choose next, nor on the design of the tower. Although they are working together on the task of tower building this interaction is primarily dyadic.

Extract 2:

| | | |
|---|---|---|
| 1. | MOT: | come and sit there<br>*sits him on her knee.* |
| 2. | MOT: | build.<br>*puts blue brick on tower* |
| 3. | | *Mother adds a red brick* |
| 4. | | *Lee moves brick closer to others and looks for the next* |
| 5. | | *Mother adds a yellow brick* |
| 6. | | *Lee tries to help her place it* |
| 7. | | *Mother hands green brick to Lee* |
| 8. | | *Lee replaces yellow brick with green* |
| 9. | | *Mother offers him a yellow brick from truck* |
| 10. | | *Lee takes green brick from tower and replaces it with yellow* |

The second subset is the largest, it comprises Michael, Theo, Toby and possibly Zaara, although she shows a slightly different profile. The majority of the interaction for these participants is triadic. Zaara is noticeably more adept at short bursts of joint attention when compared to the others in this group. Extract 3 illustrates triadic interaction. Jackie and Toby are playing with the jigsaws. Toby has just completed the teletubby jigsaw when the extract begins. He and Jackie start to name each of the four teletubbies (Po, Dipsy, Lala and Tinky-Winky), thus maintaining triadic interaction over several turns. Toby follows Jackie's deictic gestures but does not look back at her at any point in the interaction. He supplies approximations of the teletubbies' names but does not look for confirmation or approval at each turn.

Within this subset, joint attention first appears interspersed between other interactions, and is gradually maintained for longer at a single time. In the following extract (Extract 4) Zaara is sitting with Lucy looking through a selection of books. Zaara initiates a conversation about the butterflies on her new shoes. Lucy takes up the new topic and the interaction is maintained over several turns. Zaara manages to engage with Lucy, but attempts to include the camera person in the interaction, by continually looking to see if the camera person is looking at her shoes.

Extract 3:

| | | | |
|---|---|---|---|
| 1. | TOB: | po | |
| | | *Picks up last piece* | |
| 2. | JAC: | po | |
| 3. | TOB: | *places last piece* | |
| 4. | JAC: | who is it? | |
| | | *pointing to $1^{st}$ piece* | |
| 5. | TOB: | digger | |
| 6. | JAC: | Dipsy | [who]'s this? |
| | | *maintaining the point* | *pointing to $2^{nd}$ piece* |
| 7. | TOB: | | ye[ah] |
| 8. | TOB: | dip (1.0) dip | |
| 9. | JAC: | who's this? | |
| | | *pointing and tapping $3^{rd}$ piece* | |
| 10. | TOB: | bummer | |
| | | *pointing to $3^{rd}$ picture* | |
| 11. | JAC: | who's this? | |
| | | *Pointing to $4^{th}$ picture* | |
| 12. | TOB: | doh | |
| | | *pointing at $4^{th}$ picture* | |
| 13. | JAC: | (0.5) good boy (1.0) its teletubbies | |
| | | *Sits back* | |

Extract 4:

| | | |
|---|---|---|
| 1. | | *Zaara points to wrist, looks at camera and then points at her shoes* |
| 2. | LUC: | your shoes |
| 3. | ZAA: | butters (0.5) butters |
| | | *looks at Lucy between attempts and points at shoes* |
| 4. | LUC: | a butterfly |
| 5. | | *Zaara points to other shoe* |
| 6. | LUC: | clever girl (1.0) another butterfly |
| 7. | LUC: | butterfly |
| | | *puts book down and makes butterfly gesture with both hands* |
| 8. | | *Zaara points at first shoe* |
| 9. | LUC: | shoes |
| | | *turning page in book* |
| 10. | LUC: | look Zaara |
| | | *pointing to picture in book* |
| 11. | ZAA: | butter |
| | | *pointing at shoe* |
| 12. | LUC: | butterfly |
| 13. | | *Zaara touches first shoe* |
| 14. | LUC: | on shoes |
| | | *turns page and watches Zaara play with shoes* |
| 15. | LUC: | Zaara (.) looking |
| | | *pointing at book* |
| 16. | | *Zaara briefly looks and points to picture then looks back at camera* |

Zaara introduces the new topic of conversation by pointing to her wrist, then checks the attention of Lucy and the camera person, before pointing to her shoes. Lucy follows the topic shift and supplies "shoes" (line 2). Zaara rejects this and makes an attempt to direct Lucy's attention to the butterfly on the shoes (line 3). She uses visual checking to ensure that Lucy is looking at the butterfly and not the shoes in general. This is successful (line 4) which prompts Zaara to include the second butterfly. Lucy elaborates with a butterfly gesture then tries to conclude the conversation (line 10). Zaara continues the topic by combining a gesture (pointing to the shoes) and attempting to say butterfly again. Lucy accepts the continuation of the topic, and when it appears naturally concluded brings Zaara back to the book (line 15). Thus Zaara introduces a topic to the attention of both the camera person and Lucy, timing the introduction at a suitable place in the interaction, and continues the topic, resisting attempts to end it, before returning to the picture book interaction.

Toby and Zaara were not recorded at home, therefore a comparison across environments can only be made for Michael and Theo. Michael is consistent in his behaviours regardless of environment. Theo shows more sustained triadic interaction with his mother. He initiates short bursts of joint attention at home by showing the camera person what he is playing with, or another item of interest to the new person in the house. Such interactions are seldom sustained for more than a single turn (Extract 5).

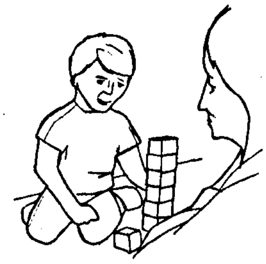
Extract 5:

| | | |
|---|---|---|
| 1. | | *Theo picks up train and shows it to the camera* |
| 2. | CAM: | oh (.) it's a Thomas! |
| 3. | THE: | Thomas. |
| | | *puts it on the track and pushes it, looking at camera person* |

The remaining participants, Nathan and Murray, form a third subset characterised by a marked increase in joint attention. Both participants initiate and maintain triadic interaction and use a range of gestures including imperative and declarative pointing gestures. In Extract 6 Nathan and Diane are playing together with some bricks. Nathan has built a tower and initiates a game of counting the bricks in the tower. He engages Diane's attention, checking in line 3 that she is attending, and only continuing to count after she has nodded at him. He combines verbal counting with deictic gestures, indicating each brick in turn. Another brick is placed on the tower and the count continues. The tower falls soon after the extract ends, ending the counting game.

Extract 6:

| | | |
|---|---|---|
| 1. | NAT: | *puts another brick on tower* |
| 2. | DIA: | ooh getting wobbly |
| 3. | NAT: | one (.) two (.) three |
| | | *points to each brick as he counts looks up at Diane* |
| 4. | | *Diane nods* |
| 5. | NAT: | four (.) six (.) seven (.) eight |
| | | *Points to and counts remaining blocks* |
| 6. | DIA: | eight! (.) good counting |
| 7. | NAT: | eight |
| | | *puts another brick on tower* |
| 8. | DIA: | ni:ne! |
| 9. | NAT: | nine |
| | | *pointing at bottom brick* |



Despite being similar at Explorers, both Nathan and Murray show a different profile at home; the only participants where environment has a marked effect. Murray receives a lot of support from his mother who has a strongly directive interacting style which results in extended periods of joint attention. This is shown in Extract 7, where Murray is playing dominos with his mother.

Extract 7:

| | | |
|---|---|---|
| 1. | MOT: | your turn |
| 2. | MUR: | turn |
| | | *Chooses domino and starts to put it down* |
| 3. | MOT: | you need (.) you need (1 sec) dogs or? |
| | | *points at dog points at cat* |
| 4. | MUR: | c[ats] |
| | | *Looking at domino* |
| 5. | MOT: | [cats] (0.2) do you have any? (0.1) yes. |
| | | *Looks at his dominos* |
| 6. | | *Murray plays domino* |
| 7. | MOT: | that's right cats |
| 8. | MUR: | cats |
| | | *Looks at mother's dominos* |
| 9. | MOT: | ok (1.2) erm (0.2) I also need dogs or cats |
| 10. | | (0.7) I'll put these (0.1) cats and cows |
| | | *places her domino* |

A successful game of dominos requires some understanding of the rules of the game, the ability to take turns, and the ability to switch attention between your own, your opponent's and the played dominos. Murray's mother makes these tasks easier by a) having all dominos on display so she can help him choose his turn, b) directing him through each turn (e.g. lines 1, 3, 5), and c) verbalising her thought process as she makes her turns (lines 9, 10) ensuring that Murray can follow the direction the game is taking. Murray initially does not choose a suitable domino (line 2) but responds to his mother obliquely showing him this (line 3) and looks more carefully at the played dominos, before completing his turn. Murray is able to maintain joint attention through out the whole of the game.

Nathan's mother, by contrast, is more passive and often lets Nathan take the lead in their interactions. At home Nathan plays more by himself than at Explorers, initiating less and showing less joint attention. It appears that Nathan requires substantial support from the adult for sustained periods of joint attention.

#### 8.1.2.1 Summary

Joint attention skills develop gradually but do impact on communication. The participants formed three subsets, the first interacted primarily dyadically, the second set was more accepting of adults and they were able to maintain triadic interaction. The third set showed a range of joint attention skills and were able to maintain joint attention for sustained periods of time with support from adults. Only minor differences were found by environment. The mother's interacting style was found to affect sustained joint attention.

### 8.1.3 Discussion

The analysis here clearly supports the evidence for a gradual acquisition of joint attention skills. Unsurprisingly joint attention was delayed in these participants. There were only two participants (Murray and Nathan) who consistently entered joint attention and maintained the interaction around that attention. In typical children joint attention is firmly established at 18 months, across a variety of measures. The participants showed some mastery of these skills at much later age (from 2 to 4 years old). The delay appears linked more to the social and communicative impairments of the children, rather than age. It seems that the greater the impairment the more difficult it is for the child to develop the joint attention skills necessary for further social and communicative development.

The environmental effect was found to be very slight. Therefore it seems that the differences found in gesture production at home compared to Explorers cannot be attributed to development of the child. In terms of joint attention and the willingness to communicate the participants behaved similarly in both environments. Murray and Nathan are exceptions to this general rule, Murray becoming more engaged at home and Nathan less so. As these two children showed the most advanced joint attention skills it seems that they have also the ability to manipulate these skills and adapt to different interlocutors. The interacting style of the mothers appeared to have a large effect on their ability to enter joint attention, with Murray's mother being the most directive and Nathan's mother the least.

## 8.2 The influence of the adult on interaction

Interaction was found to be considerably influenced by the adult. They tended to support the child's attempts at communication, and created a favourable environment for the promotion of the child's communication. This was achieved by providing structure and direction in the interaction. These two factors will be examined in more detail in this section, firstly individually, and then in combination with each other.

### 8.2.1 Directiveness

In adult-child interaction there is a large imbalance of power, the majority being held by the adult who appears as an authoritative figure to the child. The term directiveness refers to the degree to which the adult dominates the unfolding of the interaction. During analysis of the data six different levels of directiveness emerged. These will be explained in detail below, but are summarised in Table 8.1. The different levels are presented in order of increasing directiveness. The levels should not be considered as categorical, but rather represent different stages on a sliding scale of directiveness.

| Direction | Description | Examples |
|---|---|---|
| Observe | Watch child playing with little to no involvement | (Little to no speech) |
| Describe | Non-judgemental summary of child's actions | You're putting the yellow one with the blue one<br>You've got the big square |
| Suggest | Propose a new course of action | Shall we put the car in the garage?<br>This is could be the snow |
| Require | Propose new course of action, or reiterate previous proposal with the expectation of compliance | Matching – where's green?<br>No, that's the barn, can you put the cow in the field? |
| Instruct | Increased use of proximal or contact deictic gesture, use of repetition and emphasis. Frequent use of imperative mood. | Rabbit (POINT) rabbits go hop hop hop<br>Yellow tub (POINT) red tub (POINT), yellow teddy (POINT) where does teddy go? |
| Prompt | Verbal or physical prompt (taking child's hand to perform action, with or without speech) | It's a d-?<br>Directing paintbrush by placing adult's hand over the child's. |

**Table 8.1: levels of directiveness in adult communication**

*Observe*: the adult watches the child play but makes little to no attempts to interact. Any utterances directed to the child will generally be behaviour modifiers, such as requests to share toys, or checking inappropriate behaviour. Observation is more prevalent at Explorers, were there is the opportunity for the children to play amongst themselves. Extract 8 is a short example of observation taken in the home context.

Theo is sitting looking at a Thomas the Tank Engine book, whilst his mother watches him from across the room. She makes some attempts to talk to him, but is content to let him look at the book without her.

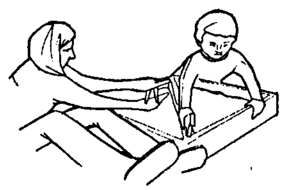
Extract 8:

| | | |
|---|---|---|
| 1. | MOT: | ooh are you looking at your book Theo? |
| *2.* | | *Theo looks at book on sofa* |
| | | (3 secs) |
| 3. | MOT: | you're a big boy |
| *4.* | | *Theo looks at book* |
| | | (9 secs) |
| 5. | MOT: | can you see trains? |

*Describe:* the adult plays alongside the child and makes non-judgemental comments summarising the child's actions. The adult does not take an active role in the play, and does not explicitly encourage interaction, but will respond to overtures made by the child. Description is more prevalent at Explorers, were the staff are required to use commentaries to expose the child to language without pressure on the child to respond. Extract 9 is an example of description at Explorers, where Katy and Nathan are playing with a large tray of dried pasta and some toy animals. Extract 10 shows Michael's mother elaborating his actions into a short story about the engines association with Thomas the Tank Engine.

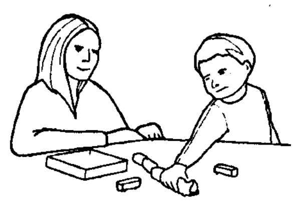
Extract 9:

| | | |
|---|---|---|
| 1. | | *Nathan puts the zebra on edge of tray and walks it forward* |
| 2. | KAT | walking (0.5) walking |
| | | *hand vertical, fingers down and waving* *same gesture on to right palm* |
| 3. | KAT | giraffe walking |
| | | *picks up giraffe and walks it along edge of pasta* |
| 4. | KAT | he can walk around |
| | | *points around circumference of tray* |



Extract 10:

| | | |
|---|---|---|
| 1. | MIC: | one morning {vocalisation} |
| | | *pulling train along table* |
| 2. | MOT: | one morning (.) Henry (0.1) was in a really |
| 3. | | good mood and he was really happy |
| 4. | MIC: | he |
| 5. | MOT: | and he was pulling (0.5) the zoo carts a:nd |
| | | *Leans over table to point to them* |
| 6. | | (0.1) a troublesome truck (0.3) and the post |
| | | *sits back up straight* |
| 7. | MOT: | not sure what that other one is |



*Suggest:* a new action or variation on the current activity is proposed by the adult. This may or may not be taken up by the child. Suggestion is very adaptable to different play activities, and may vary in the forcefulness of the suggestion, or in the success of the new proposal's instigation. Suggesting expansions on the current play activity is very frequent both at home and at Explorers, and appears to be the preferred directive level of the parents. Extracts 11 and 12 are both taken from home. In the first (Extract 11) James's mother suggests putting animal toys in a box, and starts a turn taking game.

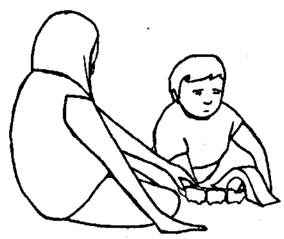
Extract 11:

| | | |
|---|---|---|
| 1. | MOT: | James (0.9) animals in box? |
| | | *pulls box in closer* *taps the box* |
| 2. | JAM: | {vocalisation} |
| | | *looks at box then away* |
| 3. | MOT: | mummy's turn |
| | | *holds toy near James* *drops it into box* |
| 4. | | *James reaches for toy* |
| 5. | | *James drops [his toys into box]* |
| 6. | MOT: | [James's turn] |
| 7. | MOT: | Mummy's turn |
| | | *drops toy into box* |
| 8. | | *James drops toy in* |
| 9. | MOT: | James's turn! |

In the second (Extract 12) Michael's mother makes a successful suggestion to push Thomas through the tunnel, but meets with opposition from Michael to her second suggestion.

Extract 12:

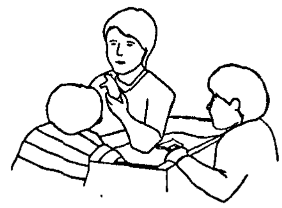
| | | |
|---|---|---|
| 1. | MOT: | shall I bring Thomas round? (.) I'll put him |
| 2. | | through the tunnel |
| | | *lines him up for the tunnel* |
| 3. | | *Michael comes over to her* |
| 4. | MOT: | fallen over (0.3) go through the tunnel (.) |
| 5. | | Thomas to Michael. |
| | | *pushes him through the tunnel* |
| 6. | MIC: | whoo whoo |
| 7. | MOT: | ready (0.2) whoo whoo! |
| | | *pushes him through* |
| 8. | | *Michael pulls him out the other side* |
| 9. | MOT: | coming out the other side yet (0.2) yeah! |
| | | *clapping* |
| 10. | MOT: | well done Thomas (0.7) he's a really useful |
| 11. | MOT: | engine in't he? (0.2) shall I put this one |
| | | *Pulls another train towards the tunnel* |
| 12. | | through (.) the tunnel? |
| 13. | MIC: | no |
| | | *shaking head* |
| 14. | MOT: | no ok then (.) I won't do that then |
| | | *puts hands in her lap* |



*Require*: the child and adult are playing together. The adult requests an action from the child, with the expectation of compliance. It may be necessary for the adult to provide more information for the child to carry out the task adequately. Requirement is common both at home and Explorers. In Extract 13 Diane is asking Nathan to name red and green dinosaurs which he does easily. In Extract 14 Murray and his mother are pretending to shop. Murray's mother wants a raspberry tart. Murray, jokingly, deliberately offers her other food items. His mother enters into the spirit of things, but still provides extra information for a successful conclusion.

Extract 13:

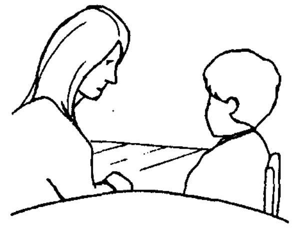
| | | | |
|---|---|---|---|
| 1. | DIA: | Nathan what colour?<br>*holding up dinosaur for Nathan* | |
| 2. | NAT: | green | |
| 3. | DIA: | gree: n (0.6)<br>*nods head at Nathan* | one for you (.) good boy<br>*searching for another dinosaur* |



| | | |
|---|---|---|
| 1. | Extract 14: | |
| 2. | MOT: | have a look and find me a raspberry cake<br>*shakes the box of toys* |
| 3. | MOT: | come on have another look<br>*points to box* |
| 4. | | *Murray picks out corn on the cob and tries to give it to her* |
| 5. | MOT: | that's a corn on the cob I don't want that |
| 6. | MUR: | {laughing} |
| 7. | MOT: | I want something with my coffee |
| 8. | | *Murray drops it back in box and offers her bread* |
| 9. | MOT: | that's bread |
| 10. | | *Murray drops it back in and offers corn on the cob* |
| 11. | MOT: | corn on the cob no (.) thank you |
| 12. | MUR: | {laughing}<br>*drops it back in box* |
| 13. | MOT: | I want a raspberry cake |

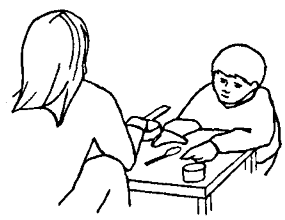
*Instruct:* the adult and child are working together. The apparent aim of the adult is the teaching of novel information or the consolidation of acquired knowledge. The adult takes a strongly directive role, choosing both the subject of discourse and its presentation. The strategies used may vary quite widely, although deictic and iconic gestures are often present, and imperative mood, emphasis and repetition are likely to feature verbally. Instruction is more prevalent at Explorers than at home. The following extracts are taken from Explorers. In the first (Extract 15) Jackie is working with Lee on imitation. She uses imperatives to achieve this (lines 1, 2, and 4).

| Extract 15: | | |
|---|---|---|
| 1. | JAC: | sitting.<br>*turns his chair towards her slightly* |
| 2. | JAC: | Lee (0.5) do this<br>*drops a shape into the tray on the floor and puts the other on the table* |
| 3. | | *Lee takes shape and places it carefully in the tray* |
| 4. | JAC: | good boy (0.3) sit down<br>*helps him back on to chair* |



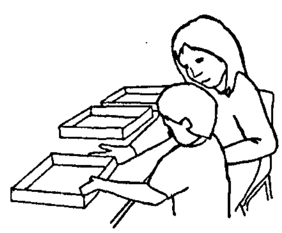
In Extract 16 Katy and Joanne are working with Toby and are teaching him the names of common household objects. Katy first labels the three objects (pan, spoon and cup) in line 1. She then asks for the spoon, emphasising the word *give.* Imperatives and Makaton gestures are used when Toby tries to grab the cup (lines 3, 4, and 5).

| Extract 16: | | |
|---|---|---|
| 1. | KAT: | pan (1 sec) spoon (1 sec) cup<br>*Touches pan holds spoon up holds up cup* |
| 2. | | *Toby stands up and reaches for cup* |
| 3. | JOA: | waiting (.) listen to [Katy]<br>*holds Toby back into chair* |
| 4. | KAT: | [waiting]<br>*hold hand in stop sign* |
| 5. | JOA: | lis[ten] |
| 6. | KAT: | [Tob]y (0.2) can you GIVE me spoon?<br>*holds hand out for spoon* |
| 7. | | *Toby picks up spoon and hands it to Katy* |
| 8. | KAT: | good boy (.) yeah |

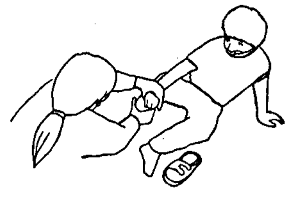


*Prompt:* the adult resorts to either verbal or physical prompts in order to achieve their objective. In a physical prompt the adult will put their hand over the child's hand and perform the action together. Despite being very directive, the long term benefits may be questioned as the child's attention is frequently not directed towards their hand. Physical prompts are more commonly used at Explorers than at home, and often only after several attempts to achieve the outcome in different (less directive) ways. Extract 17 is an example of a verbal prompt, and Extract 18 a physical prompt.

| Extract 17 | | |
|---|---|---|
| 1. | DIA: | what is it?<br>*gives green box to Toby* |
| 2. | | *Toby takes things out of box* |
| 3. | DIA: | it's a? |
| 4. | | *Toby takes something out of box and puts it back* |
| 5. | DIA: | it's a? |
| 6. | TOB: | it's a pig |
| 7. | DIA: | it is a pig |



| Extract 18: | | |
|---|---|---|
| 1. | JAC: | Nathan fasten<br>*pointing at straps on shoes* |
| 2. | | *Nathan touches Velcro strap then tries to get up* |
| 3. | JAC: | this<br>*takes his hand and puts it on strap* |
| 4. | JAC: | fasten<br>*Uses his hand to fasten shoe* |



During interaction with the child the adult will fluctuate between the different directive levels. A change in directiveness may be prompted by the changing needs or responses of the child, in addition to the requirements arising from the ongoing activity. As a group the staff members appear to have greater flexibility in their directiveness, making use of all six levels. Parents, by comparison, show less adaptability, generally using description, suggestion, and requirement only.

In speculative terms, a didactic interactive style would be expected to correspond to the levels of requirement, instruction and prompting. Certainly the more educationally oriented sessions at Explorers do lean towards the higher end of the directiveness continuum. As the parents seem to favour description, suggestion and requirement they can only be said to be using a moderately didactic style. This seems to counter the argument that English parents have a strongly didactic style, as this would be more likely to be associated with the levels of requirement, instruction and prompting.

#### 8.2.1.1 Summary

To summarise, six levels were identified in the data, corresponding to increased directiveness on the part of the adult in adult-child interaction. The level of directiveness is dynamic in ongoing interaction, responding to the child and the activities within which the interaction is situated. Staff at Explorers were found to use all six levels, whereas the parents tended to use only three, of moderate directiveness.

### 8.2.2 Structure

Structure is the framework supporting interaction. It is often introduced through a simple question and answer sequence, or by rigid adherence to previously established routines. An essential component to structure is repetition, either immediate, or as a consistent feature of interaction between two interlocutors. There is a distinction between emergent structure, which naturally grows out of the ongoing interaction, and structure which is externally imposed, such as that required by a PECS exchange. Each will be considered in turn.

Emergent structures were grouped into pausing, naming, action and elaboration structures. Once again these groups arose from close observation of the data. Each group will be discussed and are summarised, with interactional sequences, in Table 8.2.

*Pausing*: this structure is used extensively at Explorers, and by some mothers, to promote social interaction with the child. The structure is integrated into the activity, provided that two requirements are met. Firstly the child must enjoy the activity and be motivated for its continuance. Secondly the power to pause or continue the activity must lie with the adult. At an appropriate place the adult will stop the activity and give a "ready steady" prompt to the child. The activity will not resume until the child supplies "go" or other socially relevant behaviour. Pausing structures can be used in a variety of activities including blowing bubbles, marble or ball runs, playing on a swing, or in tickling games.

*Naming*: a common theme running through this group of structures is the teaching of new vocabulary. There are a variety of structures (Table 8.2) which arise when the activity uses a set of objects; commonly collections of animal pictures, jigsaws or shapes and blocks. The structure also is used to count objects, such as the number of pegs on a board, or number of bricks in a tower. If the structure is integrated into the activity a question will be posed at an appropriate point. For example during a craft activity the child may be requested to name the colour of the pen they are about to draw with, or the shape of a block to be used for printing. As with the pausing structure the adult must be able to retain the desired object until the sequence has been fulfilled. Alternatively the naming can become the focus of the activity (e.g. matching activities were the corresponding feature is named prior to the match being completed). Occasionally naming structures are child initiated, in these instances they provide a framework for requesting novel information, or to consolidate previous knowledge. These structures are used both at Explorers and at home.

| Type | Structure | Sequence | Comments |
|---|---|---|---|
| Pausing | Ready steady go | A* ready, steady<br>C go<br>A reward | Usually adult initiated, occasionally by child. Integrated into activity; pause immediately before desirable event (blowing bubbles, tipping water out of container etc), only resume when child supplies "go", or appropriate gesture. Reward is the continuation of the activity. |
| Naming | Counting and labelling (statement) | A/C point and count/label<br>(C) copy point and repeat<br>A confirmation and praise | Usually adult initiated, occasionally by child. Used to name or count a set (colours, shapes, animals etc). Used with some flexibility, either repetition of structure for each item in set, or whole set completed in one sequence. Differing levels of response tolerated from clear pointing and labelling to attendance without response. |
| | Counting and labelling (question) | A/C point (and question)<br>C/A answer<br>A confirmation/praise | Adult initiated, rarely by child. Similar to previous but used to test knowledge, not teach new knowledge. Used when whole set is visible, first step in sequence may be with or without speech (e.g. what shape? Or simply pointing). Used with some flexibility, either repetition of structure for each item in set, or whole set completed in one sequence. |
| | Questioning (reward) | A question (WH or choice)<br>C answer<br>A confirmation/praise<br>A reward | Adult initiated, usually integrated into activity – e.g. name colour of the ball before it goes down the ball run. Initiated with WH question (What colour?) or choice (yellow or red?), child gives response, which is confirmed and reward is the continuation of the activity (ball is dropped down the run). |
| | Questioning (educational) | A question (WH or choice)<br>C answer<br>A confirmation/praise | Adult initiated, usually the focus of the activity. Often used in directed developmental tasks, for example a matching task using pictures of animals. Adult will hold up card and pose question, either WH (What animal?) or choice (cat or dog?). Child responds, correct response is confirmed and the card is placed on matching picture. |
| Action | Direction or imitation | A imperative<br>C response<br>A confirmation/praise<br>A repeat with controlled variation | Adult initiated, usually the focus of the activity. Often used in directed developmental tasks, for example giving the child a spoon and asking them to mime feeding themselves. An appropriate response will be praised then repetitions will be made with changes (e.g. feed dolly, feed teddy, feed Joanne). |
| Elaboration | Picture book | A direct attention<br>C demonstration of attention<br>A elaboration on picture | Usually adult initiated, occasionally by child. Usually the focus of activity. Attention directed to relevant picture by an attention getter (oh look) coupled with point and name (rabbit). Child demonstrates their attention through looking, pointing or verbalising, adult elaborates on picture (lion with imitation roaring and claws) with words and/or gesture. |

**Table 8.2: Types of emergent structure**

*A = adult, C= child

*Action*: this structure targets a physical response from the child. It is adult initiated and is presented either as an imperative (point to dolly's hair) or by an action accompanied with an imperative. It does not require a vocabulary element. It can be used to develop ideas of sharing and turn taking, by presenting an action followed with the instruction "your turn". Turn taking is used by some parents, but is frequently used at Explorers. Comprehension checking, and imitation are rarely found at home, and only occasionally at Explorers.

*Elaboration*: this is a very loose framework, often arising from picture book interactions. The adult ensures that the child is attending to a picture before elaborating. When the topic shifts to a different picture, joint attention is once again checked before discussing the picture. This can be initiated by adult, and occasionally by the child. It is used both at Explorers and at home.

Emergent structures are dynamic and can be adapted, extended or combined. Extract 19 is an example of adaptation of the pausing structure. Rather than an explicit ready steady go sequence James's mother has embedded the pause into an action nursery rhyme. When James looks away she pauses, both verbally and gesturally and does not continue until James either makes eye contact or moves her hands, thus providing a social link between them.

Extract 19:

| | | |
|---|---|---|
| 1. | MOT: | James (0.2) twinkle twinkle?<br>*kneels in front of him and lifts him on to windowsill* |
| 2. | MOT: | {singing} twinkle twinkle<br>*opening and shutting hands as sings stops when he looks away* |
| | | (0.8 sec) |
| 3. | | *James looks at her* |
| 4. | MOT: | {singing} little star how I wonder<br>*opening and shutting hands as sings stops when he looks away* |
| 5. | | *James climbs on to bed (1 sec) looks at her* |
| 6. | MOT: | {singing} what you are<br>*opening and shutting hands as sings* |

The following extract (Extract 20) is an illustration of a questioning (educational) structure, based around a computer programme. Different cartoon animals appear on the screen, and Jackie requires Michael to name them. The basic structure, initiated by Jackie, has been extended with the inclusion of two more steps:

a) **Question**: what can you see?

b) **Reply**: name of the animal

c) **Model**: I see X

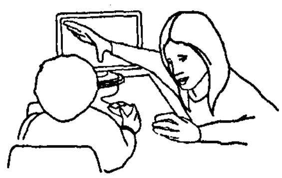
d) **Correction/repetition**: correct name of animal or repeat of b)

e) **Confirmation**: elaboration on the animal

Steps a), b) and e) follow the basic pattern for the educational questioning sequence. Two further steps have been inserted. Jackie is attempting to teach Michael the structure "I see X" in answer to her question. Therefore, although Michael often supplies the correct answer in b) it is not correct in terms of the formula it is couched in. Step c) provides a model of the appropriate answer. Michael incorporates this into step d), if he named the animal incorrectly, but does not use the provided model to frame his answer. In the final step Jackie accepts the answer and rewards Michael by elaboration on the animal, interspersed with praise for his responses. Each component of the sequence is marked in the extract below.

Extract 20:

| | | | |
|---|---|---|---|
| 1. | (**a**) JAC: | what can you see? | |
| 2. | (**b**) MIC: | it's a lion | |
| | | *Jumping up and moving close to screen* | |
| 3. | (**c**) JAC: | I see lion | |
| 4. | (**d**) MIC: | lion | |
| 5. | (**e**) JAC: | raaa | raa |
| | | *Pounces on him with hands as claws* | *pounces then tickles him* |
| 6. | MIC: | {laughing~ | |
| | | *presses mouse button* | |
| 7. | HAR: | look at this! | |
| | | *Shouting from off camera* | |
| 8. | JAC: | look at this (.) good boy Harvey! | |
| 9. | | *Michael stands up and looks close at the screen* | |
| 10. | (**a**) JAC: | what can you see? | |
| 11. | (**b**) MIC: | bugs. | |
| | | *sits down and puts thumb in mouth* | |
| 12. | (**c**) JAC: | bugs good boy (0.3) I see dragonfly | |
| | | *Nodding pulls thumb out of his mouth* | |
| 13. | (**d**) MIC: | a dragonfly | |
| 14. | (**e**) JAC: | a dragonfly | |



Jackie chooses to elaborate in the first sequence, pretending to be a lion much to Michael's enjoyment. The elaboration is much simpler in the second sequence. The structure is strong enough to withstand the interruption in lines 7 and 8 where Jackie's attention is diverted to another child. This interruption occurs in a natural break between sequences.

Extract 21 is a combination of two structures; a questioning reward structure, coupled with a pausing structure, using ready steady go. Murray and Katy are playing with a wind up train. The reward is watching the train travelling around the track. The sequence, initiated by Katy, is as follows:

a) **Question** questioning location of train

b) **Response** chooses location

c) **Prompt** ready steady

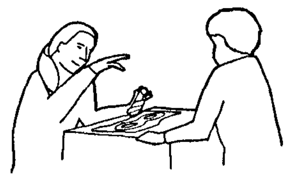
d) **Response** go

e) **Reward** release train

The first two steps establish the location of the train, and are used to test Murray's understanding of vocabulary. Steps c) and d) introduce the pausing structure, before the reward is given in step e). These components are marked in the extract below.

Extract 21:

1. **(a)** KAT: shall we put train with the ducks (0.3) or
*points to the ducks*
2. with the houses?
*points to houses*
3. **(b)** MUR: duck
*points to board*
4. KAT: with the ducks
*Points then uses fingers as a beak for duck*
5. **(c)** KAT: ready steady
*holds the train ready and looks at Murray*
*(0.5)*
6. **(d)** MUR: go
7. **(e)** KAT: go (1.5) oh bye bye train
*lets go of the train* *waves to the train*
8. *Murray watches the train go round the board*
9. KAT: oh stopped
10. *Murray picks up the train and looks at it*



The second group of structures are inflexible as the framework is imposed. These include the structure around the use of PECS and the transition structure imported from the TEACCH programme. Table 8.3 summarises these structures. The PECS exchange framework depends upon the level at which the child is working (as discussed in Chapter 3, Section 3.4.3). Transition structures remain unchanged through out the child's time at Explorers (transitions are discussed more fully in Section 8.2.3.1). PECS and transition structures are extremely rare at home, even though parents are encouraged to use the PECS system. This may be an artefact of the selected recording, for example PECS may be used at dinner time, or timetables may be used to structure the day when the children awakes, but not used in play activities with their parents.

| Structure | Sequence | | Comments |
|---|---|---|---|
| PECS exchange (my turn) | A*<br>C<br><br>A/C<br>A | "my turn" take and play with motivator<br>Build PECS strip and hand over<br>Talk through strip together<br>Praise and reward | Indirectly adult initiated (taught routine). Adult takes motivator (e.g. bells) and plays with it within view of child. Child builds appropriate PECS strip, dependent on the level to which they are working, PECS strip is handed over to adult. If beyond single symbol stage, strip is held by both and each symbol is pointed at and verbalised (adult uses child's hand to form point). Adult accepts strip, child is rewarded with motivator. |
| PECS exchange (WH question) | A<br>C<br><br>A/C<br>A | WH question<br>Build PECS strip and hand over<br>Talk through strip together<br>Praise and reward | Adult initiated (taught routine) Motivator is within child's view, adult prompts (what do you want?). Child builds appropriate PECS strip, dependent on the level to which they are working, PECS strip is handed over to adult. If beyond single symbol stage, strip is held by both and each symbol is pointed at and verbalised (adult uses child's hand to form point). Adult accepts strip, child is rewarded with motivator. |
| PECS exchange (snack time) | C<br><br>A/C<br>A | Build PECS strip and hand over<br>Talk through strip together<br>Praise and hand over food or drink | Child initiated (taught routine) Child builds appropriate PECS strip, dependent on the level to which they are working, and travels to adult. Taps adult on arm and PECS strip is handed over to adult. If beyond single symbol stage, strip is held by both and each symbol is pointed at and verbalised (adult uses child's hand to form point). Adult accepts strip, child is rewarded with requested food or drink. |
| Transition | C<br><br>C<br>C<br><br>C | Card symbol returned to visual timetable.<br>Place symbol in finish box<br>Symbol for next activity taken from timetable<br>Symbol taken to location of next activity | Adult initiated (taught routine). Initial prompt to begin transition (choose finished), more explicit prompt on way to timetable if necessary (pictures Toby). Most children independent through routine, occasionally physical prompts (moving child's hand to perform required action) used. |

**Table 8.3: Imposed structures**
*A=Adult, C=Child

#### 8.2.2.1 Summary

Two groups of structures were identified, the first, emergent structures, are dynamic and adaptable, the second are externally imposed and inflexible. The framework provided by structure can be used to promote social interaction (pausing), to target vocabulary (naming) and physical actions (action). The establishment of joint attention can be facilitated through elaboration structures. Structures are used at Explorers and at home, although staff members make use of a more varied range than the parents.

### 8.2.3 Context of interaction

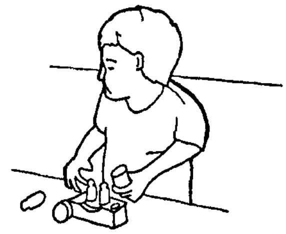
As has been seen in the previous section varying amounts of structure and direction are used by the adults when interacting with the child. Different contexts of interaction can be identified which are distinguishable by the overall aim of the interaction, or by the use of differing levels of structure and direction. This is especially true at Explorers where there is an educational element running through the interactions. A three way distinction can be made between play, directed tasks and other activities. The third group includes training in the PECS system and snack time. Directed tasks are activities which are chosen by the adult and which the child is required to complete. They are more prevalent at Explorers than at home. Play is characterised by the lowest levels of both direction and structure, directed tasks by increasing input from the adult, and the final group all share an extremely high level of either structure or direction.

#### 8.2.3.1 Defining contexts

Play can be subdivided into three different contexts; free play, explanatory play and collaborative play. Each context shows increasing use of both structure and direction. Free play is often solitary. This rarely occurred in the data collected at home; most parents were reluctant to leave their child playing without attempting to join in. For a limited time each Explorers session the children are free to play by themselves. There is little to no interaction in this context; direction is at the observation level and structure is minimal, Extract 22 is an example.

Extract 22:

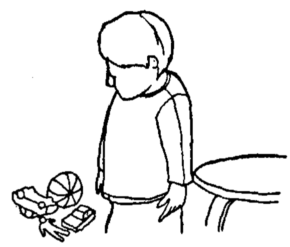
| | | |
|---|---|---|
| | | *Lee is playing with magnetic blocks* |
| | | (15 secs) |
| 1. | | *Lee puts person in magnetic car and plays with it* |
| | | (20 secs) |
| 2. | | *Lee looks round the room then plays with car again* |
| | | (30 secs) |
| 3. | | *Lee walks across room to gate* |
| 4. | | *Lee stands by the gate and tries to open it* |
| | | (14 secs) |
| 5. | | *Lee opens the gate* |
| 6. | KAT | ooh (0.2) Lee (0.3) Lee! |
| | | *jumps up and closes it.* |
| 7. | | *Lee watches her shut and fasten gate* |
| 8. | | *Katy sits down* |
| 9. | | *Lee stands in front of her watching* |



The context of explanatory play more often arises at Explorers than at home, possibly due to the commitment to non-directive therapy. Structure remains minimal, but direction is characterised by descriptions. The child determines the activity and when to finish. The adult plays alongside and provides a commentary on the child's actions, thus exposing the child to language without pressure to reciprocate. Extract 23 is an example taken from James playing at home with his mother.

Extract 23:

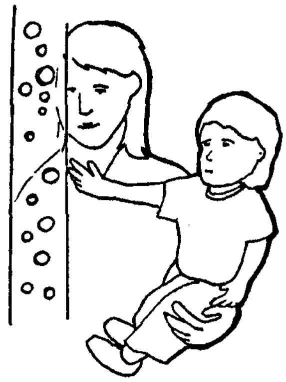
| | | |
|---|---|---|
| 1. | JAM: | ~vocalisation~ |
| 2. | MOT: | oh James go ~blows rapsberry~ (0.2) |
| 3. | | raspb[erry] |
| 4. | JAM: | [~vocalisation~] |
| | | *Puts toy in mouth* |
| 5. | MOT: | not in mouth James |
| 6. | JAM: | ~vocalisation~ |
| | | *Takes toy out and shakes head from side to side* |
| 7. | MOT: | ~laughing~ James shake head (0.2) |
| 8. | | not in mouth |
| 9. | | *James puts toy in mouth* |
| 10. | | *James removes it but puts it back in and kneels up* |
| 11. | MOT: | good b (.) not in mouth (0.2) good boy |
| 12. | | *James removes it and looks at it carefully* |
| 13. | MOT: | what's that? |
| 14. | | *James stands up and runs round the room* |
| 15. | MOT: | James running. |



Collaborative play occurs when the adult and the child are both involved in the play activity. This context provides the majority of the interaction in the home environment. The activity is jointly decided between the child and the adult, the adult taking an equal or more dominant role. There is large variation within collaborative play. All emergent structures may be used and the directiveness levels of suggest and require are frequently used. Extract 24 is an example from an interaction between Diane and Zaara.

Extract 24:

| | | |
|---|---|---|
| 1. | DIA: | shall we look at the bubbles? |
| | | *turns to bubble pipe* |
| 2. | | *Zaara reaches out and touches pipe* |
| 3. | DIA: | bubbles! (0.3) look! (.) shall we press |
| 4. | | buttons? |
| | | *presses buttons* |
| 5. | ZAA: | aah! |
| | | *pointing to buttons* |
| 6. | DIA: | Zaara do it |
| | | *moves her closer* |
| 7. | | *Zaara presses button* |
| 8. | DIA: | pressing button (0.6) gree:n |
| | | *presses green button* |
| 9. | | *Zaara looks then turns away* |
| 10. | DIA: | yell[ow] |
| | | *presses yellow button* |
| 11. | ZAA: | [up] (0.2) up |
| | | *holds hands in air to be lifted* |
| 12. | DIA: | you want to get up (.) OK |
| | | *Helps her stand up* |

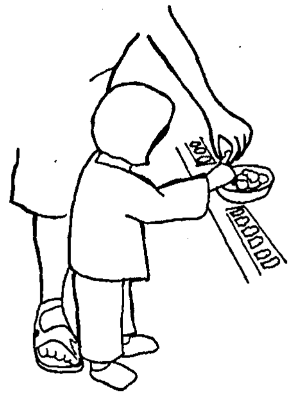


Diane uses a range of directiveness from suggestions (lines 1, 2), to requirement (line 6), then, on compliance, decreases levels of directiveness back to descriptions (lines 8 and 10). Zaara chooses when to end the activity (lines 11 and 12).

Directed tasks are often similar to collaborative play in terms of use of structure and direction. They can be divided into developmental, craft, group and functional tasks. The majority of directed tasks are one to one with an adult. As these tasks encompass a wide range of activities the levels of structure and directiveness provided by the adults in order to accomplish them also vary greatly.

Developmental tasks are primarily concerned with hand to eye co-ordination and the development of motor skills. They include placing pegs in holes, threading bobbins on a lace, and placing hoops on spikes. The individual work stations created for each child at Explorers as part of the TEACCH programme fall into the category of directed developmental tasks. All emergent structures are used, and the levels of directiveness range from suggestions, through requirement to instruction. Extract 25 is an example.

| Extract 25: | | | |
|---|---|---|---|
| 1. | DIA: | let's match teddies (0.5) can Zaara do it? | |
| | | *brings some teddies out of a dish* | |
| 2. | ZAA: | yes | |
| 3. | DIA: | yellow teddy | |
| | | *gives teddy to Zaara* | |
| 4. | ZAA: | yellow [teddy] | |
| 5. | DIA: | [where's] yellow teddy? (.) find him | |
| | | *pointing along line of teddies* | |
| 6. | | *Zaara puts teddy on yellow picture* | |
| 7. | DIA: | clever girl (0.2) ooh find red teddy (1 sec) | |
| 8. | | red | |
| | | *pointing at red picture* | *moves dish nearer* |
| 9. | | *Zaara picks up red teddy.* | |
| 10. | DIA: | yeah (.) red teddy! | |
| 11. | | *Zaara puts it on red picture* | |
| 12. | DIA: | good girl Zaara | |



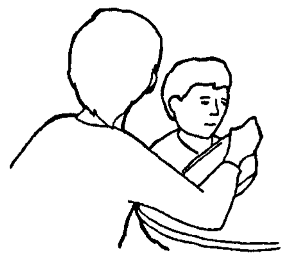
The structure is a minimal form of the educational questioning sequence (question posed in lines 5 and 7, Zaara's response in lines 6 and 9, and praise in lines 7, 10 and 12). In lines 3 and 5 Diane combines instruction (line 3) by naming the yellow teddy as she hands it to Zaara, with requirement (line 5) through indicating the choices of location. In the second sequence Diane again uses requirement (line 7) but reverses the task by indicating the location and requiring Zaara to choose the appropriate colour from the selection in the dish.

Craft tasks include painting, printing or sticking. These tasks are concerned with the creation of an object, and teach a sequence of actions, for example the glue goes on the paper before the glitter. Craft activities can also provide some development of co-ordination and fine motor skills. Craft tasks were not used in the data recorded at home. As with developmental tasks directiveness ranges from suggestion to instruction, all emergent structures are used.

In most sessions at Explorers the children are brought together to do a group task. This may be watching a video, singing, or playing games. Increased structure is used by the adults to ensure that each child takes a turn, occasionally making use of the PECS structure. Directiveness ranges from suggestion to instruction, with a slight preference for instruction to counter the distraction inherent in working together as a group. The focus of group activities is often similar with the emphasis placed on sharing and turn taking. In the following extract (Extract 26) the children are baking Thomas the Tank Engine buns, the icing sugar has just been emptied into a bowl.

Extract 26:

| | | |
|---|---|---|
| 1. | JAC: | mmmm smell |
| | | *holds bowl up to Theo* |
| 2. | JOA: | oh can you smell that [Andrew]? |
| 3. | JAC: | [smell] |
| | | *moves bowl across to Harvey* |
| 4. | JOA: | that smells [lovely] |
| 5. | JAC: | [smell] |
| | | *passes bowl around table and back to Katy* |
| 6. | KAT: | we need water |
| 7. | JAC: | does it say how much? |
| 8. | KAT: | its says (.) er (.) [ten two ten milli two] |
| | | Reading packet for icing |
| 9. | | teaspoons |
| 10. | JOA: | [sit down please Andrew] |
| 11. | JAC: | Harvey (.) in |
| | | *helps Harvey pour water into icing sugar* |
| 12. | JAC: | lets see if Andrew can put one in |
| | | *Katy moves the bowl round to Andrew* |
| 13. | JOA: | oh good boy |
| 14. | JAC: | [this one Andrew] (0.3) that's it |
| | | *Helps pour water in* |
| 15. | KAT: | [Mark I'll hold Th]omas |
| | | *takes icing shapes away from Mark* |
| 16. | JAC: | well done |

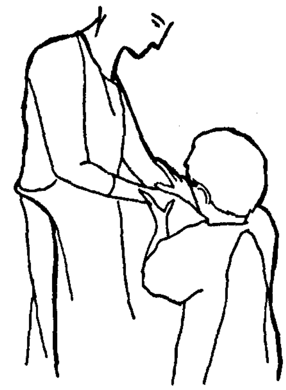


Structure is used to ensure that each child has a turn, firstly of smelling the sugar by passing the bowl around the entire table, and secondly by creating numerous individual actions that each child can perform (e.g. the first collecting the water, a second pouring the water into the bowl, the third stirring etc.). The enjoyable task of smelling the icing sugar is achieved through the suggestion level (lines 1, 2, and 5). The more difficult tasks of adding water into the bowl are achieved through a mixture of requirement (line 11) and instruction (lines 10 and 14). Requirement is also used to regulate behaviour, when the children are not engaged with the main focus of the activity (lines 10 and 15).

The final subgroup of directed tasks, functional tasks, are characteristically of short duration and include washing hands, taking shoes on and off, collecting a chair to sit on etc. They tend to be highly directive, at the require and instruct level, but are rarely structural. In Extract 27 Murray is trying to take off his apron.

There is no structure during the accomplishment of this task. Murray asks for help to take his apron off, and Diane obliges (lines 2 and 3). She then hands the apron back and asks him to hang it up, using the require level of direction (line 4). Murray does not immediately respond, but is praised (line 8) when he does hang the apron up.

| | | |
|---|---|---|
| Extract 27: | | |
| 1. | MUR: | ~vocalisation~ |
| | | *walks out of kitchen and looks back to Diane* |
| 2. | | *Murray walks back into kitchen and signs for help* |
| 3. | | *Diane takes his apron off* |
| 4. | DIA: | Murray (.) hang it up |
| | | *hands apron back to Murray* |
| 5. | | *Murray pulls sleeves down* |
| 6. | DIA: | good boy are you rolling sleeves down? |
| 7. | | *Murray takes apron and hangs it up* |
| 8. | DIA: | good boy |
| | | *helps him pull sleeve down completely* |

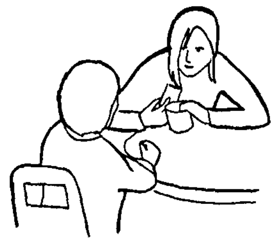


The remaining three contexts (comprising the *other* group) are found mainly at Explorers. They include, PECS training, snack time and transitions. PECS is used at Explorers and introduced into the home via the parents. Each child receives individual PECS training. This is labour intensive, requiring two staff to each child. Children progress through each level (described more fully in Chapter 3, Section 3.4.3). Motivation for successful exchanges is provided by the reward of a toy or food. At the simplest level the child requests a toy through a PECS exchange (my turn structure). As the children advance through the levels exchanges are initiated by Wh-questions (Wh-question structure). New concepts are introduced prior to exchanges. This takes the form of verbal labelling and physical matching of the object to the PECS symbol. A PECS session is characterised by extremely high levels of structure, with many exchanges repeated in one session. The directiveness is initially high with extensive use of physical prompts, but reduces to the requirement level as the child progresses and becomes increasingly independent. Extract 28a illustrates the introduction of new concepts, Extract 28b a successful exchange. It should be noted that the structure and directiveness is only apparent during intensive training sessions. Once the child begins to spontaneously use PECS in their communication the directiveness from the adult dramatically reduces.

In the first extract Katy uses the instruct level to name the colours of each container, and links them to the PECS symbol. Physical prompts are used during the exchange (second extract, lines 6 and 7). The exchange uses the Wh-question structure, the sequence is initiated in line 4, Toby builds and exchanges the strip in lines 5 and 6. Katy and Toby talk through the strip (line 7) prior to the reward (line 8) and praise (line 9).

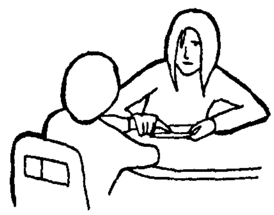
Extract 28a:

| | | |
|---|---|---|
| 1. | KAT: | good boy (.) come and sit down<br>*touches chair, quick thumbs up, returns hand down towards chair* |
| 2. | JOA: | come and sit down<br>*pats chair* |
| 3. | | *Toby sits down at table.* |
| 4. | KAT: | Toby (0.4) red (0.8) container (0.8) red<br>*Holds up red container* *holds symbol next to container* |
| 5. | KAT: | yellow container (1 sec) yellow<br>*Holds yellow container* *holds symbol next to container* |



Extract 28b:

| | | |
|---|---|---|
| 1. | KAT: | red.<br>*holding red container* |
| 2. | | *Toby reaches for it* |
| 3. | KAT: | one (.) two biscuits (.) red<br>*puts biscuits in container and replaces lid.* |
| 4. | KAT: | what do you want Toby?<br>*holds both containers and shakes them as offers them to Toby.* |
| 5. | | *Toby begins to compose PECS strip.* |
| 6. | | *Joanne moves his hand to give strip to Katy* |
| 7. | KAT: | I want red container (.) take red Toby<br>*uses Toby's hand to point to each symbol on strip as says them* |
| 8. | | *Toby reaches across and picks up red container.* |
| 9. | KAT: | aah red (.) good boy<br>*helps open the container.* |
| 10. | KAT: | biscuits! (.) yum yum |
| 11. | | *Toby takes and eats biscuit.* |



Snack time can last for 10-15 minutes and occurs towards the end of the session. Children have the choice of two juices, and several different snacks, such as crisps, biscuits, cake, or raisins. Snack time develops the children's use of PECS as they are expected to ask for their food and drink through appropriate exchanges. On receiving their requested item they return to the table to consume it. The reliance on PECS introduces artificiality into the interactions at snack time. Verbal requests may or may not be accepted, as a result the levels of structure and direction are very similar to those of a PECS session.

In accordance with the TEACCH programme each transition from one activity to the next at Explorers follows a rigid routine, thus introducing high levels of both structure and direction. Each child has a visual timetable which is used in an unvarying four step procedure:

a) on completion of an activity the card symbol for that activity is returned to the visual timetable.

b) The old activity symbol is placed in the finished box at the bottom of the timetable.

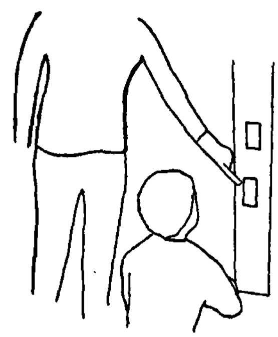
c) The card symbol for the next activity is taken from the timetable, (always the uppermost symbol).

d) The card symbol is taken to the location for the new activity and the activity is commenced.

Initially, as the child is learning the routine, a transition from one activity to the next may take several minutes. The time reduces once the child understands the system. Direction ranges from requirement to physical prompts. Extract 29 illustrates the four steps. The structure is initiated by Joanne (line 1). Theo continues through the transition relatively unaided (lines 2, 4 and 6).

Extract 29:

| | | |
|---|---|---|
| 1. | JOA: | sticking finished |
| | (a) | *hands him the sticking symbol.* |
| 2. | (b) | *Theo takes it and puts it in tray.* |
| 3. | JOA: | you can? |
| | | *pointing to next symbol* |
| 4. | (c) | *Theo takes the symbol* |
| 5. | JOA: | you can choose |
| 6. | (d) | *Theo sticks it on choose sheet.* |
| 7. | JOA: | well done Theo (0.3) you can choose |
| | | *opens gate into room one* |
| 8. | | *Theo runs into room one* |



The relationships between contexts are represented visually in Figure 8.2. Directiveness is represented on the x-axis, running from observation at the far left to prompting at the far right. Structure is represented on the y-axis and runs from no structure at the bottom, through emergent structures to imposed structures at the top. The circles represent the different contexts, locating them in terms of directiveness and structure. A larger circle denotes greater variability within that context, for example directed tasks show a large difference in directiveness (running from approximately suggest through to instruct). Overlapping circles represent similarities in directiveness and structure. The area within the grey square represents interaction where gesture is used most extensively.

Immediately apparent is the positive correlation between directiveness and structure. Whilst it may be possible to envisage structure without direction, or direction without structure (as is the case to some degree in functional tasks) it seems that this does not often occur in spontaneous interaction. Gesture was used to the greatest extent (by both adult and child) in the interactions falling inside the grey square. It seems that a certain level of direction and structure is beneficial to communication, thus leading to increased levels of gesture. The contexts of developmental and craft task and collaborative play seems most suited to the facilitation of gesture. Although both these contexts show a large amount of variation it centres around the mid range for both structure and directiveness. The extreme ends of these two continuums inhibit communication.

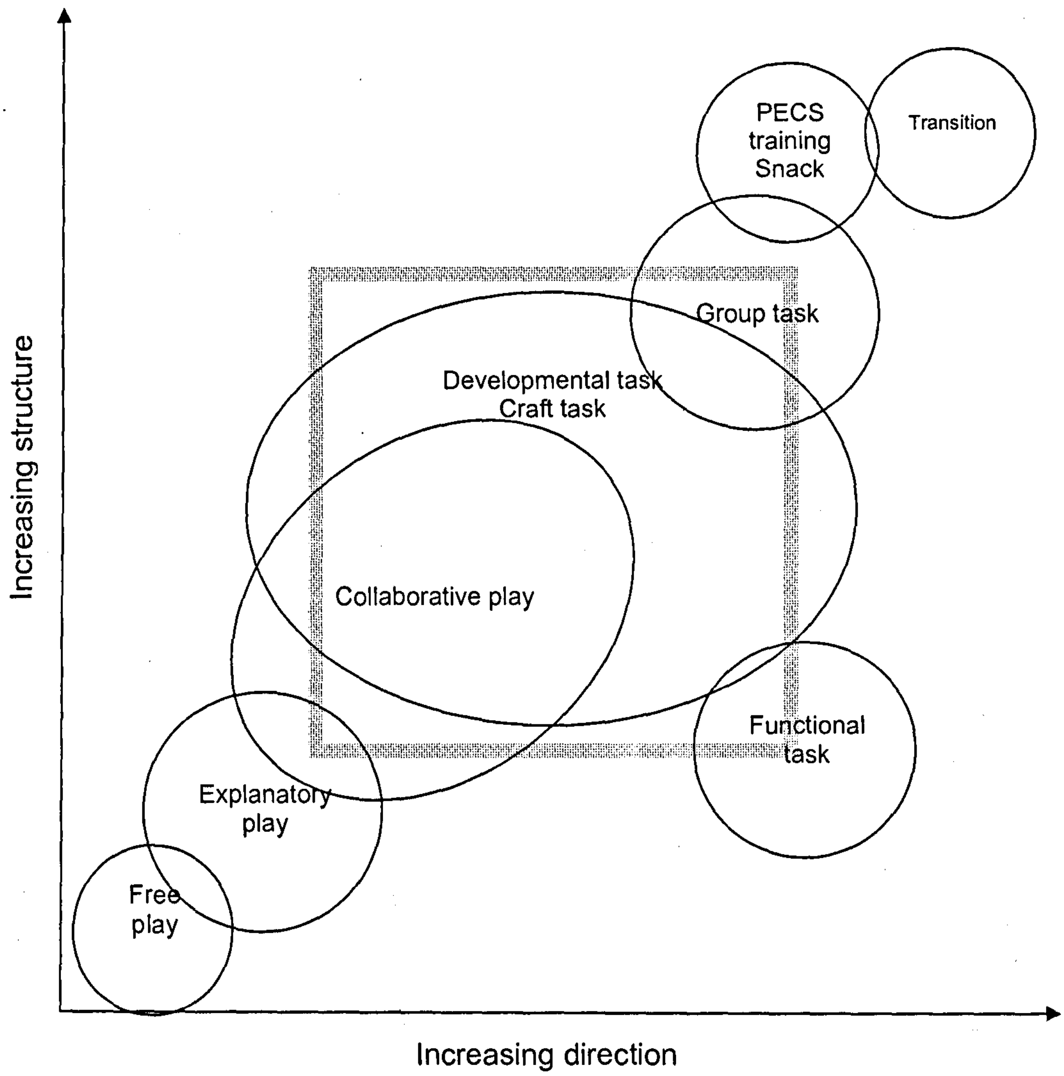



**Figure 8.2: Visual representation of contexts of interaction**

In the free and explanatory play contexts there is very little structure or direction. Interactions are often one sided, the child is able to (and does) ignore the adults while continuing to devise their own play schemes. This limits the communication opportunities. On the other hand too much structure and directiveness is also detrimental, as in the case of PECS training, snack time and transitions. Each of these contexts has an imposed structure which forces the interaction along pre-determined lines. Rigid adherence to these structures limits the gestural choices which can fit those roles. These interactions are dominated by physical prompts and deictic gestures. This analysis refers to the pedagogical aspects of PECS and not to its communicative use once acquired. Functional tasks are probably the most goal orientated of all the contexts, and thus are highly directive. They are characterised by either compliance without communication on the part of the child or objection through disruptive behaviours such as tantrums and aggression.

The individual activities undertaken in each interactional context may have an independent effect on communication. However many activities are used across different contexts, for example a jigsaw could be used in free play, explanatory play, collaborative play or as a developmental task. This is true of many of the activities used at Explorers and home. Thus it seems that whilst the activity may have some effect on interaction and gesture use, the overriding effect comes from the context; i.e. *how* the activity is used is more important than *what* the activity is.

#### 8.2.3.2 Context by environment

The amount of time devoted to the different contexts varies across the two environments. As a general rule the home data shows less even distribution of the three types of contexts. It should be remembered that the results presented here are based on the recorded samples, and may not be an accurate representation of the therapy provision during an entire Explorers session. Figure 8.3 shows the division between play, tasks and other activities (including PECS training, snack time and transitions) in both environments.

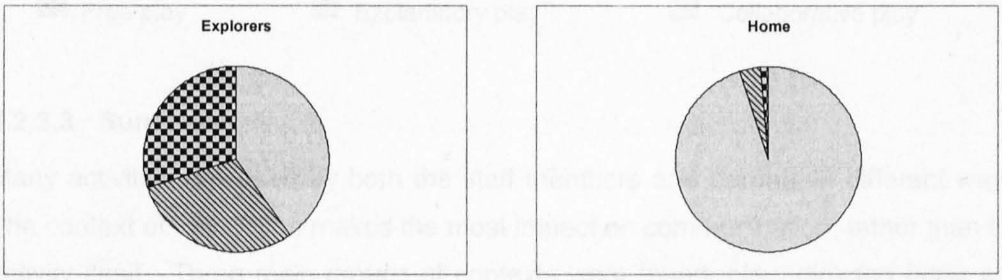



**Figure 8.3: distribution of contexts of interaction at home and Explorers**
Play directed tasks other activities

Just over a third of the data recorded at Explorers comprised playing activities. The remaining time was divided approximately equally between directed tasks and other activities. In contrast play activities accounted for 95% of the data collected at home, of the remaining 5% over two thirds comprised directed tasks and approximately 1% of the data was other activities.

Turning now to look at play activities in more depth, a similar pattern emerges (Figure 8.4). Collaborative play at Explorers accounts for just under half of all play activities, the remaining time is devoted approximately equally between explanatory and free play. Approximately 88% of the home data is collaborative play, 10% is explanatory play and the remaining 2% comprise free play.

Although these results appear striking, some of the devotion to collaborative play in the home context may be attributable to the observer's paradox. It was abundantly clear that mothers were providing the sort of interaction which they believed the researcher required. Children were rarely left to play by themselves, and when they were disinclined to interact parents often anxiously checked with the camera operator if the interaction was alright. This has undoubtedly led towards a bias in collaborative play in the home environment. The observer's paradox appeared to have less influence at Explorers.

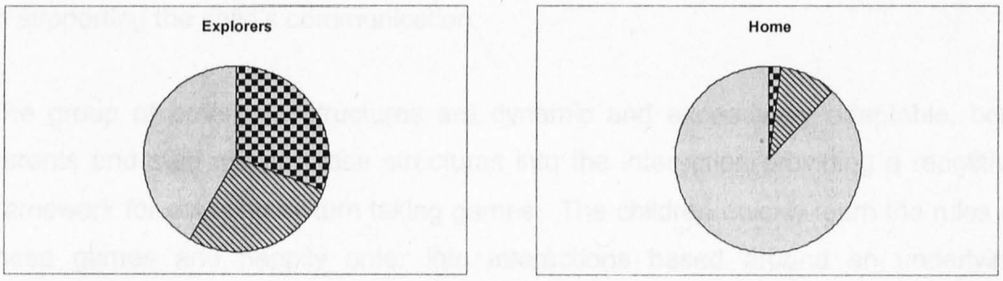



**Figure 8.4: distribution of types of play at Explorers and at home**

Free play Explanatory play Collaborative play

### 8.2.3.3 Summary

Many activities are used by both the staff members and parents in different ways. The context of interaction makes the most impact on communication, rather than the activity itself. Three main groups of contexts were found; play, directed tasks and other activities which mainly targeted intervention. The play context was overwhelming favoured at home, whilst the three groups were more evenly distributed at Explorers.

The staff seemed more adept at manipulating the whole range of directivenss and structures compared to the parents, but the mid range of directiveness and emergent structures appeared to facilitate gesture use (and communication) in the child. Parents made the most use of these mid levels of direction.

### 8.2.4 Discussion

Both parents and professionals successfully manipulate the levels of structure and direction in interaction with the participants. The staff appear to have more dexterity, as they incorporate a wider range of directiveness levels and both emergent and imposed structures. The ability to adapt to the child and switch between different levels of directiveness within a single activity appears to facilitate the child's communication the most. It seems that there is a balance to be struck between allowing the child freedom to express themselves and directing the interaction. If too much direction is given the interaction becomes narrow and repetitive, such as in PECS training and snack time. Too little direction and the child does not seem able to either initiate or maintain interaction. The levels of suggest, require and instruct appeared the most appropriate for the promotion of communication within this group. The extreme ends of the directiveness spectrum (as used by the Explorers staff) may serve other purposes but do not seem relevant in supporting the child's communication.

The group of emergent structures are dynamic and exceedingly adaptable, both parents and staff merge these structures into the interaction providing a repetitive framework for counting or turn taking games. The children quickly learn the rules of these games and happily enter into interactions based around an underlying structure. The imposed structures such as PECS exchanges and TEACCH transition sequences were observed at Explorers, and were rarely used at home.

The parents were more individual in their interacting style, each parent showing a slightly different profile in terms of directiveness and structure. These all tended to the mid range of the directiveness scale, and were not overly didactic. The staff appeared to be more homogenous as a group, demonstrating more flexibility in the range of directiveness and structure incorporated into their interaction. A greater awareness of communication, resulting from their training appears to make them more adaptable in their interaction and possibly quicker to respond to the changing needs of the child.

## 8.3 Picture book interaction: a series of case studies

The interactions based around picture books consistently provided a gesturally rich interaction. This activity was chosen to provide a central thread running through a series of case studies. These case studies will illustrate how the child and adult work together to shape the interaction. The case studies include Lee and Michael interacting with their mothers, Nathan and Zaara talking about books at Explorers, and Murray using a book with Jen as part of his ABA programme.

### 8.3.1 A visit to Toy Town

Lee and his mother sat on the sofa looking at several different picture books. The extract below is taken just after a Noddy book has been chosen. Lee's mother has opened the book and begins to talk about it (Extract 30).

Extract 30:

| | | |
|---|---|---|
| 1. | MOT: | oh look this is (0.5) I don't know what town it |
| 2. | | is but it's Noddy's town [in't it?] |
| 3. | | [*Lee moves her finger to picture*] |
| 4. | MOT: | teddy bear |
| 5. | | *Lee moves her finger to picture* |
| 6. | MOT: | doggy |
| 7. | | *Lee moves her finger to picture* |
| 8. | MOT: | chickens |
| 9. | | *Lee moves her finger to picture* |
| 10. | MOT: | house |
| 11. | | *Lee moves her finger to picture* |
| 12. | MOT: | (0.3) house |
| 13. | | *Lee moves her finger to picture* |
| 14. | MOT: | garage |
| | | *Moves book closer* [*to Lee*] |
| 15. | MOT: | [look find me Noddy] (0.2) |
| 16. | | where's Noddy?[(0.1) where's] |
| 17. | | [*Lee moves her finger to picture*] |
| 18. | MOT: | no: that's (0.5) PC Plod |
| 19. | | *Lee holds her finger and looks at her* |
| 20. | | *Lee moves her finger to picture* |
| 21. | MOT: | and that's a cat |
| 22. | | *Lee moves her finger then stands back from the book* |

Lee is collaboratively using the book although his joint attention skills are limited. Lee maintains an interaction with his mother based on the book, but does not include the global picture (a busy town scene). Instead he directs his mother's attention to different components. This is transitory; as soon as his mother names the picture he moves to the next. Lee directs his mother's attention by taking her hand and using it to form a point to indicate the different pictures. He does not incorporate visual checking into the physical prompts, however this may be redundant as Lee can assume that his mother will be attending to where her hand is. Confirmation is received when his mother names each picture. Lines 3-14 follow this simple repetitive structure (point, name, point, name etc).

In line 15 his mother breaks this structure, moving from a descriptive role to a suggestive role, by asking Lee to find the picture of Noddy. She physically signals this change by repositioning the book. Lee ignores this invitation and continues to indicate elements of the main picture (a policeman followed by a cat). His mother interprets these as attempted responses to her question and elaborates her answer according (no, that's PC Plod, that's a cat). Lee recognises this change and in line 22 stops the naming structure by moving back, away from the book.

Line 18 shows some evidence of Lee's developing social understanding. He uses his mother's hand to indicate the picture of the policeman (line 17). His mother responds, but forgets the name of the policeman, causing a half second pause before providing the required information (PC Plod). During this pause Lee looks at her to discover why she is not responding. This shows some understanding that if her attention is diverted (as interpreted through eye gaze) then she will not take her turn in the sequence of interaction.

### 8.3.2 How to brush your teeth

Zaara and Lucy have been looking through a selection of picture books before being captured on camera. The extract below occurs within two minutes of the start of the recording. Lucy has just turned the page in a book about the morning routine, and has found a picture of someone brushing their teeth (Extract 31).

Extract 31

| | | |
|---|---|---|
| 1. | LUC: | look (.) brush (0.2) brush teeth<br>*points at book brushing teeth, holding toothbrush* |
| 2. | | *Zaara looks at book looks at Lucy and imitates action with finger as brush* |
| 3. | | *Zaara continues gesture but looks at camera* |
| 4. | LUC: | brush teeth (0.5) Zaara brush teeth<br>*Still brushing points to Zaara with thumb* |
| 5. | | *Zaara looks at camera*<br>*(0.5)* |
| 6. | LUC: | Zaara do it<br>*strokes her arm to get her attention* |
| 7. | | *Zaara looks at book, points to it then does brushing teeth gesture* |
| 8. | LUC: | brush teeth (.) brush (.) brush (.) brush<br>*gesture to brush teeth* |
| 9. | | *Zaara looks back at the camera then at the book* |
| 10. | LUC: | brush brush brush |

In this short extract Lucy is being very directive. The majority of her turns are at the requirement level (line 1: "look", "brush teeth"; line 4: "brush teeth", "Zaara brush teeth"; line 6: "Zaara do it"; and line 8: "brush teeth"). Lucy is basing the interaction loosely around an action structure; modelling the gesture for Zaara to imitate. There is no reward or praise when Zaara does imitate, instead Lucy changes from a requirement to a descriptive level (lines 8 and 10 "brush brush brush").

Zaara has become more interested in the camera than the book. She follows Lucy's direction in line 2, firstly looking at the book following Lucy's deictic gesture, then at Lucy as she performs the brushing gesture. Zaara imitates this gesture without being explicitly asked. Lucy and Zaara perform the gesture in slightly different ways. Lucy uses an imagined object form, where her hand is shaped as if she is holding a brush. Zaara however extends her forefinger, using a body part to represent the brush, a cognitively less demanding gesture. In lines 3-5 Zaara becomes distracted by the camera, and when recalled by Lucy, overtly demonstrates the return of her attention by pointing to the picture before repeating the gesture once more.

Lucy is being increasingly directive to compensate for Zaara's preference for the camera rather than the book. Yet Zaara does show joint attention skills and easily switches between watching the camera and interacting with Lucy.

### 8.3.3 Puppies and penguins

In this extract Nathan and Joanne have begun reading a book about animals. The whole interaction unfolds over approximately five minutes. The first extract is taken from close to the start of the interaction, and the second from near the end. They clearly show a progression in the way the book is used. In the first extract (Extract 32a) Joanne is reading the first page to Nathan. It is a rhyme about four puppies, the extract begins part way through.

Throughout this extract Joanne is working hard to establish Nathan's attention on the book. She does this through a series of deictic gestures; either pointing at the relevant pictures (lines 1, 3, 4, 6, 8 and 14), or tracing the writing as she reads (lines 14 and 16). Verbally she is at the describe level of directiveness; reading the text without making comments, interpretations or suggestions. Gesturally she is working at the borderline between the suggestive and requirement levels as gestures are used to indicate where Nathan should be directing his attention, with some expectation that he will. Nathan is accepting of this direction, and reciprocates by imitating her gestures (lines 5, 7, 13 and 15) and by verbally repeating "one" (line 11). He demonstrates some awareness of joint attention, directing his attention where Joanne indicates through her gestures. However he does not attempt to direct her attention, and is easily distracted by the flap in the book and noises in the room (lines 10-11).

Extract 32a:

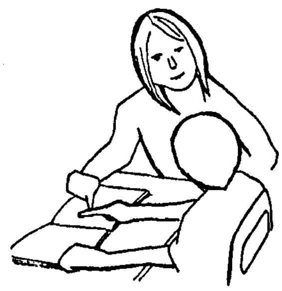
| | | |
|---|---|---|
| 1. | JOA: | three little puppies<br>*pointing at picture of three puppies in turn* |
| 2. | JOA: | what could I do?<br>*moving Nathan's hand from the writing* |
| 3. | JOA: | I took the black one home then there were<br>*pointing at black puppy* |
| 4. | | (.) one (.) two<br>*pointing at each puppy* |
| 5. | | *Nathan imitates points at the puppies* |
| 6. | JOA: | two little puppies playing in the sun<br>*pointing at each puppy* |
| 7. | | *Nathan imitates points* |
| 8. | JOA: | I took the grey one home<br>*tapping grey puppy moves tapping to last puppy* |
| 9. | JOA: | then there was?<br>*holds finger up* |
| 10. | | *Nathan looks at Joanne then plays with flap* |
| 11. | NAT: | one<br>*Looks round at noise then back and sees her finger* |
| 12. | JOA: | one |
| 13. | NAT: | o[ne] [one]<br>*Imitates finger held up* |
| 14. | JOA: | [one] little [pup]py looking very sad<br>*pointing at single puppy* *pointing at text* |
| 15. | | *Nathan copies point to puppy* |
| 16. | JOA: | I took it home and then there were none (.)<br>*finger traces writing* |
| 17. | | look<br>*opens flap* |

In the extract taken from the end of the picture book interaction Nathan is taking on a fuller role. His attention becomes focused and he begins to introduce topics and drive the interaction himself. Joanne's use of deictic gestures has decreased, as has her reliance on an imposed framework given by the text in the book. In Extract 32b (below) Nathan works collaboratively with Joanne to talk about the various animals on that page.

In this extract Nathan actively seeks interaction, and has the necessary joint attentions skills to ensure that his attempts are successful. Nathan not only introduces topics (lines 2 and 10) but is able to sustain the topic over several turns. At the start of the extract Nathan directs Joanne to the cats, by combining a verbal naming (meow) with a pointing gesture and visually checking. Nathan looks back at the cats once he knows that Joanne is also looking at them (lines 2-3). Joanne accepts the topic, and Nathan maintains it over another turn (line 4). In line 6 Nathan attempts to introduce the penguins, again with a vocalisation and pointing gesture. However he does not look at Joanne, and she does not follow his lead, instead she chooses to elaborate on the lions with an iconic pouncing gesture. This disparity in topics continues through lines 8-10, with Joanne completing a sequence that has emerged earlier, of naming the picture (line 5), elaborating (line 7), then renaming (line 9). Nathan attempts to reintroduce penguins by pointing at a different penguin picture (line 8), but again does not look at Joanne.

Extract 32b:

| | | |
|---|---|---|
| 1. | JOA | look |
| 2. | NAT | meow<br>*points to the cat picture then looks at Joanne* |
| 3. | JOA | meow (.) are they cats?<br>*nods and points to cats then looks back to Nathan* |
| 4. | NAT | they're cats |
| 5. | JOA | this one's a li[on]<br>*points to picture of lion* |
| 6. | NAT | [mmm]<br>*points to picture of penguin* |
| 7. | JOA | raa::::<br>*hands as claws pouncing* |
| 8. | | *Nathan points to penguin on far side of picture* |
| 9. | JOA | l[ion]<br>*points to lion* |
| 10. | NAT | [ra:]<br>*maintains pointing but looks at Joanne then back to picture* |
| 11. | JOA | penguin<br>*points to penguin looking at Nathan* |
| 12. | NAT | penguin<br>*points to 3rd penguin* |
| 13. | JOA | this one goes<br>*picks up Nathan's hand and moves it to lion picture* |
| 14. | JOA | this one goes raa::<br>*taps lion picture* *hands as claws* |
| 15. | NAT | ra::[:]<br>*Imitates and looks at her* |
| 16. | JOA | [ra:]::<br>*Hands as claws then turns page* |



In lines 10 and 11 the roles have almost become reversed. Joanne has completed her lion sequence and is now ready to respond to Nathan, whereas Nathan attempts to give a response to Joanne's lion sequence by imitating her roaring whilst maintaining the penguin point and looking at her (line 10). Joanne picks up on these cues and labels the penguin in line 11. Nathan completes a common naming structure with his next turn (question achieved through gesture, line 10; model response, line 11; confirmation/repeat in line 12). Thus far in the interaction both interlocutors have been working at the suggestion level of direction, but Joanne changes to prompting by physically moving Nathan's hand to the lion picture (line

13). On establishing the lion topic, Joanne once more elaborates with the iconic pouncing gesture. Nathan copies her and they turn the page together.

In this second extract both Joanne and Nathan take an almost equal role in the achievement of the interaction. As a result the interaction is shaped collaboratively with both Nathan and Joanne making use of structure, direction and joint attention skills. Looking across the two extracts it can be seen that initially Joanne introduces direction and structure, using primarily deictic gestures to focus Nathan's attention. Once this has been achieved Nathan can engage in the interaction taking an active role in the formation of its subsequent shape.

### 8.3.4 Pingu's ice cream

Michael and his mother spent just over twenty minutes looking through a child's magazine. It featured many characters from children's TV programmes, with activities such as guiding a character through a maze, following jumbled up lines to find out which characters have which toys etc. The extract below (Extract 33a) comes towards the end of the interaction. Earlier Michael and his mother spent several minutes trying to find the page featuring Pingu. They found it, completed the activity (following different geometrically shaped lines e.g. zig zags, wavy lines, 90° corners, with their fingers), then spent some time describing the Antarctic scene. Just prior to the extract Michael's mother noticed a second activity and they counted all the fish they could see on the page. The first extract begins here, with Michael's mother asking about the colour of these fish.

Michael's mother introduces the idea of colour in line 1, then moves into a simple naming structure, from lines 3-15. Michael gives the correct response to the questions extremely quickly, with the exception of lines 13 and 15 when he takes longer to respond. This marks the end of the sequence with the interaction turning to a discussion of the black and white fish. Although Michael is quick to respond throughout this sequence he does not look up at his mother, but remains looking at the book throughout. He follows his mother's lead and does not attempt to direct her attention.

Extract 33a:

| | | |
|---|---|---|
| 1. | MOT: | are they all different colours these fish? |
| 2. | MIC: | don't know(?) |
| 3. | MOT: | they are (0.1) these are (.) what colours that |
| 4. | | one? |
| | | *Pointing to picture* |
| 5. | MIC: | green |
| 6. | MOT: | ye:ah and what colours that [one]? |
| | | *Pointing to picture* |
| 7. | MIC: | [red] |
| 8. | MOT: | and that one? |
| | | *Pointing to picture* |
| 9. | MIC: | yellow |
| 10. | MOT: | and that one? |
| | | *Pointing to picture* |
| 11. | MIC: | yellow |
| 12. | MOT: | and that one? |
| | | *Pointing to picture* |
| 13. | MIC: | (0.7) green |
| 14. | MOT: | and that one? |
| | | *Pointing to picture* |

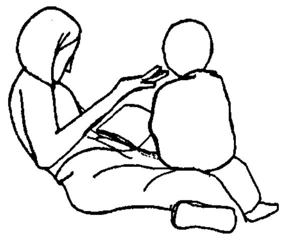
The second extract (Extract 33b), occurs only a minute after the first. After discussing the black and white fish in the basket, Michael restates that Pingu has dropped his ice cream. This was his first observation on finding the Pingu page and was followed by a discussion of the ice cream flavours. This time his mother asks what Pingu will do now.

Michael introduces the new topic verbally. He does not look at his mother, nor does he use gesture to point to the picture of Pingu. His mother uses Michael's observation as the basis to ask what Pingu will do next. Unlike the factual questions in the first extract, this question is speculative and open-ended. Michael appears to have difficulty in answering it. His mother repeats the question three times (lines 4-7) before Michael attempts a response in line 9. It is unclear if this is in answer to his mother's question, or is another observation arising from the picture in the book. His mother interprets it in the former light (lines 10-11) and rephrases her question accordingly.

In line 12 Michael's mother provides the answer for him (in question form), and asks for his agreement, a strategy she repeats again (lines 16-17 and 19). Michael verbalises during his turn, showing awareness of conversational structure, but does not provide a clear response, even to the easier task of giving agreement. Michael appears to have most difficulty in line 13. This is the only time that Michael looks to his mother, and it follows a pause in the interaction, and a rephrasing of the question. Eventually Michael returns to the original observation, and his mother agrees once again that Pingu has dropped his ice cream.

Extract 33b

| | | |
|---|---|---|
| 1. | MIC: | Pingu's dropped his ice cream |
| 2. | MOT: | Pingu's dropped his ice cream (.) he has! |
| 3. | | (0.2) oh no! |
| | | *points to ice cream and nods* |
| 4. | MOT: | what's he going to do? (2 secs) what's he |
| 5. | | going to do? |
| | | *Spreads hands out palm up* |
| 6. | | *Michael holds on to the book* |
| 7. | MOT: | hey? (1.5) what do you think he's going to |
| 8. | | do? |
| 9. | MIC: | a fish |
| | | *pulling comic down* |
| 10. | MOT: | a fish? (0.5) do you think he's going to get a |
| 11. | | fish? |
| 12. | MOT: | or is he going to get another ice cream? |
| | | (1.5 secs) |
| 13. | MIC: | ~vocalisation~ |
| | | *looking at mother* |
| 14. | MOT: | what do you think? |
| 15. | MIC: | a fish a fish a fish |
| | | *Looking at mother and talking quietly* |
| 16. | MOT: | I think he's going to go get another ice |
| | | *Points to picture of ice cream* |
| 17. | | cream (0.3) do you? |
| 18. | MIC: | a fish a fish a fish |
| 19. | MOT: | do you think he is? |
| 20. | MIC: | Pingu's dropped his ice cream. |
| 21. | MOT: | Pingu's dropped his ice cream yeah. |
| | | *nodding* |



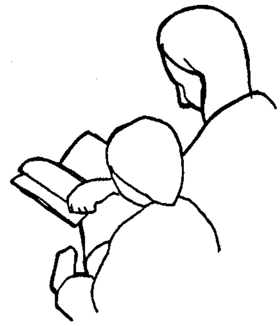
The extent to which Michael intended his statement regarding Pingu's ice cream to be communicative is unclear. The statement is made verbally with no attempt to either attract the attention of his mother, nor to check that he has that attention. He makes limited responses to his mother's attempts to continue the interaction. This may be due to the complex nature of the question when compared to the fact based ones posed in the previous extract. However Michael does fill his conversational turn, which indicates a certain level of competence in the collaborative building of the interaction.

### 8.3.5 Where's that bus?

In the previous extracts the books have been used to name different pictures, or to provide a stimulus for interaction not tied to the context of the book. In the following extract Jen uses a book to develop Murray's intelligibility, within the ABA programme. Jen encourages Murray to provide certain sentences as she reads the book. The story is about two animals, Rabbit and Mole, waiting at a bus stop to go to tea with Squirrel. They are easily distracted and miss numerous buses (Extract 34).

Extract 34:

| | | |
|---|---|---|
| 1. | JEN: | ok (0.5) ready? (.) steady? |
| | | *shuffles closer to Murray* |
| 2. | MUR: | go |
| 3. | JEN: | go |
| | | *turns the first pages of the book* |
| 4. | JEN: | Squirrel has asked us to tea said Rabbit |
| 5. | | (0.3) yipperty? |
| 6. | MUR: | yipperty opp |
| 7. | JEN: | good boy (0.2) I love going to tea |
| 8. | | *Murray shuffles backwards* |
| 9. | JEN: | listen |
| | | *Puts hand on his knee to keep him still* |
| 10. | JEN: | it's too far to walk said Mole we'll get the? |
| | | *Points to book* |
| 11. | MUR: | bus |
| 12. | JEN: | good talking |
| | | *turns the page* |
| 13. | JEN: | they hopped and scurried to the bus stop |
| 14. | MUR: | where's that bus |
| 15. | JEN: | good boy (.) said Mole (0.7) look said Rabbit |
| | | *pointing to text in book* |
| 16. | | (0.1)flowers |
| 17. | | *Murray starts to fidget* |
| 18. | JEN: | I'm going to pick a whopping great bunch for |
| 19. | | Squirrel (.) she scampered away from the |
| | | *points to book* |
| 20. | | bus stop (0.1) we might miss the bus (0.2) |
| 21. | | called Mole (.) mind you (0.1) Squirrel does |
| 22. | | like flowers (.) I think I'll pick some too |
| | | *turns the page* |
| 23. | JEN: | Rabbit and Mole picked some flowers |
| | | *points to picture of bus and looks at Murray* |
| 24. | MUR: | uh oh |
| 25. | | *Jen turns the page* |
| 26. | JEN: | then they went back to the bus stop (.) |
| 27. | | where's? |
| | | *Looking at Murray* |
| 28. | MUR: | that bus |
| 29. | JEN: | said Mole |



For the majority of the story Murray sits passively next to Jen looking at the pictures. Jen indicates his contributions using a combination of verbal, gestural and gaze cues. The book is started with a simple pausing routine (ready steady go). Jen cues Murray's response verbally by using rising intonation, and visually by looking at him. She repeats this combination of cues in lines 5 and 27. In line 10 Jen uses the verbal and visual cues again, but also includes a gestural cue in the form of a point to the text. The remaining two cues (lines 13 and 23) do not use a verbal prompt. Instead, in line 13, Jen prompts Murray solely through pausing in the reading of the book and looking at him. Murray uses this more subtle cue and quickly provides his response (line 14). The final cue occurs in line 23, and is indicated solely by Jen pointing to the bus in the distance whilst Rabbit and Mole pick flowers. Jen only looks at Murray once he has begun the expected response.

Although Murray takes a limited role in the interaction he is able to maintain joint attention throughout the reading of the book and to extract his turn through a multiple of verbal, gestural and gaze cues given by Jen.

### 8.3.6 Summary

Each case study used the same activity, talk based around a book but each resulted in very different interaction. Lee controlled the use of the book with his mother, using it as a resource of pictures for labelling. He showed no interest in further discussion, and disengaged from his mother when she tries to use the book in a different way. In contrast Zaara took a less active role and imitated Lucy's lead in the teeth brushing gesture. Rather than labelling different components of this picture (such as brush, person, mouth, hand, sink etc) the global action of teeth brushing formed the basis of the short conversation.

Nathan and Michael used the books similarly. They both took a fairly active role, either initiating or responding to their interlocutors. Nathan increased and maintained his attention for longer as the interaction developed. This resulted in the ability to successfully initiate a new topic, working around the constraints of the structure used by Joanne. Michael did not show the same progression but did respond to fact based questions and more speculative questions differently, thus influencing the shape and sequential unfolding of the interaction.

Yet another use of the book was found by Jen and Murray where it was used to improve Murray's intelligibility through repetition of target sentences. Murray was quick to respond to Jen's verbal and gestural cues. He had a clearly defined role within the interaction, as it was presented as a task to be completed within the confines of the ABA programme.

## 8.4 Main summary

This chapter sought to provide observations on the interaction recorded between the children on one hand and the staff and parents on the other. Interaction was acknowledged to be complex and collaborative. The participants divided into three subgroups dependent on their dominant interaction form which included dyadic interaction, triadic interaction and sustained joint attention. Interaction was consistent with their socio-communicative development and did not vary across environments.

In contrast several differences were found between parents and the staff at Explorers. Two factors were identified; directiveness and structure. The professionals were more flexible with both and combined them into more varied contexts of interaction. In contrast the parents only made use of the mid levels of both continuums and collaborative play dominated their interactions. The final part of the chapter attempted to illustrate how interaction is collaboratively achieved between the child and adult by means of a series of case studies with the unifying theme of picture book interaction. Great variety was found in the interactions arising from the picture books, even within the short extracts presented in this chapter.

# Chapter 9

# Discussion

This chapter seeks to draw together the various threads of the thesis. The three main strands of development, input and interaction are discussed separately, before the links between strands are considered. Attention then turns to gesture's place in intervention, and some suggestions are made for the future direction of gesture assessment.

## 9.1 What is the gestural profile of children with ASD?

Much of the existing literature on gestural communication in autism only provides a detailed discussion of deictic gestures. This project expands the body of literature to iconic gestures and emblems in addition to providing a comprehensive examination of gesture functions. A description of gesture form and function will be provided, prior to linking the observed behaviour patterns to current proposals for the cognitive processes of ASD.

### 9.1.1 Gesture form

The study confirmed that gestural communication is delayed in children with ASD. Deictic gestures, accounting for over 80% of all gesture, form the core of the gestural repertoire. The remaining gestures comprise mainly emblems, with some limited iconic gestures. The following sections discuss each gesture form in turn.

#### 9.1.1.1 Deictic gestures

Development is similar to the typical experience as requests and protests appear before pointing gestures. Frequent requests were one or two handed reaching gestures and physical prompts. Ritualised requests, such as reaching towards the object whilst opening and shutting the hand, were not observed. It was often difficult to determine the degree of communicative intent behind a reaching gesture. Visual checking, the most obvious candidate for assessing intent, was rarely used by the participants, neither did they repeat nor repair failed communicative attempts. This did not appear to be attributable to a lack of communicative intent in the original act, but rather the child lost interest in prolonged communication. In an attempt not to ignore communicative behaviour, reaching was considered communicative if the target object was beyond the reach of the child. This coding decision may have led to slightly inflated scores for request and protest gestures.

The use of physical prompts is well attested in the literature to the point of being considered a marker of ASD. The results of this study do not completely agree with this account. Only the most developmentally delayed children, James and Lee, consistently produced such gestures. Comparable to typical development, physical prompts are an early, conceptually simple form of deictic gesture which gives way to pointing. Due to the delay in social and communicative development this gesture form is observable for a longer time period in children with ASD. A physical prompt minimises the need to monitor the attention of the interlocutor as they can be assumed to be attending to the location of their hand. For this reason physical prompts may be beneficial for children who are struggling with triadic interaction as a precursor to full joint attention. It should be viewed as an indicator of the child's social and communicative development, rather than a gesture which is specific to ASD.

The most frequent protesting gesture was the pushing away of an adult's hand or object. If the adult persisted, protesting behaviours escalated into turning away, stiffening of the body, crying and tantrums, and throwing of objects. This is an area which lends itself to further study as the ability to self regulate emotion is necessary for the maintenance of joint attention. Although not formally tested, the more extreme protesting behaviours appeared associated with limited social development.

Seven of the eight participants were either pointing at the start of, or developed pointing during, the study. Imperative and declarative pointing has been extensively researched with mixed results. Either declarative pointing is not present at all (Baron-Cohen, 1989), it develops after imperative function but only in children with a mild form of autism (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003), or the declarative function is only found in children who can also point (Stone *et al* 1997). All researchers agree that declarative function is impaired compared to imperative function.

The current study also supports the final statement in the preceding paragraph, and is in partial agreement with two of the above studies. A developmental sequence from imperative to declarative was identified (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003) but declarative function was observed in six of the eight participants, ranging from mild to moderate autism. Declarative function was absent in the two children who did not point (Stone *et al*, 1997), but pointing emerged for Lee at 46 months, and no declarative function was observed in his interaction over the remaining three months of data collection. The present study did not replicate the finding that declarative function is entirely absent (Baron-Cohen, 1989).

One question remains to be answered, that is why are there elevated levels of declarative function (six of eight participants) in the present study compared to previous ones? Methodological differences may provide the answer. Baron-Cohen observed spontaneous group interaction of ten children, with an unreported number of adults. Children with ASD approach adults in preference to their peers, therefore the number of adults is highly relevant. Secondly the results presented in this thesis demonstrate that group interactions decrease communication and gesture. In a session where Nathan was in group interaction with six children and three adults he produced three gestures, in comparison to one on one interaction were he produces thirty eight. Baron-Cohen's results may be reinterpreted as showing that children with ASD find all communication increasingly difficult in a group situation, thus decreasing the chances of observing declarative function, which is relatively rare in the output.

Both Camaioni *et al* and Stone *et al* used elicitation methods with one on one assessment in their studies, an ideal context for the production of declarative function. Such gestures were reported for both studies, but at low frequency. There seems little opportunity for the child to familiarise themselves with either the experimenter or the assessment room in either study. In contrast, the present study recorded children in two familiar environments and with adults they knew well. Such favourable circumstances may have contributed to the increased levels of more complex interactional functions.

#### 9.1.1.2 Iconic gestures and emblems

Previous studies have found emblems restricted to certain individuals (Camaioni *et al.*, 1997; Camaioni *et al.*, 2003; Stone *et al.*, 1997), this finding was replicated. Different emblems were used by different participants; Theo often did HIGH FIVE and THUMBS UP gestures but rarely nodded or shook his head, Nathan showed the opposite pattern. Unsurprisingly the emblems most frequently modelled by parents were acquired by the child. For children with ASD emblems may only imitate social routines and have no inherent social meaning (Camaioni *et al*, 1997). This is hard to verify as emblems were appropriately embedded within interaction by all participants who produced them.

Iconic gestures are never highly frequent, even for typically developing children (Goodwyn & Acredolo, 1993), yet they are practically non-existent for children with ASD. The vast majority of iconic gestures were produced during recitation of nursery rhymes or action songs, contexts which result in multiple instances of modelling. Picture book interactions also lead to increased imitation of iconic gestures: Nathan imitating MONKEY and LION, and Zara BRUSH TEETH. Michael and his mother incorporated TRAIN WHISTLE into play at home, although Michael never produced this at Explorers, and never initiated its use at home.

A discrepancy in imitation of iconic gestures was found between environments; at Explorers 90% of all iconic gestures produced by the child were imitations compared to 29% at home. It is unlikely that the mirror neuron account can explain this finding, as imitation requires the same subset of skills in both environments. It may be a false result arising from the small number of iconic gestures observed, thirty for Explorers and eighteen at home. Environmental differences are likely to contribute; there are more actions songs and nursery rhymes at Explorers, the staff model more iconics and explicitly ask the child to imitate. This may have increased the levels of iconic gesture through imitation.

### 9.1.2 The gestural repertoire – function

Apart from the well documented dissociation of imperative and declarative function found in children with ASD, little else is known about gestural functions. Three main functions were discovered in this study: emotional displays, facilitating gestures and organisational gestures. Each is discussed below.

#### 9.1.2.1 Emotional display

In general emotional display gestures were found to decrease with age, comparable to typically developing children. Emotional display gestures may linger in children with ASD as, due to limited language, they may be the sole means of expression.

Discrepancies were found in the data for Lee and James; emotional display gestures decreased at Explorers but increased at home. When followed up by qualitative analysis no differences in the joint attention behaviours were found in the two participants across environments; indicating no differential language use. However the environments did change in terms of the context of interaction, with collaborative play dominating at home. Such a context may be conducive to the expression of emotion, thus explaining the prevalence of emotional display gestures at home. This does not explain why they should increase, and only for two participants. An extensive reanalysis of the existing data, coupled with further collection is needed to fully understand this trend.

#### 9.1.2.2 Facilitating gestures

The overwhelming majority of gestures are facilitating, and of these gestures most are deictic. The imperative/declarative disassociation in ASD has already been discussed. Remarkably little is known about other gesture functions, either in typical or atypical development. This study attempted to provide an account of the functions of early gestures in children with ASD.

The attainment of immediate needs formed the core of gesture functions. This is similar to imperative function, but also included protesting gestures. For the more linguistically able and socially aware gesture is combined with speech to form questions. Gesture is more commonly used as a response to a question. This is very often in the form of a deictic gesture, either alone or with words. The social function included simple turn taking games, nursery rhymes and action songs, and greeting gestures.

A distinction was made between commenting and declarative function. Commenting did not require attention to be shared with another. Commenting gestures were observed in picture book interactions, craft activities and developmental tasks or play activities with a range of novel stimuli. Only gestures with a clear requirement for the adult to respond were coded as declarative. This was felt to be a necessary restriction, but may have resulted in underrepresentation of this function.

#### 9.1.2.3 Organisational gestures

Organisational gestures were extremely rare, accounting for less than one per cent of all gestures. Only half the participants produced at least one organisational gesture. Organisational gestures may be equally rare in typical development, to the researcher's knowledge this has not as yet been investigated. Certain pre-requisites are necessary for successful emergence of the organisational function.

Firstly the child must acknowledge that tasks cannot be abandoned at will. This necessitates a) the acknowledgment that another has different intentions, b) that permission to start or end a task should be sought, c) the ability to successfully seek this permission.

For the participants who did enter into negotiation (Michael, Murray, Nathan, Theo, Zaara) there is no reason to suppose that this should be achieved through gesture. Indeed all but Murray were more likely to enter into verbal negotiation. Murray was notable for his increased use of organisational gestures, due to a single Babysign FINISH which he used when he wished to end an activity.

### 9.1.3 Can Theory of Mind, Weak Central Coherence and Executive Functions accounts explain the observed gestural patterns?

The lack of declarative function in gesture has long been assumed to be related to the theory of mind deficit. For children less than four years old similar deficits can be seen in joint attention skills, commonly believed to be precursors for theory of mind (Charman *et al.*, 2000). The results obtained in this study complement the literature. Declarative gestures were rare, as discussed in Section 9.1.1.1, and can be attributed to corresponding deficits in the early precursors of a theory of mind.

The rarity of iconic gestures may be ascribed to weak central coherence. Gesture is subject to the same sense making difficulties as language. This is particularly acute in imagistic gestures; not only is there inherent symbolism in iconic gestures, but meaning is reliant on the accompanying speech. Research has shown that the speech context is not taken into account to interpret meaning of words (Jolliffe & Baron-Cohen, 1999). It is unlikely that verbal context will be used to assign meaning to the gestural modality. The ability to discern coherence between different objects, or in this case across modalities, is considered most difficult for people with ASD (Plaisted, 2001). Under this view iconic gestures prove doubly difficult; the sense of the gesture must be assigned, and then integrated with speech to form a coherent whole. This interpretation is supported by Silverman *et al* (2007) who conclude that integration of iconic gesture and speech is impaired in adolescents with high functioning autism. Not surprisingly if such gestures are hard to interpret they will not be used spontaneously by the child. The imitation of the gestures observed during this study may have been produced entirely without meaning.

This account predicts that emblems should be more frequent than iconic gestures in the gestural repertoire of children with ASD, this was indeed the case. Emblems do not require speech to be understood, therefore there is a single, rather than double, handicap associated with these gestures. The difficulties evident in comprehension of representational gestures, and problems with the integration of gesture and speech raise questions about the usefulness of manual sign systems in intervention for ASD.

Executive dysfunction is unlikely to play a part in the behaviour observed in the participants in this study as they are too young for this to have developed. Yet studies show correlation between executive function and joint attention skills (Griffith *et al.*, 1999). Speculatively executive function may be implicated in the production of organisational gestures as they require the ability to plan changes between tasks. However this relies on the verification of several assumptions. Firstly organisational gestures should be fewer in children with ASD than control groups. Secondly such gestures should remain consistently few over the course of development, reflecting a deficit rather than delay. Thirdly the low levels of organisational gestures should not be able to be explained by other means; such as the power imbalance between adult and child, or verbal preference for negotiation.

### 9.1.4 How does the processing architecture develop?

The processing architecture for speech and gesture proposed in Chapter 2 (Section 2.2.3) aims to unify speech and gesture. Thought is transformed into communicable form in the conceptualiser. The verbal component is sent to the formulator where the lexicon, syntax and morphology are accessed. A motor programme is produced which results in overt speech. Simultaneously the gestural counterpart is sent to the gesture generator. The formulator and generator are linked, resulting in temporal synchronicity in the performance of speech and gesture. It is not possible to investigate gesture speech mismatches with respect to the development of the processing architecture in ASD as the data collected in this project does not inform on this phenomena.

The development of the architecture was argued to be a gradual process; evidence for this claim was presented in Chapter 6 (Section 6.1.3.2). The first development is located in the conceptualiser. Initially the conceptualiser cannot segment the communicable form, nor can messages be sent to both formulator and generator simultaneously. Behaviourally this corresponds to gesture and speech appearing isolated from each other. Greater flexibility is brought into the system as the formulator and generator expand and begin to link together. The conceptualiser still cannot segment but can send to both routes simultaneously. This corresponds to the first non-synchronised reinforcing cross-modal combinations. As the links between the formulator and generator become more established, temporal synchronicity is achieved. With the achievement of segmentable communicative forms different components can be sent to the appropriate modality. This corresponds to the first supplementary combinations, which in turn precede two word combinations.

This proposal gave rise to certain predictions; firstly that words and gestures would be used independently, secondly that reinforcing cross-modal combinations would emerge as non-synchronous and gradually increase in synchronicity, thirdly that supplementary cross-modal combinations would emerge temporally synchronised from outset, and finally that two word combinations would appear last. In typical acquisition the onset of these behaviours may be rapid, however due to the language delay associated with ASD onset of behaviours should be more clearly distinguishable.

The first two predictions will be examined with reference to James, Lee and Toby. James and Lee produced no cross-modal combinations in the first session, but did use gesture without speech. Both were preverbal, but separated vocalisations from gesture. The first prediction is supported; words (vocalisations) and gestures are originally independent. The second prediction, that reinforcing cross-modal combinations will emerge temporally non-synchronised and develop increasing synchronicity also was borne out. A period of non-synchronicity was observable for all three participants, ranging from one to six months.

There are indications that first words appear after the first cross-modal combination but before synchronicity is achieved. A notable exception is James, whose first words appear more than four months after cross-modal synchronisation. It is difficult to discern patterns in a group of three, especially in a disorder where heterogeneity is large. Nevertheless this could indicate that initial links between the formulator and generator are forged prior to the formation of a productive lexicon, perhaps word comprehension could provide a stimulus for this change. Yet a productive lexicon may be necessary for fully established integration between the two modalities. This requires experimental confirmation, and would benefit from a larger sample size.

The remaining two predictions will be considered with respect to five participants, Michael, Murray, Nathan, Theo and Zaara, all of whom produced supplementary cross-modal combinations. The onset of synchronised reinforcing cross-modal combinations cannot be verified as all five participants produced such combinations in the first recorded session. Supplementary combinations followed after a delay of one week to just over four months. All supplementary cross-modal combinations were synchronised from outset, thus confirming the third prediction. Once the links between formulator and generator are established they are activated by any type of cross-modal combination.

The final prediction, that supplementary cross-modal combinations precede, or are concomitant with, two word combinations, has been replicated many times for typically developing children (Butcher & Goldin-Meadow, 2000; Capirci *et al.*, 2005; Capirci *et al.*, 1996; Capobianco *et al.*, 2007; Iverson *et al.*, 1994; McEachern & Haynes, 2004). It is argued that sharing the semantic component across two modalities eases the cognitive burden by removing the need for hierarchical structure. For three of the five participants in the present study two word combinations appeared simultaneously with supplementary combinations. For Nathan cross-modal combinations were recorded two weeks prior to two word combinations, and for Michael two word combinations preceded cross-modal combinations by four months. Given the language delay this is an unexpected finding, as it would be supposed that a longer duration between supplementary and two word combinations commensurate with the language delay would be observable.

Three possible explanations may be offered. Firstly one modality may be subject to a greater delay in comparison to the other. There is currently no standardised assessment which can accurately measure gestural development. An unequal delay across modalities means that supplementary combinations, which rely on close integration of speech and gesture, may simply be impossible to form at an earlier stage in development. Counting against this explanation is that, on the measures devised for this study, gesture does not seem to be noticeably behind or in advance of speech. Reinforcing combinations are not delayed; it would be remarkable if a gestural delay did not also affect these combinations.

Secondly the difficulty may reside at the level of the conceptualiser, namely in the segmentation of the communicable form. If the ability to segment is missing then it becomes irrelevant whether components are re-combined across one or two modalities. Yet the simultaneous appearance of cross-modal and two word combinations suggests that the cognitively easier option of sharing elements across two modalities is found to be as difficult as two word combinations. Considerable experimentation would be required to disentangle the various processes required to isolate the moment of difficulty.

A third option is at the level of integration of speech and gesture. This ties in with the weak central coherence account of gesture and the experimental evidence of gesture-speech integration in adolescents (Silverman *et al*, 2007). As yet this explanation is tenuous indeed. A difficulty in integrating gesture and speech in production has yet to be proved. Further, to furnish this suggestion with any kind of explanatory power deictic gestures, which form the majority of cross-modal combinations, must be encompassed. Deictic gestures are a recognised strength in children with ASD. The only empirical evidence for this suggestion (Silverman *et al*, 2007) manipulated reinforcing and not supplementary combinations. This hypothesis needs extensive work to obtain plausibility. It requires demonstration that integration is problematic in production, that difficulties extend across all gesture forms, and that it is a factor in early development. Whilst explanations of the close alliance in the emergence of supplementary combinations and two words speech are possible, none at the moment are satisfactory.

In sum, the proposed development of the processing architecture does explain the observed pattern of speech and gesture development. However once the architecture is in place children with ASD seem to make less use of the cognitive benefits to processing that it brings.

## 9.2 Do adults adapt their gestures when talking to children?

Several researchers propose that, analogous to motherese, child directed gesture is systematically adapted, forming a gesturese (Bekken, 1989; Iverson *et al.*, 1999; O'Neill *et al.*, 2005; S. Ozcaliskan & Goldin-Meadow, 2005). For the first time this study contains data from both parents and professionals in an atypical development setting. Replicating earlier research, gesture was found to systematically change.

These changes are discussed and advantages they bring to language learning are considered. A second area of focus is to ascertain the extent to which parents and professionals differ, and whether this is attributable to their different status, or whether it arises from the atypical development of the child.

### 9.2.1 Does gesturese extend to children with ASD?

The answer to this question is an unqualified yes. Several similarities were found in both the parental and professional group, namely that gesture is used in 15-20% of the communication directed to the child, that the gestural repertoire is limited, that deictic gestures are primarily used, gestures are conceptually simple, concrete and contextually bound and finally that gestures serve to reinforce speech. Each of these will be considered in turn as a potential discriminator for gesturese.

Gesture is known to be less frequent in adult-child interaction than adult-adult interaction, at 15% and 24% respectively (Bekken, 1989). The parental group in the present study agrees with these previous results as gesture is used for 13% of all communication. Yet the proportion of gesture in the staff's communication is much higher at 26%. This is discussed further in Section 9.2.3, suffice it to say that there is evidence that for parents fewer gestures is an indicator of gesturese.

Two further related features were observed; the gestural repertoire was limited and restricted primarily to deictic gestures. Deictic gestures accounted for two thirds of all gestures, and ranged from SHOWING through to distal pointing. Emblems accounted for around 20% of gestures, and were primarily used to give feedback (CLAP, THUMBS UP, NOD HEAD, SHAKE HEAD) or accompanied instructions (WHERE, RECEIVE, INVITE). Iconic gestures accounted for 6-10% of all gestures and were slightly more prevalent in the professional group. Iconics named animals (MONKEY, LION, BUTTERFLY, BIRD), depicted actions (WALK, PUSH, TRAIN WHISTLE, WASH HANDS), or were action sequences (INCEY WINCEY SPIDER, ROW YOUR BOAT, THREAD THE BOBBIN). The remaining, infrequent gestures were Makaton signs and were found in the staff group.

The majority of gestures in the input have conventional meanings, that is they are either deictic or emblems (80-90% of all gestures). As meaning is stable such gestures are conceptually simple when compared to iconic gestures. Yet simplicity is also evident in imagistic gestures. Metaphoric gestures, the representation of abstract ideas, are entirely absent. Instead the iconic gesture represents a feature of an animal (lion's claws, bird's beak) or an action (fingers imitate leg movement in walking, rubbing hands together to imitate washing) which is clearly recognisable. All child directed gestures are concrete, thus abstract pointing and beat gestures are eliminated from the repertoire along with metaphorics.

Gesturese is contextually bound; the referent is located in the immediate context. The following scenario illustrates this concept. A favourite toy at Explorers is a group of four plastic eggs. The eggs can be opened by buttons and a dinosaur pops out of the cracked egg. Each button works by a different movement such as pushing, twisting, rocking etc. Occasionally a child would have difficulty in opening the eggs. Staff members provided support in one of two ways. Either they directed the child to the correct button with a deictic gesture, thus providing a concrete and conceptually simple aid to speech. On further difficulty the staff would model the appropriate action to work the button by means of an iconic gesture. The gesture is tailored to the specific movement needed to operate the button. The iconic gesture is contextually tied to the toy in front of the child, it depicts a movement they need to perform rather than an abstract notion of pushing.

One final observation concerns the relationship between gesture and speech. Around 90% of gesture occurred with speech and of that 80-85% reinforced speech. To the researcher's knowledge no research programme has investigated the proportion of reinforcing, supplementary and disambiguating cross-modal combinations in adult-adult interaction. Yet many researchers conclude gesture is communicative by claiming that gesture conveys information not present in speech (Beattie & Shovelton, 1999, 2002; McNeill, 1992). This implies that supplementary cross-modal combinations are present, and possibly frequent, in adult-adult interaction. This in turn indicates that the high levels of reinforcing cross-modal combinations are a feature of child-directed gesture.

To summarise; gesturese does exist. Adult-child gesture is characterised by a lower proportion of gesture, but high levels of reinforcing cross-modal combinations. Gestures are limited, repetitive, consist mainly of deictic gestures and are concrete, contextually bound and, consequently, are conceptually simple.

### 9.2.2 Does gesturese benefit language acquisition and if so, how?

Child directed speech is sensitive to the development of the child (Snow, 1995). For example high pitch and exaggerated intonation characterises speech directed to children just beginning to decode prosody and is not continued into later development. A comparable sensitivity is not evident in gesturese; indeed the gestural system does not change regardless of the child's age, language ability (Iverson *et al.*, 1999; S. Ozcaliskan & Goldin-Meadow, 2005) or context of interaction (O'Neill *et al*, 2005). This finding suggests the function of the gestural input is constant throughout the child's development.

Gesture highlights and reinforces salient aspects of speech. It offers an alternative means to draw attention to relevant linguistic detail, as pitch and intonation have done before. The gestural modality can be exploited to provide scaffolding to language, following Vygotskian theory (1962). This may account for the lower levels of gesture observed in child directed speech; gesture serves a different function for adult-child interaction then the wholly communicative function of adult-adult speech.

### 9.2.3 Explaining the differences between parents and professionals

This project extends previous research in two ways; the inclusion of professional adults in addition to parents, and atypically developing children. Any differences observed between the two groups of adults may be the result of professional training, or arise from the demands of atypical development. In practice these two factors are probably closely interlinked. The differences between parents and professionals are discussed and probable causes identified. In the absence of any comparable professional data with typically developing children, such as that provided at a nursery or play school, or other atypically developing children, such as programmes to target Specific Language Impairment, the following discussion is unavoidably somewhat speculative.

There are slight differences across all gestural measures. The professionals essay fewer communicative attempts than the parents, but with a higher proportion of gestural communication. There is more variation within the professional group than the parental group on both measures. It was concluded that, due to higher gestural levels, the staff's communication was more efficient, decreasing the overall need for communicative acts (Chapter 7, Sections 7.3.1 and 7.3.4). The variation in the professional group may be due to the variety of contexts at Explorers compared to home (Chapter 8, Section 8.2.3.2). Play, directed tasks and other activities were characterised by differing communication profiles. The dominating context of collaborative play at home may have a unifying effect on these measures in the parental group. It should be remembered that the dominance of collaborative play may be a consequence of the observer's paradox (Chapter 8, Section 8.2.3.2). With this caveat in mind, the difference between parents and staff in verbal and gestural communication appears to be one of training.

Gestural levels for the professionals were elevated compared to parents and previous studies (Bekken, 1989; Iverson *et al*, 1999; Ozcaliskan & Goldin-Meadow, 2005; but see O'Neill *et al*, 2005). The increased awareness of language and communication gleaned through provision of training and working with atypically developing children may account for this. If so, elevated gestural levels would be predicted in professionals working with other communication disordered groups but not for those working with typically developing children. This could be empirically tested in future projects.

A second difference is the form of gesture. Parents relied on slightly higher levels of deictic gestures (approximately 70%) compared to the staff (approximately 60%) who also used slightly more iconic and Makaton gestures. This too may arise from a heightened awareness of language and communication. This hypothesis could be tested with the same empirical design described above.

Two final differences were observed; the first lay in the internal components of the facilitating gestures; the functions of feedback, commenting and directing and the second in the distribution of disambiguating and supplementary cross-modal combinations. Together the cross-modal combinations account for less than 10% of all gestures. Facilitating gestures subdivide into thirteen separate functions organised into five groups. Therefore the perceived differences are based on relatively few instances of gesture and may not be reliable. The different interaction styles within the group may be responsible for these differences which would disappear given a larger, more representative sample.

To conclude the differences found in the fine grained analysis may not be indicative of fundamental differences between the parents and professionals. On the other hand the staff use less deictic gestures and more iconics, and also more gesture overall; a profile which may reflect the need to support atypical language development. Increased variation within the professional group may be attributed to the numerous different contexts of interaction at Explorers, compared with the dominance of collaborative play at home.

## 9.3 Do adults influence the child's gesture?

Although specific links between the adult and child were not the focus of study, interesting differences in the children's communication were observed across environments. This section recaps these differences and attempts to explain them.

The observed differences include a higher communicative rate, consistent gestural levels and increased non-synchronised cross-modal combinations at home. Physical prompts were more prevalent at home, as were emotional displays but to a lesser extent. Iconic gestures were fewer in number, but more likely to be spontaneous at home. It is conceivable that these differences arise solely from the child and not from the differences between the two groups of adults. This possibility was examined in Chapter 8, Section 8.1. Social and communicative development was assessed through joint attention skills. No differences were found across environments; individually the children used similar interaction strategies, be that dyadic, triadic or sustained joint attention. A finer grained qualitative analysis has not been undertaken; further variation may be discovered which could prove a factor in the environmental differences. Yet this does not explain why changes occur, this is likely to be dependent on the adult.

Parents and staff differed in directiveness, structure and contexts of interaction. Parents restricted directiveness to the central area of the continuum. The full range of structures was not incorporated into the interaction and externally imposed structures were rare. The dominating context was collaborative play. Despite the limited range of directiveness, structure and contexts, parents instinctively employed the factors which were found to promote communication in the children. The home environment relates to a general increase in communication, but no corresponding increase in gesture. Increased input appears to lead to increased production from the child. Yet the home is familiar and secure, apparent gains may not be immediately generalisable.

Thus far unexplained are the inflated levels of physical prompts, emotional displays, spontaneous iconic gesture and the preference for cross-modal combinations. The dominance of collaborative play is a consistent feature of the interactions at home and may account for the above behaviours. If this conjecture is correct the context of collaborative play at Explorers will show a similar gestural profile. There are several problems inherent to a comparison. Firstly considerable overlap between collaborative play and directed craft and developmental tasks exists. This is likely to obscure genuine differences. Secondly the corpus of collaborative play from Explorers would be decidedly smaller than those to which it is being compared. In the absence of adequate comparative data explanations remain speculative. Taking collaborative play and the familiarity of the home environment together, the children may feel able to express themselves more freely at home which could lead to an increased number of emotional display gestures, increased vocalisations and possibly more physical prompts. Possible reasons for the increased spontaneity of iconics have been previously discussed (Section 9.1.1.2).

It is possible that individual influence, rather than group influence, also exists. Such an analysis has been beyond the scope of this study. Yet evidence suggests that Nathan and Murray can adapt their interactional style dependent on interlocutor (Chapter 8, Section 8.1.2). All participants entered into structures and turn taking games devised by the adults, indicating sensitivity to interlocutor and the collaborative building of interactions. Adults influence the participants' production of gesture, both in ways which are clearly apparent, some yet to be identified.

## 9.4 Uniting development, input and interaction

When considering the development of gesture in the participants a discrepancy was discovered between environments. It appeared that an earlier form of gesture was employed at home, characterised by increased use of gesture without speech or in non-synchronous cross-modal combinations, and more frequent emotional display gestures and physical prompts. These factors could indicate that fundamental differences exist in the gestural communication at home compared to other environments. However this interpretation was not supported by the evidence gained from a consideration of interaction. Such a fundamental difference would cause discrepancy between environments throughout all communication of the child, and this did not occur. Indeed little to no difference was found in the interaction strategies of the participants when examined by environment.

The explanation of these differences must lie elsewhere, and supporting evidence was found in the input. Perhaps surprisingly the gestural differences found in the participants' production were not mirrored in the gestural input. There was very little disparity found between the professionals and the parents in their gestural communication. However the contexts within which the interaction was situated differed greatly. Such contexts were far more diverse at Explorers, which may have necessitated a greater range of communicative acts on the part of the child, which in turn may have been realised through more extensive use of gesture.

The complete picture is highly complex, with the three components of development, input and interaction impacting on each other. Yet the different insights provided by each strand either corroborate or contradict the alternative interpretations arising from observations of the data.

## 9.5 Implications for intervention

Whilst the use of gesture by children with ASD is of theoretical interest, the practical implications are equally important. This section will consider how this study informs evidence based clinical work. Firstly gestural milestones will be identified and discussed, followed by recommendations for promoting communication, gesturally and verbally. Finally the utility of manual communication supporting systems will be discussed with reference to ASD.

### 9.5.1 Gestural milestones

Gestural communication is especially important in the preverbal and first word stage of language acquisition. Knowledge of gestural milestones at this early stage may allow therapists to identify children at risk for later language delay or social impairment. Early communication is characterised by deictic request and protest gestures and emotional displays, most often produced in the absence of speech. A significant development, intrinsically linked to social understanding, is the emergence of pointing. The use of pointing coincides with triadic interaction, as the point indicates an object or location to another. Once pointing is established earlier deictic forms begin to decline. The use of declarative pointing marks yet more progress in the development of social understanding.

Reinforcing cross-modal combinations have been linked to later language development in typically developing children (Capobianco *et al*, 2007). A reasonable assumption is that a delay or deficit in reinforcing combinations could be a valuable clinical measure, although this has not yet been investigated. A second assumption which needs validation is that early verbal and gestural dexterity should lead to increased language ability at later ages. Therefore the onset of reinforcing gestures, and the development of temporal synchronicity should be noted. The final milestone for this early language period in typical children is the emergence of supplementary cross-modal combinations which predict the onset of two word speech.

One of the first critical milestones for children with ASD is the emergence of pointing and other joint attention skills. On all measures in this study the development of speech and gesture in children with ASD appeared in line with that of typically developing children, with the two caveats that declarative pointing and showing and representational gestures (emblems and iconics) were infrequent. The ability of supplementary combinations to predict two word speech appears diminished as the behaviours emerge almost simultaneously. For children with ASD two milestones seem most salient; the development of pointing and the emergence of reinforcing cross-modal combinations.

### 9.5.2 Promoting communication

The promotion of communication in children with ASD is an important clinical aim. The qualitative analysis revealed three factors which could be manipulated to increase communication; these were structure, directiveness and contexts of interaction.

The dynamic nature of the highly frequent emergent structures makes them easy to incorporate into spontaneous interaction and elicitation tasks. They are adaptable to the individual needs of the child. Structure targets vocabulary, physical actions, teaches and consolidates knowledge, and promotes social interaction. Many structures rely on a turn-taking framework which introduces basic conversational skills. Engagement in structural sequences appeared a relative strength for the participants. The repetitive nature, strong routine and clear expectation of a response may all help children with ASD to develop their communication skills.

Six levels of directiveness were identified, but only three; suggest, require and instruct, appreciably promoted communication in the child. The ability to be flexible across levels and to be adaptable in response to the changing needs of the child are major assets for a therapist. A communication rich environment is provided through the levels of observe and describe, giving the child freedom for self-expression. The following three levels (suggest, require and instruct) provide increasing support for the expected response but diminishing opportunities for self-expression. The therapist must choose the level which contains an appropriate balance of support and freedom dependent on the child's needs and momentary unfolding of the interaction. The most directive level, prompting, should be used sparingly. It is imperative that the child is attentive during physical prompting otherwise any potential benefits for learning are lost.

Intervention should be delivered through a variety of contexts. Collaborative play and directed developmental and craft tasks gave rise to increased communication. Other play contexts and snack time provide valuable relaxation time. Group tasks focus on social development. Careful planning of each session is crucial. The ability to retrospectively reflect on the efficacy of intervention is a necessary skill. It is hoped this discussion of structure and directiveness will equip therapists for this reflection and help to develop greater sensitivity to the needs of the children under their care.

This study indicates that gesture is an essential component in the delivery of intervention. Specifically it was found that iconic and Makaton gestures are more prevalent at the expense of deictic gestures. Gestures used in the clinic should follow the characteristics of gesturese, in sum they should be conceptually simple, concrete, contextually bound and reinforce speech.

With the exclusion of declarative pointing, comprehension of deictic gestures is not problematic for children with ASD (Baron-Cohen, 1989; Camaioni *et al* 1997, 2003; Stone *et al*, 1997). Deictic gestures aid comprehension and help to establish joint attention, crucial for the further development of language (Tomasello, 1992). The use of deictic gestures by therapists for this group of children should be encouraged. Representational gestures (emblems and iconics) are more challenging for children with ASD. Children produce (Camaioni *et al* 1997, 2003; Stone *et al*, 1997) and understand (Smith & Bryson, 2007) some emblems. The conventionality of emblems probably makes these gestures more accessible to children with ASD. Emblems are particularly suited to the giving of praise and feedback. Iconic gestures may be more harmful than helpful. There is evidence for a deficit in children with ASD. Further, the presentation of an iconic gesture with speech apparently increases the processing complexity, hindering comprehension. This issue can only be resolved through further research but has implications for the efficacy of manual sign systems. By this account such systems may impede, rather than facilitate the communication of children with ASD. Alternatively the conventionality and arbitrariness of signs may overcome such processing difficulties.

These issues merit further investigation before recommendations regarding manual systems can be determined.

## 9.6 The future of gesture assessment in young children

There are two lines of research in the assessment of gesture: the first to develop assessments of comprehension, and the second to develop a thorough assessment of gesture production. Each of these themes will be developed below.

### 9.6.1 Assessing comprehension

Accurate assessment of gestural comprehension is problematic for several reasons. Gesture is rarely used without speech, making it impossible to ascertain if the child understands the gesture or is reliant on the verbal modality. Empirically divorcing gesture from speech necessitates complex verbal instructions, placing the task beyond the abilities of young children. Ingenious methods have been devised (Kelly, 2001; McNeil *et al.*, 2000; Morford & Goldin-Meadow, 1992; O'Reilly, 1995; Striano *et al.*, 2003) but more remains to be done.

Despite the known problems regarding parental report techniques in the assessment of comprehension, this was attempted in this study. Parents of a small group of children with ASD responded twice. The scores for comprehension showed large regression across multiple sections for three out of the five participants. A second disadvantage was found in the added complexity of the instrument. In conclusion the assessment of gesture comprehension does not lend itself to such a format.

Turning now to children with ASD, several unresolved issues surround the comprehension of iconic gesture. Two questions are relevant and may inform on the utility of manual sign systems; firstly does conventionality in gesture meaning aid comprehension, and secondly do children with ASD have difficulty in processing integrated speech and gesture? As regards conventionality, such a research question is difficult to answer and would require careful experimental design to overcome the problems of presenting iconic gestures without speech in a simple task. Some progress has been made on the second question (Silverman *et al*, 2007) and the paradigm may prove adaptable to younger children.

### 9.6.2 Assessing production

Many assessments of early communication exist, yet all take a global view of language and gesture. There is a real need for a comprehensive assessment of gestural development. Gesture production lends itself to being assessed through parental report, and this was attempted in the Gesture Checklist (GC) reported in Chapter 5. The GC had good validity when compared to the gesture section of the MacArthur-Bates Communicative Developmental Inventory, the current gold standard for the assessment of early communication. The GC confirmed gesture increases with age, both as an expanding repertoire (types) and in frequency (tokens). Differences were found between girls and boys around the age of eighteen months. Girls stopped expanding their gestures at approximately eighteen months old and began to use words, for boys this occurs later. Hand choice was found to correlate with age. Yet despite these strengths several revisions are necessary. The inclusion of verbal production increased complexity in both scoring and completion. It would be advantageous to assess this separately. Large floor effects were discovered in the later sections. As a first step in devising a gesture assessment the GC was invaluable, some fundamental changes should be made in view of insights from this research and that of others. A comprehensive assessment of gesture should contain form and function of gesture and distinguish between cross-modal combinations.

Deictic gestures are the first to emerge and form the backbone of the gestural system. Development of such gestures corresponds closely with the development of joint attention skills, thus providing invaluable information about social development. Other gesture forms include emblems and iconics which name objects or depict actions. With the exclusion of imperative and declarative gestures, other gestural functions in young children's communication have not previously been investigated. This study suggests that at least a further three functions are frequent; social gestures, commenting and formulating or responding to questions. The ability to combine words and gestures at an earlier age is a positive indicator for later language outcome and is vital when assessing gesture. This creates a methodological challenge as parents find it difficult to distinguish between reinforcing and supplementary cross-modal combinations (O'Neill personal communication).

The need for a comprehensive assessment of gesture is universally acknowledged by researchers working in the field of gesture development. The assessment would also have extensive benefits in a clinical setting. It can be used as a screening tool, or in conjunction with other tests, it provides a means of assessing and monitoring the communicative abilities of a wide range of children. It may also be used as a diagnostic aid, for example differentiating between children with Specific Language Impairment (SLI) and Pragmatic Language Impairment (PLI), currently a debated area (Bishop *et al.*, 2000).

# Chapter 10

# CONCLUDING REMARKS

This chapter attempts to evaluate the research undertaken for this thesis. Attention is first directed to a discussion of using multiple methodologies, before moving on to recap the main findings of this research. These will be explicitly linked to the approach to development that was outlined in Chapter 1. This leads naturally to a discussion of the various issues which arose in the course of the research, and suggestions for the resolution of these in future work.

## 10.1 On multiple methodologies

The use of multiple methodologies provides the opportunity to investigate related research questions by accessing similar behaviour from different viewpoints. Through these means a highly detailed account of the development of gesture in children with ASD was achieved. The form and function of gesture was considered, in addition to the nature of the input and the two way influence of interaction.

Methodological difficulties abound when investigating ASD. A representative and homogenous sample is hard to obtain due to the nature of the disorder. Group studies often contain participants with impairments ranging from mild to severe, thus impacting on the integrity of the group for statistical analysis. Statistical methods require two control groups; both typically developing and developmentally delayed children. This in turn raises issues with the matching of participants; both the degree of accuracy and choice of measurement will affect results. These problems were eliminated in this study by methodological choices which did not entail large group analysis. Homogeneity is not a requirement for the micro-genetic method which incorporates large individual variation into group comparisons. Corroboration was achieved by a qualitative analysis which explored and explicated the initial findings. A small, non-representative group does reduce the generalisability of the results. Quantitative methods were restricted to data collected from typically developing children, as issues of representation and variation are greatly reduced for this population.

It is important that research questions are clearly defined and the chosen methodology is capable of providing a comprehensive answer. Clear differentiation should be maintained between the methodologies, so results can support arguments without running the risk of being circular. Multiple methodologies proved extremely illuminative in the study of gesture in children with ASD, particularly through the combination of psychological and linguistic approaches. The following section summarises the research undertaken for this thesis.

## 10.2 A summary of the main research findings

This section will take the main areas of interest; development of speech and gesture in children with ASD, the nature of the input, interactional factors and gesture assessment in typical and atypical children and discuss them firstly in terms of the main research findings, and secondly interpreting them in the spirit of the developmental approach outlined in Chapter 1. This approach claims that the child is predisposed to interact with the world and learn independently, yet social interaction plays a vital role in continuing development.

### 10.2.1 Development: gesture form, function and relationship to speech

The communication impairment associated with ASD also impacts on the gestural modality. Deictic gestures were found to form the core of the gestural repertoire, accounting for over 80% of all gestures. These developed from requests and protests to pointing gestures. Other gestural forms did not exhibit equivalent developmental trajectories. Limited numbers of emblems were found, and iconic gestures were extremely rare and often imitated. It may be the case that these representational gestures are performed through rote learning. In Piagetian terms although the gestures are present, the concept behind them is still absent and not understood. Although this was not explicitly tested in this observation study the high levels of imitation of iconic gestures could be seen to support this view. In contrast deictic gestures are highly productive and generalised.

The majority of gestures facilitated the continuance of the current activity, either socially in games and routines or through questioning, responding, and commenting. The imperative function was present in all children and declarative function for some. Organisational gestures were extremely rare. Emotional display gestures were present for all children, but prevalent in the children with the most severe ASD. The absence of organisational gestures may be akin to typical children. This cannot be verified as no comparable data currently exists. Alternatively it may be attributable to the social difficulties and executive dysfunction experienced by children with ASD. Low levels of declarative function are commonly linked to social difficulties. The social impairment will lead to less interaction, which in turn will diminish the input available to the child. At best this will impede the rate of development, and at worst, prevent development in some domains entirely.

Research findings from typically developing children informed the proposal of a processing architecture for speech and gesture. This represents the innate capacities of the child. The input provides the stimulus for this to develop, as described in Chapter 2. The development of speech and gesture from the pre-verbal to the two word stage was comparable to typical development, albeit delayed. Each prediction derived from the processing architecture was met, thus the proposed architecture appears robust. The developmental trajectory was found to be similar to typical development, in that words (vocalisations) were independent from gesture before combining in non-synchronous reinforcing cross-modal combinations, synchronicity increased before the emergence of supplementary combinations which in turn predicted two word combinations. Yet children with ASD appeared to have difficulty in accessing the benefits that integration can bring. The problems apparent with the integration of speech and iconic gestures may have consequences for subsequent development of communication.

### 10.2.2 Input: Evidence for gesturese

Evidence suggests that adults not only systematically change their speech when talking to children, but gesture also undergoes systematic change. This thesis extended earlier work in two distinct ways; an examination of changes occurring in speech directed to children with communication disorders and gestural differences between parents and professionals. Parents and professionals were similar in that gesture was combined with speech, served to reinforce speech, and facilitated the ongoing activity. The professional group used a wider variety of gesture forms, but fewer communicative attempts than parents. No differences were observed arising from the developmental level of the child. In conclusion the training the professionals received appeared to impact on gesture: they exploited the gestural modality to a greater extent than parents, both in terms of frequency and form of gesture. This may reflect an increased awareness of communication and the needs of atypically developing children.

Given the social difficulties of children with ASD, the Vygotskian ideal of scaffolding children's ability to learn becomes important in increasing their access to social input. The changes apparent in gesture may aid this process by highlighting and reinforcing salient aspects of speech. It is not clear if the strategies of the professionals or the parents provide the most successful scaffolding, nor even if this is a pertinent question. Some participants demonstrated the ability to adapt to their interlocutor. If the children can adapt, the quality of the gestural changes is no longer relevant. It may be the case that concrete, conceptually simple and reinforcing gestures provide the necessary scaffolding without cause to delve deeper into the exact distribution of these factors. Indeed gestural changes remain constant regardless of the child's age or language ability. Given this fact it is unlikely that either style will result in greater development from the child.

### 10.2.3 Interaction: a collaborative achievement

Given that interaction provides some of the input for development, and forms the context for gestural communication, a qualitative analysis focused on this aspect of the relationship between the child and adult. Children were found to interact either in a primarily dyadic or triadic fashion. Occasionally the participants engaged in sustained joint attention. Their strategies for interaction appeared linked to their development and did not change with environment.

The factors of directiveness and structure were important elements in the adults' interaction. Six levels of directiveness were identified, ranging from observing to prompting. Communication was enhanced at mid range of the continuum. A distinction was made between emergent and imposed structures. Dynamic emergent structures supported communication, whereas imposed structures were restrictive. Directiveness and structure combined to create different contexts of interaction. The professionals were found to use more levels of directiveness, varied structure and many different contexts of interaction. In contrast the parents used the mid range of both directiveness and structure and the context of interaction was dominated by collaborative play. This latter finding may be a consequence of the observer's paradox.

These findings will be most beneficial to those engaged in explicit teaching of the child which occurs in more formal interactions. Teaching is likely to be enhanced if the adult is able to flexibly move between levels and structures in response to the changing needs of the child.

### 10.2.4 The interplay between development, input and interaction

As our understanding of cognitive development becomes more comprehensive, the corresponding models of that development become increasingly complex. As described in Chapter 1 it is now believed that the child develops not just through their physical interaction with the world, but also through social, cultural and emotional interaction with other people. The links between language, and by extension communication, and cognition are extremely close. Gesture provides an alternative window through which these links may be examined.

As described in Chapter 9 the three components of development, input and interaction are closely intertwined. These strands have formed the core of this thesis and the strength of the relationships between them lend credence to the current approach to cognitive development. Without a consideration of all three strands, it would not have been possible to identify or disentangle the various aspects of gestural development in children with ASD. Although this methodology has obtained a detailed understanding of the factors relevant to gestural communication, and the nature of its development, other questions have arisen during the course of this investigation. These will be discussed in the subsequent sections.

## 10.3 Future directions

Inevitably whilst providing a fuller picture of gesture development, this study has raised further, in some cases unexpected, issues. These will be discussed in view of future directions for this research.

### 10.3.1 The assessment of gesture

The Gesture Checklist was designed to enable a detailed assessment of gesture in young children between the ages of six and twenty four months. Initial findings indicate that the developmental rate, for both comprehension and production is most rapid prior to eighteen months. After this age the verbal modality becomes increasingly important for girls and thus their use of gesture declines. Boys however continue to expand on their use of gesture, with a slower introduction of the verbal component into their communication. Although the pilot study revealed several refinements which would be beneficial to a revised version of the assessment, nevertheless the pattern of results did reflect the literature. The children with ASD were shown to be delayed compared to typically developing children, and this delay corresponded to the severity of their socio-communicative impairment.

Although assessing gesture in this way is a departure from the longitudinal view adopted throughout the remainder of the thesis, this approach is essential in terms of clinical assessment. Comparison of atypical groups against typical development can inform on the severity of the gestural impairment. The normative data provides a means of standardising gestural measures across communication disorders, and also allows for the monitoring of individual cases. With revision the Gesture Checklist could become an important clinical tool, especially in view of recent developments in the role of gesture in the pre-verbal to two word speech stages of language acquisition. In revising the Gesture Checklist several aims should be kept in mind. The primary aim must be to create an assessment for gesture which is comprehensive, reliable and valid. Parental report allows the spontaneous nature of gesture to be captured in the assessment, but in turn requires that the instrument be simple and user friendly and crucially require no previous or detailed knowledge of gesture for completion.

A pilot study of the revised Checklist should be undertaken with children aged eight to twenty four months. These should be balanced for gender and socio-economic status. Bilingual children, or those with existing medical conditions relating to verbal and gestural development should be excluded. It is essential to assess the reliability and validity of the Checklist. Reliability could be measured through a test-retest structure and validity by observing a subgroup of participants interacting with their parent and comparing the resulting analysis with the parental report. Complexity of the Checklist could be monitored through the response rate of completed forms received and also by encouraging feedback through simple questionnaires.

Although the development of an assessment of gesture is a large undertaking the benefits are correspondingly great for both the academic community and speech and language therapists.

### 10.3.2 The integration of speech and gesture in children with ASD

There is some evidence that integration of iconic gestures and speech is impaired in children with ASD. This fits with reformulations of weak central coherence which predicts difficulty in achieving coherence across modalities. Iconic gestures are doubly difficult for individuals with ASD: firstly non-conventional meaning must be ascribed and secondly, this must be integrated with meaning on the verbal modality. Emblems and signs have more conventional meanings, and do not require speech which may prove easier for individuals with ASD (see Chapter 9, Section 9.1.3 for a full discussion).

This argument relies on several, as yet, untested assumptions. Firstly the precise nature of the difficulty with iconic gestures remains to be resolved. It could be interpretation of meaning, or integration with speech, or with both factors. Secondly the iconicity of representational gestures is presumed problematic, yet appears to be mitigated somewhat by the conventionality of emblems. This has implications for manual sign systems such as Makaton; does the conventionality of such signs support language acquisition or does their iconicity hinder acquisition? By investigating the claim that increased conventionality aids gesture comprehension, advice can be given to therapists regarding the use of manual sign systems for children with ASD. As discussed in Chapter 2, Section 2.3.1, assessing comprehension of gesture is methodologically difficult, although eye tracking techniques have been used with some success and could be adapted to this research question.

### 10.3.3 The nature of gesturese in parental and professional interaction

Very few studies have investigated systematic gestural changes in child directed speech, and all focus on parents and typically developing children. This thesis extends this line of research to parents and professionals with atypical children. Due to the lack of comparable data concerning professional interaction with typically developing children it was not possible to fully interpret the differences found between the parents and professionals. These may be due to general professional training and the influences of institutionalised talk such as the prioritising of the educational aspects. Alternatively it may be due to training to raise awareness of different forms of communication when working amongst children with communication disorders. Purely speculatively, it is likely to be the latter, as educational influences are less of a priority in pre-school children. This should however be verified with a comparison study between parents and professionals working at nurseries or play schools with typically developing children and with parents of families containing children with and without ASD.

## 10.4 Final comments

The body of literature on gesture development in children with ASD is not large. Many researchers consider gesture only as one of many facets of early development. It is hoped that by putting the spotlight firmly on gesture, this thesis has not only brought together these diverse approaches but has also provided a much fuller picture of the development from pre-verbal to two word communication, a picture which also encompasses the role of gestural input and its interactional context.

Almost inevitably in an exploratory study, the investigation of some issues has led to the raising of others. Whilst this thesis does not pretend to give a definitive answer to all of the questions it has posed it does provide a strong foundation for future research on this fascinating topic.

# ASSESSMENT OF PARTICIPANTS

During the Explorers programme each participant is assessed at three monthly intervals. The assessments routinely used at these review sessions are the Socialisation Checklist (The Ryegate Children's Centre, 2006), the Living Language Detailed Profile (Locke and Beech, 1991), and the Surrey Speech, Language and Communication Profile (McGregor and Cave, 1996). The complete sets of scores for each participant are reported in the tables below.

| Child | Age | Adaptability to rules and routines | Socialisation | Communication | Learning Independence | Total |
|---|---|---|---|---|---|---|
| James | 2;9 | 9 | 16 | 9 | 16 | 50 |
| | 3;1 | 13 | 19 | 10 | 25 | 67 |
| | 3;4 | 19 | 24 | 10 | 30 | 83 |
| | 3;6 | 19 | 29 | 11 | 33 | 92 |
| Lee | 3;2 | 9 | 18 | 11 | 16 | 54 |
| | 3;6 | 19 | 23 | 11 | 25 | 78 |
| | 3;9 | 28 | 35 | 13 | 39 | 115 |
| | 4;0 | 28 | 39 | 13 | 53 | 123 |
| Michael | 3;0 | 19 | 34 | 13 | 36 | 102 |
| | 3;3 | 23 | 44 | 22 | 42 | 131 |
| | 3;7 | 28 | 51 | 26 | 49 | 154 |
| | 3;10 | 29 | 43 | 23 | 47 | 152 |
| Murray | 2;9 | 17 | 32 | 10 | 28 | 87 |
| | 3;4 | 27 | 37 | 12 | 40 | 116 |
| Nathan | 2;3 | 21 | 29 | 12 | 31 | 91 |
| | 2;7 | 22 | 41 | 17 | 42 | 122 |
| | 2;11 | 30 | 51 | 28 | 53 | 162 |
| Theo | 3;0 | 15 | 33 | 15 | 35 | 98 |
| | 3;8 | 19 | 38 | 17 | 39 | 113 |
| Toby | 2;7 | 12 | 19 | 10 | 22 | 63 |
| | 3;0 | 22 | 27 | 12 | 35 | 96 |
| | 3;2 | 29 | 38 | 17 | 45 | 129 |
| Zaara | 1;9 | 9 | 17 | 10 | 15 | 51 |
| | 2;1 | 15 | 21 | 10 | 24 | 70 |
| | 2;3 | 21 | 38 | 19 | 40 | 118 |

**Table A.1: The Socialisation Checklist**
NB. lower scores correspond to greater impairment.

| Child | Age | Physical Skills | Self-help and independ-ence | Eye-hand co-ordination | Play and social development | Listening and understanding | Expressive skills |
|---|---|---|---|---|---|---|---|
| James | 2;5 | 18-24** | 12-18* | 12-18* | 12-18* | n/s | 12-18* |
| | 2;9 | 18-24** | 12-18* | 12-18* | 12-18* | 12-18* | 12-18* |
| | 3;1 | 18-24** | 12-18** | 18-24* | 12-18* | 12-18* | 12-18* |
| | 3;3 | 18-24** | 18-24* | 18-24* | 12-18* | 12-18* | 12-18* |
| | 3;6 | 18-24*** | 18-24* | 18-24* | 18-24* | 12-18* | 12-18* |
| Lee | 3;1 | 18-24* | n/s | 12-18* | 12-18* | 12-18* | 12-18* |
| | 3;6 | 18-24* | 12-18* | 18-24* | 18-24* | 12-18* | 12-18* |
| | 3;9 | 18-24*** | 18-24* | 18-24** | 18-24* | 12-18* | 12-18** |
| | 4;0 | 2-3* | 18-24* | 2-3* | 2-3* | 12-18* | 18-24* |
| Michael | 2;11 | 18-24* | 12-18* | 18-24* | 12-18* | n/s | 12-18* |
| | 3;3 | 18-24** | 12-18* | 18-24** | 18-24* | 12-18* | 12-18* |
| | 3;8 | 18-24*** | 18-24* | 18-24** | 18-24* | 18-24* | 18-24* |
| | 3;10 | 2-3* | 2-3* | 3-4* | 2-3* | 2-3* | 2-3* |
| Murray | 2;9 | 18-24* | n/s | 18-24* | 12-18** | 12-18* | n/s |
| | 2;11 | 18-24*** | 12-18** | 18-24** | 18-24* | 12-18* | 18-24* |
| Nathan | 2;2 | 18-24** | 12-18* | 18-24** | 12-18* | n/s | n/s |
| | 2;6 | 18-24** | 12-18** | 18-24** | 12-18* | 12-18* | 12-18* |
| | 2;8 | 2-3* | 18-24* | 2-3** | 18-24* | 18-24* | 18-24* |
| | 2;11 | 2-3* | 18-24* | 3-4* | 2-3* | 2-3* | 3-4* |
| Theo | 3;4 | 3-4* | 2-3* | 2-3* | 2-3* | 2-3* | 2-3* |
| | 3;8 | 3-4* | 2-3* | 2-3* | 2-3** | 2-3* | 2-3* |
| Toby | 2;1 | 18-24* | 12-18* | 18-24* | 12-18* | 12-18* | 12-18* |
| | 2;7 | 18-24** | 12-18* | 18-24* | 18-24* | 12-18* | 12-18* |
| | 2;11 | 18-24** | 18-24* | 18-24* | 18-24* | 12-18* | 12-18* |
| | 3;1 | 18-24*** | 18-24* | 18-24* | 18-24* | 12-18* | 12-18* |
| Zaara | 1;7 | 12-18* | n/s | 12-18* | 12-18* | 12-18* | n/s |
| | 1;10 | 12-18* | n/s | 12-18* | 12-18* | 12-18* | 12-18* |
| | 2;0 | 12-18* | 12-18* | 18-24* | 12-18* | 12-18* | 12-18** |
| | 2;3 | 18-24* | 12-18* | 18-24* | 12-18* | 12-18* | 12-18*** |

**Table A.2: Living Language Detailed Profile**

NB: In order to report these results concisely a star system is used. One star denotes that less then four skills are acquired, two stars reflects the acquisition of between four and nine skills and three stars between ten and twelve skills have been noted. In order to score at a higher age level, each child must have displayed at least five skills at the previous age range.

| Child | Age | Receptive | Expressive | Speech Production | Impact | Interaction | Behaviour | Total |
|---|---|---|---|---|---|---|---|---|
| James | 2;9 | 49 | 41 | 34 | 14 | 82 | 32 | 259 |
| | 3;6 | 47 | 40 | 27 | 14 | 89 | 29 | 246 |
| Lee | 3;8 | 35 | 35 | 26 | 11 | 53 | 16 | 176 |
| Michael | 3;10 | 33 | 34 | 16 | 12 | 71 | 28 | 207 |
| Nathan | 2;4 | 35 | 29 | 16 | 14 | 72 | 25 | 204 |
| | 2;11 | 29 | 28 | 11 | 10 | 62 | 21 | 161 |
| Theo | 3;9 | 33 | 22 | 9 | 11 | 56 | 29 | 160 |
| Toby | 2;8 | 41 | 37 | 15 | 12 | 90 | 42 | 259 |
| Zaara | 1;10 | 47 | 37 | 30 | 12 | 82 | 32 | 230 |
| | 2;3 | 31 | 23 | 15 | 11 | 70 | 17 | 167 |

**Table A.3: Surrey Speech, Language and Communication Profile**

NB. A score of 0 means that the language is age appropriate, through to 7 which is the most impaired. There is no normative data for this assessment, the lower the score the less impaired the language.

# Appendix B

## THE GESTURE CHECKLIST

Participant code: __________

Child's Name: ________________ Date of Birth ______________

Male or female? ______________ Today's date _____________

This checklist covers many of the gestures that children will make when they are aged between 6 months and 2 years old. Please complete all 7 sections. Remember that not all children will do all of the different gestures, and some only develop as children grow older. Please first answer these questions, to provide some background information about your child:

- Does anyone speak to your child in a language other than English (if so, which language)?

- Were there any complications at birth, or any subsequent development problems for your child? If yes, please explain.

### *General Instructions:*

Fill in each section as described here, unless you are directed to do differently at the beginning of each section:

- When we speak we often gesture. If you feel that your child could understand the gesture *without* speech then please tick the column "understands without speech".

- If you feel that your child needs the words to understand the gesture then tick the column "understands with speech".

- If your child does not understand the gesture, leave both of these columns blank.

- If your child uses the gesture, with or without speech, first decide how often, then tick the appropriate column:

  **Not yet**: your child does not use the gesture yet.
  **Sometimes**: if there is a situation where the gesture could be used, your child will use the gesture less than half the possible number of times.
  **Often**: if there is a situation where the gesture could be used, your child will use the gesture more than half the possible number of times.
  **Has a word**: your child no longer uses, or never used, a gesture because they use a word or phrase instead.

- Sometimes the squares for your reply are shaded in grey. This means that any reply here would be meaningless. If the square is shaded, please ignore the column for that particular gesture.

- If you are experiencing any difficulties in completing any part of the form, you can use Section G to explain why it is difficult to make a decision.

| Section A: Pointing | | | | | | |
|---|---|---|---|---|---|---|
| Please use the general instructions | understands | | Uses | | | |
| Does your child understand or understand and use: | Without speech | With speech | Not yet | Some -times | Often | Has a word |
| 1. Reach out to take something? | | | | | | |
| 2. Hold out hand palm up, opening and closing the hand to request something? | | | | | | |
| 3. Point at something, such as a picture in a book when they are by themselves? | | | | | | |
| 4. Touch the thing being pointed at? | | | | | | |
| 5. Point at something in order to be given it? | | | | | | |
| Are these directed to something near | | | | | | |
| distant | | | | | | |
| 6. Point at something interesting to share comments on it? | | | | | | |
| Are these directed to something near | | | | | | |
| distant | | | | | | |

| Section B: Communicating | | | | | | |
|---|---|---|---|---|---|---|
| Please use the general instructions. | understands | | Uses | | | |
| Does your child understand or understand and use: | Without speech | With speech | Not yet | Some -times | Often | Has a word |
| 1. Extending arm to show something to another person? | | | | | | |
| 2. Extending arms upwards to signal a wish to be picked up? | | | | | | |
| 3. Waving "bye bye"? | | | | | | |
| 4. Shaking head "no"? | | | | | | |
| 5. Nodding head "yes"? | | | | | | |
| 6. Blowing kisses from a distance? | | | | | | |
| 7. Smacking lips in a "yum yum" gesture to show something tastes nice? | | | | | | |
| 8. Rubbing tummy to show something tastes nice? | | | | | | |
| 9. Putting finger on lips for "hush"? | | | | | | |
| 10. Shrugging to indicate "all gone" or "where'd it go"? | | | | | | |
| 11. Clapping hands to show that something is good or exciting? | | | | | | |
| 12. Lifting palms to indicate "where" or "all gone"? | | | | | | |
| 13. Blowing to show that something is hot? | | | | | | |
| 14. Using your hand as a tool (for example putting it on top of a jar to be opened)? | | | | | | |

| Section C: Naming | | | | | |
|---|---|---|---|---|---|
| • Complete the "understands" column using the general instructions.<br>• If your child doesn't use gesture or words to name any of the things below tick "no" in the uses section.<br>• If your child does use gesture to name things, then fill in the "how many" column in the uses section by entering a number from this list:<br>1 1-3 different gestures<br>2 4-6 different gestures<br>3 7 or more different gestures<br>• If your child uses words instead of gestures tick the "has a word" column. If they use both also fill in the gesture sections. | | | | | |
| | understands | | Uses | | |
| Does your child understand or understand and use gestures to: | Without speech | With speech | No | How many | Has a word |
| 1. Ask for nursery rhymes or songs? (e.g. row your boat, incy wincy spider). | | | | | |
| 2. Name any animals? (e.g. bird, monkey, elephant). | | | | | |
| 3. Name any vehicles? (e.g. car, plane, train). | | | | | |
| 4. A gesture for: | | | | | |
| dummy | | | | | |
| book | | | | | |
| favourite food | | | | | |
| favourite toy/object | | | | | |
| hat | | | | | |
| other(s) | | | | | |

| Section D: Actions | | | | | | |
|---|---|---|---|---|---|---|
| Please use the general instructions. | understands | | Uses | | | |
| Does your child understand or understand and use a gesture to: | Without speech | With speech | Not yet | Some -times | Often | Has a word |
| 1. Mime going to sleep with head on hands? | | | | | | |
| 2. Mime for something to drink? | | | | | | |
| 3. Mime for something to eat? | | | | | | |
| 4. Mime any other actions (please give details in section G) | | | | | | |

| Section E: Describing | | | | | | |
|---|---|---|---|---|---|---|
| Please use the general instructions. | understands | | Uses | | | |
| Does your child understand or understand and use a gesture for: | Without speech | With speech | Not yet | Some -times | Often | Has a word |
| 1. Big? | | | | | | |
| 2. Small? | | | | | | |
| 3. Thin? | | | | | | |
| 4. Fat? | | | | | | |
| 5. Square? | | | | | | |
| 6. Round? | | | | | | |
| 7. More? | | | | | | |

| Section F: Hand Preferences | | | | | | | |
|---|---|---|---|---|---|---|---|
| For each of the sections could you please indicate how your child performs the gesture by ticking the column which seems to best describe your child? | | | | | | | |
| Section | Doesn't do these yet | Left hand only | Right hand only | Only uses one hand but changes between left and right | Uses both hands, each doing the same thing | Uses both hands but each doing different things | Sometimes uses one hand, sometimes two |
| A: Pointing | | | | | | | |
| B: Communicating | | | | | | | |
| C: Naming | | | | | | | |
| D: Actions | | | | | | | |
| E: Describing | | | | | | | |

| Section G: Other Comments |
|---|
| Please use this space to add information to any of the previous answers, or to include anything else your child does with gestures. |
| |

Thank you for taking the time to complete this questionnaire.

# FURTHER COMPARATIVE SCORES FOR GESTURE INPUT

The gestural input of the parents and Explorers staff was assessed with several measures (see Chapter 7). The table below give the group means and standard deviation (in parentheses) for these staff and parents with two comparison groups. The Explorers whole group comprises all eight participants. The comparison home and Explorers group excludes Toby and Zaara.

| | Communicative acts | Gestural communication | Synchronised cross-modal | Gesture without speech | Reinforcing | Disambiguating | Supplementary | Organisational |
|---|---|---|---|---|---|---|---|---|
| Explorers (whole group) | 9.83 (3.57) | 0.26 (0.08) | 0.87 (0.08) | 0.09 (0.06) | 0.82 (0.06) | 0.03 (0.04) | 0.05 (0.03) | 0.10 (0.05) |
| Explorers (comparison group) | 10.98 (3.82) | 0.20 (0.94) | 0.89 (0.08) | 0.10 (0.07) | 0.82 (0.07) | 0.03 (0.05) | 0.05 (0.04) | 0.08 (0.03) |
| Home (comparison group) | 12.45 (3.14) | 0.13 (0.04) | 0.92 (0.07) | 0.06 (0.05) | 0.85 (0.07) | 0.09 (0.03) | 0.01 (0.02) | 0.08 (0.03) |

| | Facilitative | Directing | Commenting | Feedback | Deictic | Iconic | Emblem | Makaton |
|---|---|---|---|---|---|---|---|---|
| Explorers (whole group) | 0.89 (0.06) | 0.51 (0.06) | 0.26 (0.06) | 0.09 (0.05) | 0.59 (0.10) | 0.10 (0.05) | 0.19 (0.07) | 0.08 (0.07) |
| Explorers (comparison group) | 0.91 (0.04) | 0.52 (0.06) | 0.29 (0.03) | 0.09 (0.05) | 0.58 (0.11) | 0.12 (0.04) | 0.17 (0.07) | 0.04 (0.03) |
| Home (comparison group) | 0.93 (0.03) | 0.46 (0.19) | 0.24 (0.14) | 0.13 (0.06) | 0.71 (0.07) | 0.06 (0.03) | 0.20 (0.11) | 0.01 (0.01) |

**Table C.1: Group comparison of gestural input scores**

# Appendix D

## TRANSCRIPTION CONVENTIONS

The following transcription conventions have been used in the Extracts included in Chapter 8:

| | |
|---|---|
| JAC | identifies the speaker |
| : | lengthened vowel |
| ? | rising intonation |
| ! | exclamation |
| (.) | micro pause |
| (0.4) | timed pause |
| [went up] | over lapping speech |
| {coughing} | meta-linguistic information |
| CAPITAL | emphasis |
| *Italic* | movement, actions or gesture |
| (a) | step in sequential structure |
| (?) | unclear transcription, interpretation from transcriber |

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