UNIVERSITY OF SOUTHAMPTON

Faculty of Medicine, Health and Life Sciences
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THE DEVELOPMENT OF JOINT ATTENTION IN PRESCHOOL AGED CHILDREN WITH AUTISM: THE EFFECTS OF EARLY INTENSIVE BEHAVIOURAL INTERVENTION

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Thesis submitted for the degree of Doctor of Philosophy
August 2006

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

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THE DEVELOPMENT OF JOINT ATTENTION IN PRESCHOOL AGED CHILDREN WITH AUTISM: THE EFFECTS OF EARLY INTENSIVE BEHAVIOURAL INTERVENTION

by Hanna Kovshoff

Eye contact, mutually understood gestures, and imitation are all forerunners to the ability to interpret and relay both verbal and non-verbal messages to others in a culturally meaningful way. Children with autism are often reported to be significantly delayed or deviant in their development of precursors to social communication including eye contact, sharing attention, and pointing out items of interest. The present study monitored the longitudinal development of early social communication skills in a group of preschool aged children with autism who received Early Intensive Behavioural Intervention (EIBI) (n = 21) and a Comparison group (n = 16) who received a range of local educational authority (LEA) provision in the South of England across two years.

The aim was to identify whether Applied Behaviour Analysis (ABA) was able to indirectly target and improve joint attention behaviours in the group of children who received EIBI. All of the children were assessed using the Early Social Communication Scales (ESCS) (Mundy, Hogan, & Doehring, 1996) at three time points (baseline, 12 month follow-up, and 24 month follow up). The ESCS is a videotaped structured observation measure that provides an index of individual differences in nonverbal communication skills.

Longitudinal data, describing the early social communication skills of preschool aged children with autism prior to and post intervention were obtained for the Intervention and Comparison groups Prior to intervention, no differences between the groups were observed either on the ESCS measures or on correlational analyses of the relations between these measures and structured measures of IQ, mental age (MA), and adaptive behaviour. Relative to the Comparison group, after two years of ABA, children in the Intervention group made significant gains in their ability to respond to joint attention (RJA) relative to the Comparison group. While initiating joint attention increased in frequency for both groups over time, significant group differences were not found. Reliable Change Index calculations indicated that a greater proportion of individual children in the Intervention group were approaching or meeting levels of reliable change with regards to their RJA abilities. However, no mediation of intervention effect was found on change in IQ by RJA over time. This non-significant result is inconsistent with the hypothesis that joint attention is a pivotal skill in persons with autism that might be sensitive to a structured intervention like ABA. Understanding how children with autism develop social communication may clarify the key social deficit characteristics of early childhood autism.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

My most sincere and heartfelt thanks go to my supervisors, Professors Bob Remington and Richard Hastings. Throughout my time writing this thesis I have been fortunate enough to receive an endless amount of encouragement, support, and advice when I had questions or concerns. I cannot thank you enough for all of your time and patience, and feel extremely grateful to you both for your tutelage, your mentorship, and your friendship. Somewhere, amidst all the chapter drafts, you have inspired a future academic. I only hope I can live up to the examples you have provided for me.

Thank you to Professor Peter Mundy who provided me with all of the ESCS forms, papers, and reliability tapes, and answered the many questions I had about the measure and coding.

Special thanks to Corinna Grindle for giving up many hours of her time to learn how to code the ESCS and for reliability coding the data.

I am also extremely grateful to all the families who have welcomed me into their homes and schools over the last few years. At the beginning of this piece of research, parents had just received diagnoses of autism for their children and were coming to terms with the knowledge that their three year old child would have a lifelong developmental disability. The creativity, strength, resolution, and sense of humour with which they respond to life's challenges was, and continues to be, my biggest inspiration.

Finally to my loving ever-supportive husband Jonathan. Thank you for your pep talks when I felt snowed under, your encouragement when I felt overwhelmed and for your counsel and unconditional love at each turn in the road. While its easy for words such as 'love' and 'support' to seem cliché and standard, as my husband and best friend, there is nothing standard about you. A more wonderful and encouraging partner is impossible to imagine.

LIST OF ABBREVIATIONS USED THROUGHOUT THE THESIS

JA	Joint Attention
ESCS	Early Social Communication Scales
IJA	Initiating Joint Attention
RJA	Responding to Joint Attention
IBR	Initiating Behaviour Regulation (Requesting)
RBR	Responding to Behaviour Regulation (Responding to Requesting)
ISI	Initiating Social Interaction
RSI	Responding to Social Interaction
EIBI	Early Intensive Behavioural Intervention
ABA	Applied Behaviour Analysis
IPP	Initial Pathological Processes
SND	Secondary Neurological Disturbance
CNS	Central Nervous System
LEA	Local Educational Authority
CA	Chronological Age
MA	Mental Age
IQ	Intelligence Quotient
VABS	Vineland Adaptive Behavior Scales
RCI	Reliable Change Index
PECS	Picture Exchange Communication System
TEACCH	Treatment and Education of Autistic and related Communication for Handicapped Children

1. THE DEVELOPMENT OF JOINT ATTENTION IN TYPICALLY DEVELOPING POPULATIONS

1.1 STRUCTURE OF THE THESIS

This thesis presents a series of investigations into the nature of joint attention deficits in children with autism, and their potential for amelioration through early intensive intervention. Chapter One defines joint attention, describes current methodological paradigms for measuring this skill, and details theoretical accounts of joint attention in typically developing children. Chapter Two describes the deficiencies of joint attention that are occasionally seen in some developmental disabilities, focusing on autism. Joint attention deficits are a diagnostic marker for autism, and theories that attempt to explain why this may be the case will be reviewed. In Chapter Three the argument for the necessity of including joint attention paradigms in intervention research is made. Chapters Four to Six present the methodology and research that form the empirical basis of the thesis. Finally, Chapter Seven reviews the findings from the empirical studies, and includes a discussion of how they relate to theory and our current understanding of the nature of autism. The questions posed in this thesis are twofold: 1) What is the longitudinal development of joint attention in the preschool years in children with autism when intensive intervention is not delivered and 2) What are the effects of early intensive behavioural intervention (EIBI) on the development of joint attention in this population. The notion of whether joint attention is a pivotal skill that must be improved prior to seeing any intervention effects will be discussed.

1.2 CHAPTER SUMMARY

As typically developing infants approach their first birthday, they embark on a journey that will eventually permit them to initiate and maintain social relationships with others. This journey begins with an increased interest in objects and events during interactions with caregivers. As this focus on factors outside of their own experience develops, infants seek to share their experiences with others. This is evidenced at approximately 12 months of age when infants begin to alternate eye gaze between an interesting object and a caregiver, or

when they coordinate attention to toy play with the attention and actions of their caregivers. These behaviours, which are examples of nonverbal social communication, are invaluable in the development of more advanced cognitive, social, and linguistic skills (Adamson & Bakeman, 1985; Bruner, 1981; Trevarthen, 1979).

In this chapter the concept of joint attention and its crucial role in development over the first two years of life will be introduced. First, joint visual attention will be operationally defined and the form and functions of joint attention will be explained. Next, the methodology used to study joint attention will be reviewed and measurement procedures discussed. Third, the development of joint attention behaviours will be tracked from infancy to the second year of life. Empirical support for the importance of joint attention in the development of cognition, social communication, social referencing, and intentional communication will be discussed. Finally, Theoretical accounts of the origins and neurological underpinnings of joint attention will be outlined.

1.3 INTRODUCTION

A 12 month old baby boy and his mother[1] are turning the pages of a picture book. On each page, the woman points to a picture and labels it, calling her son's attention to the object: 'That's a dog. Look! A teddy bear.' She watches as he takes in the information. A few moments later, the infant imitates his mother's point to a picture. He looks up at his mother to make sure that he has captured her attention and that she is indeed concentrating on *his* point this time. His mother smiles and says 'Yes I see, that is a cat!' The little boy returns his mother's smile and looks between her and the picture, proud that he was able to influence her behaviour and share his interests.

In this example, the boy wished to share his interest in a picture, captured his mother's attention by pointing out an item of interest, and monitored her focus to ensure that she was fixated on the same item as him. Scenes much like this are repeated several times per day in the life of the vast majority of children on the planet growing up in a nurturing environment.

[1] For clarity of expression, throughout the thesis, children will be referred to as masculine and adult caregivers will be referred to as feminine.

1.3.1 OPERATIONAL DEFINITION OF JOINT ATTENTION

In its most narrow sense, joint attention is described as a pattern of interpersonal responding that refers to the ability to follow another's direction of gaze, or simply to 'look where someone else is looking' (Butterworth, 1991). This may occur when a child demonstrates that he has noticed an adult has shifted her attention onto an object by following her eye gaze or head turn from one orientation to another, thereby shifting the focus of his attention to the object upon which the adult is focusing. A child may also follow an adult's physical point and turn his head and eye gaze in the direction indicated. Conversely, a child may point out an object of interest, or show an item with the purpose of sharing it with a caregiver.

In order for attention to truly be 'joint', not only must a child follow the eye gaze or head turn of another, point, or show an item of interest to an adult. He must also *monitor* the adult's behaviour and check the focus of her attention in order to retrieve information that confirms whether she is actually attending to the item indicated. Specifically, this more broadly defined notion of joint attention includes responding to, initiating, or maintaining a communicative channel with a partner (Adamson & McArthur, 1995) and refers to the ability to coordinate primarily visual, but also auditory attention, with others regarding objects and events (Mundy & Gomes, 1998).

Thus, joint attention is not simply a *geometric* phenomenon concerning two lines of visual orientation (Tomesello, 1995). Two people who simultaneously attend to the same event, such as when a loud noise outside leads them to look through separate hotel windows, are not engaging in joint attention. It is essentially a *social* phenomenon; two individuals must know they are attending to something in common.

Throughout development, children acquire the ability to share their interests with others through joint attention acts. If a child were playing with a toy, he could establish joint attention in various ways; He could look between his toy and his mother's face to share his interest in the object, to convey information about the toy, or to seek information in an ambiguous situation (e.g., 'Should I be afraid?). For these interactions to meet the definition of joint attention, the attentional focus of the child and caregiver must truly be *joint* in

the sense that they are aware that they are both attending to precisely the same thing, and crucially, each must be monitoring the other to ensure this common focus.

For the purpose of discussion in this thesis, joint attention will be operationally defined in these broader terms, where *joint* refers to two persons sharing a common experience and converging their *attention* to some third object or event. To meet this definition, they must be aware that the person with whom they are interacting is also attending to the same thing (Bruner, 1983; Leekam & Moore, 2001), for example by shifting their eye gaze between the object of interest and their social partner.

1.4 EXAMPLES OF JOINT ATTENTION

In this section the various forms that joint attention bids may take, the role of both initiating and responding to joint attention episodes, as well as the function of joint attention bids will be defined and clarified.

1.4.1 FORMS OF JOINT ATTENTION BIDS

The primary role of joint attention is to initiate, maintain, and respond to a social communicative partner. The form this communication takes may be a gesture (e.g. a point), a vocalisation, or an alternation of eye contact between an object of interest and another person. Initial research on the skills or behaviours that are important for the development of joint attention focused primarily on two general areas: head and eye gaze shifting and pointing. In many of the early studies of joint attention, it was defined narrowly and an infant who merely followed eye gaze or turned his head in the same direction of a model's was said to display joint attention abilities (Butterworth, 1995; Butterworth & Cochran, 1980; Butterworth & Grover, 1990; Butterworth & Jarrett, 1991; Scaife & Bruner, 1975). Based on this narrow definition, researchers suggested that infants were able to engage in joint visual attention as early as 6 months of age as they were able to follow attention. However, following the attentional bids of others, while an important precursor skill to joint attention, must not be confused with true joint attention where two people are sharing a common focus.

Pointing is another form of communication that may be used to establish joint attention. This is accomplished by gesturing to capture another's attention or to direct the attention of another to an interesting event. It may also be used to influence the behaviour of others or to refer to a proximal object. Typically developing children are unable to follow another's points to even nearby objects until approximately 8 to 10 months of age (Butterworth, 1991; Murphy & Messer, 1977). Points directed towards more distant objects can be followed at approximately 14 or 15 months of age (Corkum & Moore, 1995; Murphy & Messer, 1977). Only in their second year do children begin to use pointing to influence the behaviour of others (Butterworth 1995; Desrochers, Morissette, & Ricard, 1995). The common theme that unites pointing to following or initiating joint attention is coordination between an infant, a social partner, and an object or event of relevance to both parties. Again, for a point to meet criterion for joint attention, it must be clear that when pointing, an infant is not simply indicating a change in focus of his own attention, without the purpose of communicating that change to a social partner (Tomasello, 1995).

1.4.2 INITIATING VERSUS RESPONDING TO JOINT ATTENTION BIDS

Joint attention can be established through *responding* to the eye contact or a point from a social partner, or through *initiating* a bid for joint attention and having a partner follow suit. While the initiation of pointing behaviours to establish joint attention is not seen before the second year of life (Bates, 1979), as seen in the previous section, the ability to follow another's attention has been reported in the literature as early as 6 months of age (Butterworth & Jarrett, 1991). Thus, after only a few months, infants are capable of responding to a social bid from their caregiver. It is not until approximately 9 months of age however, that infants are able to display clear social initiatives in interactions, for example, smiling before their mother smiles (Cohn & Tronick, 1987). In a longitudinal study of 24 typically developing infants from 9 to 15 months of age, Carpenter, Nagell, and Tomasello (1998) explored the trajectory of joint attention on a monthly basis. At each monthly interval, children interacted with their mothers as they normally would for 10 minutes. They found a reliable pattern in

the emergence of these social cognitive skills. In the first few months of observations (9 – 11 months), infants shared attention with an adult by alternating gaze between the adult and an object. This was followed by the ability to declaratively point out objects of reference to an adult at 12 months. Next, at 13 months, infants developed the ability to follow the attention of others by looking where adults themselves had looked or pointed. Subsequently, at 14 months, infants followed another's behaviour by imitating their actions on objects. Finally, at 15 months, infants were able to direct others' attention and then others' behaviour through the use of requesting and sharing gestures such as points and reaches.

Age	Skill
9 – 11 months	Alternate eye gaze between adult and object
12 months	Point out items of interest
13 months	Follow the points or eye gaze direction of others
14 months	Imitation of action on objects
15 months	Direct others' attention through pointing, reaching, sharing and requesting gestures

* Based on work by Carpenter, Nagell, and Tomasello (1998)

Table 1.1 Developmental Trajectory of Initiating and Responding to Joint Attention*

The tendency to initiate and respond to joint attention bids is associated with later cognitive and language development. This may be because the ability to communicate using these nonverbal behaviours reflects the maturation of important social, cognitive and self regulatory capacities within the infant (Butterworth & Cochran, 1980; Corkum & Moore, 1997; 1998; Mundy & Gomes, 1998; Ulvund & Smith, 1996). Mundy and Gomes (1997) examined the relation between responding to joint attention and language development. They found that a measure of responding to joint attention bids, namely the tendency of a child to follow the direction of gaze and pointing of an experimenter, was a

significant predictor of receptive language development in a sample of 14 to 17 month old toddlers, even after controlling for initial variance in cognitive or linguistic ability. In this study, measures of the initiation of joint attention bids through pointing or showing did not display the same degree of association with measures of receptive language. In a follow-up study, Mundy and Gomes (1998) investigated the relationship between early initiations of joint attention and later language development in their sample 14-17 month old children. They found that after taking into account initial variance in language and cognitive status, initiating joint attention was a significant predictor of expressive language. Thus, in summary, Mundy and Gomes (1997; 1998) found that responding to joint attention may predict receptive speech, while initiating joint attention may predict expressive language. Additionally, other researchers have found that initiating joint attention may also be a significant predictor of IQ in childhood (Ulvund & Smith, 1996).

1.4.3 THE FUNCTION OF JOINT ATTENTION BIDS

Communicative function can take one of two forms (Bates, 1979). Protoimperatives, or requesting behaviours, are used by an infant to elicit aid in attaining objects or events. For example, an infant may point to a desired toy that is out of reach while making eye contact with a parent. Protodeclaratives refer to joint attention gestures and are used to direct attention to objects or events. In this case however, attention directing is not used to attain the object or event, but rather to share the experience of it. For example, an infant may point to a toy that is within reach while making eye contact with his social partner. There is some evidence that these two classes of nonverbal communication acts may have at least partially independent developmental pathways early in life, as certain disorders are associated with delays or deviances in one but not both of these domains (Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992).

It has been suggested that the critical difference between protoimperative and protodeclarative behaviours may be tied to the use of affect in conjunction with these behaviours (Adamson & Bakeman, 1985; Bruner, 1981; Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992). Mundy and

colleagues (1992), for example, examined the use of affect in 32 typically developing infants with a mean age of 20 months while they engaged in protoimperative and protodeclarative behaviours. They found that positive affect was displayed for over 50% of the duration of the display of joint attention (protodeclarative) behaviours (range 56-70%). Alternatively, the mean duration of positive affect displayed during requesting (protoimperative) behaviours did not exceed 36% for any one type of behaviour (range 18-36%). Thus, the authors concluded that not only did joint attention involve the coordination of attention to objects and events, but also the capacity to coordinate or share affective experience vis-à-vis objects and events through the use of eye contact and smiling.

1.5 METHODOLOGY FOR STUDYING JOINT ATTENTION

Scaife and Bruner (1975) pioneered joint attention research by examining how infants' shifts in eye orientation indicated their ability to follow attention. They created the 'prototypical' joint attention paradigm in which an experimenter engages in a face-to-face interaction with an infant and attempts to establish eye contact. Once this has been established, the experimenter changes the direction of his or her eye gaze and the infant's response to this change of attention is noted. For each subsequent trial, the experimenter re-establishes eye contact, and then changes the direction of his or her attention (e.g., an eye direction and/or head orientation change). An episode of joint visual attention was said to occur if the infant aligned his attention with that of the experimenter or looked in the direction of the experimenter's eyes. Scaife and Bruner (1975) delivered two trials, one to each side of the infant. In each trial, the experimenter moved his head and eyes 90 degrees to fixate on a target not visible to the infant. Joint visual attention was said to be established if the child turned to look in the same direction as the experimenter on at least one of these trials. They found that 30% of 2 month olds aligned their attention with the experimenter's on at least one trial and, by 11-14 months, all of the infants demonstrated head turning on at least one trial.

1.5.1 TARGET LOCATION

In an attempt to improve the ecological validity of joint attention experiments, Butterworth and colleagues (Butterworth, 1995; Butterworth & Cochran, 1980; Butterworth & Grover, 1990; Butterworth & Jarrett, 1991) used Scaife and Bruner's (1975) paradigm with mothers assuming the role of the experimenter. Based on the results of their studies, they suggested that infants develop basic joint attention skills (as defined by gaze-following in their study) between the ages of 6 and 19 months in three stages: ecological, geometric, and representational. These stages will be outlined briefly here, and presented in greater detail in Section 1.7.1 in a discussion of age specific mechanisms. In the first stage (ecological), which occurs at approximately 6 months of age, infants will reliably turn their head to attend towards the correct side of the room for targets within their field of vision but they are only able to locate the first target they fixate on. At 12 months of age, or the second stage (geometric), infants begin to track their caregiver's gaze and will orient to and watch the object or event to which their caregiver is attending. At this stage however, infants only have the ability to follow their caregiver's gaze if the object is within their field of vision (i.e., not behind them). In the final stage (representational), the infant at 18 months is able to turn around and attend to an object or event. They are now able to locate the direction and location of targets when they are out of their initial scan of the visual scene, or their direct field of vision. Even at this stage however, infants will only search behind them for targets when their own visual field is empty of targets.

1.5.2 AN IMPROVEMENT IN MEASUREMENT PROCEDURES

Scaife and Bruner (1975) and Butterworth and colleagues (e.g. Butterworth 1995; Butterworth & Jarrett, 1991) used head and eye gaze shifting in the direction of an adult's attention to indicate that joint attention had been established. Head and eye orientation are good predictors of direction of attention because they often occur at the same time (i.e. we most often move our heads and eyes together to focus our attention). However, the preceding research paradigms failed to take into account cases in which head and eye orientation are not in synchrony (e.g., moving the eyes to change the focus of attention, but not

moving the head). In those cases, eye orientation provides the most reliable information about the focus of attention.

The relative salience of changes in head and eye orientation, versus changes solely in eye orientation, were investigated by Lempers (1979) and Butterworth and Jarrett (1991). Lempers (1979) explored the effectiveness of eye gaze shifting alone as a tool for establishing joint attention in 9, 12, and 14 month old children. Butterworth and Jarrett (1991) used the same paradigm with 18 month old children. The results of both studies indicate that a combined head and eye shift is more effective as a cue for following attention than a change in eye orientation alone. Lempers (1979) found that while none of the 9 month old children in his sample were able to establish joint attention based on eye gaze shifting alone, 50% of the 12 and 14 month old children had developed this skill. In their study, Butterworth and Jarrett (1991) found that 42% of 18 month old children were able to shift attention based on a change in an adult's eye orientation alone.

Building on previous work, Corkum and Moore (1995) explored the perceptual features infants employ to determine where a social partner is looking, and how they align their own gaze with that of another person's. Additionally, they attempted to clarify the nature of the behaviours involved in responding to joint attention bids. Using a methodology similar to Scaife and Bruner's (1975), they required the infant to follow an experimenter's point following a shift in head or eye orientation. However, they employed a more stringent scoring criterion to establish whether infants' tracking occurred at a rate that exceeded chance. This was achieved by differentiating instances of attentional alignment from instances of non-alignment, in other words by comparing the infants' matches of attention (aligning attention with a model) with their mismatches (shifting attention in the opposite direction from that of a model's). Sixty children in five age groups between the ages of 6 and 18 months participated in the Corkum and Moore (1995) study. Four different cues signalling a change in attentional focus were used: 1) Head Change: a change in head orientation but with eyes remaining on the infant; 2) Eye Change: head remained facing towards the infant, but eyes changed in their direction of orientation; 3) Congruent Head + Eye Change: both head and eyes changed in orientation in the same direction;

and 4) Incongruent Head – Eye Change (both head and eyes changed orientation, but in opposite directions). There were no specific targets upon which to fix attention but a small piece of tape was provided for the experimenter to ensure that attention was aligned at the same height and direction on each trial.

In Corkum and Moore's (1995) sample of children, joint visual attention, defined as significantly more frequent matches than mismatches with the experimenter's direction of eye gaze, was not reliably established until 15 months. However, they did find a developmental difference such that 12-13, but not 6-7 or 9-10 month olds, had significantly more matches than mismatches indicating that early stages of joint attention may be present by 12 months. Findings from the 15 month olds indicated that they followed attention based on information about head position, whereas the 18-19 month olds relied on the more informative cue of congruent head and eye orientation for determining direction of gaze and attention. None of the infants studied aligned with the direction of the experimenter's attention based on information from eye gaze alone at a frequency that exceeded chance. This contrasts with data from Lempers (1979) and Butterworth and Jarrett (1991) who found that a significant proportion of 14 and 18 month olds were able to use information from eye gaze switching to align their attention with a model's. Butterworth and Jarrett (1991) found that 42% of their sample established joint attention based on eye gaze versus 50 % on eye gaze and head turning. Lempers (1979) found that 50% of the infants in his study engaged in joint attention based on eye orientation alone, compared to 90% of trials for head and eye gaze together. One explanation is that congruent head and eye movements produce a clearer signal of attention change than eye orientation change alone. Furthermore, the combined movement may signal that the focus of attention is more interesting as the viewer is deploying more than one attention change mechanism (i.e. both eye gaze and head position change). Additionally, the weight of the empirical evidence presented in the reviewed literature suggests that the onset of joint visual attention (as defined by the authors) may hinge on the criteria employed for scoring it. The more rigorous methodology and stringent scoring procedure utilized by Corkum & Moore (1995) required that infants aligned their eye gaze with the experimenter's on significantly more trials than they misaligned with the experimenter's gaze

direction, thus removing the possibility of significant results due to chance. Thus, the discrepancy of findings in the above studies may have been attributable to differences in whether the researchers considered errors, or the tendency of infants to turn their heads away from the direction of gaze of a social partner, as well as correctly turning their head in the direction of a partner's head turn, in determining whether this skill is consistently present in early infancy (Corkum & Moore, 1995; 1998).

The results of the preceding studies must be interpreted with caution owing to the use of an operational definition of joint attention as simply a head turn or gaze following behaviour. These behaviours would not be considered unambiguously to be episodes of joint attention, because it is uncertain whether infants were aware that they were attending to the same object as the parent or experimenter at the same time. These head and eye gaze following behaviours were reviewed, however, as they lay the foundation for the development of joint visual attention. Moreover, this literature can not be dismissed as, at the time, the experimenters believed they were dealing with joint attention in the full sense of the term.

1.5.2.1 The Early Social Communication Scales

Another methodology used to study joint attention in typically and atypically developing populations is the Early Social Communication Scales (ESCS). The ESCS is a videotaped semi-structured observation paradigm in which child-experimenter interactions are designed to elicit joint attention and requesting behaviours (Mundy, Hogan, & Dohering, 1996). During the administration of the ESCS, an infant and a tester sit directly across from each other at a table. A standard set of toys are presented to the infant in a manner designed to elicit joint attention, requests, directions, shared attention, social interaction, and turn taking from the child, and the frequency of each type of behaviour is noted. This method of assessing joint attention is arguably more ecologically valid as it mimics a greater variety of interactions that occur during infancy than previous paradigms. Additionally, the coding and scoring procedure used in the ESCS is stringent enough to avoid false positive errors. Clear operational definitions of the behaviours to be coded are used consistently and reliability testing is

performed to ensure that coders are consistent with each other. Individual differences on ESCS scores from as early as 6 months of age have been related to subsequent differences in language and cognitive development (Morales et al., 1998, 2000a, 2000b; Ulvund & Smith, 1996) (See Chapter 4 for a detailed description of ESCS tasks and procedures, or the full manual in Appendix A).

1.6 THE DEVELOPMENTAL TIME COURSE OF JOINT ATTENTION

In this section, a tentative developmental pattern for the acquisition of joint visual attention will be outlined. Empirical data will be discussed in light of a definition of joint attention that requires both the infant and their social partner to be active and engaged social participants in a joint attention interaction. Briefly, by 8 months infants are able to show items of interest to caregivers, and align with another's attention by 10-11 months. At 12 months, children reliably demonstrate joint visual attention through social cues (i.e. orienting their attention based on an adult's head or eye gaze). Despite the fact that infants are able to detect changes in eye orientation from birth (Mayer & Dobson, 1982), and spend more time scanning the eye region of the face than any other area (Hainline, 1978; Haith, Bergman, & Moore, 1977), they are unable to use a model's eye gaze orientation to direct their own visual attention until the end of the first year. By 18 months of age, infants are able to orient their attention based on information from eye orientation, but only when this is accompanied by a head turn. As children develop, they are increasingly able to attend to eye orientation and begin to understand that eye orientation gives the best and most reliable information of where another is looking.

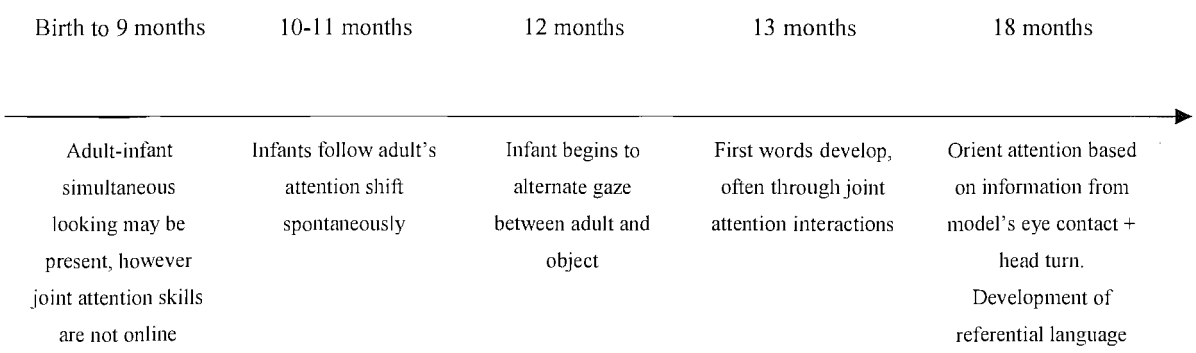


Figure 1.1 The developmental progression of joint attention stages in first 18 months of life.

1.6.1 ABSENCE OF JOINT ATTENTION IN THE FIRST 9 MONTHS OF LIFE

Joint attention serves an important function during the prelinguistic period in that it permits basic information about interesting events or objects of desire to be communicated from caregiver to child. In the first few months of life, infants spend much of their time in face-to-face dyadic interactions with others. It is within this context that they begin to acquire early skills essential for the development of social communication, including engaging in mutual eye contact, vocal exchanges, and turn-taking sequences (Fogel, 1993; Leekam & Moore, 2002).

However, recall that joint attention must involve awareness of both parties that they are attending to the same aspect of their common environment. Interactions between infants less than 9 months of age and their caregivers seldom share this quality. Tomasello (1995) argued that there are primarily two common forms of adult-child interactions that lack the criterion of jointness. First, both infants and adults may look to the same object and even focus on the same aspect of the object, but they do so independently. This may occur when an adult follows a child's gaze and watches them engage with an object, when a child watches an adult perform an activity, or when attention is drawn to the same object at the same time for fortuitous reasons (e.g., looking out separate windows of the house after a loud bang was heard from outside). Attention in these cases cannot be said to be 'joint' as neither party is necessarily aware of the

other's attentional focus. In the second scenario, a child may once more attend to the same object and even the same aspect of the object as his caregiver, but does this as a result of having learned that looking where adults look leads to interesting sights (Corkum & Moore, 1995). Similarly, a child may lift an object to show an adult, however without following the adults' focus of attention to ensure that they are attending to the item. Tomasello (1995) calls this 'cued looking' and argues that it a psychological phenomenon concerning two foci of visual attention and not necessarily joint attention as once more, the infant does not necessarily know the adult is attending simultaneously.

As outlined earlier in this chapter, Corkum and Moore (1995) found that prior to 10-11 months of age, infants were just as likely to respond to head turning cues by looking in the opposite direction, as in the same direction as an experimenter. However, by 10-11 months of age, infants followed adult gaze spontaneously. Additionally, prior to 9 months of age, very little gaze alternation between an object and a person is seen (Tomasello, 1995). Gaze alternation is a good, though not infallible, indicator of joint attention as an infant will typically look between his caregiver and a toy, monitoring whether the adult is attending to the toy simultaneously.

1.6.2 EMERGENCE OF JOINT ATTENTION BETWEEN 9 AND 18 MONTHS OF AGE

Between 9 and 18 months of age, a new, more social understanding of others develops. This is evidenced by a qualitative shift in the ability to spontaneously engage in joint attention sometime around an infant's first birthday (Morisette, Ricard, & Gouin-Decarie, 1995). Accordingly, children may follow an adult's head turn to an attractive object, and then immediately look back to check on the adult's focus, independent of any adult behaviour (Butterworth, 1991). Also at this time, infants will begin to show objects to adults by holding them out for them to see, as well as point to items of interest while alternating eye gaze to ensure the adult is paying attention (Bates, 1976). At this stage, infants and their caregivers begin to engage in prolonged periods of coordinated joint attention (Bakeman & Adamson, 1984; Tomasello, 1995). This refers to play where an infant actively coordinates his attention with an adult and the object he is playing

with (Sugarman, 1984; Walden & Ogan, 1988). Joint attention interactions at this stage also involve the coordination of affective experience as infants will display more positive affect with their parents or familiar others whilst engaging in turn taking or object play (Kasari et al., 1990; Mundy, Kasari, & Sigman, 1992). Not only do children display their own affective experience, they are also able to follow an adult's attention to an object, assess their caregiver's affective reaction, and then adopt the same emotional stance (Uzgiris, 1989; Walden & Ogan, 1988). This is also the time when children begin to use protoimperative and protodeclarative gestures. Between 12-14 months of age, infants use self initiated protoimperative pointing to signal a request, however they do so while monitoring the adult's intentions to retrieve the object. Protodeclarative behaviours also develop around this age and infants begin to use spontaneous gaze alternation between objects of proximal distance and adults as they point out or show objects (Butterworth, 1991).

1.6.3 JOINT ATTENTION BETWEEN 18-24 MONTHS

Half way through their second year, infants begin to acquire more sophisticated forms of joint attention which can be seen through their use of referential communication. Accordingly, when an infant uses language to get his needs met or to comment on his environment, he is attempting to manipulate the attention of another person (Talmy, 1993; Tomasello, 1995). One of the first indices of an infant's new understanding of the significance of shared joint attention interactions can be documented through verbal understanding at 18 months of age (Sigman & Kasari, 1995). At this stage, if an adult labels an object that she is looking at when an infant is looking at a different object, when asked to which object the label applies, the child will select the object of the adult's gaze (Baldwin, 1991). This is one of the first clear markers that infants are developing an understanding that other people can focus attention and have intentions that are different from their own.

Apart from following and directing an adult's focus of attention, infants also tend to look at their caregiver's face for information and reassurance. The term used to describe this type of coordinated attention is social referencing and refers to the ability to use another's emotional display to guide one's own

response to something novel (Baldwin, 1995). Surprising, ambiguous, or threatening situations may produce a reaction from an infant involving him looking from an object or event to his caregiver for reassurance or information of how to best interpret the event (Feinman & Lewis, 1983; Gunnar & Stone, 1984; Hornik & Gunnar, 1998). In each of these situations, in addition to gaining and maintaining joint attention, the child is also monitoring and interpreting the adult's intentions or attempting to seek information about the situation. These cases index an early form of social awareness, showing that infants have a vested interest in understanding the attention and emotions of others. Thus, an infant who is approached by a remote controlled spider whilst his parent reacts with fear will hesitate to approach the toy (Zarbatany & Lamb, 1985). However, if the parent looks happy, the infant will more readily approach the toy and continue to play freely.

Sigman and Kasari (1995) investigated the use of shared joint attention in social situations in 51 typically developing children between the ages of 8 and 30 months using an early version of the Early Social Communication Scales (ESCS) (Seibert, Hogan, & Mundy, 1982). Patterns of behaviours observed included eye contact while an experimenter held a toy, gaze alternation between the experimenter and a toy, pointing, and showing. Developmental changes were found in all behaviours except showing which was rarely observed in any of these age groups. Developmental changes in a social referencing situation were also found using a paradigm in which a toy robot entered a room where an infant, parent and experimenter were playing. When the robot appeared, the parent and the experimenter play acted either fear or amusement for 30 seconds. Sigman and Kasari (1995) found that older children tended to look more frequently from adult to robot, particularly in the fear situation.

The authors found parallels between the type of structured play situation used in the ESCS tasks and the robot task. Children who alternated gaze more frequently in the ESCS's social play situation also looked more frequently and for longer durations at the adult during the social referencing situation. These associations remained independent of chronological age. Children who were able to follow an experimenter's point behind them in the ESCS, as well as turned to reference parents more frequently and for longer durations in the social

referencing task, had higher scores on an index of language. Thus, responsive joint attention and referential looking seem to index a level of social understanding, and joint attention may be uniquely important in the development of language with increasing age.

1.6.4 EARLY JOINT ATTENTION SKILLS PREDICT SUBSEQUENT LANGUAGE ABILITIES

Children acquire language skills as part of their social interactions with adults, in much the same way as they learn to share joint attention. Several researchers have asked whether children's earliest language skills emerge out of the prelinguistic joint attentional activities they engage in with caregivers, or whether they develop through other sources. In the Carpenter, Nagell, and Tomasello (1998) study reviewed earlier in this chapter, where children were followed on monthly intervals from 9 to 15 months of age, children interacted with their mothers as they normally would for 10 minutes. During the interaction, the researchers collected data on the amount of time each mother-child dyad spend in joint attentional engagement and the percent of utterances from the mother that followed her child's focus of attention. At each interval, mothers reported on gestures used by their child, as well as the number of words their child had mastered both receptively and expressively. They found that mothers who spent more time in joint attentional activities with their child at 12 months of age, had children who used more gestures and comprehended more language between 13 and 14 months, and used more language expressively at 14 and 15 months. Furthermore, mothers who followed their child's attentional focus with referential words at 12 months had children with larger receptive vocabularies at 13 and 14 months, and more expressive language at 14 and 15 months.

While the link between following and initiating joint attention and language development was made earlier in this chapter, some more specific joint attention skills are reviewed here. Recall that responding to joint attention may be an especially strong correlate of early receptive language skills (Markus et al., 2000; Morales et al., 2000a; 200b; Mundy & Gomes, 1998). Morales and colleagues (Morales, Mundy & Rojas, 1998) found responding to joint attention measured at 12 months to be related to the amount of mother child joint attention

interactions at 18 months in typically developing children. Responding to joint attention made a unique contribution to the prediction of language in this sample, relative to other mother-child interaction measures of joint attention. Responding to joint attention has also been found to predict language development into the third year in 'at risk' samples between 12 and 13 months of age (Ulvund & Smith, 1996; Willoughby, Mundy, & Claussen, 1997). Finally, responding to joint attention has been observed to predict language development even when variance shared with early standardized measures of cognition and language development are taken into account (Morales et al., 2000; Mundy & Gomes, 1998; Mundy et al., 1995). Thus, the assessment of responding to joint attention during the 12-18 month period of development may provide information about subsequent language development that is not provided by contemporaneous measures of language development or cognitive status.

1.6.5 CONCLUSIONS

Several research programmes have provided unequivocal support for the central role that joint attention plays in the development of social cognition and related skills. By providing a means of gauging others' interests, intentions, and goals, joint attention is a critical component in children's increasing understanding of other people's mental state (Phillips, Baron-Cohen, & Rutter, 1992). While the age of onset and correlates of key joint attention skills have been documented and replicated through many lines of research, the nature of joint attention skills are less well understood. What impels infants to follow and match the attention of others, and why is it so crucial for later social development? The schools of thought that seek to characterise the cognitive and neurological development of key areas responsible for the development and onset of joint attention will be organized along two general themes for the purpose of this thesis. They encompass a cognitive or behavioural approach, and a social cognitive or affective account of the development of joint attention. While neither approach truly reflects independent, isolated domains of research activity, the suggested mechanisms responsible for the presence of joint attention differ. The literature is reviewed in the next segment.

1.7 THEORETICAL ACCOUNTS OF THE ORIGIN OF JOINT ATTENTION

There are two basic themes that arise consistently in the research literature regarding the foundations of joint attention episodes. First, there is a general body of research that is concerned with the developmental origins of joint attention behaviours. This includes Butterworth and colleagues' (Butterworth & Cochran, 1980; Butterworth and Jarrett, 1991) focus on stage related developmental mechanisms responsible for joint visual attention and Baron-Cohen's (1995) Theory of Mind account; a modular description of cognitive architecture assumed to be directly responsible for changes in joint attention. A second area of interest can be categorised along a social cognitive theme where joint attention behaviours form the basis of a social understanding of others that debuts in the first year of life. Most commonly associated with this view are Tomasello's (1995) social cognitive model of joint attention acquisition and Mundy's (Mundy, 1995; Mundy & Crowson, 1997; Mundy & Neal, 2001; Mundy, 2003) social orienting theory. The associations between these models are explored in the following sections.

1.7.1 DEVELOPMENTAL ORIGINS OF JOINT ATTENTION: AGE SPECIFIC MECHANISMS

Much of the work concerned with the origins of joint attention has developed out of literature on the emergence of infant's gaze following behaviour (Dunham & Moore, 1995). Butterworth's (Butterworth and Cochran, 1980; Butterworth and Jarrett, 1991) research programme was outlined briefly in Section 1.5.1 of this chapter in the discussion of target location. Their work consisted of a series of studies that replicated and extended Scaife and Bruner's (1975) seminal gaze following and joint attention studies. They used a paradigm that required a mother to change the focus of her gaze or turn her head in one direction to focus on a target, and studied whether infants would respond by producing an eye gaze shift in the same direction. Infants between 6 and 18 months were studied. They found evidence for three successive mechanisms of joint visual attention that are involved in 'looking where someone else is looking (Butterworth, 1991; 1995).

The first stage to emerge at 6 months is termed 'ecological'. At this age, infants are presumably predisposed to turn their attention in the direction of their mother's gaze. They are naturally able to shift their attention and fixate on objects in their visual field; however they do not show evidence of being able to correctly identify which precise target their mother is focusing on. Instead, they tend to focus on the first object in their path of scanning. Thus, at six months of age, a change in adult direction conveys information about the direction in which to look, but the precise location is not specified. The second stage, 'geometric' surfaces at 12 months. By their first birthday, infants are able to identify the correct object their mother is focusing on, even when they are required to ignore objects that appear in their path of scanning prior to the actual target. However, at 12 months of age, infants still fail to search for targets that are located behind them. By 18 months, infants will search behind them for targets, though they will only do so if the are no targets in their immediate field of view. This third stage is termed a 'representational' spatial mechanism as it is based on an understanding that targets can be accessed from adult head and eye movement signals, so long as there is no competition from targets in the infant's perceived space.

The natural predisposition to engage in these joint attentional acts is combined with the tendency of infants to fixate on particular objects they encounter in their shifting visual fields. Butterworth argues that this natural tendency gradually develops into more precise joint attentional skills along a maturational process. We will see in the following section that Baron-Cohen (1995) postulates similar maturational changes in early gaze following during infancy, elaborating on the specific developmental mechanisms he believes are responsible for these descriptive changes in more detail.

1.7.2 JOINT ATTENTION AS A PRECURSOR TO THEORY OF MIND

Like Butterworth, Baron-Cohen postulates that human infants are predisposed toward gaze-following behaviours. Specifically, he outlines a theory incorporating modular cognitive architecture that matures across the first year of life with joint attention behaviours, developing into a fully functional theory of mind in the preschool years. Theory of Mind refers to the ability of children to

attribute mental states such as beliefs, desires, and intentions to themselves and to other people, as a way of making sense of others and predicting behaviour (Tager-Flusberg, Baron-Cohen, & Cohen, 1993). Baron-Cohen (1994, 1995) has pursued the idea that in addition to two brain modules that are presumed to exist in many species, the intentionality detector and an eye direction detector, humans also possess a shared attention mechanism that has evolved in order to recognise situations in which two individuals are attending to a common object. This shared attention mechanism is responsible for joint attention episodes involving coordination of attention between an object or event and another person. Joint attention skills in the first year of life are viewed as precursors to a later, more sophisticated, representational theory of mind. The following is a brief review of Baron-Cohen's (1994, 1995) theory.

1.7.2.1 Intentionality Director (ID)

Baron Cohen (1994, 1995) purports the existence of an evolved modular brain mechanism called an intentionality detector (ID). ID is explained as a perceptual device that interprets motion stimuli in terms of the primitive mental states of goal and desire. The human organism needed a system such as ID throughout time in order to make sense of approach and avoidance behaviours in the environment. ID is activated when it perceives any input that might be identified as an 'agent'. Agents are defined as anything exhibiting self propelled motion or making a non-random sound (e.g, a loud noise coming from outside that you have neither seen nor felt, but must still be decoded in order to decide which action, if any, to take). ID's role is to interpret the data in terms of an agent's goals and/or desires. Developmentally, ID is the first basic mechanism needed for infant joint attention and later social cognition. ID is able to accept input via any sensory modality including vision, touch, and audition, and also interprets information from stimuli that vary greatly in form. Baron Cohen bases this idea on Premack's (1990) work, suggesting that goal detection, as perceived by motion, is innate to humans and animals, and has developed and refined itself through evolution.

1.7.2.2 The Eye Direction Detector (EDD)

In contrast to ID which is able to interpret sensory information from a variety of sources, the eye direction detector (EDD) works only through vision to form dyadic representations of self and other. EDD has developed over the course of human evolution and its main purpose is to provide the brain with information that 'eyes are looking at me', building representations of 'eye behaviour'. EDD has three basic functions: (1) to detect the presence of eyes or eyes-like stimuli; (2) to compute whether eyes are directed towards the individual or towards something else; and (3) to infer, from experience, that if another organism's eyes are directed at something, then that organism sees that thing. EDD is responsible for forming representations of the relation between eyes and the thing towards which eyes are directed. Baron-Cohen argues that EDD is particularly important in the development of joint attention and later theory of mind as it allows an infant to ascribe a perceptual state to another organism (e.g., mummy sees me, mummy sees a dog). Thus, while ID interprets stimuli in terms of the volitional mental states of desire and goal, EDD interprets stimuli in terms of what an agent sees.

Adaptively, EDD has the job of differentiating between whether eyes are looking at the individual while ID uses this information to determine why (i.e., to determine the intention of the eyes it is observing). ID must also decipher that if EDD detects eyes that are not looking at the individual, whether those eyes are in the process of detecting a possible threat, a food source, or something else salient to the organism. By 6 months, infants look two-to-three times longer at a face looking at them, than at a face looking away from them (Papousek & Papousek, 1978), showing a natural preference for looking at eyes. Interaction games such as peek-a-boo, that involve occluding and revealing the eyes may be important developmentally in terms of refining EDD (Baron-Cohen, 1995; Bruner, 1983). Finally, by 3 years of age, typically developing children are able to detect whether a face is looking at them or away from them from pictures of various faces, even when eye direction is the only clue available (Baron-Cohen & Cross, 1992). In support of the adaptive properties of EDD, illustrations of EDD-like behaviour are found in non human primates. Chimpanzees, for example, look at

the direction of a fellow chimp's eyes in order to detect the location of a hidden object (Menzel & Halperin, 1975).

1.7.2.3 The Shared Attention Mechanism (SAM)

The Shared Attention Mechanism's (SAM) function is to detect whether an individual and another organism are both attending to the same thing. In contrast to the dyadic representations formed by EDD, SAM is able to use information from EDD to build triadic representations between the self, another agent, and an object or event. These triadic representations are analogous to joint attention episodes consisting of shared attention directed at an object or event. Baron-Cohen (1995) argues that information from SAM is required to develop joint visual attention. To perform this task, SAM uses information retrieved from EDD output regarding another agent's perceptual state and compares this against the individual's own personal state (e.g., Mummy sees that I see the dog). Dyadic representations are required to form triadic ones and thus SAM's function depends heavily on EDD. Additionally, SAM (and thus joint attention) appears to play a crucial role in the ontogenesis of a theory of mind.

Support for SAM's connection with EDD comes from much of the same pointing and gaze monitoring research reported earlier in this chapter. Spontaneous gaze monitoring emerges in infants between 9 and 14 months of age, whereby an infant moves his gaze towards an object that his caregiver is looking at, and then alternates his gaze between the object and the caregiver. Infants do this seemingly to identify whether they and their caregiver are looking at the same thing, thus engaging in joint visual attention episodes (e.g. Butterworth, 1991, 1995; Corkum & Moore, 1995; Desrochers, Morisette, & Ricard, 1995; Scaife & Bruner, 1975). Additionally, protodeclarative pointing gestures develop around this period of development whereby an infant directs another's visual attention by pointing to an object and then alternating their gaze between the object and another person to ensure that person has located the object of interest (Bates et al., 1979; Butterworth, 1991).

1.7.2.4 Theory of Mind Mechanism (ToMM)

The theory of mind mechanism (ToMM) is described as a cognitive system for inferring the full catalogue of mental states of others including pretending, thinking, knowing, believing, imagining, dreaming, guessing, and deceiving (Baron-Cohen, 1994). ToMM uses information gleaned from ID in terms of the intentional goals and volitional states of others, EDD in terms of the perceptual mental states of others, and SAM's triadic representational forming abilities to develop a theory of how others 'think'. This implicit knowledge of other people's minds may only be evident after a child has achieved a mental age of 30 to 36 months (Lewis & Osborne, 1990; Wellman, 1990). The joint attentional abilities utilized by SAM are therefore required as precursors to a fully functional, normally developed theory of mind. Evidence for a developing ToMM comes from the onset of pretend play in toddlers between the ages of 18 – 24 months (Leslie, 1987). Leslie (1987) argues that the mental state of 'pretend' is probably one of the first epistemic mental states understood by young children. Following this, children from 36-48 months develop understanding of additional epistemic states including understanding they can 'know' something that others may not, and that additionally, people can hold false beliefs (Perner, 1991; Wellman, 1990).

1.7.2.5 Conclusions

Baron Cohen (1995) argues that humans are 'hard-wired' to develop shared (or joint) attention, and specific neurological modules are dedicated to the promotion of this skill in both humans and non-human primates. ID, EDD, and SAM work to steer the infant towards an awareness of movement and intentionality, to detect information, and to attribute meaning to the actions of others in order to identify potential sources of danger or means of having needs met. With critical review of the literature, however, Baron Cohen's (1995) theoretical discourse appears to be somewhat circular in nature and the empirical evidence that he provides to account for the presence of each mechanism is correlational, rather than cause. For instance, his evolutionary account for the presence of joint attention in non-human primates is at best, unrelated. While other primate species may be socially oriented and use eye contact to communicate, it is only

humans who can clearly evidence joint attentional states and interact with others in such a way that they are aware of a convergence of shared attention. Of concern for this thesis, however, is whether SAM is sufficient to develop joint attention and whether a neurological module dedicated to forming these triadic representations is necessary to explain the existence of joint attention. In Baron-Cohen's theory, theory of mind is the endpoint, and joint attention is the precursor to developing this ability. In his emphasis of this process, he misses the relationship between joint attention and social cognitive development. Theory of mind skills emerge considerably later than joint attention skills, and the question remains whether these later emerging, and presumably relatively advanced cognitive processes can be used as an endpoint to explain the development of joint attention. Conversely, rather than joint attentional skills being an early index of the capacity to represent the internal psychological states of others, it may be that joint attention behaviours involve simpler cognitive or affective processes than those involved in representing these states. Baron-Cohen is unclear as to what the underlying continuity of this relationship between joint attention and theory of mind actually involves. To overcome this theoretical limitation, Tomasello (1995) suggests a theory of joint attention development that emphasizes a developmental trajectory of children's understanding of intentional agents to mental agents.

1.7.3 JOINT ATTENTION AS SOCIAL COGNITION: THE ROLE OF INTENTION

Tomasello (Tomasello et al., 1993; Tomasello, 1995) argues that infants undergo a revolution in their understanding of persons at around 12 months of age that is equally coherent and important as the one they undergo around 4 years of age when they develop a theory of mind. Crucially, around the first year of life, infants develop an appreciation for the concept of intention. In order to comprehend what an adult is attending to when she looks at an object or event, and to subsequently enter into a joint attention interaction with her, the infant must understand something of the adult's intention in the particular situation. Thus, infants begin to understand others as intentional agents in terms of their goals, and it is this understanding of intentions and not beliefs that is

foundational and may drive children to develop a theory of mind. Tomasello (1995) argues that this way of looking at joint attention in children allows for a more coherent and continuous view of social-cognitive development, rather than a view that there is only one interesting phenomenon to study, namely theory of mind, and that all other manifestations of children's understanding of persons are either precursors or sequelae.

Prior to their first birthday, children develop insight into other persons that includes this understanding of their intentions. At 12 months they come to understand that others' intentions may differ from their own, and between 18 and 24 months they begin to comprehend that the intentions of others may not match with the current situation (i.e., mismatches between intentions and actual situations). Accordingly, when infants are able to view others as intentional agents, they begin to understand that other persons may attend selectively (intentionally) to some things in the environment and ignore others. They also begin to understand that that attention may be directed to things in the environment – an understanding of joint attention.

Tomasello's (1993, 1995) contention that an understanding of intention is necessary to develop joint attention has implications for the understanding of joint attention and social cognition. As was stressed earlier in this chapter, for attention to truly be joint, it must go beyond visual orientation and simultaneous looking. Accounts of joint attention development must include more than a simple taxonomy of head and eye gaze behaviours (c.f., Butterworth & Jarrett, 1991; Scaife & Bruner, 1975). With regards to the theory of mind literature, Baron-Cohen (1994) may propose that children use gaze following of others (EDD) to infer their goals (ID), however he does not recognize that children must use their understanding of other persons' goals to go beyond simple gaze following to an appreciation of another's attentional focus (Tomasello, 1995). Suggesting that joint attention is little more than a precursor to a purely cognitive theory of mind misses the continuity between joint attention and other social cognitive behaviours that also develop in the first two years of life such as language. Moreover, one can argue that theory of mind is little more than a postcursor to joint attention skills as an understanding of others as intentional

agents is an important foundation for later social cognition and theory of mind (Tomasello, 1995).

1.7.4 SOCIAL ORIENTING THEORY: INTEGRATION OF INFORMATION PROCESSING AND AFFECTIVE RESPONSE

Mundy and colleagues (Mundy et al., 1986, 1990; Mundy, Sigman, & Kasari, 1993) considered the possibility that joint attention interaction between two people relies on the use of affect to convey meaning. They argue that early non-verbal social communication development between birth and 5 months predominantly involves sharing affective states (e.g., happiness) and affective symbols (e.g., smiling) between the caregiver and her child (Adamson & Bakeman, 1982; Trevarthen, 1979). Joint attention behaviours in particular may be direct descendants of these early affective interactions because a primary purpose of joint attention interactions is to share the experience of an object or an event with others. Requesting behaviours on the other hand, serve the purpose of having needs and desires met, and are not primarily used for social sharing purposes. Thus, the declarative function of joint attentional abilities may involve the conveyance of affect to a greater degree than the instrumental function of requesting behaviour (Bruner, 1981; Mundy, Sigman, & Kasari, 1993). This hypothesis was supported by two studies that recorded the facial affect of young children while they engaged in joint attention and requesting behaviours (Kasari et al., 1990; Mundy et al., 1992). They found that children were more likely to display positive affect to another person with joint attention behaviours significantly more often than with requests. Thus, joint attention involves not only the coordination of attention to an object or event and another person but also the conveyance of affect. Furthermore, joint attention behaviours and requesting behaviours may be distinguished on the basis of affect.

Accordingly, Mundy and colleagues (Mundy, 1995; Mundy & Crowson, 1997; Mundy & Markus, 1997; Mundy & Neal, 2001) proposed a social orienting theory: a model of joint attention acquisition based on theory suggesting that early affective experience drives a substantial portion of postnatal brain development. Like Baron Cohen (1994), Mundy also believes that the brain has evolved neural mechanisms that are primed to receive certain pieces of

information from the environment (Black et al., 1998). The infant development literature highlights that in the first year of life, children have biases or predispositions that guide their attentional focus to differing elements in their environment (Karmiloff-Smith, 1995). These biases prepare infants to learn about their social environment and may provide a starting point around which subsequent neurological and behavioural elements of the brain organize (Mundy & Neal, 2001). According to social orienting theory, the brain produces an overabundance of potential neural connections early in life. Research on cortical development suggests that the number of synaptic connections between neurons is greatest in the first few years of life, but especially between the ages of 12 and 24 months. Subsequently, the synaptic density of the brain gradually decreases (Huttenlocher, 1994), indicating a culling in the early proliferation of synaptic neural connections through the effects of experience into a more efficient and functional system of connections (Brown, 1994; Changeux & Danchin, 1976; Gottleib, 1991; Greenough et al., 1987; Huttenlocher, 1994; Mundy & Neal, 2001). Information retrieved through the visual or auditory senses, as well as social and affective stimulation, appear to trigger the activation of particular aggregations of synapses during sensitive periods in development (Black et al., 1998; Mundy & Neal, 2001). The human neural behavioural system is self organizing, so it is plausible that social-cognitive information is prioritized at an early stage in development because this is the most frequent and reliable means of an infant having his needs met. In this model, joint attention skill measures are employed to inform the degree to which social orienting has developed typically or atypically (Mundy & Markus, 1997).

1.7.4.1 Conclusions

Mundy's theory, as will be presented in greater detail in Chapter 2, has been put forward to try to explain the social orienting and joint attention deficits seen in children with autism. Mundy argues higher order cognitive dysfunctions play a role in the development of pathological processes in autism. Thus a self organizing system that serves to prioritize social approach affective information must be impaired in children with autism, leading to the behaviours associated with the disorder. While a consideration of the possible links between

neurological systems and behaviour are important, a complete understanding of this linkage is not yet clear. Theory and research on neural plasticity suggest that a sufficiently powerful disturbance in early behaviour may, in and of itself, lead to a subsequent disturbance in neurological development (Greenough et al., 1987). Nevertheless, Mundy's argument relies on identifying brain areas and processes which are yet to be examined and the only proposed mode of measuring these deficits are through the assessment of joint attention abilities. The presence or absence of joint attention may indeed be linked to neuroaffective deficits; however it may also be associated with motivational, experiential, and situational factors. Unless more precise fMRI studies are conducted in both typically and atypically developing persons, it will be difficult to either support or refute Mundy's argument. An alternative test of his theory is presented in this thesis and will be discussed in greater detail in Chapter 3.

1.8 SUMMARY

This chapter introduced the concept of joint attention and defined it broadly the coordination of attention with a social partner, vis-à-vis some object or event. Joint attention may be responsive or initiated, and is used predominantly for protodeclarative functions. Following, the methodology for studying joint attention was outlined, and paradigms for measuring joint attention were discussed. We saw that conflicting results in the literature may be more of a function of the scoring procedure utilized in the task, than other factors such as the use of targets when establishing joint attention. The Early Social Communication Scales (Mundy, Hogan, & Dohering, 1996) were described as one of the more naturalistic procedures that maintains a stringent scoring procedure.

Next, a developmental time course for the acquisition of joint attention behaviour was summarised. We saw that it is unlikely that true joint attention is present prior to 9 months of age. At 10 months, infants are able to follow the attention of others and by 12 months they can alternate gaze between an object and a caregiver. Between 18 and 24 months, infants' use of joint attention behaviours becomes increasingly complex and they are able to use eye and head turn information to orient their attention, coupled with the understanding and use

of referential language. Finally, theoretical accounts of the nature of joint attention were reviewed. Two overarching themes emerge from the study of joint attention: one concerned with the development of behavioural and cognitive mechanisms of joint attention and another social cognitive theme that sees joint attention as the beginnings of an understanding of social relationships.

We will see in chapter two that the development of joint attention may not consistently progress according to the time line and mechanisms outlined in this chapter. The inability to establish conventional use of joint attention, resulting from either primary or secondary neurological disturbances, may be linked to severe forms of pathology in atypical populations as in the case of autism. The relationship between atypical development of joint attention, special populations, and theory will be examined.

2. THE DEVELOPMENT OF JOINT ATTENTION IN ATYPICAL POPULATIONS

2.1 INTRODUCTION

Research into joint attention and social understanding historically focused on typical populations. However, over the last two decades, researchers interested in the mutually informative relationship between typical and atypical development began investigating parallels and discrepancies in joint attention between atypical populations. As the ability to selectively attend to a communicative partner and a third object or event in early infancy was shown to be related to later cognitive and language abilities in normal development, researchers were interested in how this process may have differed in children with special needs and what their individual outcomes were. Thus, joint attention skill development has been documented in children with sensory, intellectual, and developmental disabilities, as well as with children at risk for developing behavioural or communication disorders (e.g., prenatal drug exposure). Themes common to those discussed in Chapter 1 run throughout the literature on atypical development. Similar questions regarding the way that joint attention is established, and what role it may play in the emergence of social communication, social interaction, and language skills have been posed. Additionally, similar methodologies have been used to examine the development of joint attention across research studies highlighting individual differences as well as universal patterns amongst children with special needs and their typically developing peers.

In this chapter, a rationale for studying joint attention in atypically developing children will be outlined. Next, the literature covering joint attention development in children with special needs, including those with sensory, intellectual, developmental, and at risk populations will be reviewed. Following, joint attention development in children with autism will be covered in greater detail as these children have an interesting, and individual pattern of strengths and weaknesses with regards to their joint attention abilities. Finally, theoretical arguments will be presented in an effort to understand why children with autism present with their particular pattern of social communication and joint attention deficits.

2.2 A DEVELOPMENTAL CONTEXT FOR STUDYING JOINT ATTENTION IN CHILDREN WITH INTELLECTUAL OR DEVELOPMENTAL DISABILITIES.

In the late 1960s, Zigler (Zigler, 1967, 1969) proposed the first formal developmental approach for studying children with intellectual disabilities. His approach consisted of three main ideas. The first principle, the 'similar sequence hypothesis', detailed how persons with non-organic intellectual disabilities proceed, in order, through normal Piagetian stages, albeit slower than typically developing children. Zigler's second idea involved similar structures of development. When matched on overall mental age to children of average intelligence, persons with intellectual disabilities, but no organic damage, should show no particular areas of strengths or weakness (Burack, Hodapp, & Zigler, 1988). The third area discussed was that of personality and motivational factors. While children with cultural or familial intellectual disabilities should develop as typically developing children do with regards to sequences and structures, Zigler acknowledged that these persons have different life experiences, leading to different goals or personal styles. While this idea predominantly was formed in the 1960s where children were more likely to be institutionalised and therefore had unique experiences in that regard, it still applies today as children with special needs are more likely to have experiences of special schools, classrooms, and different levels of support. In addition, children with intellectual disabilities were assumed to have a learning history that included a greater degree of failure, which would influence their problem solving style. Instead of welcoming new challenges and tasks, children were expected to avoid these tasks and look to others for solutions when possible (Zigler, 1984).

In later work, Burack, Hodapp, and Zigler (1988) recognized that individuals who have intellectual disabilities with organic causes (e.g., Down syndrome, fragile X, Williams syndrome) needed to be better characterized. Burack and colleagues (1988) noted that it was simplistic to treat as identical the behaviour of persons with organic intellectual disabilities to those with non-organic causes. Thus, persons with organic causes of intellectual disabilities are expected to have a unique developmental profile. Although this may include

some similarities in terms of their developmental sequence or cognitive structures, it is mistaken to assume a 'normal' developmental profile without proper investigation. Developmental approaches can still be used when studying children with a clear organic cause, and Hodapp and Zigler (1995) refer to these attempts as examining development 'in the face of defect'. Organically affected children may have sensory, motivational, or neurobiological differences which make their developmental course vary from other children with cultural/familial forms of intellectual disability, and they are more likely to experience developmental regressions (cf., Wishart, 1993; Wishart & Duffy, 1988).

Studying the development of joint attention in infants who have sensory impairments or developmental disabilities is important in helping explain how these children come to an awareness that they are sharing the focus of attention with another person. It is also informative to document the difficulties they encounter in establishing joint attention along their developmental process, so that they can be better targeted or made more salient in their acquisition process. Finally, examining joint attention in children who are atypically developing provides a context in which the relative importance of factors thought to influence joint attention acquisition in typically developing children can be investigated.

2.3 JOINT ATTENTION IN CHILDREN WITH SENSORY, INTELLECTUAL AND DEVELOPMENTAL DISABILITIES

In exploring the onset and course of joint attention in children with sensory and developmental disabilities four areas will be reviewed, focusing on one in greater detail. The reasons for this are twofold. The first is that joint attention has been studied in relatively little detail and with only a few atypically developing populations. This review is therefore somewhat limited to the available literature. Secondly, the atypical population to be covered in the greatest detail, autism, has been the focus of the most extensive joint attention work. This is because joint attention deficits are almost universally present in children with autism, are considered by some to be the 'core' deficit, are regarded as prognostic factors, and are used as intervention goals. The importance of joint attention development to the later development of communication, language and social skills in

typically developing children, and its relative absence in children with autism, make it an important research and intervention area for those interested in this disorder.

Before discussing autism however, the development of joint attention in children who are congenitally blind will be reviewed. As joint attention, and attention more generally, is often thought of primarily as a 'visual' skill, it is interesting to consider whether, and if so how, those without vision acquire the intersubjective skill of joint attention. Next the literature in 'at risk' children, that is children who have experienced some level of social or perinatal deprivation, will be discussed. Caregivers are known to play a mediating role in the development of joint attention, and stimulation must be optimal for joint attention to be established. Children with intellectual disabilities are considered in the following section. Although these children have often formed a comparison group for children with autism in many joint attention studies, the relatively small body of research on their joint attention skills will be reviewed. Finally, joint attention development in children with autism will be outlined, detailing the difficulties in joint attention that are present in this population and describing the evidence for these deficits in infancy. The forms and functions joint attention takes, and the potential for remediation of joint attention skills, will also be covered.

2.3.1 THE DEVELOPMENT OF JOINT ATTENTION IN INFANTS WITH VISUAL IMPAIRMENTS

Research into the development of joint attention has been reliant primarily on a methodology focusing almost exclusively on the visual modality: Little attempt has been made to gain empirical evidence regarding how joint attention develops in children with visual impairments. Identifying the process of joint attention development in children who are blind is important because it may clarify how an awareness of others is acquired, and how experience is shared with others without the use of sight. Despite the apparent role that vision plays in the emergence of joint attention, blind infants are still believed to develop joint attention skills.

Baron-Cohen (1995) has speculated on how blind infants might acquire joint attention through his Shared Attention Mechanism (SAM), which develops in typical children through input acquired primarily through visual means. However, he proposed that as SAM is believed to be able to use information derived from any sensory modality to develop triadic representations, blind infants should be able to achieve joint attention through the use of touch, hearing, and also through directing others' attention. For example, blind children may achieve joint attention through taking someone's hand and putting it on an object to share the experience. Thus, joint attention is possible for blind children, though it is assumed that they will acquire it later than typically developing children as SAM needs to develop an understanding of triadic representations without the use of sight.

Hobson (1990, 1993) also hypothesized that blind children will develop, with some delay however, use of joint attention. However, Hobson believes that children's social experience drives the onset of joint attention abilities. In comparing blind children with children with autism, Hobson argued that both groups of children have difficulty in establishing joint attention. However, while children with autism are impaired in their ability to respond to and identify with the emotions of others, blind children have difficulty perceiving how the attentional and emotional reactions of others can be directed at objects and events in an outside world. Through social experience, visually impaired children may find alternative routes to acquiring these skills. These predictions were supported by a study of blind children with autistic features and sighted children with autism (Brown, Hobson, Lee, & Stevenson, 1997). In their sample, the blind children who had patterns of behaviour reminiscent of autistic symptomology did not necessarily present with the interpersonal social-emotional impairments characteristic of autism, suggesting that the autistic-like symptoms may be driven from other sources. Brown and colleagues (1997) concluded that the autistic like features in the blind children stemmed from limitations in their ability to experience shared perspectives. Thus, their blindness made it difficult for them to engage in joint attention episodes, because they found it more challenging to coordinate their behaviour with that of others. Teaching alternative means of

sharing attention in children who are blind may therefore be an important intervention objective to lessen the presence of autistic features.

Bigelow (2003) hypothesized that joint attention emerges in blind children as they develop self-awareness in relation to space and object manipulation. As their experience with objects increases, children learn to understand that the object that they reach for exists, that they have a permanence of their own, and that they can use their bodies to explore them. Once they have acquired this capacity, blind children learn that they can effectively act on the environment with predictable outcomes (Bigelow, 1995).

Bigelow (2003) longitudinally studied two congenitally blind children with no additional sensory or intellectual impairments from birth to document the emergence of joint attention. She examined their videotaped behaviour monthly on seven different object search tasks for acts that suggested that they were aware that they and a partner were focused on the same object or event. Bigelow found that without the use of sight, these children were delayed in their ability to develop joint attention. Conservatively construed joint attention acts included behaviours in which the children indicated that they were aware of the adult's role in their interaction with the objects. These included instances where (1) game-like sequences occurred in which the child passed an object between himself and an adult, where the object was not the focus, but rather the tool to achieve interaction with the adult; (2) the child labelled an object that he was engaged with at the request of an adult (in a game-like fashion again); (3) an object was brought into an established child-adult game; and (4) a child cooperated with an adult to manipulate an object. Both children studied displayed joint attention behaviours, indicating that vision is not necessary for joint attention to occur. The children relied on subtle and indirect cues for figuring out where others' attention was directed, and used clues, including other's speech, to converge attention on an object or an event with another person. Bigelow concluded that while the myriad of sensory and linguistic information needed for blind children to establish joint attention taxes their abilities beyond those of their sighted peers, joint attention is attainable in this population.

Interestingly, Bigelow discussed findings by Urwin (1979) who noted that blind children can prompt and influence their parents' actions once play or

interaction routines have been established. However, the initiation of such routines depends on, and is enhanced by, these children having physical contact with objects, and parents actively pursuing a role in their child's development of play routines and object manipulation. If unsighted children lack adults who respond sensitively to them, or when other social-emotional problems prevail, they may be at increased risk for autistic-like behaviours (Brown et al., 1997). Furthermore, language was an important social-pragmatic tool that aided joint attention episodes between the children and adults, highlighting the importance of comprehension and expression of language to the development of joint attention.

2.3.2 JOINT ATTENTION IN INFANTS AT RISK

Infants with low birth weights (LBW) or with prenatal exposure to drugs are at risk for developing a number of disorders in later childhood including behavioural, language, and social communication disturbances. There are currently no developmental data on the progression of joint attention in this population. However, owing to its ability to predict level of language and social attainment, performance in measures of early joint attention skills may provide a marker for those children who will go on to develop later complications.

Ulvund and Smith (1996) led one of the first research programmes designed to study whether non verbal communicative tasks bear any relation to later language and cognitive skills in LBW children (Field, Dempsey, & Shuman, 1993; Landry, 1986). They investigated the predictive validity of nonverbal communication skills to determine later language and cognitive skills. They hypothesized that if language acquisition was related to the ability to coordinate attention between an infant and his social partner (cf., Seibert, Hogan, & Mundy, 1982), then early intervention programmes with premature infants would have to be managed such that joint attention development was given a primary role. Accordingly, they found that individual performance on the ESCS at 12 months of age was related to cognitive competence at 5 years. Initiation of joint attention and initiation of requesting were most closely related to later language and cognitive development.

Moreover, early joint attention skills may be better predictors of long term developmental success than the Bayley Infant Developmental Scales (Bayley, 1993) test scores. Ulvund and Smith (1996) also found that in their sample of LBW infants, initiation of communication at 13 months was related to IQ and language skills at 5 yrs of age, and initiating joint attention and requesting were the most predictive of subsequent cognitive and language competencies. As most of the LBW infants in the study were delayed in language, few were using any words at the point of their first assessment at one year of age. Thus, results could not be explained simply in terms of continuity in language. Furthermore, when number of initiating joint attention bids was added to a regression model, it overruled the Bayley as a predictor of long term language and developmental skills.

Mundy and colleagues (Claussen, Mundy, Mallik & Willoughby, 2002; Sheinkopf, Mundy, Claussen, & Willoughby, 2004) also conducted two studies of joint attention in children at risk. These researchers examined the predictive effects of joint attention abilities on behavioural and social emotional competence in children with prenatal exposure to cocaine. Such children are likely to be vulnerable to a range of biological and psychosocial risk factors in multiple domains. For example, prenatally exposing the monoaminergic systems of the developing brain to cocaine may result in disturbances in arousal, attention regulation, and communication development (Mayes, Grillon, Granger, & Schottenfeld, 1998; Singer et al., 1999; Volpe, 1992). Cognitive and language skills may also be affected in some cocaine exposed children (Lester, LaGasse, & Seifer, 1998). Care giving may be less than optimal and is also a likely risk factor for psychosocial difficulties later in life (Beeghly & Tronick, 1994; Hans, 1999; Tronick & Beeghly, 1999), and has been observed to be related to later joint attention development (Flanagan, Coppa, Riggs, & Alario, 1994; Wacks & Chan, 1986).

In their first study, Claussen and colleagues (Claussen et al., 2002) found an association between disorganized attachment status in cocaine exposed children and their development of joint attention. Specifically, attachment status was correlated with the tendency to initiate joint attention bids, rather than the ability to respond to bids from an unfamiliar tester. This finding may be due to

the fact that substance abusing mothers may lack a certain quality in their interactions with their infants and fail to engage in joint attention as frequently as infants who have different attachment statuses. As there was no comparison group of disorganized attachment children who were not prenatally exposed to cocaine, it is not possible to conclude whether these results are specific to substance exposed infants or a more general developmental trend. However, this line of research is of particular interest in light of the evidence for a relation between joint attention skills and later language and cognitive functioning because attachment status may play a moderating role in the development of these skills.

In the second study using the same participants, Sheinkopf and colleagues (2004) examined whether joint attention skills predicted social behaviours in children who were prenatally exposed to cocaine. They found that joint attention behaviours were related to behavioural outcomes in their sample. Higher rates of joint attention initiation and responding were associated with lower ratings of disruptive behaviours, whereas higher rates of requesting behaviours were predictive of higher disruptive behaviour ratings. While the possible effects of prenatal cocaine exposure and associated behavioural disturbances may be specific to this population, the results are consistent with the notion that disruption in joint attention skill development may be indicative of behavioural disorders in later development.

2.3.3 JOINT ATTENTION IN INDIVIDUALS WITH INTELLECTUAL DISABILITIES

Children with intellectual disabilities have also served as participants in joint attention research. However, while the attainment of joint attention skills is an important factor in determining the rate and nature of early language, communication, and/or social skill development in these populations, they have often not been the focus of research studies, but rather, used as mental age comparison groups in research designs. As such, the literature on the development of joint attention in persons with intellectual disabilities is less detailed than it is for other disorders (i.e., autism spectrum disorders).

In a large scale longitudinal study of children with autism, developmental delay, and Down syndrome (DS), Sigman and Ruskin (1999) found group differences in the development of joint attention and communicative abilities. While children with autism performed differently from the other groups, no group differences were found between the developmentally delayed children, the children with DS, and a typically developing comparison group in terms of the frequency of initiating or the percentage of responding to bids of joint attention. While typically developing children requested items more often than the three groups of children with disabilities, the three groups did not differ from one another in their frequency of behaviour regulation (requesting). These findings reveal that while children with autism exhibit a deficit in their development of joint attention abilities, children with DS do not differ in nonverbal communication skills from children with other forms of developmental delay. While the children with DS requested items less frequently than the typically developing children, this appears to be a deficit shared by all of the developmentally delayed children in the study.

The authors also compared the children's social communication abilities with later language skills. They found that the percentage of time that the children with autism responded to bids for social interaction, and the frequency of requesting behaviours made by the children with DS were correlated with later language ages.

2.4 EVIDENCE FOR EARLY JOINT ATTENTION DEFICITS IN CHILDREN WITH AUTISM

Autism Spectrum Disorders (ASD) are characterised by impairments in verbal and non verbal communication, social interaction, and imaginative play skills (APA, 1994). Additionally, repetitive and stereotyped behaviours and interests are often present. As autism is a spectrum disorder, it affects individuals differently and with varying degrees of severity. The prevalence of autism is estimated to be between 0.52 in 1,000 (Fombonne, 1999) and 6.7 per 1,000 (Bertrand et al., 2001), taking into account differing diagnostic criteria, genetic factors, environmental influences, and/or case finding methods of a range of epidemiological studies. There is a gender difference such that autism is 3 to 5

times more likely to affect boys than girls (APA, 1994; Klinger & Dawson, 1996).

Young persons with autism do not display a pervasive deficit in all areas of nonverbal social-communication skills (Mundy & Sigman, 1989). Rather, they display a syndrome specific pattern of strengths and weakness in their social communication skills that change throughout development (Charman, 1998; Mundy & Markus, 1997; Mundy & Sigman, 1989). Children with autism are less likely to initiate non verbal joint attention acts than their typically developing peers, or children with intellectual disabilities (Mundy, 1995; Mundy & Markus, 1997). If joint attention skills do appear, these behaviours tend to emerge very late in development and do not have the same quality in terms of the shared positive affect shown by typically developing children (Kasari, Sigman, Mundy & Yirmiya, 1990; Leekam & Moore, 2001). While children with autism experience the most difficulty in their development of non verbal joint attention skills, they display only moderate difficulty in the development of social turn-taking skills, and even less difficulty with the use of eye contact and gestures to display nonverbal instrumental or requesting skills (McEvoy, Rogers, & Pennington, 1993; Mundy & Crowson, 1997; Mundy, Sigman, Ungerer, & Sherman, 1986).

The majority of evidence of joint attention deficits in the first years of life comes from four separate types of research paradigms. The first involves the retrospective analysis of early behavioural symptoms of children who have gone on to acquire a diagnosis of autism. The second paradigm involves prospectively screening children in general or those more at risk (e.g., with a sibling with autism). Symptoms known to differentiate children with autism from normally developing children as well as children with other disabilities are monitored and children are evaluated as to whether they go on to develop autism. The third type of study involves observational coding and analysis of the presence or absence, as well as the form and function, of joint attention abilities in groups of children with autism. Finally, longitudinal studies of joint attentional skills in children with autism are conducted to monitor the development and changes in these skills, as well as to find any correlates of joint attention difficulties across time.

2.4.1 RETROSPECTIVE STUDIES

Two types of retrospective studies have been conducted with families of children later diagnosed with autism, looking back to the first year of the child's life for joint attention deficits. In the first sort of research study, parents were asked to report retrospectively on their child's behaviour and symptoms between 12 and 18 months (Gillberg et al., 1990; Ohta, Nagai, Hara, & Sasaki, 1987; Stone, Hoffman, Lewis, & Ousley, 1994). While there is some evidence for early abnormalities in sensory, motor, and repetitive and stereotyped behaviours (Rogers, 2001; Charman & Baird, 2002), the best discriminators that come out at this age are joint attention impairments including difficulty making eye contact, gaze monitoring, and responding to name (Stone et al., 1994).

In the second type of retrospective study, video tapes from the first year of life of children later diagnosed as having autism are analysed. Adrien and colleagues (Adrien et al., 1993) conducted a study of blind ratings of 12 children later diagnosed with autism and 12 normally developing children based on home movies. They found that in the first year of life, children later diagnosed with autism showed impairments in social interaction, lack of social smile and appropriate facial expression, hypotonia, and poor attention span. In the second year, children with autism had additional impairments including a preference for being alone, ignoring other people, and a lack of social of eye contact and appropriate gestures.

Consistent with the notion that joint attention difficulties are present in the first year of life, Osterling and Dawson (1994) conducted an analysis of first year birthday party videotape data. This showed that, compared to their normally developing peers, children with autism were less likely to look at others, to show an object or point out an object, and to respond to their name by orienting their attention. Werner and colleagues (Werner, Dawson, Osterling, & Dinno, 2000) extended these findings, reporting that in videotapes taken between 8 and 10 months of age, children with autism could be differentiated from typically developing children on the basis of less frequent orienting to their names. Finally, Baranek (1999) compared children with autism, developmental delay, and typical development and found that the children with autism (but not the other groups) had abnormalities in orientation to visual stimuli, aversion to

touch, and delayed response to name. Thus, early abnormalities in preverbal social communication and joint attention behaviours in children with autism can be reliably identified towards the end of the first year of life.

2.4.2 PROSPECTIVE STUDIES

Several studies have attempted prospectively to identify cases of autism using screening tools in both the general population (Baird et al., 2000; Baron-Cohen et al., 1996) and in referred or high risk populations (e.g., sibling with autism) (Baron-Cohen, Allen, & Gillberg, 1992; Scambler, Rogers, & Wehner, 2001). Various joint attention and social communication behaviours are monitored including giving, showing, following eye gaze, and producing and following points. Using screening instruments (e.g., the Checklist for Autism in Toddlers; CHAT), deviances in early social communication, specifically a lack of gaze monitoring and pointing for interest, combined with an absence of simple pretend play at 18 months, are highly predictive of autism (Baird et al., 2000).

2.4.3 OBSERVATIONAL STUDIES

Researchers have attempted to identify and delineate joint attention skill deficits in various groups of children with autism and other developmental disabilities. Mundy and colleagues have conducted research in this area for many years using the Early Social Communication Scales (ESCS). The ESCS is a procedure in which an experimenter attempts to elicit joint attention, requesting, and social interaction behaviours through toy play, turn taking attempts, commands to follow instructions, and bids to engage in play. They have, through this paradigm, been able to identify deficits in the ability to initiate versus the ability to respond to joint attention bids in children with autism as compared to developmentally delayed, or mental aged matched typically developing comparison groups. Declarative gestures (triadic gaze switches between an object and experimenter and showing behaviours) were found to be specifically impaired while imperative gestures were found to be relatively intact (Mundy, Sigman, & Kasari, 1990). Mental age is also important for the ability to produce high level (pointing out items of interest) versus low level (eye contact) joint

attention gestures, with older mental ages being able to display more advanced forms of joint attention skills (Mundy, Sigman, & Kasari, 1994).

2.4.4 LONGITUDINAL STUDIES

Longitudinal studies involve following children over time and measuring whether joint attention predicts ability levels at later ages. These studies allow for associations to be identified between joint attention behaviours in the preschool years and later language and social developmental outcome. For instance, in typically developing children, individual differences in child-caregiver joint attention episodes were related to language at 18 months (Markus, Mundy, Morales, & Delgado, 2000; Siller & Sigman, 2002; Tomasello & Farrar 1986), and the ability to respond to joint attention bids at 6, 8, 10, 12, and 18 months positively related to individual differences in vocabulary development at 24 months. In a 6 week follow up study, Mundy and Gomes (1998) found that initiating joint attention bids at 14 months predicted expressive language development at 17 months, while responding to joint attention predicted receptive language development.

Mundy and colleagues (Mundy et al., 1990) reported on the social communication skills of a sample of 15 children with autism at 45 months, and re-assessed at 58 months of age. They found that joint attention, as measured by the ESCS, was associated with language skills at follow up. All of the other measured social communication skills (requesting, social interaction) and baseline child functioning skills (IQ, CA, language) had no association with language abilities at follow up.

In a large scale follow-up study, Sigman and Ruskin (1999) reported on the longitudinal social communication development, as measured by the ESCS, of 54 children with autism with a baseline age of 47 months and a follow up one year later. In their sample, expressive language at follow up was associated with responding to and initiating joint attention, initiating behavioural requests, and initiating social interaction, even with initial age and language ability covaried. A further follow up study of the sample at 12 years of age revealed that responding to joint attention was associated with a gain in expressive language, and initiating

joint attention was marginally significant. There were no associations with receptive language.

Finally, Charman and colleagues (Charman et al., 2003) reported on the longitudinal associations between a gaze-switching joint attention measure at 20 months, and language outcome at 42 months. They found that receptive, but not expressive language outcome was significantly positively associated with performance on the joint attention task at 20 months. Thus, with increased responding to joint attention ability at 20 months, the greater the child's receptive language skills at 42 months.

Thus, longitudinal associations have been demonstrated between aspects of joint attention and later language skills in young children with autism. These longitudinal associations have important clinical applications, including the identification of early indicators of autism which leads to better and earlier diagnosis of the disorder, as well as targeted intervention goals (Charman et al., 2003).

2.4.5 RESPONDING TO VERSUS INITIATING JOINT ATTENTION BIDS

Some children with autism have difficulty in both responding to joint attention bids (e.g., turning one's head to look where another person is pointing) and in initiating them (e.g., pointing out an object of interest to another person) (Baron-Cohen, 1989). It may be however, that older or developmentally more advanced children with autism have difficulty only in initiating and not in responding to joint attention bids (Dilavore, Lord, & Rutter, 1995; Mundy et al., 1994).

Using the PL-ADOS, Dilavore, Lord, and Rutter (1995) assessed 2, 3, and 5 year old children with autism longitudinally to measure joint attention skill impairments over the preschool years. While they did not find specific impairments in simple requesting at 2 years of age, they found impairments in more complicated forms of requesting, which disappeared by age 3. Declarative joint attention, requiring the coordination of eye contact with a gesture, was also measured. Two, 3, and 5 year old children showed specific impairments in their ability to initiate joint attention, but only the 2 and 3 year olds showed deficits in following or responding to declarative joint attention gestures.

2.4.6 FUNCTION OF JOINT ATTENTION BIDS: INTACT PROTOIMPERATIVE BUT IMPAIRED PROTODECLARATIVE ABILITIES

Curico (1978) initially reported that children with autism communicated frequently with their teacher in a classroom setting to make non verbal requests or display imperative behaviours. However, they rarely communicated through declarative non verbal joint attention acts. Subsequent investigators have documented, using various research paradigms, the difficulties that children with autism face in declarative joint attention skill development relative to their abilities to display imperative acts. These investigations have typically employed mental aged (MA) matched children with developmental or specific communication delays as comparisons.

Mundy, Sigman, and colleagues (Mundy et al., 1986; Sigman et al., 1986) found that children with autism were impaired in their ability to engage in turn taking sequences, respond to an invitation for social interaction from an adult, point for interest, show a toy, and make or alternate eye contact between an adult and an interesting toy or event. However, children with autism displayed a comparable amount of eye contact and requesting behaviours to a group of MA matched developmentally delayed children. In a group of children with autism, Baron-Cohen (1989) also found intact protoimperative behaviours including responding to and initiation of pointing behaviours to request. However, these children displayed a specific deficit in their protodeclarative abilities including following and producing points to indicate items of interest.

In another longitudinal study, Mundy and colleagues (1990) investigated the joint attention skills of 3 to 4 year old children over the course of 13 months. They found that at intake and follow-up, declarative joint attention behaviours (showing behaviours, and alternating eye gaze between an object and an experimenter) were impaired in the children with autism relative to developmentally delayed, and typically developing mental aged matched comparison groups. However, imperative gestures with or without eye contact were intact and no different from the other groups of children. Moreover, similar to Ulvund and Smith's (1996) study of low birth weight children, declarative

joint attention behaviours strongly predicted language level at follow-up, above both initial language level and IQ score. Thus, the nature of joint attention impairments in children with autism changes throughout the first few years of life.

2.4.7 CONCLUSIONS

Joint attention skills are a behavioural marker of the early manifestation of autism (Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000; Charman et al., 1998; Mundy, 1995). Joint attention deficits discriminate 80% to 90% of young children with autism from children with other developmental delays (Lewy & Dawson, 1992; Mundy et al, 1986), and are manifest in young children with autism regardless of intellectual or developmental level (Mundy et al., 1994). Theory suggests that individual differences in early social communication skills development may predict outcome among children with autism in terms of the capacity for symbolic thinking, the development of social-cognitive skills, and the ability to relate to the emotional experiences of others (Hobson, 1993; Leslie, 1987; Mundy et al., 1993; Tomasello, 1995). However, theory must also explain how and why joint attention deficits occur in children with autism. The following section will review current theoretical accounts on the nature of autism, as well as the relative importance each theory places on the role of joint attention as being either the cause, or consequence, of deficits we see in the social communication abilities in persons with autism.

2.5 THEORETICAL EXPLANATIONS FOR THE JOINT ATTENTION DISTURBANCE IN AUTISM

In general, relatively little remains known about the causes and the physiology of autism spectrum disorders, as well as the means by which medical treatments can reduce autism's severity if applied early enough. Our current understanding of the nature of autism spectrum disorders is that it is a neurodevelopmental condition with underlying organic and/or genetic disruptions to neurological development and organization (Lord & Volkmar, 2002). However, the specific neurological areas and/or contributing genetic anomalies remain unresolved, and different theories highlight different areas of the brain thought to be of import.

Consequently, various theories place differential importance on the role that joint attention contributes to the atypical development of persons with autism. A comprehensive model of autism will need to address these very early onset preverbal social communication deficits that are characteristic of the syndrome. Thus, joint attention plays a key role in theories that utilize a dynamic systems approach (e.g., Baron Cohen, 1995; Mundy & Neal, 2001). In these theories, abnormal psychological development consequent on primary neurological deficits, can have secondary effects on later brain development and functioning through negative feedback. Thus, primary brain impairments may attenuate or alter the development of joint attention, which may lead to later neurological or psychological deficits. What follows are theoretical accounts of the nature of autism that emphasize to various degrees joint attention's pivotal role in the development of the disorder.

2.5.1 THEORY OF MIND

Baron-Cohen, Leslie, and Frith (1985) proposed that three of the cardinal symptoms of autism: abnormalities in social development, communication development, and pretend play, may be the result of a failure in the development of 'mind reading'. The study of theory of mind in children with autism has led to conclusions regarding the way in which they are able to infer the mental states of others, represent the world in the mind (metarepresentation), and understand that other people have thoughts and feelings that may differ from their own. Thus, children and adults with autism have been shown to have difficulty 'reading others' minds' (Baron Cohen, 1994; 1995) (See Chapter 1 for a detailed explanation of ToM modules).

The prototypical theory of mind task is the 'Sally-Anne test' which assesses the understanding that others can hold beliefs that are false. In this task, Sally puts a marble into a basket and leaves the room. Ann enters the room and puts the marble into a box. The child is then asked where they think that Sally will look for the marble upon return.

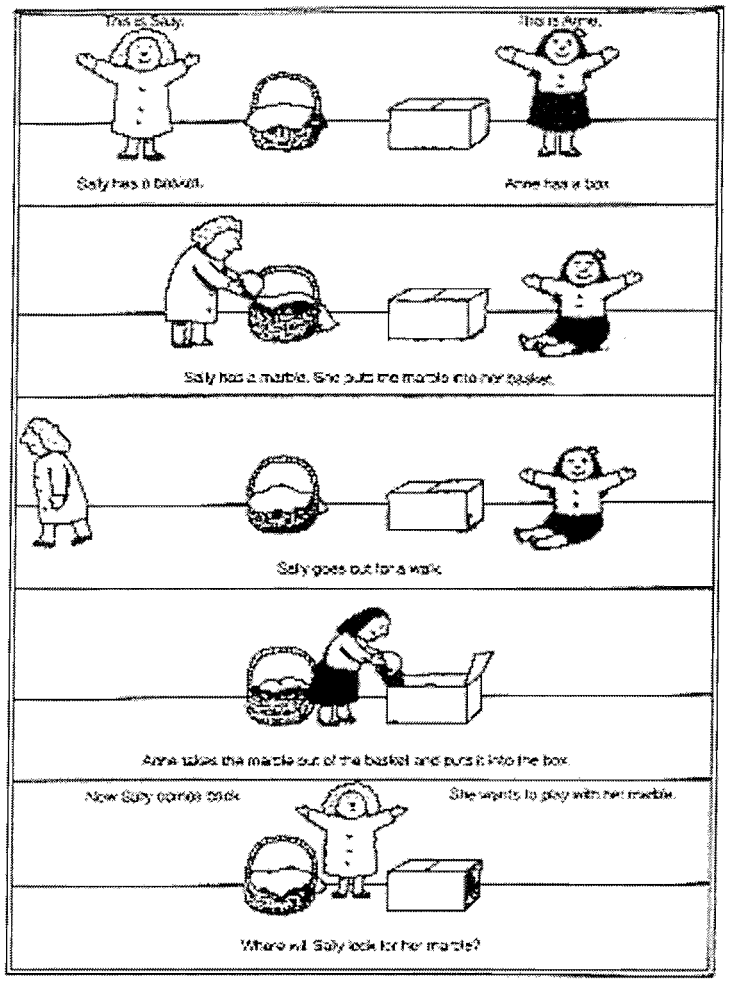


Figure 2.1 Sally-Anne Test (Wimmer & Perner, 1983)

Between 3 and 4 years of age, typically developing children are able to understand that Sally will look in the basket for the marble, as she will hold the false belief that it is still there. As Sally does not know that Anne has moved the marble, her false believe will guide her action. Conversely, Baron Cohen, Leslie, and Frith (1985) found that 80% of preschool aged children with autism failed the Sally-Ann task by saying that Sally would look into the box for the marble.

Lending support for a lack of theory of mind in children with autism, deficits also exist in pretend or symbolic play (Baron-Cohen, 1987), in recognizing mental state words (e.g. anxious, depressed) (Baron-Cohen et al., 1994), in using a range of mental state words (Tager-Flusberg, 1992), and in understanding complex causes of emotion (Baron-Cohen, 1991). These impairments highlight major difficulties in the ability to attribute or comprehend the mental states of others, and proponents of this theory argue that a lack of

theory of mind is central to the major social and communication deficits seen in persons with autism.

In Baron-Cohen's (1995) model, the intentionality detector (ID) is intact in children with autism as they are able to interpret the goals and desires of others. This is evidenced by their use of the word 'want' in spontaneous speech (Tager-Flusberg, 1989; 1992), and in their descriptions of picture stories involving agents (Baron-Cohen, Leslie, & Frith, 1985) (e.g., 'She wants the ice cream'). Secondly, children with autism are able to distinguish animacy (Baron-Cohen, 1991a) a concept close to agency which is distinguished by ID. Finally, children with autism appear to understand that desire causes emotions and that someone who gets something they want will feel happy, whereas someone who does not get something they want will feel sad (Baron-Cohen, 1991b; Tan & Harris, 1991).

The Eye Direction Detector (EDD) is also likely to be intact in children with autism because they are able to detect when a person in a photograph is looking at or away from them (Baron-Cohen et al., 1996; Leekam, 1993). Eye direction is also detected as someone 'seeing' something and the word 'see' is used in spontaneous speech (Baron-Cohen, Leslie, & Frith, 1986; Tager-Flusberg, 1992).

The system that breaks down for children with autism is the Shared Attention Mechanism (SAM) (See Section 1.7.2.3 in Chapter 1 for further discussion). According to Baron-Cohen (1995), this is inferred because they appear to be unable to build triadic representations that both the self and another are attending to the same object or event. Thus, children with autism are prevented from developing appropriate joint attention and sharing experiences with others. Because SAM does not work in any one sensory modality, it is deemed responsible for the absence of protodeclarative behaviours. SAM is also responsible for the inability to establish joint auditory attention, one reason why children with autism may speak too loudly, too softly, or with little or abnormal intonational inflection (Frith, 1989). Baron-Cohen (1995) argues that in the absence of output from SAM, the development of theory of mind in children with autism is not possible.

2.5.2 EXECUTIVE FUNCTIONS

A second body of literature explains the behaviours we characterize as 'autistic' as the result of a general cognitive disturbance in the neurological processes that control goal directed behaviour. Executive functioning (EF) is a broad term used to describe functions such as planning ability, working memory, inhibition, set shifting, impulse control, and self-monitoring. These abilities are generally associated with the frontal lobes of the brain and are impaired in persons with acquired frontal lobe dysfunction. EF deficits are also seen in persons with a range of neurodevelopmental disorders in which the frontal lobes may be affected, including attention deficit hyperactivity disorder (ADHD), obsessive compulsive disorder, Tourette syndrome, phenylketonuria (PKU), schizophrenia, and autism spectrum disorder (Hill, 2004).

In neurotypical children, development in joint attention abilities parallel changes in behavioural flexibility, shown for example by a reduction in perseverative behaviour (Butterworth &Grover, 1988; Corkum & Moore, 1998). Only a few researchers have been able to conduct EF research on preschool aged children with autism. This is mainly because the tasks used in this type of research predominantly involve higher order abilities that are not easily scaled down to the preschool level. Using a spatial reversal task, McEvoy and colleagues (McEvoy, Rogers, & Pennington, 1993) found an EF deficit in preschool aged children with autism compared with matched clinical and typical comparison groups. The authors also found a significant relationship between performance on the spatial reversal task and measures of joint attention and social interaction. When the study was replicated in a younger group of children with a mean age of 51 months, the autism-specific EF deficit effect disappeared, but EF was still related to joint attention ability (Griffith, Pennington, Wehner, & Rogers, 1999). Similarly, Barth, Fein, and Waterhouse (1995) failed to find group differences in preschool aged children with autism on EF tasks. Dawson and colleagues (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998) did however report EF deficits in preschool aged children with autism as compared to matched clinical and typical controls on a task thought to tap into dorsolateral prefrontal functioning (delayed response) and medial temporal lobe functioning (delayed non-matching to sample). The authors found that the prefrontal task was

significantly correlated with imitation performance but not with social behaviour, whereas the medial temporal task was more consistently related to social deficits (Rogers & Bennetto, 2000). Additionally, in young children with brain lesions, Caplan and colleagues (Caplan et al., 1993) found that impairments of joint attention behaviours related specifically to the extent of damage to the prefrontal cortex. However, Swettenham and colleagues (Swettenham et al., 1998) found that infants with autism have more difficulty shifting attention between people than objects, suggesting a social orienting abnormality, rather than an attentional set shifting problem per se.

Inconsistent results in this area leave the question open as to whether the executive dysfunction reported in persons with autism is present from birth or if it develops as a consequence of the autism. If executive dysfunction is not present early in autism, it can not explain the behavioural manifestation of the disorder, nor can we be certain that executive dysfunction distinguishes persons with autism from other clinical groups.

2.5.3 SOCIAL ORIENTING THEORY

Mundy and colleagues believe that a frontally mediated neuroaffective motivation system whose purpose is to prioritize social information is impaired in children with autism (Mundy, 1995, Mundy & Neal, 2001). This leads to a negative feedback loop were social information is continually not prioritized in the brain, and thus social information becomes even less salient or motivating to attend to. While it is clear that a deficit in higher order cognitive processes play an important role in the manifestation of the social and communication deficits in autism, a clear neurological pathway leading to the disorder remains unidentified. These neurological links remain important goals for autism researchers.

Mundy and colleagues (c.f. Mundy & Neal, 2001) suggest that joint attention skill development reflects the integration of cognitive and motivational factors that are necessary for subsequent language and social development. The ability to regulate and coordinate attention via joint attention skills is critical for infants' active participation in social learning opportunities and forms the basis for cognitive and communicative development. Accordingly, in autism, a failure to initiate joint attention bids in infancy may in turn fail to elicit the emotional

and verbal response from caregivers that facilitates optimal development of social communication skills. In typical populations, spontaneous social orienting and ultimately gaze monitoring may organize input to facilitate infants' capacity to profit from incidental language learning opportunities (Baldwin, 1993). Thus, joint attention skills may configure an early neurologically based self organizing system, which systematizes external visual and auditory bids for attention, and leads the child to initiate or participate in learning about social communication.

Mundy argues that children with autism suffer from an early disturbance in the self organizing functions of joint attention, and that joint attention deficits form part of a broader impairment in social orienting (Tantum, 1992). A core social orienting deficit may be reflected in the use of current diagnostic criteria (e.g., lack of joint attention and social reciprocity) commonly associated with autism, and may also play a part in the atypical development of social, cognitive, and neurological functions through a negative feedback system. If infants are predisposed to regulate their attention to aspects of the environment for example, they may also be predisposed to social orienting. In this case, joint attention skill deficits in autism may reflect a disturbance in the ability to attend to and process social orienting information in the first years of life (Mundy, 1995; Mundy & Neal, 2001).

Empirical evidence to support Mundy's claims include findings that 20 month old infants subsequently diagnosed with autism at 42 months displayed far less social orienting and joint attention behaviours (e.g., spontaneous gaze shifts between objects and people) at 20 months, than did comparison infants (Charman et al., 1997, 1998; Swettenham et al., 1998). In another study of joint attention ability, spontaneously orienting gaze between an object and a person discriminated 94% of a sample of children with autism from comparison children (Mundy et al., 1986). While social orienting and joint attention skills typically emerge between 9 and 12 months in non-disabled populations (Morales et al., 1998), retrospective videotape studies reveal that children with autism do not have joint attention or social orienting behaviours at 12 months (Osterling & Dawson, 1994). Dawson and colleagues (Dawson et. al., 1998) investigated orienting to social versus non-social stimuli in children with autism. They found that the children in their study displayed deficits in orienting to both types of

stimuli, but performed markedly worse when orienting to social stimuli. Also, individual differences in social orienting, but not object orienting, were related to a measure of joint attention in this sample.

Mundy (1995) argues that the joint attention impairment in persons with autism may reflect an early onset error in sensitivity to the reward value of social interaction. This in turn leads to an imbalance where infants fail to engage in an optimal level of social approach behaviours with caregivers and underemphasize social information processing. Through a compensatory mechanism, the system may in turn overemphasize non-social information processing which may explain why orienting to objects may be relatively more intact in this population (Mundy, 1995; Mundy & Neal., 1997). Attenuation of reward sensitivity may result in many affected areas but Mundy believes that the deficit lies in the left frontal system which typically serves to prioritize social orienting and joint attention (Fox, 1991; Fox & Davidson, 1987, 1988).

Research on the neural development of the brain highlights the processes of experience expectant neural development (Greenough et al., 1987). These are biases and predispositions that guide attention and learning in infancy, and form the basis of early neural development. This leads to an initial overproduction of potential neural connections in the brain, especially in the first 12 to 24 months of life. Brain volume subsequently decreases due to a culling of synaptic neuron connections through effects of experience into a more efficient functional system. This may be a sensitive period for sensory, visual, and social affective information processing. Functional synapses are retained, while non-functional synapses degenerate. Consequently, variation in the environment and stimulus input during an early sensitive period of neural plasticity may lead to fundamental effects on physiological, morphological, and functional aspects of central nervous system development that lay a foundation for future typical or atypical development (Black, Jones, Nelson, & Greenough, 1998). Mundy (1995) argues that autism is characterized by initial neuropathological processes (INP) which lead to suboptimal social orienting behaviour in the first few months of life. Attenuation of social orienting leads to a secondary neurological disturbance (SND) in autism via a negative feedback system (Mundy & Crowson, 1997). However, to the degree that early intervention increases the tendency of young

children with autism to process social information, then the SND contribution to the developmental processes involved in autism should be reduced (Mundy & Crowson, 1997). This would help explain why early intervention works better than later intervention and why more intensive intervention works better than less.

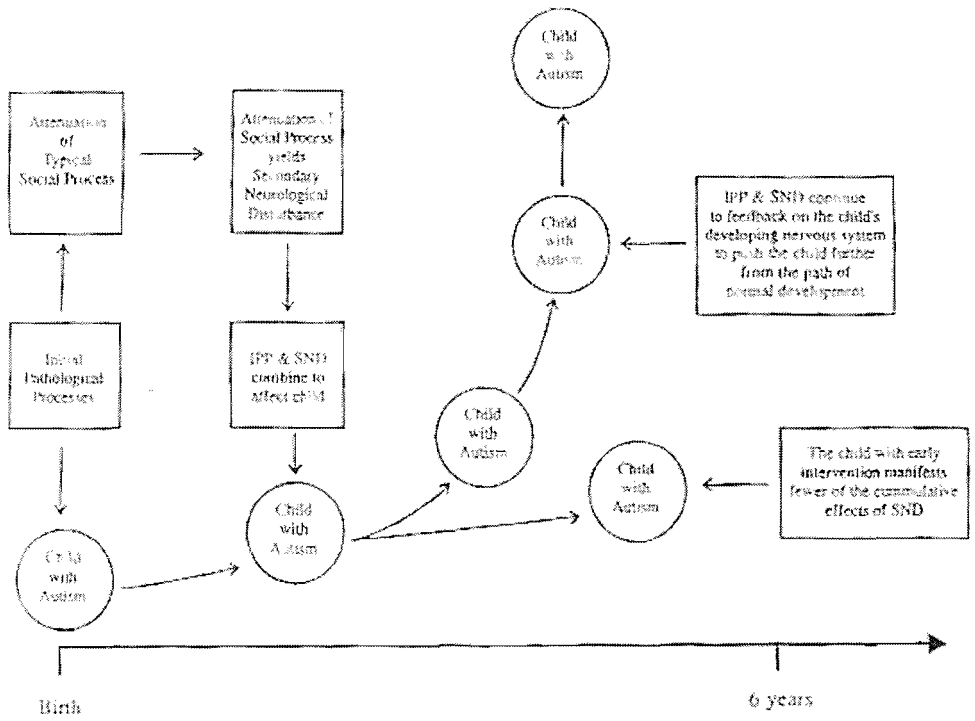


Figure 2.2 Social Orienting Theory (Mundy & Crowson, 1997)

2.6 SUMMARY

Several studies reviewed in this chapter lend support for the central role that joint attention plays in the development and identification of children with autism. Deviances in the form and function of joint attention may be observed in the first year of life and prospectively help to identify those who will later be diagnosed with an autism spectrum disorder. Joint attention abilities at a young age also show a relationship to later language and social communication abilities. While several theories attempt to account for the deficits in joint attention seen in the autism population, no theory has yet been adopted universally and much of the data to support various theories are correlational or inferred processes. Mundy's Social Orienting theory provides the best account of how an early neurological

deficit may impair children with autism from prioritizing social information, leading to a secondary neurological deficit and the asocial and atypical behaviours that characterize autism. If this theory is correct, early intervention may attenuate the effects of a secondary neurological disturbance through increased and intensive social input. All the evidence taken into account, the potential positive outcomes of early intervention, and the specific targeting of joint attention skills for later language and social development, are crucial in order to provide best-case treatment for children with autism. In Chapter 3, the potential positive role of early intervention on the social and neurobehavioural development of autism will be reviewed.

3. THE VALUE OF USING SOCIAL COMMUNICATION OUTCOME MEASURES IN INTERVENTION RESEARCH

3.1 INTRODUCTION

The literature on joint attention interventions, as well as interventions that may result in joint attention improvement even when it is not the specific target of change will be reviewed in this chapter. There is a clear need for researchers to translate theoretical and empirical findings on joint attention impairments in children with autism into practice. Thus, the components of joint attention that may be measured in intervention studies will be examined. Early social communication and joint attention skill measurement may help elucidate a pivotal skill hypothesis in the theoretical and intervention literature for persons with autism (i.e., that joint attention deficiencies lead to autistic disorder, and moderating or eradicating these deficiencies may lead to an improvement or even recovery from autism). Finally, a discussion will focus on a model of intervention effects on joint attention and how this thesis relates to the existing literature on joint attention and autism intervention.

Chapters 1 and 2 showed that the development of joint attention is critical for future communication and social development. Thus, joint attention outcomes may be particularly beneficial as a measure in early intervention outcome research relative to other social-cognitive, theory of mind, executive function or play measures. This is the case for two reasons: 1) nonverbal social communication skills such as joint attention appear to tap into a fundamental component of the early social disturbance of autism and can be measured at earlier stages than some other social communication skills (e.g., Theory of Mind); and 2) joint attention has been shown to relate to neurological, cognitive, and affective processes that play a role in autism (Mundy, 1995; Mundy & Crowson, 1997).

As we have also seen in Chapters 1 and 2, joint attention plays an important role in the ontogeny and maintenance of autistic symptoms (c.f., Baron-Cohen, 1995; Mundy, 1995). Furthermore, it is a key factor in the development of language abilities in young children with autism (Mundy, Sigman, & Kasari, 1990; Mundy, Kasari, & Sigman, 1992; Sigman & Ungerer,

1984; Ungerer & Sigman, 1984) and longitudinally, data show that better joint attention skills result in better language and social outcomes (Mundy, Sigman, & Kasari, 1990). However, while there is both theoretical and empirical evidence to support a focus on interventions aimed at ameliorating joint attention deficits, relatively few systematic studies have been conducted. Similarly, there are few studies where joint attention has been measured as an outcome. Although most interventions make use of joint attention episodes, there is a paucity of published research that directly reports on joint attention skill development in comprehensive early intervention programmes.

3.2 THE PIVOTAL SKILLS HYPOTHESIS

The Miriam-Webster online dictionary defines 'pivotal' as 'vitally important, and 'crucial.' Over the last 20 years, researchers and theoreticians have published several studies and essays outlining different skills, behaviours, or components of the autistic spectrum that they believe are crucial for the development of autistic disorder, as well as the maintenance of autistic behaviour (c.f., Baron-Cohen, 1995; Charman, 2003; Mundy, 1994; Ozonoff, 1995). In early intervention, the pivotal skill hypothesis is that changes in one or two key behaviours may lead to important improvements in the broader range of autistic behaviours (Koegel & Frea, 1993; Koegel, Koegel, & Schreibman, 1991; Mundy & Crowson, 1997).

As reviewed in Chapters 1 and 2, theory and research suggest that joint attention can be measured at an early age, and that the process of engaging in joint attention may contribute to the development of symbolic abilities (Hobson, 1993), language (Baldwin, 1995; Mundy, Sigman, & Kasari, 1990; Mundy, Kasari, & Sigman, 1992; Sigman & Ungerer, 1984; Ungerer & Sigman, 1984), and the development of general social-cognitive processes in children (Baron-Cohen, 1995; Bruner, 1975; Mundy, 1995; Tomasello, 1995). Mundy (1995) has also suggested that joint attention deficits may be a marker of an early disturbance in a neurological system that serves to motivate children to attend to and develop social relationships with their caregivers. Therefore, measuring joint attention development in intervention studies may shed light on which skills are necessary and crucial for the development and maintenance of autistic behaviour. If changes in joint attention correspond with a reduction in symptomology and a

general improvement in social communication and social cognitive areas, it may be that it serves as a pivotal skill which any intervention programme would necessarily need to target. The hypothesis here is that joint attention would mediate the intervention effects in, for example, early intensive behavioural intervention programmes (e.g., Applied Behaviour Analysis; ABA). Thus, intervention first has an impact on joint attention, and then on the development of cognitive and other related skills.

If, as Mundy (1995) believes, the reward sensitivity to social communication is disturbed in children with autism, intervention may well seek to help develop the social motivation to communicate (Koegel & Koegel, 1995). This notion is supported by research studies detailing that interventions designed to teach communication skills may also increase the motivation to communicate and joint attention levels amongst children with autism (Bondy & Frost, 1995; Yoder, 2005; Yoder & Stone, 2005; Yoder, Warren, Kim, & Gazdag, 1994). Furthermore, interventions are also beginning to target joint attention directly as a pivotal skill in autism (Kasari, Freeman, & Paparella, 2006; Lewy & Dawson, 1992; Whalen & Schreibman, 2003). Including better social communication outcome measures in early intervention research would help elucidate which skills are pivotal to autism, as well as which intervention methods are more or less successful in facilitating the development of different social communication skills.

3.3 HOW EARLY INTERVENTION MAY CHANGE THE DEVELOPMENTAL COURSE OF AUTISM

Mundy and Crowson (1997) have outlined a hypothetical model of early intervention effects among children with autism. Based on contemporary research and theory, they outline two propositions. First, while intervention with children with autism may be effective at all chronological ages, early intervention between the ages of 2 and 4 may be of most benefit and lead to a better developmental outcome (Rogers, 1996). Second, the authors assume that an early neurological disturbance may contribute to autism spectrum disorder (Panskepp, Siving, & Normansell, 1985; Zilbovicius et al., 1995). As described in chapter 2, Mundy and Crowson (1997) believe that a fundamental component

of autism may involve neurological impairments that impede social information processing in children. This disturbance may lead to an attenuation of the amount of social information that is provided as input to the child's developing nervous system (Courchesne, 1989; Dawson & Lewy, 1989; Hobson, 1993; Mundy, 1995; Mundy & Crowson, 1997). This may, in turn, have a negative effect as a reduction in the amount of social information received may deprive the child of the stimulation required for the normal shaping of neurological connections involved in the early processes of social development.

Without the necessary social input required to form a neurological and behavioural system that would support optimal social development, the child may deviate further and further from the typical developmental path. Secondary forms of behaviour disturbance may then develop as a result of the underlying, malformed, neurological structure (Kraemer, 1985; Mundy & Sigman, 1989; Mundy & Crowson, 1997). Thus, Mundy and Crowson (1997) suggest a 'cybernetic model of autism in which *an initial neurological disturbance in children with autism feeds back upon itself* to give rise to additional, and perhaps pernicious components of the neurodevelopmental disturbance associated with this syndrome.' (Mundy & Crowson, 1997, p. 669) (See Figure 3.1).

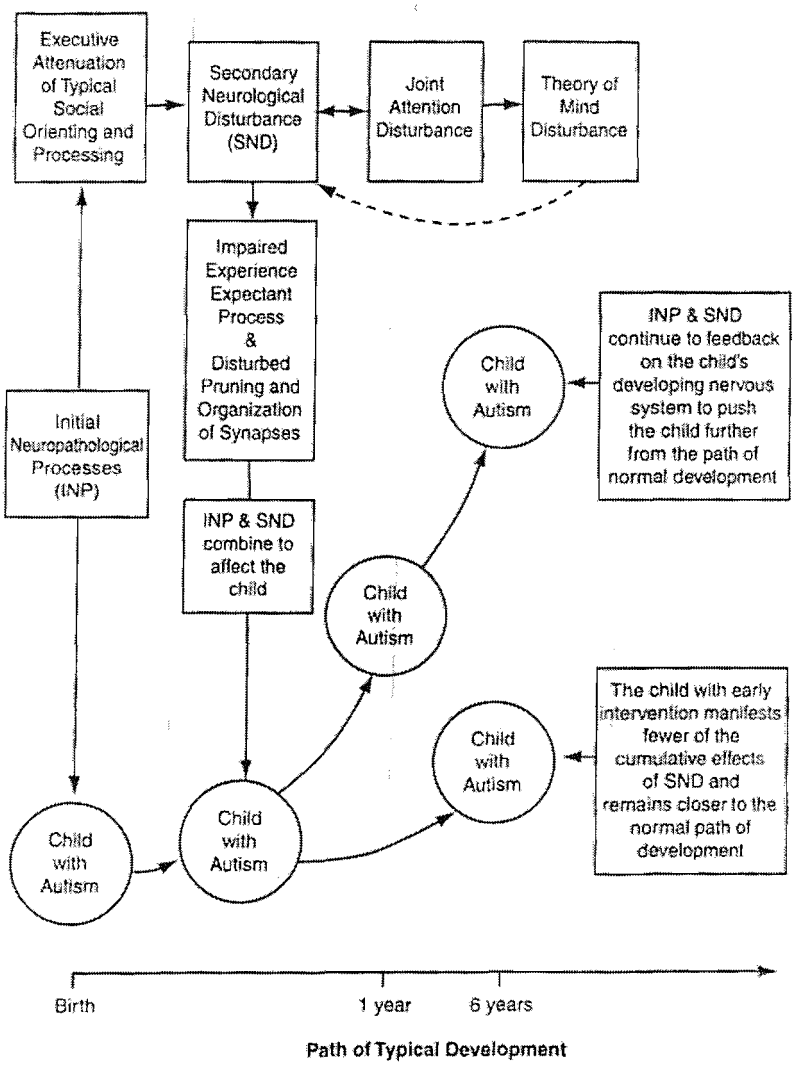


Figure 3.1 Mundy and Crowson's (1997) Cybernetic Model of Autism

In Mundy and Crowson's (1997) model, children with autism may be affected by 'Initial Pathological Processes' or IPP which result in a reduction in the child's capacity to attend to and process social information early in life. Over the first 24 months of life, the IPP begins to give rise to a 'Secondary Neurological Disturbance' or SND, which is the result of the interaction between a lack of activation from the IPP and ongoing central nervous system (CNS) development that is not receiving input to develop appropriately. The SND results in increasingly abnormal neurobehavioural architecture as a result of a lack of stimulation from the IPP necessary for normal CNS development. The role of early intervention then is to provide an optimal level of social input for the child to help combat the negative effects of the SND, shifting the path of

development of the child towards a more 'typical' course. As the brain of children is most plastic at younger ages, there may be an optimal time for this input which is before the age of 5 or 6 years.

If this model is correct, the major benefit of intensive early intervention may be to lessen the impact of neurological disturbances which are compounded by ongoing attenuated social input, causing CNS development to veer off the typical path of development. Early intervention would provide the social input that would have a direct, crucial impact on neurological development and would maximise the likelihood that children with autism would make developmental gains. In summary, high quality, structured, and intensive early intervention delivered in the course of social interaction, building on joint attention episodes, may provide the child with increased social input necessary to reflect change in any SND acquired by the child.

3.4 THE RELATIONSHIP BETWEEN INTERVENTION AND JOINT ATTENTION

An extensive literature search reveals a small number of research studies that have reported improvements in joint attention skills in children with autism following either direct intervention on these skills or in conjunction with interventions targeting separate but related skills (i.e., communication).

3.4.1 ADULT IMITATION OF TOY PLAY PROMOTES JOINT ATTENTION DEVELOPMENT

In one of the first of such studies, Lewy and Dawson (1992) compared groups of children with autism with children with general intellectual disabilities. The aim was to establish whether adult imitation of a child's behaviour would result in greater joint attention development than when an adult directed the child's attention towards an object. They hypothesised that young children with autism would display an increase in social behaviour in response to an imitation intervention that made social stimulation contingent on the behaviour of the child (Dawson & Adams, 1984; Dawson & Galpert, 1990; Dawson & Lewy, 1989; Klinger & Dawson, 1996). The primary social behaviour assessed was the initiation of joint attention acts, defined in terms of the child's alternating

looking between toys and the experimenter, pointing to toys while looking at the experimenter, or showing toys. The authors compared groups of MA matched children with autism, Down syndrome, and a typically developing group. Children's social and non social engagement was compared in two experimental play situations and one unstructured play session with a parent. In the imitation condition, joint attention behaviour closely followed and was contingent on the behaviour of the children. The authors found that all of the children displayed much more joint attention behaviour in the imitation condition, though the children with autism were significantly less responsive than the typically developing comparison group. For the adult directed condition, no improvements were noted in all three groups of children. Although this study took place over a short period of time, the results imply that imitation may be an effective medium that could be used to improve joint attention skills in children with autism.

3.4.2 PRELINGUISTIC MILIEU TEACHING

Protoimperative and protodeclarative communication skills have also been targeted through prelinguistic milieu teaching (PMT; Yoder & Warren, 2002). PMT is a child-led, play based incidental teaching method that was designed to instruct prelinguistic intentional communication (Yoder & Warren, 1998; 1999). Yoder and Warren (1999) found that children with developmental delay, whose parents were responsive to their communication over 70% of the time before the treatment began, experienced an increase in generalized requesting and initiation of joint attention as a result of PMT.

When combined with responsive education for parents, the treatment is called Responsive Prelinguistic Milieu Teaching (RPMT). RPMT is a play and imitation based intervention designed to teach communication skills through joint attention routines and uses modelling to elicit child commenting (i.e., initiating joint attention - IJA), gestures, or verbal indicators of shared interest, coordinated with attention to the parent. Yoder and Warren (2002) administered this intervention to a non-autistic group of children with mixed aetiologies in a clinic based protocol for 20 minute sessions, three to four times per week, for 6 months. Parents were offered up to 12 sessions to learn responsive communication techniques at the same time. They found that relative to a

treatment as usual group, the experimental group elicited a greater number and proportion of child communication acts to which the parents responded. Additionally, children in the experimental group who had fewer child-initiated comments initially, showed greater progress in commenting than did children in the comparison group. This study makes an important contribution to the literature by showing that it is possible to successfully promote IJA development in children with previously low levels of this behaviour through a combination of direct intervention with children, alongside parent education to support parents' responsivity to their child's efforts at communication. However, this study does not specify whether both direct intervention and parental involvement components are necessary.

In order to compare RPMT against a more widely used alternative communication system, the Picture Exchange Communication System (PECS; Bondy & Frost, 1992), Yoder & Stone (2005) ran a randomized controlled study that randomly allocated 36 places to low or nonverbal children with autism or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) in either a RPMT or a Picture Exchange Communication System (PECS; Bondy & Frost, 1992) intervention group. PECS uses images and symbols to teach children to give an adult a picture of a desired object in exchange for that object. PECS training has been shown to increase requesting behaviours in two experimental design studies (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz & Simpson, 2004). However, neither study established whether PECS affected object-exchange, turn-taking, or joint attention. Yoder & Stone (2005) found that relative to the RPMT communication intervention, PECS facilitated the initiation of joint attention as measured by the ESCS, even in a relatively low intensity intervention (one hour per week for 6 months). Thus, joint attention was improved indirectly, through an increase in requesting abilities as learned through the PECS programme. However, the authors did not distinguish between initiation and responding to joint attention in their coding system. Thus, it is unknown whether children were more likely to initiate joint attention acts as a result of learning to communicate requests more effectively, or if the use of PECS requests led the children to be better able to respond to the joint attention acts of others.

3.4.3 SPECIFIC TARGETING OF JOINT ATTENTION

The studies reviewed so far provide evidence to support the hypothesis that intervention may successfully increase joint attention abilities in young children with autism as an indirect result of some interventions. When joint attention is targeted directly, one would expect to see an even greater increase in skill. Unfortunately, there have only been two published studies, of which one is a single subject design. This latter study used a discrete trial training (DTT) behavioural approach to teach joint attention skills specifically and systematically to young children with autism (Whalen & Schriebman, 2005). Five children of approximately 4 years of age (MA equivalent ranged between 16 and 32 months) participated in the intervention and four completed treatment. Based on both structured and unstructured joint attention assessments, all of the children demonstrated severe deficits in the initiation of joint attention and protodeclarative pointing prior to starting treatment.

A single-subject, multiple baseline design was used. Children participated in baseline for two-to-ten weeks according to the multiple baseline design. Discrete trial training procedures were provided in two stages: 1) Response Training: training to respond to protodeclarative joint attention bids of the researcher and 2) Initiation Training: training to initiate joint attention bids to the examiner. Each stage included sequenced levels of intervention, each with its own mastery criteria. Intervention included the use of prompts, the combination of mastered tasks with new tasks, child choice of activities, contingent reinforcement of prompted and unprompted correct responses, and the use of reinforcers that related to the task. Child changes were assessed using structured (ESCS) and unstructured observations and changes were reported on the child's response to showing, following gaze or points, coordinated eye gaze shifting, and protodeclarative pointing.

After three weeks of training (3 days per week, 90 minutes of training per day), all four children who completed treatment showed significant improvement in joint attention initiations in post treatment observations. Moreover, these behaviours generalized to other settings and people as assessed through the same structured and unstructured joint attention assessments that were administered at baseline. However, in a three-month follow-up evaluation, all of the children's

coordinated gaze shifting between an object and a social partner decreased (though still remained higher than baseline levels). One possible explanation for this decline is that parents were not involved in the treatment and untrained in the training programme and thus the behaviour underwent extinction. This highlights the need for parent education on maintaining learned behaviours. Alternatively, the behaviour may have decreased due to a lack of motivation to engage in joint attention due to the absence of contingent reinforcement. As the children were all given tangible reinforcers (toys) when they engaged in joint attention episodes with limited generalization training, they may not have developed the ability and/or motivation to share experiences without the use of reinforcement. Once more, if children made joint attention bids that were not noticed by caregivers in the natural environment, and subsequently were not reinforced, these behaviours may have inadvertently been put on extinction.

In a randomized controlled study, Kasari, Freeman, and Paparella (2006) allocated 58 children with autism between the ages of 3 and 4 years into a targeted joint attention intervention, a symbolic play intervention, or a control group. Interventions were conducted for 30 minutes per day for 5-6 weeks and assessed at four time points: pre intervention, post intervention, 6, and 12 months later. The ESCS was used to measure improvement in the joint attention condition, and a structured play assessment was used in the play condition. All of the raters were blind to the children's intervention group status. Both groups of children receiving intervention made improvements relative to the control group on certain behaviours. The children in the joint attention condition displayed more showing behaviours and response to joint attention. They also showed increased rates of initiating joint attention in an unstructured caregiver-child interaction. Children in the symbolic play group showed a more diverse range of symbolic play behaviours in interaction with their caregivers, and higher rates of play in the symbolic play assessment, as well as with their mothers. These improvements for both groups remained present at the 12 month follow up assessment and measures of baseline joint attention and play predicted greater growth in language at 12 months post intervention.

These results show that both joint attention and play skills can be taught to children with autism, even given the sometimes infrequent presence of these

abilities. Post treatment, the skills were generalized to unstructured play interactions with their parents and maintained at the one year follow up: the joint attention intervention children showed more joint attention behaviours with their parents, while the children who had play therapy engaged in more play. Another interesting finding that comes out of this study involves the specificity of the interventions. Intensity was controlled for in this study as all of the children received 6 hours per day of an early intensive behavioural intervention preschool, and parents reported no additional treatments. When tested against each other, the joint attention and play treatments yielded some similar and some separate outcomes. The children in both conditions gained joint attention and joint engagement (co-ordinated looking) skills. However, only the children in the play intervention showed improvements in their level of play skills. This may be because symbolic play is less intuitive and a uses more direct teaching approach. Notably, no improvements in play or joint attention were found in the control group, despite 6 hours of one-to-one intervention daily. The lack of improvement in this group may be due to the adult-centred and guided approach of early intensive intervention, and the focus on skills other than joint attention and play. This suggests that to robustly affect changes in children, both joint attention and symbolic play may need to be a direct focus of intervention. These data come from the first randomized controlled design in which young children with autism both gained and generalized joint attention and play skills; abilities thought to be core deficits of the disorder. As intensity was controlled, comparison between groups was not about the amount of treatment, but rather the content of the treatment.

As children in the previous study generalized skills to interactions with parents, parent training programmes targeting joint attention may be beneficial in reinforcing, teaching and maintaining joint attention behaviours. In an earlier study, Kasari, Wong, and Kwon (2005) taught mothers of 33 children with autism, with a mean chronological age of 31 months and a mean mental age of 20 months, how to initiate and engage their children in joint attention episodes. The intervention consisted of 24 30-minute sessions in which ten modules were taught to mothers to help them learn how to engage their children in joint attention interactions. A 10 minute free play session was recorded between

mother and child following each teaching session. The results indicated that after the intervention, mothers engaged their children in more joint attention interactions, and children changed the amount of time spent in joint attention episodes from one third of the time at baseline to one half of the time at completion.

The studies reviewed above have important implications for the study of joint attention and autism. This research shows that children with autism can be taught joint attention skills, an area of profound and enduring weakness and a diagnostic marker, from the second year of life. Children with autism with a mental age as low as 16 months have learned joint attention skills not only through direct instruction, but also indirectly when other skills were being targeted. Additionally, changes in related child competencies that were associated with enhanced parent-child interactions were also reported (Kasari, Freeman, & Paparella, 2006).

An important and currently unanswered question relates to the role of joint attention training in intensive interventions that aim to enhance *all* aspects of development through individualised teaching. Would this type of treatment be effective in improving language and social outcomes, the primary areas of difficulty in autism over time? Does joint attention need to be targeted directly in the preverbal period in order to enhance language and social skills development as in the Kasari et al., (2005) study, or does targeting language, social, cognitive, and self help skills indirectly lead to an improvement in specifically measured joint attention abilities over time, relative to children who receive no intensive intervention? In other words, does early intensive behavioural intervention indirectly improve joint attention relative to a treatment as usual control group, or do these programmes need to target joint attention directly to improve these skills. These findings could help to determine whether joint attention is a pivotal developmental skill which plays a significant role in later related skills, as suggested by Mundy and Crowson (1997).

3.5 WHY MEASURE JOINT ATTENTION IN INTERVENTION RESEARCH?

The inclusion of measures of joint attention in intervention research may improve the ability of investigators to address directly important hypotheses about early intervention mechanisms (Mundy & Crowson, 1997). Identification of deficits in early social communication skills are key markers of the early symptoms of autism (Charman, 1998; Osterling & Dawson, 1994), and mark possible neurological components of autism (Mundy, Card, & Fox, 2000). As there are links in the literature between more advanced joint attention skills and increased language abilities, measures of joint attention may be particularly useful in evaluating the degree to which early intervention affects the frequency of social communication in children with autism. The following sections describe in greater detail the types of questions or hypotheses that may be addressed with the inclusion of joint attention measures in early intervention research.

3.6 OPERATIONALLY DEFINING MEASUREMENT PARAMETERS

Because there is tremendous value in including joint attention measures in intervention research, it is important to correctly and carefully identify which social outcome measures and variables to use. Due to an uneven profile of social communication skills, children with autism may make eye contact with people as frequently as other children with developmental delays after being tickled (i.e., to request more tickles), when a mechanical toy is moved out of reach (to request access to the toy), or when a tester sits quietly (Mundy et al., 1986). Children with autism may also point in imitation or use pointing to request as often as other children (Mundy et al., 1986, 1994).

Thus, global measures of eye contact or pointing may not be especially sensitive to the central social skill deficits in young children with autism. This is why a measure that also distinguishes the function of the behaviour must be identified and used at all times (e.g., the ESCS). For example, children with autism infrequently alternate eye contact between an active mechanical toy and another person and they rarely point to toys or show toys simply for the purpose of sharing the experience with others (Mundy et al., 1986, 1994). The capacity to initiate a social communication bid must also be distinguished from the capacity

to respond to the bids of others, such as turning one's head to look in the direction that has been pointed out by another. While young children with autism have difficulty with both initiating and responding to joint attention bids (Baron-Cohen, 1989; Mundy et al., 1986), older or developmentally more advanced preschool children with autism may display little difficulty responding to joint attention bids (Dilavore, Lord, & Rutter, 1995; Mundy et al., 1994). Furthermore, initiating joint attention bids may remain an area of profound disturbance throughout life (Dilavore, Lord, & Rutter, 1995; Mundy et al., 1994).

3.7 APPLIED BEHAVIOUR ANALYSIS: AN INFORMATIVE MODEL

Structured, intensive, early intervention, targeted to a child's individual needs, and delivered by trained therapists, may lead to significant developmental gains for children with autism (Birnbrauer & Leach, 1993; Bondy & Frost, 1995; Koegel & Koegel, 1995; Lord & Schopler, 1994; Lovaas, 1987; Yoder & Warren, 2002). While many interventions for children with autism may be derived from communication, social, physiological, or behavioural models, the common ground between early intervention programmes is that they are all delivered within a social context and include enduring forms of interaction. Interventionists work to facilitate a child's experience with their environment, through focusing the child's attention on external stimuli (e.g., a symbol, an object, or a person). These experiences are typically embedded in episodes of joint attention; the therapist must ensure that the child is primarily aware of the therapist, and that they are attending to the same object as them. The child must also be aware of the therapist's attentional focus so that they can receive appropriate feedback. Therapists may initiate joint attention episodes several hundred times per day through redirecting the child's attention towards the goal of the task/session. For example, if a therapist and child were seated at a table, the therapist might first gain the child's attention, and then redirect it to the object they are using to teach. They may then check that the child is indeed attending to the same object by monitoring the child's eye gaze and watching to see that eye gaze is moving between the instructor and the object. It is critical that children with autism receiving early intervention learn to respond to joint attention bids to access the intervention programme's curriculum and to become

engaged in interactions that are linked to later language, social, and communication development (Bono, Daley, & Sigman, 2004).

Applied Behaviour Analysis (ABA) is a method of instruction, popularized for children with autism by Lovaas (1987). Within an ABA model, intervention goals are broken down into their component parts, and each part is taught successively using contingent reinforcement. Thus, the broad skill of 'doll play' may begin with teaching the child the small step of imitating a tutor rock a doll in his or her arms. For block play tasks, a brief example of how this may be taught is: A child is given a set of blocks, along with a pattern of what the blocks should look like when built. For each block successfully placed in the correct position, the child is given praise and verbal encouragement. Incorrect block placements are corrected or ignored. As the child's correct responding becomes more reliable, reinforcement for each block placement is withdrawn, until they may only be receiving reinforcement upon completion of the task, or only when the child is able to complete the task independently. Typically, the initial stages of teaching in ABA programmes are completed one-on-one at a table, with detailed planning of the requests, timing, wording, and the tutor's reaction to the child's response. As the programme moves on, tasks should be carried out in every setting, at every available moment. The skills taught in drills must be practised in natural settings, with multiple people and prompts to encourage generalization. Generalization training is complete when the behaviours are exhibited in natural situations, without prompting (note that this is only one example of ABA tuition and there may be variation between children in terms of their particular experiences on the programme, dependent on level of functioning and rate of progress).

3.8 THE PRESENT THESIS

In September 2001, the Southampton Childhood Autism Project (SCAmP) began a three year Applied Behaviour Analysis (ABA) based Early Intensive Behavioural Intervention (EIBI) outcome study for preschool aged children between the ages of 2 years, 6 months and 3 years, 6 months. As long term clinical benefit depends on interventions remaining effective in typical service settings, the SCAmP study was designed as a field effectiveness trial, rather than

a randomized control trial (RCT). Thus, children of families who actively chose EIBI methods from a range of different reputed service providers in the UK were compared with children whose parents were not seeing EIBI and were in receipt of typical statutory services. The lack of control over the interventions delivered may be seen as problematic if one is interested in establishing the efficacy of an intervention, but it is a strength in deciding whether a treatment is robust enough to work in the "real world". Thus, the SCAmP study was a tough test of whether Early Intensive Behavioural Intervention for children with autism can be beneficial in routine use. The field effectiveness evaluation model additionally obviated otherwise pressing ethical concerns raised by randomization (no other proven methods of early intervention for children with autism), and circumvented methodological problems relating to the impossibility of ensuring the "blindness" of the families to the nature of the intervention over a 2-year trial period.

The design of the intervention was such that each child in the Intervention group received up to 30 hours per week of one-to-one therapy designed to teach pre-academic, social, communication, and adaptive behaviour skills. The skills were taught using Applied Behaviour Analysis: each goal was broken down into intermediate steps and taught successively with the use of reinforcement. In the ABA Intervention group, each child received home based, intensive, structured, and individualised one-to-one intervention from a team of trained tutors and expert supervisors for up to 30 hours per week, 50 weeks per year, for two years.

The Comparison group children received statutory educational services (treatment as usual) from their local educational authorities (LEAs), and were included as a Comparison group against which to measure any intervention effects. Again, the treatment as usual group received a variety of interventions that were impossible to control for ethical reasons. However, most of these interventions were school or nursery based rather than home based, and none was as intensive or structured as the ABA intervention. Additionally, most of these interventions took place within a group setting and were not tailored to the individual child's needs.

This design provided an excellent opportunity to assess non-verbal social communication skills at a very young age, prior to intervention, and to reassess

these skills at regular intervals to measure any change in joint attention skill development. The data from the SCAmP two year controlled comparison of Early Intensive Behavioral Intervention against Treatment as Usual within the UK education system showed a positive advantage for the Intervention group. Specifically, robust group effects were found for IQ, Mental Age, Reynell Expressive Language and Language Comprehension, and Vineland Daily Living Skills after 24 months of intervention. Although slightly less robust, there were also significant changes in Vineland Motor Skills.

As the ABA intervention is more intensive and delivered within a social context, one would expect the children in the ABA Intervention group to develop social communication and joint attention abilities that exceed those children for whom the intervention was not as intense, or the social input not as individualized. This should be the case particularly if the intervention utilizes educational techniques to help gain and maintain joint attention and focus on educational material. This design also provides a context in which Mundy and Crowson's (1997) model of intervention effects can be evaluated. According to their model, in addition to any cognitive or language benefits, early intervention that sufficiently and regularly provides an external scaffold to the child's development of social interaction skills, may result in better developed social outcomes.

The inclusion of a social communication measure in an ABA outcome study broadens the number of valid measures, and increases precision and sensitivity in evaluating intervention effects. Moreover, ABA intervention is a good starting point to look for changes in joint attention as it is intensive, delivered primarily in a one-to-one context increasing the amount of time that may be spent in joint attention episodes, and delivered within a social context: both the child and the therapist must interact and monitor each other's actions throughout.

3.9 KEY HYPOTHESES

It is the goal of this thesis to integrate theory and empirical findings on the nature of the social disturbance of autism with research on early intervention. The

methodology of the study, as well as methodological issues will be discussed in greater detail in the Chapter 4.

A description of the participants and a series of exploratory analyses into the development of joint attention and social communication across the preschool years in the Comparison children will be presented in Chapter 5. Many exploratory analyses will be presented, however the main hypothesis concerns whether the early baseline assessment of joint attention skills are predictive of later cognitive, language, or adaptive skills, above and beyond the variance associated with these outcome measures at baseline (cf. Ulvund & Smith, 1996). If early joint attention skills have predictive validity, they would potentially mark a child's learning potential prior to a time when these skills can be assessed reliably. Thus, correlational analyses will be conducted to look at relationships between early social communication skills and child outcome measures. Partial correlations, controlling for baseline child outcome measures will also be conducted to identify whether joint attention skills predict outcome. Thus, it is hypothesized that early joint attention skills will be correlated with two year follow up IQ, language, and adaptive behaviour skill scores, even when the variance associated with these skills at baseline is controlled.

The of outcomes of children after two years of intensive behavioural intervention versus treatment as usual will be analysed and discussed in Chapter 6. These analyses provide insight into the question of whether early intensive behavioural intervention leads to positive effects in terms of a child's joint attention and social communication. Evaluation of the effectiveness of early intensive behavioural intervention on the development of social communication made use of Analysis of Variance and Covariance models. In the interest of being conservative, because the groups were not actively matched at baseline, baseline scores on joint attention measures were entered as a covariate into analyses that thus consisted of one between-groups factor, Group (Intervention group versus Comparison group), and one repeated measures factor, Time (outcomes at 12 months vs. 24 months). In these models, a significant main effect of Group would suggest larger changes in one group seen at both 12 and 24 months. Finding no main effects or interaction effects would suggest that the two groups did not differ after either 12 and 24 months.

Because the children in the Intervention group were receiving intensive, individually programmed therapy delivered within a social interaction framework, it was hypothesised that they would develop joint attention and social communication skills exceeding those of their peers in the Comparison group for which any early treatment lacked intensity and specificity. Therefore, it was predicted that, because of their educational history, the children in the Intervention group would have greater joint attention skills, and that these changes in joint attention abilities may be driving their changes in IQ, language, and adaptive behaviour. The goal of the research is to generate findings that will add to the growing body of joint attention measurement in the intervention literature, and help further stimulate and guide work on the important topic of early intervention effects and social development in young children with autism.

4 METHODOLOGY AND DESIGN OF THE STUDY

4.1 METHODS SECTION

The aim of the current chapter is to introduce and discuss the methods that were used in the present study. Both standardized and semi-structured measures were conducted to evaluate the cognitive, behavioural, and linguistic potential of the participants. The Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996) will be presented in the greatest detail as it is the measure that was used to assess joint attention and social communication.

4.2 STANDARDIZED CHILD ASSESSMENTS

Norm referenced assessments were used to gather the cognitive, linguistic and behavioural outcome data for the children in this study. The assessments were chosen based on their good psychometric properties and their previous use in published studies with similar populations. An important additional consideration in choosing the assessments was their potential use for children with autism. Children with autism have multiple behaviours and symptoms which may affect their performance on standardized measures. Deficits associated with autism exist in the domains of language, intellectual, neurological, adaptive behaviour, and inter-personal difficulties which impact on the reliability and validity of any standardized score. Many tests require well developed language abilities and sustained attention, two domains which may also be weakly developed in children with an autistic disorder. However, every caution was taken to obtain the most reliable and valid score possible. A trained psychometrician (HK), with many years experience assessing children with autism, administered all of the measures. For all of the assessments, children were seated at a child sized table and chair in a quiet room in their house, or in their school. Every effort was made to reduce the number of potential distractors in the environment.

4.2.1 RATIONALE FOR STANDARDIZED ASSESSMENT CHOICES

The Bayley Scales of Infant Development: Second Edition (BSID-II), the Stanford Binet Intelligence Scale: Fourth Edition (SB:FE), the Reynell Developmental Language Scales: Third Edition (RDLS), and the Vineland

Adaptive Behavior Scales , Interview Edition, Survey Form (VABS), were used. The Bayley was chosen as a developmental assessment as it was designed for children aged between 1 and 42 months. The low floor on this test was deemed necessary for those children who had intellectual disabilities, or whose language skills were not advanced enough to take a full scale IQ test. Additionally, for those children who were unable to achieve a standardized score on this measure, the Bayley manual provides data that allows one to determine a mental age equivalent score based on the raw score. The Stanford Binet was also chosen partly due to its low floor. The normative data on the test begin at two years of age and extend into early adulthood, and unlike the Wechsler scales (e.g., WPPSI, WISC), there is only one timed subtest allowing children a greater opportunity to respond to items. Finally, use of the Stanford Binet is in line with other published research in the area as it is the most frequently used outcome measure used to evaluate cognitive status at the conclusion of intervention studies, according to a review of 72 autism intervention study articles conducted by Wolery and Garfinkle (2002).

The Reynell was chosen primarily as it is widely used in the literature with children with autism, is one of the few language assessments that incorporates both receptive and expressive subscales in the same test, and has UK norms updated within the last ten years. However, previous versions of the Reynell used age equivalent norms that began at 12 months of age (Reynell, 1985). Even at this relatively low language age equivalent score, other researchers have had difficulty with achieving baseline scores with children with autism at young ages (cf, Charman et al., 2003). The current 1997 version uses norms that begin at 1 year, 9 months of age, significantly higher than the 1985 version. Unfortunately, it proved not to be a very good measure for the present study, as few children were able to achieve a baseline score on either the receptive or expressive scales. The items were too difficult for the children in the present sample, most of whom, when first assessed between 30 and 42 months of age, had little or no language or communication skills. Finally, the Vineland Adaptive Behaviour Scales were chosen based on their prolific use in the literature, and the fact that a short version (the survey form) is available so as to reduce the amount of time required by families to complete assessment measures.

In the following sections, each measure will be reviewed in greater detail, outlining how the test is scored, the reliability and validity of the measure, and how it was standardized.

4.3 THE BAYLEY SCALES OF INFANT DEVELOPMENT – SECOND EDITION (BSID-II)

Ratio IQ and mental age (MA) were calculated based on the information from the Mental Scale of the Bayley Scales of Infant Development, Second Edition (Bayley, 1993) for all of the children for their baseline assessment. The Bayley Scales are an individually administered developmental scale designed for use with children from 1 to 42 months of age. Items on the measure assess shape discrimination, sustained attention, purposeful manipulation of objects, imitation, comprehension, vocalisation, memory, problem solving, auditory and visual habituation, and object naming. Age appropriate toys and visual materials are used to elicit responses from children which are scored in a Bayley Scales record form. The manual provides standardized directions for administering and scoring each item. The Bayley Scales took approximately 45 minutes to administer to the children with autism in this sample, although some children required 75 minutes or more depending on their ability level, behaviour, and past experience of one-to-one working situations.

4.3.1 SCORES

Raw scores on the Bayley were converted into Mental Age (MA) scores using Table B.2 on page 325 of the manual. Mental age was used to calculate ratio IQ for all children using the (MA/CA x 100 = IQ) formula. Although the Bayley provides a standardized Mental Developmental Index (MDI, M = 100, SD = 16) with scores based on normative data from typically developing children, many of the children with autism in this sample were unable to attain scores that allowed them to access the norms on the test. Thus, to use the same IQ estimate throughout, all children were provided with a ratio IQ whether or not they also were able to obtain an MDI score. This process is used for children with developmental delays who are unable to access normative standardized data due to low scores on the measure.

4.3.2 STANDARDIZATION

The Bayley has been standardized on a national, stratified, random sample representative of the United States population for typically developing infants between 1 month and 42 months of age. The sample consisted of 1700 children which included 100 cases in each of 17 age groups. A greater number of children were sampled in the 1 – 12 month range than in the 13 – 42 month range since development occurs more rapidly in younger infants.

4.3.3 RELIABILITY AND VALIDITY

Reliability coefficients for the 17 age groups range from .78 to .93 on the Mental Scale (r^2 = .88). Mental Scale reliabilities are fairly consistent throughout the age periods covered by the test. The Bayley Scales manual reports correlations between the Bayley and the Wechsler Preschool and Primary Scale of Intelligence – Revised (WPPSI-R; Wechsler, 1989). The WPPSI-R is an individually administered intelligence assessment for children between the ages of 3 years, 0 months and 7 years, 3 months. The Bayley Scales and the WPPSI-R were administered in counterbalanced order to a sample of 40 children ranging in ages from 36-42 months (M = 39.2, SD = 3). The interval between testing sessions ranged from 1 to 15 days. The MDI composite score on the Bayley and the Full Scale IQ score on the WPPSI-R were highly correlated (r = .73). These results suggest that the Bayley Scales measure a construct similar to general intelligence as measured by the WPPSI-R.

4.3.4 STANFORD BINET INTELLIGENCE SCALES: FOURTH EDITION (SB: FE)

The Stanford Binet is a full scale IQ test for children between the ages of 2 and 18 years that includes a total of 15 verbal and non-verbal subtests. The 15 subtests are not used through all ages of the scale. Some are administered only at the preschool and primary school ages, whereas others are administered only at the upper year levels. Of the fifteen subtests, only 6 run throughout the scale. Based on their age, eight subtests on the Stanford Binet were administered to the children in this sample. The subtests provide information related to Verbal,

Abstract/Visual, Quantitative Reasoning, and Short-Term Memory abilities. Items tap vocabulary, comprehension, picture absurdities, memory for sentences, copying a bead chain from memory, similarities, form-board items, and quantitative items. Items on the Stanford Binet are arranged in order of increasing difficulty, and children continue to answer items on the test until they fail three out of four consecutive items. Books are provided that allow children to see a picture or other visual aid to help them answer the test item, while the test item and range of correct responses are provided for the examiner on the back of the page. The item book lists correct and incorrect responses, as well as responses needing inquiry. Children were administered the Stanford Binet in their 12 and/or 24 month follow-up assessments if their language and attention levels permitted them to access the items and test instructions. If they were unable to complete and achieve a reliable and valid score on the Stanford Binet, children were re-administered the Bayley Scales and a ratio IQ score was calculated based on the MA score derived from the raw score on the test.

4.3.5 SCORES

Raw scores on the SB: FE are converted into three types of standard scores: the subtests, which have a mean of 50 and a standard deviation of 8; and the area and Composite scores which have means of 100 and standard deviations of 16. The Composite score is the full scale derivation IQ score. The manual also provides test-age equivalents which were used to calculate the children's mental age based on their performance on the measure.

4.3.6 STANDARDIZATION

The standardization sample consisted of 5, 013 individuals in 17 age groups. The number of persons ranged from 194 in the 18-0 to 23-11 age group to 460 in the 5-0 to 5-11 age group. The sample was selected so that it was representative of the American population based on the 1980 U.S. census data.

4.3.7 RELIABILITY

Internal consistency reliabilities for the Composite Score range from .95 to .99 over the 17 age groups included in the normative data. The median composite

score reliability is .97. The median standard error of measurement (SE_m) is 2.8 for the Composite Score. The stability of the Stanford Binet was assessed by retesting two groups (57 children with a mean age of 5 years, 2 months, and 55 children with a mean age of 8 years, 1 month), after an interval of two to eight months. For the 5 year olds, the stability coefficient was .91, and for the 8 year olds the stability coefficient was .90 for the full scale IQ score.

4.3.8 VALIDITY

The Technical Manual for the Stanford Binet presents several studies investigating the Scale's criterion validity. Comparisons were made with various other tests, including the Stanford-Binet: Form L-M, WISC-R, WPPSI, WAIS-R, and K-ABC, for both typical and exceptional populations. In the 13 studies reported in the manual, correlations between the fourth edition of the Stanford Binet and these criterion measures ranged from a low of .27 (for a study of a gifted sample who were administered both the fourth edition and Form L-M of the Stanford Binet), to a high of .91 (*Mdn r* = .80). In 10 of the 13 studies, the SB: FE yielded lower mean scores than did the criterion test. In most cases, however, differences were 5 points or less.

4.4 VINELAND ADAPTIVE BEHAVIOR SCALES – INTERVIEW EDITION, SURVEY FORM

Adaptive skills were assessed using the Vineland Adaptive Behaviour Scales - Interview Edition, Survey Form. The Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cicchetti, 1984) are an individual assessment of adaptive behaviour. Adaptive behaviour is defined on the basis of day-to-day activities necessary to take care of oneself and get along with others, and is age-based as defined by the expectation of standards of others. Adaptive behaviour represents the typical performance, rather than the potential ability of the individual – what a person actually does as opposed to what a person is capable of doing. The VABS interview measures personal and social sufficiency in four global domains: (a) communication (e.g., uses sentences of four or more words - age 2 years), (b) daily living skills (e.g., is toilet trained during the night – age 3 years) , (c) socialization (e.g., addresses at lest two familiar people by name –

age 1 to 2 years) , and (d) motor skills (e.g., walks down stairs with alternating feet, without assistance – age 3 to 4 years). Motor skills are typically measured until the age of 6 years, though the manual provides instructions for administering and scoring the Motor Skills domain for older individuals for whom a motor deficit is suspected. It also provides an Adaptive Behavior Composite Score as well as a Maladaptive Behaviour Score which may be measured from the age of 5 years. The VABS requires that a respondent familiar with the person in question's behaviour answer the behaviourally oriented questions. Typically, a trained examiner may ask a broad question that would allow them to score several items at once, following up with more specific questions to clarify items. A broad question may be something like 'Please give me a picture of NAME's speech or expressive language skills' followed up with a more specific question such as 'How many words does NAME typically use in a phrase'. It is very important that the respondent is aware that they must answer questions based on what the individual in question actually DOES rather than what that individual CAN DO. The VABS only scores items that are typically and usually performed.

4.4.1 SCORES

The Standard Score shows the extent to which a person's raw score exceeds or falls below the mean score of persons of similar age with whom the child was compared. The Vineland has a mean standard score of 100 and a standard deviation of 15. The Survey Form contains 297 items administered during a 30-to-60 minute interview. Raw scores as well as standard scores are reported for the Vineland domains analyses in the current study as the means and standard deviations vary considerably from age group to age group (Silverstein, 1986). These fluctuations mean that it is difficult to compare individuals across ages or perform longitudinal comparisons for the same individual using the standardized scores. Thus, the use of age-equivalent scores to measure domain differences across time may be misleading due to lack of comparability in range across domains and subdomains. For example, several Vineland domains have relatively low ceilings (the highest possible age-equivalent scores in receptive communication is 7 years, 10 months).

Furthermore, as with many other psychometric measures, there are some issues relevant to the interpretation of standardized scores for children with autism. Specifically, children with autism have uneven development and present with profiles that include inter-domain scatter in terms of their adaptive skills, especially within higher functioning groups (Burack & Volkmar, 1992). However, very low functioning children with autism may show relatively little scatter in domain scores due to basal effects (Carter et al., 1998). For the reasons listed above, as well as because the Vineland was used as an outcome measurement and not a diagnostic tool in this study, Carter et al.'s (1998) recommendation to use raw scores in research applications was taken.

4.4.2 STANDARDIZATION

The standardization sample closely matched the population as described by 1980 United States census data. Three thousand individuals formed the sample ranging in age from newborn to 18 years, 11 months. Stratification variables included sex, race or ethnic group, geographical region, community size, and parents' educational level. Normative data are available for children between birth and 18 years, 11 months of age. From birth to 1 year, norms are broken down into 1-month increments; from 2 through 5 years, into 2-month increments; from 6 through 8 years, into 3-month increments; and from 9 through 18 years, into 4 month increments.

4.4.3 RELIABILITY

The manual provides data on three measures of reliability; split-half, test-retest, and inter rater reliability. Split-half reliability coefficients range from .73 to .93 for the Communication domain (*Mdn r* = .89); .83 to .92 for the Daily Living Skills domain (*Mdn r* = .90); for the Socialization domain they range from .70 to .95 (*Mdn r* = .86); and for the Motor Skills domain they range from .70 to .95 (*Mdn r* = .83). The Adaptive Behavior Composite split-half reliability coefficients range from .84 to .98 (*Mdn r* = .94). Test-retest reliability was conducted with a two-to-four week interval and reliability coefficients are in the .80s and .90s. Interrater reliability coefficients range from .62 to .75. Standard

errors of measurement range from 3.4 to 8.2 over the four domains, and from 2.2 to 4.9 ($M\ SE_m = 3.6$) for the Adaptive Behavior Composite.

4.4.4 VALIDITY

Concurrent validity was established by correlating the Vineland with a small number of related tests. With typically developing populations, correlations between the Vineland Adaptive Behavior Composite and other intelligence and ability tests were as follows: rs = .32 and .37 with the Kaufman ABC Mental Processing and Achievement Scales, respectively. Correlations with the PPVT-R, a one-word receptive language measure equivalent to the BPVS were r = .28.

4.5 THE REYNELL DEVELOPMENTAL LANGUAGE SCALES

The Reynell Developmental Language Scales – Third Edition (RDLS-III) was used to measure receptive and expressive language. The Reynell is an individually administered comprehensive measure of language skills for children up to the age of 7. The receptive language subscale assesses a child's ability to comprehend verbal language and includes sections on the comprehension of single words, basic relations between words, understanding of attributes and spatial relations, understanding of thematic roles in sentences, and complex grammatical and inferencing skills. The expressive language subscale measures a child's ability to use language productively. Six sections cover object, action, and spatial attribute words, grammatical context, three and four element clausal structure, imitation, error correction, and utterance completion. Items in both sections include toys and pictures accompanied by verbal instructions. Children are asked to respond to pictures play with toys for various tasks used to elicit expressive language or designed to prompt a response, measuring receptive language.

4.5.1 STANDARDIZATION

The Reynell was administered to 1074 typically developing children in England, Scotland, Wales, Northern Ireland and the Republic of Ireland for the standardization. Ages ranged from 1 year, 3 months to 7 years, 6 months and the

sample contained roughly equal numbers of males and females. The first language of all the children was English.

4.5.2 SCORING

Typically, raw scores on the Reynell are converted into age equivalent scores, percentiles, and standard scores with a mean of 50 and a standard deviation of 10. While the normative baseline data for the Reynell begins at 1 year, 9 months of age, the majority of children in our sample had receptive and expressive language levels that were below this age and had difficulty responding to the entry level items. Thus to account for this difficulty with the measure, the Reynell scores will be reported and analysed dichotomously in terms of whether the children were able to access any items on the test, or not.

4.5.3 RELIABILITY

The Kuder-Richardson reliability coefficient, a statistic that is mathematically equivalent to the mean of all possible split-half reliability coefficients, was used to assess reliability. The reliability coefficients based on all children in the standardization were .97 for the Comprehension scale and .96 for the Expressive scale. For the subsets of the children by age, the reliability was between .44 (for the 6 year olds) and .96 (for the group of children between 1 year, 9 months and 3 years) for the Comprehension scale. According to the Reynell manual, the lower reliability coefficient for older children taking the comprehension part of the test reflects a limitation of the test to discriminate well between older children with respect to comprehension (Edwards et al., 1997; p. 24). The Expressive scale reliability coefficients were between .85 and .92.

4.5.4 VALIDITY

The manual reports concurrent validity for a subgroup of the sample that was tested with two other tests widely used by speech and language therapists. The Test for Reception of Grammar (TROG) (Bishop, 1983), and the British Picture Vocabulary Scale – Second Edition (BPVS-II) (Dunn, Dunn, Whetton, & Burley, 1997) were administered to 196 children between the ages of 4 years, 0 months, and 7 years, 6 months in Edinburgh and Reading. The TROG tests a series of

grammatical contrasts via picture selection, in which the child is required to select from an array of four pictures which includes both grammatical and lexical distractors. The BPVS is a one-word receptive vocabulary test in which the child is required to select a picture that best corresponds to a single word. Unfortunately, the authors did not include a test that measured expressive vocabulary or language abilities in their validation of the Reynell. Correlations between the tests were calculated using raw scores for the Reynell Scales and the BPVS-II, and number of blocks passed for the TROG. Correlations for the Comprehension scale were .68 for the BPVS-II and .70 for the TROG. For the Expressive scale, correlation coefficients were .75 and .67 for the BPVS-II and the TROG respectively.

4.6 NON-VERBAL SOCIAL COMMUNICATION

Nonverbal social communication skills were assessed with the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996). The ESCS is a 20 minute videotaped standardized procedure designed to assess a variety of non-verbal communication skills in young children with limited or no verbal skills. During the administration, the tester and the child sat facing each other across a small table. A set of toys was placed beside the tester, in view but out of reach of the child. Four posters with recognizable characters (Tweenies, Teletubbies, Thomas the Tank Engine, and Bob the Builder) were placed 90 degrees to the child's left and right, and approximately 165 degrees behind the child to the right and left. A video camera was positioned on a tripod to capture a three-quarter view of the child's face along with a profile view of the tester's face, as well as the position of the toys and posters (see Figure 4.1 for an example).

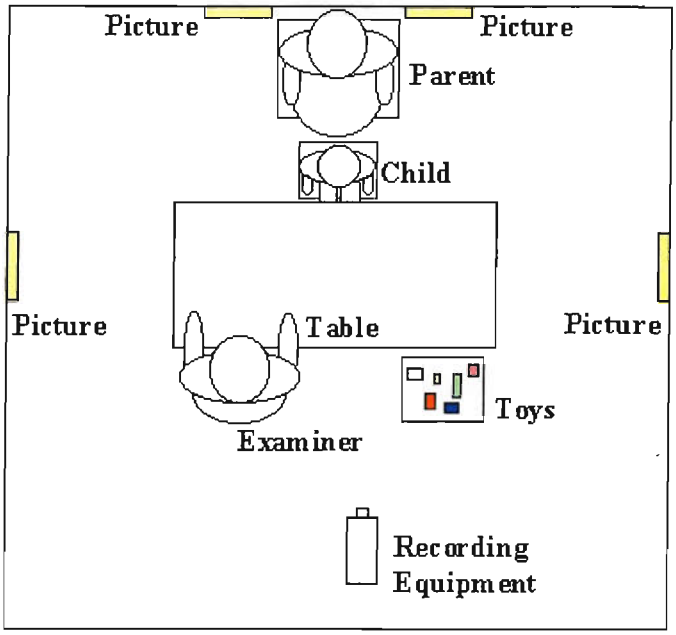


Figure 4.1 Drawing of ESCS Testing Room

The ESCS requires several objects that make up the tasks. These items are: five wind-up mechanical toys (3 toys for the Object Spectacle Task and 2 for the Plastic Jar Task); three hand-held toys (e.g., pop-up puppet, balloon, objects activated by a pull cord); a ball that is approximately 4-6 inches in diameter; a car (medium-sized plastic car, 4-6 inches long); a Picture book (large with distinct pictures); a hat; a comb; glasses; and a clear plastic jar with screw-on lid (approximately 6 inches tall). The tester presented the child with a sequence of activated wind up toys (3 trials), hand operated toys (3 trials), opportunities to play a tickle turn taking game (2 trials), opportunities to take turns wearing a hat, comb, and glasses (3 trials), and an opportunity to look at pictures in a book with the tester (1 trial). The child was also presented with two sets of four trials in which the tester first gained the child's attention and made eye contact, and then turned to visually fixate on a poster while pointing at the poster and saying the child's name three times with increasing emphasis. Trials to the left, left-behind, right, and right-behind were conducted in each set.

4.6.1 SPECIFIC TASK ADMINISTRATION GUIDELINES

The ESCS manual provides specific task administration guidelines that every attempt was made to follow. However, unlike other experimental or clinical

tasks, absolute standardization of presentation may violate the ecological validity of the social interaction. Thus, some variation from the guidelines may be expected in the administration of the ESCS for a given child. For example, children may dislike certain items and request that they be put away, or develop preferred items and demonstrate high frequencies of communicative bids with these items. Consequently, the manual allows for preferred items to be presented more frequently or for longer durations than is indicated in the guidelines as an acceptable variation in the presentation of the ESCS. Variation in presentation is acceptable providing that all the ESCS items are presented appropriately during the course of an administration.

4.6.2 DETAILED EXPLANATION OF TASK ADMINISTRATION

Administration procedures of the tasks incorporated in the ESCS are as follows:

4.6.2.1 Follows Commands

The target behaviour for Follows Commands is Responding to Behavioral Requests. Any of the objects may be used and trials were administered during tasks that involve objects (e.g., wind up toys). The child's ability to follow the commands of the tester was assessed at least eight times throughout the protocol. Generally, the ESCS manual recommends as a good guide to administer a Follows Commands trial at least once for each toy presented. If the child did not give the toy spontaneously to the tester within approximately 10 – 15 seconds, the tester verbally requested the toy twice ("Give it to me!"). Then, if necessary, the tester used both a palm-up 'give it to me' gesture while stating "Give it to me!" two times. If the child did not respond, the tester gently retrieved the toy. The child was given approximately three seconds to respond after stating the command before the tester repeated the command or retrieved the toy.

The tester was careful to use a clear "command" tone of voice when making requests (rather than a polite or playful tone). The use of a more directive tone of voice was important to convey the imperative function. The phrase "Give it to me" was used consistently. Elaborations such as "Please give the toy to me" or "Can you give me the toy?" were not typically used and not coded if stated by accident.

4.6.2.2 Object Spectacle Tasks

Initiating Joint Attention, Initiating Behavioral Requests, and Responding to Behavioral Requests were targeted through the Object Spectacle tasks. Three wind-up mechanical toy spectacles, two hand-held mechanical toys (pop up toy, string pull toy) and one balloon task were presented. In each presentation the tester activated the toy on the table in front of, but out of reach of the child. The toys were wound up enough to remain active for approximately 6 seconds but not so long that the child lost interest.

The ESCS manual instructs the tester to remain silent but attentive to the child while the toy is active, to give the child the opportunity to initiate joint attention bids vis-à-vis the spectacle. If the child spontaneously initiated a bid (e.g., alternated eye contact between the active object and tester), the tester provided a natural but brief response (e.g., "Yes, I see!"). Occasionally, the child also bid to obtain the toy and the tester responded to these bids by moving the toy within reach. If the toy ceased and the child had not bid for the toy, the tester placed the toy within reach of the child. The child was then allowed to play with the toy for approximately 10 seconds or until the child gave the toy to the tester.

Each object spectacle, whether it was a wind-up mechanical toy or hand held mechanical toy, was activated and presented to the child three times. If the child showed particular interest in one toy it may have been presented up to two additional times. However, no toy was presented more than five times. The child was informed "we'll play with that again later" and was moved on to the next task. For the balloon task, the balloon was inflated and held to the tester's side, in front of but out of reach of the child. The air was let out of the balloon slowly with several pauses. The tester attempted to release the air from the balloon in such a way as to make a light squeak, rather than a loud aversive sound. Once the balloon was deflated, it was given to the child. For hygienic purposes, the child was given a different balloon of the same color, not the balloon the tester inflated. The child was allowed to attempt to inflate the balloon themselves.

4.6.2.3 Turn-Taking Tasks

Initiating and Responding to Social Interaction were targeted through the Turn-Taking tasks. Two tasks were presented using the ball and the car, with a maximum of 12 turns per item. In these tasks the tester placed either the toy car or ball within the child's easy reach, and placed her hands apart on the table in a posture ready to catch the ball or car if the child threw or rolled it to her. The tester remained in this posture for about 10 seconds. If the child did not initiate a turn-taking game, the tester requested and/or retrieved the toy and rolled it to the child while making a playful sound (e.g. "brrrrrm", "wheeeee", or "zoom"). If the child responded by throwing or rolling the ball or car to the tester, the tester retrieved the ball and rolled it back to the child. This turn-taking activity continued until the child stopped throwing or rolling the ball or car, or if the child had taken 12 turns (e.g. threw the ball to or away from the tester). If the child failed to throw or roll the ball or car to the tester, the tester retrieved the toy and rolled it to the child again. If the child did not respond, the object was requested using a Follows Commands trial (see description of trial above). If the child still did not return the ball, the tester brought the ball back in front of her and rolled it to the child again. If the child did not respond to this turn-taking bid two times in a row the turn-taking trial was discontinued.

4.6.2.4 Social Interaction Task

The Social Interaction Task targeted Initiating and Responding to Social Interaction. This item did not require any objects and occurred twice during the session, presented at two different times. It consisted of three touches or tickles for each administration. For this task, the tester removed all of toys from the table and said "Let's sing a song". The tester then sung a few bars of "The Wheels on the Bus". After approximately 10 seconds of song the tester gently ran her fingers across the table while softly saying 'I'm going to tickle you', and touched or tickled the child. A decision with regard to touching or tickling was made on the basis of how tolerant the child was for this slightly invasive task. If the child found the sound of the tester's singing voice aversive and/or covered his or her ears, the tester ceased singing and proceeded to administer the tickling task with caution, taking into account how it was being received by the child. If

the child did not wish to be touched, the trial was abandoned and attempted once more during the course of ESCS administration. If the child was engaged, the tester may also have said 'Got you!' when she made contact with the child. The tester then returned her hands to her side of the table and paused, attending to the child for approximately five seconds. This allowed the child time to bid for the tester to repeat the tickling by hitting the table, making eye contact, or wiggling his fingers on the table. After the five second interval, or a child bid, the tester repeated the procedure of running her fingers across the table and touching or tickling the child and returning to a rest position. After a five second interval, or a child bid, this procedure was repeated a third time. Six trials were conducted in total (three at each time point), at two different times during the ESCS.

4.6.2.5 Gaze Following Task

Responding to joint attention was targeted through the Gaze Following task. This occurred twice during the session and did not require any manipulable objects. Instead this task used four posters placed around the room. This task was typically presented immediately after the Social Interaction Task to ensure that the child was engaged with the tester at the beginning of the trials. The trials began with the tester bringing the child's attention to her face. The child's attention was usually attained by tapping the table, gently touching the child and then touching the tester's own nose, or by calling the child's name.

The Gaze Following Task involved a sequence of the tester looking and pointing to targets while emphatically stating the child's name. Four targets were located to the left, right, behind left, and behind right of the child. Left/right targets were placed at approximately 60 degrees from the child's midline. The tester attempted to direct the child's attention to each target in the following order: Left, Left-Behind, Right, and Right-Behind.

On all trials the tester obtained the child's attention, then turned her entire torso (not just her head and arm) and visually oriented to a target while pointing at it. To reduce the likelihood that arm movement may have affected the child's behavior, the tester always pointed with the elbow of the pointing arm in contact with her side. This forced the tester to display a 'short-arm point'. During the pointing trial the tester said the child's name three times with increasing

emphasis (e.g., 'Jonathan, 'Jonathan!, 'JONATHAN!!'). The tester did not look back at the child until after stating the child's name for the third time. Approximately two seconds were left between each enunciation of the child's name, and so each pointing episode was maintained for at least six seconds. This was to insure that the children had enough time to process the social information presented to them. Finally, on the Behind Trials, the tester leaned slightly forward and to the left or right of the child as if they were looking at something interesting directly behind the child. However, the pointing finger of the tester was always at least two feet in front of the child. Two sets of four pointing trials were presented at different times during the ESCS. Following each trial the tester made a statement related to the target (e.g., "There's Bob the Builder"; "Did you see Thomas?") to acknowledge that the child turned and saw the target or to further engage the child if he or she did not turn.

4.6.2.6 Response to Invitation Task

The Hat, Comb, and Glasses were used for Responding to Social Interaction trials. In this task the tester presented the hat, comb or glasses to the child. Each object was presented at different times throughout the ESCS, and the trials were distributed throughout the ESCS presentation.

Either the hat, comb, or glasses were placed directly in front of the child and the child was allowed to play with the item for approximately 15 seconds. If the child used the object in a socially conventional fashion (i.e., hat on head, glasses on face, comb to hair) the tester leaned forward, shook her head gently and said 'Can I play?' This question was stated three times with a 2-second interval between repetitions, or until the child moved the hat, comb or glasses toward the tester's head. If the child did not spontaneously use the object in a conventional fashion the tester placed the hat or glasses on the child or combed the child's hair briefly and then invited the child to play as stated above. Some children did not tolerate the tester putting the hat, comb or glasses near or on their head. In these cases, after attempting to place the object on the child's head, the invitation to play was stated three times.

4.6.2.7 Book Presentation Task

A picture book was used to target Responding to Joint Attention. In this task, a picture book was opened and presented on the table within the child's reach. Several distinct pictures were displayed on the pages of the book. The tester said, 'What do you see?' If the child pointed to pictures spontaneously the tester responded briefly, but naturally ('Yes, I see'). After a twenty second interval the tester began pointing to pictures in the book regardless of whether the child had spontaneously pointed or not. The ESCS manual recommends that a steady pointing gesture should be held for three seconds, approximately two inches from each picture. However, for the children in this sample, if the tester did not lightly touch or tap the picture while pointing, the child did not orient to the picture. Lightly tapping the picture was therefore used throughout the study to help gain and maintain the children's attention to the pictures. Although tapping the book is not formally recommended in the ESCS manual, there is nothing to suggest it would violate validity as it was used consistently throughout. While pointing, the tester also said the child's name to refer them to the picture. The tester began by pointing to a picture on a side of the page that the child was not attending to, followed by a new picture on the same open pages, but on the opposite side of the book. The page was then turned and the procedure was repeated twice, each time on a new set of open pages in the book. If the child rejected the book (e.g., pushed it away) or refused to attend to the book, the book trial was attempted once again at a later time.

4.6.2.8 Plastic Jar Task

Initiating and Responding to Behavioural Requests were measured with a Plastic jar and two wind-up mechanical toys. This task was presented once during the ESCS using the following procedure:

1) The tester showed the child a transparent plastic jar with a sealed lid and two novel wind-up mechanical toys inside. The tester then unscrewed the lid and 'poured' the toys onto the table. Before the child could play with the toys the tester returned them to the jar and sealed the lid sufficiently well to ensure that a small child would not be able to unscrew the lid.

2) The tester then gave the jar to the child and waited for approximately 10 seconds, or until the child gave the jar back to the tester. If the child did not give the jar, the tester requested the jar verbally by saying 'Should we open?' or 'Help?' and, if necessary, with a palm up gesture and verbal request. If the child did not respond, the tester gently retrieved the jar.
3) The tester then opened the jar and removed one of the wind-up toys. The jar with the remaining toy inside was set aside near the other toys. The wind-up toy that was removed from the jar was wound up once and placed on the table. Once the toy became inactive, it was given to the child.
4) If the child did not give the toy back after 10 seconds, the tester requested the toy verbally ('Give it to me.') and, if necessary, with a palm up gesture and verbal request. If the child did not respond, the tester gently retrieved the toy.
5) Steps 4 and 5 were then repeated with the second wind-up toy still in the jar.

4.6.3 ORDER OF TASK PRESENTATION

Specific task situations are presented in the ESCS and the order of presentation that was used in the current study was as follows: (1) Mechanical (wind-up) object spectacle #1, (2) Ball – Turn –Taking task, (3) Glasses – Invitation task, (4) Hand Operated Object Spectacle #1, (5) Song-Tickle Game, (6) First Pointing (Look) trials, (7) Hand Operated Object Spectacle (balloon) #2, (8) Book task, (9) Mechanical Object Spectacle #2, (10) Car - Turn-taking task, (11) Hat Invitation task, (12) Mechanical Object Spectacle #3, (13) Song-Tickle Game, (14) Second Pointing (Look) trials, (15) Plastic Jar, (16) Comb Invitation Task, and (17) Hand Operated Object Spectacle #3.

However, as was previously stated, the ESCS is designed to be an ecologically relevant measure. Thus, valid and optimal assessment of social communication skill development is dependent on the responsiveness of the tester to the communication bids of the child. If a child rejected a toy or requested a toy that was due to be presented later on in the order of presentation, the tester responded by acknowledging and responding to the child's requests.

4.6.4 TIME ESTIMATES

Throughout the tasks and inter-task intervals, the tester was mindful of presentation time estimates that are provided in the manual. The tester used silent time counts (e.g., subvocalizing 'one second, 'two seconds', 'three seconds') to approximate times. The authors of the ESCS argue that if time limits are strictly followed (e.g., through using a stopwatch), it would interfere with the validity of the social interactive nature of the ESCS presentation.

4.6.5 ESCS OPERATIONALIZED DEFINITIONS OF CODES

Videotaped observations of the tester-child interaction on the ESCS yielded frequency of behaviour scores in six categories: (1) Initiating Joint Attention (IJA); (2) Responding to Joint Attention (RJA); (3) Initiating Behaviour Regulation (requesting) (IBR); (4) Responding to Behaviour Regulation (RBR); (5) Initiating Social Interaction (ISI); (6) and Responding to Social Interaction (RSI). Both Joint Attention and Behaviour Regulation involve coordinating attention between objects and events. The Social Interaction scales assess turn-taking and the ability to maintain interactions with the tester, but not necessarily coordination of attention to objects and events. Behaviours were operationalized as detailed in the following sections.

4.6.5.1 Initiating Joint Attention (IJA)

Scores refer to the frequency with which the child used eye contact, pointing, and showing to share the experience of an active mechanical or hand operated toy with the tester. Behaviours include (1) making eye contact whilst holding a toy, (2) alternating eye gaze between an active object and the tester, (3) pointing to an active mechanical toy, hand operated toy, or distal objects in testing room, or (4) showing an object to the tester through holding it up at eye level or raising it towards the tester's face.

Figure 4.2 Example of Initiating Joint Attention (IJA) Alternates

4.6.5.2 Responding to Joint Attention (RJA)

Scores refer to the number of times over the course of eight trials in which the child correctly turned his eye gaze and aligned attention in the direction of the tester's distal point to a poster. On side trials, the direction of gaze must have shifted beyond the tester's extended finger (approximately 45 degrees off midline). On behind trials the child must have turned their head more than 90 degrees off their midline. The total number of eight trials in which the child correctly turned his eyes and aligned attention in the direction of the tester's proximal point to a picture in a book were also counted.

Figure 4.3 Example of Responding to Joint Attention, Behind Trial

4.6.5.3 Initiating Behaviour Regulation (IBR)

Scores refer to the frequency with which a child (1) made eye contact when an object was moved out of reach, (2) made eye contact while reaching to objects out of reach (see Figure 4.4), (3) pointed to inactive objects on the table or to the collection of visible but out of reach toys (4) gave inactive toys to the tester (e.g., moved toys towards tester's hands) to be reactivated or put away, or (5) reached for an out of reach item.

4.6.5.4 Responding to Behaviour Regulation (RBR)

Scores refer to the frequency with which a child responded to the tester's requests to 'Give it to me' as the child was holding or examining a toy.

4.6.5.5 Initiating Social Interaction (ISI)

Scores refer to whether the child initiated a turn taking game with a ball and a car without prompting from the examiner (0, 1, or 2 times). This must have occurred before the child observed the tester roll the ball to the child.

4.6.5.6 Responding to Social Interaction (RSI)

Scores refer to the frequency of eye contact or gestural behaviours displayed by the child following being ticked, once the tester had moved back to pause before the next trial (the child vocalized or banged the table or reached to the tester after the tester had tickled the child), the amount of turns maintained with the ball or car between the child and the examiner, and whether the child responded to the verbal request 'Can I play?' by placing sunglasses, a hat, or a comb on the examiner when the child was manipulating the object.

4.6.6 CAREGIVER BEHAVIOURS

If a parent or other caregiver was present during testing they were asked to sit behind the child. This enabled the child and the tester to interact without the parent's influence on her child or the toys, and allowed the tester to maintain the child's attention. If the child turned around to interact with the parent, it was noted and coded separately for information. These data have not been analysed as less than half of the children had a parent or caregiver present during testing, and having a parent present was inconsistent over time.

If a parent was present during testing, they were provided with instructions that were similar to those provided it the ESCS manual: "I will be showing your child a variety of toys and we want to see how he uses gestures, eye contact, and language (if appropriate) to communicate with me. I recognize that your child would rather interact with you than with a less familiar person, however, it is important to try to keep your child's attention on me. If your child tries to interact with you, acknowledge him by nodding or saying something like 'I see it', and then direct his attention back to me. It is also important that you do not help your child operate the toys. We do not expect your child to be able to operate the toys on his own. This is not a test and there is no right or wrong way

to act. You can assist me by keeping your child in the chair and by picking up toys if they fall onto the floor." (Mundy et al., 2003; ESCS manual, p. 4).

4.6.7 RELIABILITY

The ESCS typically yields reliable and valid indices of the development of early social communication (e.g., Mundy et al., 1988, 1994, 1995, 1998; McEvoy, Rogers, & Pennington, 1993; Ulvund & Smith, 1996). In this study, interrater reliability was assessed using videotape data from nine children at each assessment point (24%) scored by an independent rater, blind to group status of the children and the hypotheses of the study, trained to reliability level on training tapes. Reliability training sessions took place for three hours per week, for 15 weeks for both the primary and reliability rater for these data. Both raters completed two reliability tapes provided by Dr. Mundy's research team. These tapes consisted of 30 typically developing children between the ages of 8 and 24 months. Discrepancies in reliability scoring were cleared up through a discussion and an agreement as to the correct coding of the behaviour in question. Reliability was said to have been achieved when both raters had intraclass correlation r's above .80 with the reliability data, and with each other.

Intraclass reliability correlations were used to assess consistency between raters' ESCS codes. In early ESCS studies, Mundy and colleagues used the 'G' or Generalizability coefficient to calculate reliability between raters. G is a derivation of an analysis of variance where the ratio of variance associated with raters versus the variance associated with individual subjects is computed and tested. However, personal communication with Mundy (13/9/2004) revealed that he used G only when he had the assistance of the statistical groups at UCLA. Since he moved to the University of Miami, he has used intraclass correlations to assess reliability, even for multiple raters. This type of analysis is readily available within the reliability package of SPSS.

Intraclass correlation coefficients were calculated based on nine tapes (24 %) of children at each of the three testing points. All Intraclass paired ratings on the data from the current study ranged from r (9) = .97 to r (9) = 1.00; t-tests (df = 8) revealed that there were no significant differences between the mean ESCS scores generated by the two raters. Please refer to Table 4.1 for a full listing of

reliability coefficients. While the correlation of .64 between raters at the 24 month follow up for ISI looks relatively low, it is because the two coders had different ratings on only one child, as ISI is a dichotomous variable. Thus, as the reliability data are good, all scores are deemed valid and suitable to use in the following analyses.

	Intraclass Correlation Coefficients		
ESCS Code	Baseline	12 Month Follow Up	24 Month Follow Up
IJA	.99	.95	.96
RJA	.96	.95	.96
IBR	.99	.94	.90
RBR	.98	1.00	1.00
ISI	1.00	1.00	.64
RSI	.99	.94	.96

Table 4.1 ESCS Intraclass Reliability Coefficient Alphas for Two Independent Raters

4.7 MEASUREMENT CHALLENGES

Autism spectrum disorders are characterised by severe social, communication, behavioural, and very often, cognitive deficits. There is also a large variability in the presentation of this developmental disorder. Some children are verbal and speak in complete sentences, others never learn to communicate effectively. Some children prefer not to engage with others, while others are affectionate and interested in other people. Though still not measured in any depth by any current research study, these individual differences in symptoms and behavioural presentation invariably affect the outcome of studies. The importance of well designed research studies cannot be underestimated, and a great deal of consideration has been taken in designing the present study. This includes sample size considerations, the probability of remaining blind to diagnosis or group status, examiner bias, and more specific issues of trial design. The measurement challenges faced in conducting the present study will be discussed in this section.

Before considering methodological issues however, it is important to consider that the groups of children in the present study form part of a larger study into the effectiveness of Early Intensive Behavioural Intervention for preschool aged children with autism in the south of England. The Southampton Childhood Autism Programme (SCAmP; Remington et al., Submitted – See Section 3.9 for greater detail) was designed as a field effectiveness trial. Thus, the effects of intervention on child outcome were examined in relation to how well they work in the 'real world'. These children were not randomly allocated to groups; rather parents opted for their children to undergo intensive behavioural treatment, or to receive statutory educational services. The difficulties of conducting a randomized control trial (RCT) with such an early intervention study are numerous. Most importantly, the independent variable of intervention is incredibly intensive, cannot be delivered blind, lacks a suitable equally intensive comparison, and the ethics of withholding treatment from controls makes it difficult. While this lack of group randomization may introduce a certain lack of control over the findings, every caution was made to control for any differences between groups statistically.

4.7.1 SAMPLE SIZE

Adequate statistical power is required to determine if any reported effects are robust and replicable. While the sample size for the present study (21 children in the Intervention group, 16 children in the Comparison group) is considerable for a study of special populations, it is nevertheless a small population for data analysis techniques and the issue of statistical power is critical. Thus, in interpreting the data presented in the following chapters, it is important to consider the possibility of Type I errors. Important findings and group differences may potentially be masked by the relatively small sample size, and the amount of analyses performed on the data. The data are thus treated as exploratory, and replication of the results is needed before any firm conclusions regarding the data can be made. Although the possibility of adjusting the p value downwards to reduce the Type I error rate was considered, a decision was made not to do so because, with a small sample, such a change would increase the possibility of Type II errors.

4.7.2 EXAMINER BIAS AND BLINDNESS

Examiner bias can introduce several problems to a research study affecting the interpretation of results and the reliability and validity of the findings. To control for these issues, examiners who conduct assessments with given populations are typically blind to the hypotheses of the study, and the group status of participants (e.g., Intervention vs. Comparison). Regrettably, in the present study, it was not possible to remain blind to group status or study hypotheses. Initially, every caution was made to keep separate from the intervention team, I had no access to intervention files, my involvement with families was limited to my yearly assessment, and families were instructed not to inform me of group status. However, as the assessments were conducted in the family home, several environmental clues were present to inform me as to which group the children were in. The Intervention group children typically had separate therapy rooms, and wall charts indicating programme progress. Additionally, parents without exception informed me that their child was receiving EIBI at some point during an assessment.

Although the group status of the children was not successfully shielded, there are several reasons why I believe that the assessments lacked bias and are reliable. Reliability coding was conducted for the ESCS, the main measure used in this thesis. The ESCS coder was blind to the hypotheses of the study and group status of children, and inter rater reliability for the ESCS was excellent (between .94 and 1.00) across time. Additionally, the child outcome measures used to look at associations with the ESCS were all standardized measures. These include detailed and well specified task requirements, and a limited range of possible correct child responses. Moreover, where independent assessments were available, the results for the assessments conducted were always within one standard deviation of the independent examiner. Thus, while examiner bias and lack of blindness is an issue for the interpretation of results, I believe that it was controlled for to the best of our ability and does not affect the findings.

5. THE DEVELOPMENT OF NON-VERBAL SOCIAL COMMUNICATION IN CHILDREN WITH AUTISM

5.1 CHAPTER AIMS

The aim of this chapter is twofold: 1. To explore the variables associated with early social communication in pre-school children with autism, and 2. To explore the relationships between early social communication variables measured on the ESCS and child functioning over time, in a group of preschool aged children with autism who have not been subject to any specific intensive intervention. Comparative group analyses between children who have received early intensive behavioural intervention and those who have not received intensive intervention will be addressed in Chapter 6, as current theory suggests that intervention should have a particular positive effect on the development of joint attention in children with autism, especially in the preschool years (Mundy & Crowson, 1997; Mundy & Neal, 2001).

5.2 INTRODUCTION

Joint attention and related social communication skills provide a foundation for the development of cognitive, language, and adaptive skills in neurotypical children (Bakeman & Adamson, 1984; Bruner, 1975; Sheinkopf, Mundy, Claussen, & Willoughby, 2002; Tomasello, 1995). However, atypically developing populations display individual differences in their development of joint attention and social communication, which in turn affect the ontogeny of their cognitive, language, and self help skills (Carpenter, Nagell, & Tomasello, 1998; Carpenter, Pennington, & Rogers, 2002; Mundy & Gomes, 1998; Ulvund & Smith, 1996). Consequently, diminished joint attention and social communication with others may lead to impoverished social information processing, in turn providing insufficient input to promote normal neurological development (Mundy & Neal, 2001).

Numerous theoretical and data driven observations suggest that a joint attention disturbance may reflect a fundamental component of the aetiology of autism (Leekam, Lopez, & Moore, 2000; Mundy, 1995; Mundy & Markus, 1997; Mundy & Neal, 2001). As presented in Chapter 2, initiating joint attention,

requesting, and turn-taking behaviours are often significantly impaired in young children with autism relative to typically developing children or children with non-autistic disorders matched on chronological or mental age (McEvoy, Rogers, & Pennington, 1993; Mundy, Sigman, & Kasari, 1990; Mundy, Sigman, Ungerer, & Sherman, 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby & Prutting, 1984). Specifically, children with autism display more pronounced difficulty with initiating joint attention acts than requesting acts, relative to developmentally matched children with intellectual difficulties or specific communication delays (Baron-Cohen, 1989; Landry & Loveland, 1988; McEvoy et al., 1993; Mundy, 1995; Mundy, Sigman, & Kasari, 1994). Children with autism also display a diminished response to the joint attention bids of others, and they spend less time engaging in turn-taking routines with others (McEvoy et al., 1993; Mundy et al., 1986; Mundy et al., 1994; Mundy, 1995).

Longitudinal associations between early social communication skills and later language and cognitive abilities have been found for typically developing children (Bates, Bretherton, & Snyder, 1988; Markus et al., 2000; Morales et al., 2000; Mundy & Gomes, 1998), and children who are at risk owing to prenatal drug exposure or prematurity (Sheinkopf et al., 2004; Ulvund & Smith, 1996). There are also a relatively small number of studies concerned with early joint attention and social communication skills relative to later developmental and linguistic abilities in children with autism (Charman et al., 2003; Mundy et al., 1990; Sigman & Ruskin, 1999). These studies have all looked at associations between early social communication skills as measured by the ESCS or joint attention tasks and, predominantly, later language abilities. Briefly, Mundy and colleagues (Mundy et al., 1990) found that joint attention, but not turn-taking or requesting skills, as measured by the ESCS, was associated with language skills at follow up. Sigman and Ruskin (1999) found that in a sample of 54 four year old children with autism reassessed with the ESCS after one year, expressive but not receptive language at follow up was associated with responding to and initiating joint attention, initiating behavioural requests, and initiating social interaction, even with initial age and language ability covaried. Finally, Charman and colleagues (Charman et al., 2003) found that receptive, but not expressive language outcome was significantly positively associated with performance on a

gaze switching joint attention task at 20 months. Please refer to Chapter 2 for a more detailed review of these studies.

5.3 METHOD

5.3.1 STUDY DESIGN AND DATA ANALYSIS STRATEGY

Children were initially seen for a baseline assessment when they were between 2 years 6 months and 3 years 6 months. They were followed up twice; after 12 and 24 months. At each assessment point, a visit to the child's home (or school for three cases) was conducted and several child measures were taken. Correlational analyses were used to identify relationships between variables at individual data gathering time points. Also, partial correlations were utilized to measure whether baseline ESCS variables were associated with follow up child outcome scores. Analysis of variance procedures were employed to identify any longitudinal trends over time. In the ANOVAs, there was a repeated measures factor of ESCS variables over time.

5.4 PARTICIPANTS

The children who participated in this study were drawn from a larger longitudinal study, The Southampton Childhood Autism Programme (SCAmP), on the effects of Applied Behaviour Analysis (ABA) based early intensive behavioural intervention for preschool aged children with autism. To increase power, the complete sample of children who took part in the current ESCS study is included in the correlational analyses of children's baseline functioning prior to intervention. Twenty one of the 23 children in the SCAmP ABA Intervention group were included in the baseline ESCS analyses (three of whom are female). Of the two children who did not participate in the ESCS study, one was withdrawn at the 12 month follow-up ESCS assessment because his mother did not wish her son to be videotaped. The other child was unable complete the baseline assessment owing to inattention and behavioural difficulties. The longitudinal analyses are limited to the children who formed part of a SCAmP Comparison group that did not receive any specific intensive intervention over 24 months. Their developmental progress was assessed at baseline, 12 and 24

month follow up sessions which took place in the family home, or in three occasions, at the child's school. Sixteen of the 21 children, two of whom were girls, who took part in SCAmP Comparison group, are included in these analyses. The five children who did not participate in this study were unable to complete the social communication assessment at baseline owing to inattention or behavioural difficulties.

Children were recruited into the SCAmP project through referrals from Local Educational Authorities (LEA), the National Autistic Society, regional autistic societies, and parent groups or charities. All of the children entered the programme with a clinical diagnosis of autism spectrum disorder. To standardize and confirm diagnosis, an independent member of the SCAmP team (Nicholas Ward) administered the Autism Diagnostic Interview – Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994), the gold standard for autism diagnosis in both research and clinical settings, to parents as part of the larger SCAmP study. Children in this study also met the following conditions: (a) they were between 30 and 42 months of age when they first contacted the project; (b) they had no history of seizure conditions, congenital, and/or chromosomal abnormalities; (c) they had good health so that it would not interfere with the intervention; and (d) they had no history of previous intensive behavioural interventions programmes prior to entry into SCAmP.

The participant characteristics are shown in Table 5.1. Data from the full sample, including both children from the Intervention and Comparison groups, is included in the baseline scores on the table to increase power for the baseline correlational analyses. These scores are all pre-intervention. The baseline, 12 and 24 month follow up data, for the Intervention and Comparison (non-intervention) children are also included. All of the children received the Bayley Scales of Infant Development, Second Edition (BSID-II) at their baseline assessment, followed by the Reynell Developmental Language Scales, Third Edition (RDLS) if appropriate. At the 12 and 24 month assessments, children either received the Bayley or the Stanford Binet to assess IQ and MA, as well as the Reynell if appropriate. For children who received the Bayley, an intelligence quotient was calculated by dividing the age-equivalent score by the child's chronological age and multiplying this figure by 100 (MA/CA x 100). Unfortunately, the Reynell

Language Scales suffered from floor effects at all three time points. The Scales have a basal age equivalent of 21 months and most of the sample fell below this level. To examine language outcomes at the 24 month follow up assessment, raw scores were used. However, as so few data points were obtained at the initial assessment, comparisons between baseline and follow up were not possible. The children's primary caregiver completed the Vineland interview about their child.

		Baseline[1]	Baseline		12 Month Follow Up		24 Month Follow Up	
		Combined (n = 37)	Intervention (n = 21)	Comp (n=16)	Intervention (n = 21)	Comp (n=16)	Intervention (n = 21)	Comp (n=16)
CA	Mean	36.6	35.8	36.6	49.0	50.1	61.6	62.4
	SD	4.3	4.1	4.3	4.1	4.9	4.3	5.3
	Range	28 – 45	28 – 44	28 – 45	42 – 59	40 – 58	54 – 71	51 – 72
MA	Mean	22.6	21.9	22.6	33.2	30.7	43.8	39.2
	SD	6.8	6.8	6.8	10.5	10.2	16.6	17.9
	Range	9 - 35	9 – 35	9 - 35	16 – 50	13 – 51	19 – 73	14 - 80
IQ	Mean	61.7	60.7	61.7	67.5	61.2	71.8	62.6
	SD	17.4	16.5	17.4	20.9	20.0	27.3	27.6
	Range	30 - 89	30 – 87	30 - 89	33 – 107	27 – 95	31 – 120	22 - 119
VABS Total (Raw)	Mean (raw)	58.5 (113.0)	59.8 (115.1)	58.5 (113.0)	62.5 (168.4)	58.1 (146.8)	61.4 (201.8)	54.9 (182.3)
	SD (raw)	6.6 (28.0)	5.9 (27.1)	6.6 (28.0)	12.8(49.6)	11.8(50.1)	15.8(64.3)	12.2(61.5)
	Range	49 – 74 (74 – 203)	49 – 74 (76 – 203)	49 – 74 (74 – 203)	45 - 94 (94 - 284)	47 – 84 (83 – 240)	40 - 92 (106-326)	42 – 83 (97 – 292)
VABS Commu nication (Raw)	Mean (raw)	60.1 (22.8)	61.2 (23.8)	60.1 (22.8)	66.7 (42.8)	58.0 (33.9)	67.7 (55.6)	60.8 (46.3)
	SD (raw)	8.7 (11.9)	7.8 (12.2)	8.7 (11.9)	25.0(23.7)	11.8(18.6)	25.0(23.7)	19.6(24.1)
	Range (raw)	50 – 81 (7 – 51)	52 – 79 (9 - 51)	50 – 81 (7 – 51)	45 - 82 (19 – 75)	47 – 89 (9 – 67)	30 - 11 (20 - 91)	42–110 (12 – 95)
VABS Daily Living (Raw)	Mean (raw)	62.0 (23.8)	62.8 (23.7)	62.0 (23.8)	62.2 (38.3)	58.6 (33.4)	59.2 (49.8)12.0 (17.0)	53.6 (43.8)
	SD (raw)	6.3 (8.6)	5.2 (7.6)	6.3 (8.6)	9.4 (14.4)	9.7 (15.7)		12.5(18.1)
	Range (raw)	53 – 8 (11 – 50)	53 - 74 (14 - 49)	53 - 85 (11 – 50)	45 - 82 (19 - 75)	47 – 77 (14 – 66)	38 – 85 (22 – 92)	36 – 82 (21 – 80)
VABS Socializ a-tion (Raw)	Mean (raw)	61.5 (23.8)	62.6 (29.0)	61.5 (23.8)	64.0 (38.0)	60.3 (34.6)	64.3 (43.6)	60.9 (42.3)
	SD (raw)	7.5 (7.1)	6.6 (6.6)	7.5 (7.1)	11.5(13.0)	10.5(11.8)	14.6(16.6)	13.5(14.8)
	Range (raw)	52 – 87 (14 - 51)	52 – 77 (14 – 47)	52 - 87(14 - 51)	51 – 95 (20 – 71)	52 – 85 (21 – 60)	50 – 92 (21 – 77)	39 – 91 (21 – 71)
VABS Motor (Raw)	Mean (raw)	70.3 (37.4)	73.2 (37.6)	70.3 (37.4)	71.7 (48.6)	64.4 (44.8)	65.6 (54.0)	59.6 (49.9)
	SD (raw)	10.9 (6.0)	11.2 (6.6)	10.9 (6.0)	14.4 (7.0)	12.7 (8.1)	17.1 (9.4)	11.9 (7.8)
	Range	52 – 9 (24 – 56)	52 – 94 (24 – 56)	52 - 94 (24 – 56)	50 – 98 (35 – 64)	52 – 96 (27 – 95)	50 – 108 (37 – 70)	48 – 93 (40 – 65)

[1] The first column of Baseline figures are based on the data for the combined Intervention and Comparison groups, prior to any intervention.

Reynell Compre-hension (Raw)	Accessing Test (n)	19% (7)	19% (4)	19% (7)	81% (17)	63% (10)	90% (19)	63% (10)
	Mean	2.7	3.0	2.7	19.1	15.1	30.6	22.3
	SD	6.0	6.7	6.0	17.0	15.6	19.7	20.5
	Range	0 - 20	0 - 20	0 - 20	0 - 46	0 - 53	0 - 56	0 – 56
Reynell Express-ive (Raw)	Accessing Test (n)	8% (3)	10% (2)	8% (3)	71% (15)	44% (7)	90% (19)	56% (9)
	Mean	0.8	0.9	0.8	9.4	22.3	17.1	12.4
	SD	2.7	2.9	2.7	7.8	20.5	12.9	13.3
	Range	0 - 10	0 - 10	0 - 10	0 - 22	0 - 56	0 - 41	0 - 43

Table 5.1 Characteristics of the Samples at Each Data Collection Point

5.5 CHILD INTERVENTIONS AND SCHOOLING FOR THE COMPARISON GROUP

Over the course of two years the children in the Comparison group received a variety of interventions aimed at enhancing level of functioning (See Table 5.2). However, none of these interventions was intensive or delivered on a one-to-one basis for the majority of time. None of the children were attending school at their baseline assessment. However, by the time of their 12 and 24 month assessments, all of the children in the Comparison group had a school placement. At the 12 month assessment, 37.5 % of children (6) were in a mainstream environment, 50% (8) of children were in a special educational needs school, and 12.5 % (2 children) had a mixed placement whereby half their time was spent in a mainstream school and the other half in a special needs school. The average number of hours spent in the different schools was similar for each child with 13.92 hours spent in mainstream, 15.75 hours spent in special needs, and 14.75 hours spent in mixed placement settings. By their 24 month assessment, 50% (8 children) were in mainstream school and 50% were in special needs school. The average number of hours per week spent in educational settings was very similar, with 24.06 hours spent in mainstream and 24.5 hours spent in special needs schools.

Speech Therapy: The most frequently reported intervention was speech therapy: 56% of children received it at the time of the baseline assessment, 75% at the 12 month follow-up, and 50% at the 24 month follow up.

TEACCH: The Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH; Schopler, Mesibov, & Baker, 1982) programme uses work stations, visual schedules and timetables to help support the learning process of children with autism. As part of the children's experience of school, parents reported a high usage of TEACCH principles (44% at the 12 month follow up and 50% at the 24 month follow up).

Alternative Communication Systems: The most frequently reported alternative communication systems used for nonverbal children with autism were the Picture Exchange Communication System (PECS) and Makaton signs. PECS involves the use of symbol cards exchanged between child and caregiver to communicate requests where as Makaton is a signed system of language. To enhance language and communication skills, Picture Exchange Communication Systems or PECS (69% at the 12 month follow up and 75% at the 24 month follow up) and Sign Language or Makaton communication systems (25% at the 12 month follow up and 50% at the 24 month follow up) were used as alternative communication systems.

Dietary Interventions: Dietary interventions (typically gluten and casein restrictions) were also relatively common with 19% of children having had dietary restrictions at baseline, 19% at their 12 month follow up, and 31% of children at their 24 month follow up. Medication and homeopathic use was also reported (see Table 5.2 for details).

	Baseline Assessment	12 Month Follow Up	24 Month Follow Up
School Placement	0%	Mainstream: 37.5% (6) Special Needs: 50% (8) Combination: 12.5%(2)	Mainstream: 50% (8)[1] Special Needs: 50% (8)
Hours Spent in School Placements	0%	Mainstream: 13.92 Special Needs: 15.75 Combination: 14.75	Mainstream: 24.06 Special Needs: 24.5
Speech Therapy	56% (9)	75% (12)	50% (8)
PECS	0%	69% (11)	75% (12)
Sign Language /Makaton	0%	24% (4)	50% (8)
TEACCH	0%	44% (7)	50% (8)
Sensory Integration Training	6% (1)	13% (2)	19% (3)
Dietary Interventions	19% (3)	19%(3)	31% (5)
Routine Prescription Usage	6% (1)	25% (4)	25% (4)
Vitamin Therapy	0%	19% (3)	31% (5)

Table 5.2 Schooling and Supplementary Interventions for Comparison Group Children

[1] The numbers in brackets refer to the N of children who received the intervention in question

5.6 PROCEDURE

5.6.1 MEASURES

The Vineland Adaptive Behaviour Scales interviews were conducted with the primary caregiver (36 mothers, 1 father for full sample, 15 mothers, 1 father for Comparison Group only). Interviews were carried out over the telephone approximately one week prior to the child's assessment visit which took place at the family home. Only three assessments were carried out in the child's school at the request of the parent. In each case, this was at the 24 month follow up assessment. Testing sessions lasted approximately 60 - 120 minutes. A single tester, HK, administered all but one of the standardised outcome measures to the parents and children. The exception was the ADI-R (Autism Diagnostic Interview-Revised; Lord, Rutter, & LeCouteur, 1994) which was administered to parents in the home by NW at the time of the first child assessment. A uniform order of administration was followed: (1) the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996) (2) the Bayley Scales of Infant Development, Second Edition (Bayley, 1993) or the Stanford Binet, Fourth Edition (Thorndike, Hagan, & Sattler, 1986, and (3) The Reynell Developmental Language Scales, Third Edition (Edwards et al., 1997).

The ESCS was delivered first because most children find the toys attractive and engaging. Additionally, the format of delivery is somewhat shorter and less structured owing to the ESCS being an ecologically relevant measure of social attention. The ESCS thus served as a good rapport building exercise. The developmental/IQ assessment followed because it was the longest measure and required the most concentration and attention. Finally, as not all of the children were able to access the Reynell language assessment, and it also takes relatively less time to deliver, it was conducted last if the children's language level was such that it permitted them to access the items on the test.

5.6.2 HYPOTHESES

In addition to a range of exploratory analyses on these longitudinal data, several hypotheses were examined in this study. The first hypothesis was that individual differences in joint attention would reflect a stable aspect of development in

young children with autism. Therefore, joint attention variables were expected to be correlated across time (See Section 1.71). A second hypothesis was that initiating and responding to joint attention would reflect partially distinct processes. Previous research has found in both typically developing and children at risk for behavioural or developmental difficulties, that certain variables (e.g., temperament) contribute specifically to the development of IJA but not necessarily RJA (Vaughan et al., 2003). Thus, cross-dimensional correlations were not expected to be significant (e.g., IJA at baseline and RJA at baseline) (See Section 1.4.2). Thirdly, longitudinal changes for social communication scores were investigated across time. It was hypothesized that as children matured, their joint attention and related skills would increase in frequency (Mundy, Sigman, & Kasari, 1991). Fourth, associations between ESCS and child cognitive, adaptive behaviour, and autism symptoms were explored at each testing point. As greater joint attention skills are associated with higher functioning it was hypothesized that joint attention would be significantly correlated with cognitive and adaptive skills, while a greater preponderance of autism symptoms or behaviours would be negatively correlated with joint attention (See Section 2.3.2). Finally, the predictive validity of early social communication abilities was investigated in order to see to what extent individual differences in early social communication skills at baseline were related to later cognitive and language competencies (Ulvund & Smith, 1996).

5.7 RESULTS

The results section will be presented in the following format: 1. Descriptive Statistics of ESCS variables; 2. The stability of ESCS variables across two years will be presented to identify if patterns exist over time in this population; 3.Any longitudinal changes in ESCS scores will be identified; 4. Associations amongst ESCS and developmental outcome measures at each testing point will be discussed and; 5. The longitudinal predictive value of baseline joint attention for the development of IQ and language will be discussed.

The Descriptive Statistics for ESCS variables are presented in Table 5.3.

		Time 1 (n = 16) (Baseline)	Time 2 (n = 16) (12 month follow up)	Time 3 (n = 16) (24 month follow up)
Initiating Joint Attention	Mean	3.6	6.2	11.7
	SD	4.9	8.8	14.2
	Range	0 - 14	0 – 30	2 – 50
Responding Joint Attention	Mean	5.9	7.1	10.3
	SD	3.9	5.2	5.0
	Range	0 - 12	1 – 14	1 - 14
Initiating Behaviour Regulation (Requesting)	Mean	14.7	11.5	11.2
	SD	12.8	6.4	4.0
	Range	1 – 51	0 – 24	4 - 16
Responding to Behaviour Regulation (percent Correct)	Mean	46.19	78.63	88.13
	SD	44.68	28.09	23.34
	Range	0-100	0-100	10-100
Initiating Social Interaction	Mean	0.2	1.0	1.4
	SD	0.5	0.9	0.7
	Range	0 – 2	0 – 2	0 - 2
Responding to Social Interaction	Mean	10.9	13.2	14.6
	SD	6.4	8.3	9.5
	Range	0 – 20	2 – 33	4 - 31

*Each instance of Initiating and Responding to Joint Attention, Behaviour Regulation, and Social Interaction during the ESCS are counted as individual occurrences and are thus frequency scores.

Table 5.3 Descriptive Statistics of Early Social Communication Scales (ESCS) for the Comparison Group

5.7.1 TESTING FOR NORMALITY OF DISTRIBUTIONS

The Kolmogorov-Smirnov Test for goodness-of-fit was used to check for normality of distribution for the ESCS variables at all three assessment time points. Significant Kolmogorov-Smirnov Z statistics for particular variables would indicate that the sample had not been drawn from the normal distribution, and indicating non-parametric tests would be better suited to any further data analysis. The only variable to meet significance on this measure was Initiating Social Interaction (ISI) at Time 1 (baseline), Kolmogorov-Smirnov Z = 2.04; p =

.001. This outcome is most probably the result of the lack of data points for this variable at the baseline assessment; only two out of the 16 children received a score. In subsequent analyses, ISI data is therefore treated as a dichotomous variable, indicating the proportion of the sample that was able to initiate social interaction.

5.7.2 TESTING FOR THE REPRESENTATIVENESS OF THE ESCS SAMPLE WITH THE SCAMP COMPARISON GROUP AS A WHOLE

Because five children in the SCAmP study Comparison group were not able to complete the ESCS assessment, Mann-Whitney tests were conducted to look for differences between their baseline scores, and those of the Comparison group of ESCS study children who were able to complete the ESCS measure. No group differences were found between the ESCS and remaining SCAmP Comparison groups in terms of their CA ($z = -1.54$; $p > .05$) , MA ($z = -.66$; $p > .05$), IQ ($z = -.33$; $p > .05$), or VABS scores [Composite ($z = -1.12$; $p > .05$); Communication ($z = -.46$; $p > .05$); Daily Living ($z = -1.03$; $p > .05$); Socialization ($z = -1.16$; $p > .05$); Motor ($z = -1.00$; $p > .05$)]. Systematic differences between the SCAmP and ESCS groups would have been problematic as there may have been something in particular about those children that made them unable to access the ESCS such as lower IQ, MA, or Adaptive Skills. Fortunately, as no group differences exist, the assumption that inattention factors may account for those children who were unable to access the ESCS holds.

5.7.3 STABILITY OF THE ESCS VARIABLES ACROSS TWO YEARS

The first hypothesis to be examined was that individual differences in joint attention and other social communication skills would reflect a stable aspect of infant social development. Therefore, baseline, 12, and 24 month follow up measures of joint attention were expected to be correlated. Also examined was the hypothesis that initiating joint attention (IJA) and responding to joint attention (RJA) reflect partially distinct processes. Thus, although within dimension correlations were expected to be significant (e.g., IJA at baseline and IJA at 12 month follow up), cross dimension correlations (e.g., IJA at baseline with RJA at baseline) were not expected to be significant.

Stability of Social Communication: Pearson-Product Moment correlation data indicating the associations between ESCS variables over time are shown in Table 5.4. Please note that the correlations with ISI are point biserial correlations as ISI was split into a dichotomous variable. The only variables found to be significantly related over time were IJA: Baseline IJA and IJA at 12 month follow up, r (16) = 0.55, $p < .05$; IJA at 12 months and IJA at 24 months, r (16) = 0.89, $p < .01$; IJA at baseline and IJA at 24 months, r = 0.53, p < .05, and RJA: RJA at baseline and RJA at 12 months, r (16) = 0.90, $p < .01$; RJA at 12 months and RJA at 24 months, r (16) = 0.74, $p < .01$; and RJA at baseline and RJA at 24 months, $r = 0.67$, p < .01. As the population sampled is small, the size of the correlation coefficients is of interest. The coefficients suggest that IJA is only moderately correlated over 12 and 24 month periods. RJA is stable over 12 months and perhaps only moderately over 24 months. All of the other dimensions do not seem to be stable at all across all three testing points. Thus, while a child's initial preschool level of joint attention skills is indicative of joint attention abilities one and two years later; other social communication skills may be more adaptable over time.

	Baseline to 12 Month Stability	Baseline to 24 Month Stability	12 – 24 Month Stability
IJA	**.55****	**.53***	**.89****
RJA	**.90****	**.67****	**.74****
IBR	.42	.23	.06
RBR	.50	.42	.26
ISI	-.10	.18	.29
RSI	.26	.40	**.52***

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Total number of Social Interaction Initiations; RSI = Total number of Responses to Social Interaction bids. Significant correlations between ESCS variables are highlighted in bold.

Table 5.4 Stability of ESCS Variables over Time

Distinctions between IJA and RJA: Many research studies have found IJA and RJA to be separate constructs with different correlates and developmental pathways (Claussen et al., 2002; Mundy & Gomes, 1997; 1998; Sheinkopf et al., 2002). Interestingly, for this sample, IJA and RJA were reliably associated over time (See Table 5.5). This finding is inconsistent with the literature in this area which has found that IJA and RJA are distinct entities and are typically not intercorrelated. Looking more closely at the data, IJA and RJA were not correlated at individual testing points (e.g., IJA at baseline with RJA at baseline), however they were associated over time evidenced by cross-lagged correlations between variables (RJA at baseline with IJA at 12 and 24 month follow up) (see Table 5.5). While these data are exploratory in nature and the sample size is small, they may provide preliminary evidence that the ability to initiate and respond to joint attention may be interrelated to some extent in preschool aged children with autism.

	IJA Baseline	IJA 12 Months	IJA 24 Months
RJA Baseline	.21	**.60***	**.54***
RJA 12 Months	.26	.47	**.52***
RJA 24 Months	.02	.41	.37

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids. Significant correlations between ESCS variables are highlighted in bold.

Table 5.5 Associations between IJA and RJA across Time

5.7.4 LONGITUDINAL CHANGE FOR ESCS SCORES

Comparison of baseline, 12, and 24 month follow-up ESCS data was conducted through the use of one-way analysis of variance (ANOVA) for each social communication variable. Significant main effects were followed by paired t-tests to identify when in time the changes occurred (e.g., between baseline and 12 month follow-up or between 12 and 24 month follow-up).

Analyses revealed significant main effects for IJA, $F(1.31, 19.62) = 5.63$; $p < .05$), RJA, $F(2, 30) = 12.80$, $p < .001$, and RBR $F(1.13, 16.2) = 9.30$, $p < .01$). The frequency of IJA, RJA and RBR increases significantly across two years.

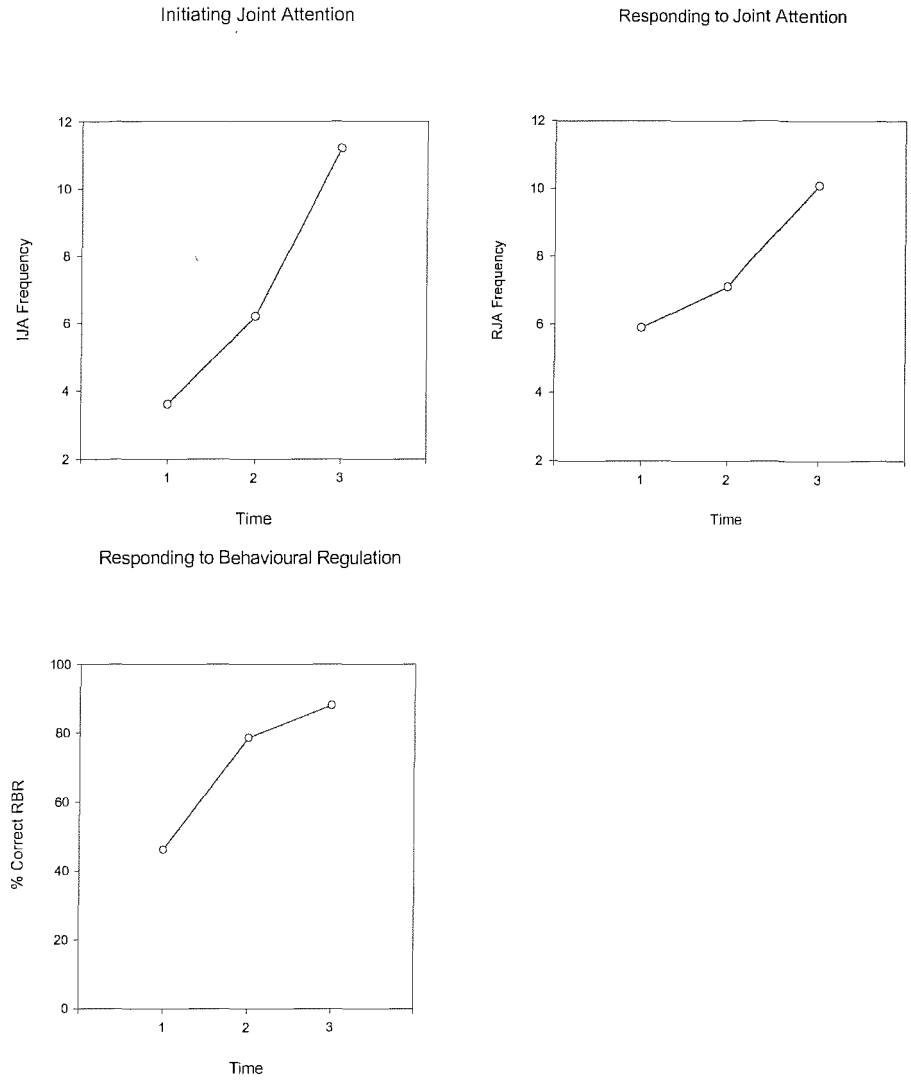


Figure 5.1 **Mean IJA, RJA, and RBR at Baseline, 12, and 24 Month Follow Up for the Comparison Group**

Initiating joint attention (IJA) showed no significant improvement between baseline and 12 month follow up, t (15) = -1.39, p = .18. However, the 12 to 24 month follow up data showed a significant increase over time, t (15) = -2.75, p < .05. A marginally significant improvement between responding to joint attention (RJA) at baseline and 12 months, t (15) = -2.00, p = .06 was found; Additionally, there was a statistically significant improvement in RJA between 12 and 24 month follow up, t (15) = -3.13, p < .01. Children correctly followed an average of 43% of RJA trials at baseline, versus 50% of trials at 12 month follow up, and 71% of trials at 24 month follow up. Improvements over time were also found for responding to behaviour regulation (RBR) between baseline

and 12 months t (15) = -2.66, $p < .05$ and 12 and 24 month follow up t (15) = -2.68, $p < .05$.

5.7.5 INITIATING SOCIAL INTERACTION

Because initiating social interaction (ISI) was split into a dichotomous variable owing to a lack of data points at the baseline assessment, Cochran's Q test for nominal data was used to analyse changes over time in this ability. The frequencies of children at baseline, 12, and 24 month follow up assessments who initiated social interaction are presented in Table 5.6.

	Initiated Social Interaction	Did not Initiate Social Interaction
Baseline	2	14
12 Month Follow Up	10	6
24 Month Follow Up	13	3

Table 5.6 Frequencies of Initiating Social Interaction at Three Time Points

It is clear from the frequency data that the ability to initiate social interaction through a turn-taking game improved over time in this sample of young children with autism, Cochran Q = 14.92; df = 2; $p < .01$. In order to assess when these improvements in ability occurred during the two year observation period, the McNemar test was used. Analyses were conducted to compare changes in ISI between Baseline and 12 month follow up, 12 and 24 month follow up, and baseline and 24 month follow up. ISI improved significantly between Baseline and 24 month follow up, $p < .01$ and 12 month follow up, $p < .05$. However, there were no significant changes between 12 and 24 month follow up ISI assessments, $p = .38$, indicating that less change occurred in the ability to initiate social interaction as children reached the latter stages of preschool, as opposed to the earlier period.

5.7.6 ASSOCIATIONS AMONGST DEVELOPMENTAL AND ESCS MEASURES AT EACH TESTING POINT

The relationships between ESCS variables and psychometric data (IQ, MA and VABS scores), as well as between the different ESCS variables at each testing point, were examined correlationally. Thirty-seven mothers and 30 fathers for the full sample, and 16 mothers and 13 fathers for the Comparison group, reported on the level of their child's autism symptomology through filling out two questionnaires: the Autism Screening Questionnaire (ASQ; Berument, Rutter, Lord, & Pickles, Bailey, 1999), and the Developmental Behaviour Checklist (Einfeld & Tonge, 1995; 2002). These scores were also used to identify any relationships between ESCS social communication variables and parent reported autism symptomology. It was hypothesized that autism symptoms or behaviours would be negatively correlated with frequency of joint attention and social communication. Thus, Pearson Product-Moment correlations were performed for each of the three testing points. In order to increase the power of the analysis at the baseline assessment, the entire sample (ABA Intervention and Comparison groups, N = 37) was used. This was possible because none of the children had received any formal intensive intervention at the time of testing. Additionally, t-tests conducted between the ABA intervention and the Comparison groups showed no significant group differences on any of the ESCS variables. The associations between variables are described below.

5.7.6.1 Correlation Matrix for Baseline Assessment Variables

Pearson Product-Moment correlation data on the relations between baseline IQ, MA, and VABS scores and ESCS Total IJA, RJA, IBR, RBR, and RSI scores for the entire (Comparison and Intervention groups, N = 37) are presented in the correlation matrices in Table 5.7a and 5.7b. Significant positive correlations between child functioning and ESCS Initiating Joint Attention variables include relationships between IJA and VABS Composite and Daily Living Skills scores.

	IJA	RJA	IBR	RBR	ISI	RSI	CA	MA	IQ	VABS T.	VABS C.	VABS DL	VABS SO	VABS M.
IJA	1.00													
RJA	.23	1.00												
IBR	.26	.32	1.00											
RBR	.10	.38*	.18	1.00										
ISI	-.18	.16	-.19	.21	1.00									
RSI	.10	.47**	.23	.34*	.16	1.00								
CA	.13	**.37****	.23	.30	.13	.15	1.00							
MA	.17	**.55****	.13	**.43****	.18	.20	.40*	1.00						
IQ	.12	**.42***	.07	.32	.12	.17	-.02	.90**	1.00					
VABS T.	**.33***	**.43***	.09	.30	-.14	.06	.40*	.66**	.49**	1.00				
VABS C.	.16	.31	.12	**.39***	-.10	.02	.28	.71**	.63**	.79**	1.00			
VABS DL.	**.40***	.47**	.06	.28	-.14	.07	.54**	.60**	.36*	.86**	.52**	1.00		
VABS SO.	.30	**.50****	.20	.20	-.13	.16	.40*	.60**	.43**	.91**	.70**	.77**	1.00	
VABS M.	.28	.26	.04	.05	-.08	-.04	.34*	.43**	.28	.69**	.33*	.70**	.54**	1.00

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. CA= Chronological Age; MA = Mental Age; IQ = Intelligence Quotient;VABS.T = Vineland Adaptive Behaviour Scales, Composite (Total) Score; VABS.C = Vineland Adaptive Behaviour Scales Communication Skills; VABS.DL = Vineland Adaptive Behaviour Scales, Daily Living Skills; VABS.SO = Vineland Adaptive Behaviour Scales, Socialization Skills; VABS.M = Vineland Adaptive Behaviour Scales, Motor Skills; IBR = Initiating Behaviour Regulation (ESCS); RBR = Percentage of Responding to Behaviour Regulation trials correct (ESCS); ISI: Total number of Social Interaction Initiations; RSI = Total number of Responses to Social Interaction bids. Significant correlations between ESCS and outcome variables are highlighted in bold.

Table 5.7a Correlations among Baseline CA, MA, IQ, VABS, and Time 1 (Baseline) ESCS Variables

Responding to joint attention was the most frequently associated ESCS variable, correlating with all of the child outcome variables at baseline with the exception of VABS Communication and Motor Skills. Finally, RBR was associated with developmental age and communication skills as measured by the VABS. Amongst parent report autism symptoms, significant negative correlations were found between RJA and mother reported ASQ, and RBR and father reported DBC-Autism Screen. No other significant correlations between child functioning and ESCS variables were found at Baseline.

Amongst ESCS variables, responding to joint attention was correlated with the ability to respond to requests and turn-taking play. Responding to requests was also associated with responding to turn-taking. All of the parental report variables were intercorrelated with the exception of fathers' ASQ and mothers DBC.

	IJA	RJA	IBR	RBR	ISI	RSI	ASQ M	ASQ F	DBC M	DBC F
IJA	1.00									
RJA	.23	1.00								
IBR	.26	.32	1.00							
RBR	.10	.38*	.18	1.00						
ISI	-.18	.16	-.19	.21	1.00					
RSI	.10	.47**	.23	.34*	.16	1.00				
ASQ M	-.30	**-.42****	-.19	-.32	.13	-.23	1.00			
ASQ F	-.22	-.35	-.31	-.03	.03	-.28	.63**	1.00		
DBC M	.11	.06	.27	-.20	-.15	.11	.37*	.22	1.00	
DBC F	.07	-.13	.25	**-.40***	-.24	-.06	.55**	.40*	.77**	1.00

Note. * $p < .05$ two-tailed, ** $p < .01$ two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. ASQ M: Mothers' Total score on the Autism Screening Questionnaire; ASQ F: Fathers' total score on the Autism Screening Questionnaire; DBC M: Mothers, Autism Screen Score on the Developmental Behaviour Checklist; DBC F: Fathers' Autism Screen Score on the Developmental Behaviour Checklist.

Table 5.7b **Correlations among Baseline Parent Reported Autism Symptomology and Baseline ESCS Variables**

5.7.6.2 Correlation Matrix for 12 Month Follow Up Assessment Variables

At the 12 month follow up assessment, there were a greater number of relations between child functioning and early social communication for the Comparison group of children with autism (n = 16). Pearson Product-Moment correlations on these relations are presented in the correlation matrices in Table 5.8a and 5.8b. At 12 month follow-up, most of the ESCS variables were correlated with child functioning. However, initiating requests stands out as the only social communication skill that is not associated with any of the outcome variables. For parent report of autism symptoms, IJA was negatively associated with mother report of ASQ. ISI was negatively correlated with father's ASQ and DBC, and RSI was negatively related to father's ASQ.

The intercorrelations between ESCS variables at 12 months were somewhat different from the baseline relationships. Responding to social interaction is the only social communication skill that is related to all of the other variables, except IBR. This suggests that the ability to respond to turn taking play may be uniquely related to other social communication skills. No other ESCS variable correlations achieved significance. For the ASQ and DBC, mothers and fathers were very much agreed on the level of autism symptoms they reported in their children.

	IJA	RJA	IBR	RBR	ISI	RSI	CA	MA	IQ	VABS T.	VABS C.	VABS DL	VABS SO	VABS M.
IJA	1.00													
RJA	.47	1.00												
IBR	.41	.27	1.00											
RBR	.40	.49	.42	1.00										
ISI	.40	.30	.29	.49	1.00									
RSI	.70**	.58*	.36	.54*	.61*	1.00								
CA	.32	.34	.22	.18	-.03	.07	1.00							
MA	**.51***	**.78****	.14	**.66****	**.51***	**.72****	.21	1.00						
IQ	.41	**.68****	.10	**.65****	**.56****	**.72****	-.13	.94**	1.00					
VABS T.	**.58***	**.54***	.12	**.58***	**.67****	**.74****	.38	.77**	.66**	1.00				
VABS C.	.45	**.55***	.12	**.67****	**.69****	**.72****	.19	.86**	.81**	.92**	1.00			
VABS DL.	**.50***	.46	.04	.40	**.52***	**.60****	.54*	.58*	.41	.93**	.74**	1.00		
VABS SO.	**.73****	.45	.21	**.59***	**.64****	**.78****	.25	.69**	.62**	.94**	.86**	.84**	1.00	
VABS M.	**.50***	**.55***	.11	.41	**.62****	**.62****	.48	.69**	.54*	.90**	.73**	.91**	.76**	1.00

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. CA= Chronological Age; MA = Mental Age; IQ = Intelligence Quotient;VABS.T = Vineland Adaptive Behaviour Scales, Composite (Total) Score; VABS.C = Vineland Adaptive Behaviour Scales Communication Skills; VABS.DL = Vineland Adaptive Behaviour Scales, Daily Living Skills; VABS.SO = Vineland Adaptive Behaviour Scales, Socialization Skills; VABS.M = Vineland Adaptive Behaviour Scales, Motor Skills; IBR = Initiating Behaviour Regulation (ESCS); RBR = Percentage of Responding to Behaviour Regulation trials correct (ESCS); ISI: Total number of Social Interaction Initiations; RSI = Total number of Responses to Social Interaction bids. Significant correlations between ESCS and outcome variables are highlighted in bold.

Table 5.8a Correlations among 12 month follow-up CA, MA, IQ, VABS, and ESCS Variables

	IJA	RJA	IBR	RBR	ISI	RSI	ASQ M	ASQ F	DBC M	DBC F
IJA	1.00									
RJA	.23	1.00								
IBR	.26	.32	1.00							
RBR	.10	.38*	.18	1.00						
ISI	-.18	.16	-.19	.21	1.00					
RSI	.10	.47**	.23	.34*	.16	1.00				
ASQ M	**-.59***	-.14	-.49	-.34	-.37	-.22	1.00			
ASQ F	-.51	-.35	-.52	-.42	**-.57***	**-.63***	.83**	1.00		
DBC M	-.25	-.35	-.30	-.25	-.27	-.28	.64**	.74**	1.00	
DBC F	-.34	-.24	-.27	-.31	**-.54***	-.53	.71**	.82**	.87**	1.00

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. ASQ M: Mothers' Total score on the Autism Screening Questionnaire; ASQ F: Fathers' total score on the Autism Screening Questionnaire; DBC M: Mothers, Autism Screen Score on the Developmental Behaviour Checklist; DBC F: Fathers' Autism Screen Score on the Developmental Behaviour Checklist.

Table 5.8b **Correlations among 12 month follow up parent reported autism symptomology, and ESCS variables**

5.7.6.3 Correlation Matrix for 24 Month Follow-Up Assessment Variables

Pearson-Product Moment correlational analyses were also conducted with the 24 month follow up ESCS and child functioning data (n = 16). Scores are presented in the correlation matrices in Table 5.9a and 5.9b. For this sample of children with autism, both initiating and responding to joint attention were correlated with measures of functioning, including developmental age and self help skills by the time of their fifth birthday. As in the previous year, responding to social interaction remained correlated with measures of child functioning. However, many associations were lost between ESCS variables and child outcome, including those between RBR and ISI. Initiating requesting continued to show a lack of association with any of the other variables. At this stage of testing, there

was the greatest number of relationships between parent reported autism behaviours and ESCS scores. IJA was negatively correlated with mothers' ASQ, and fathers' ASQ and DBC. The ability to respond to joint attention (RJA) and behavioural requests (RBR) were associated only with father's DBC score. Finally, RSI correlated with father's ASQ score.

At the 24 month follow up, RSI remained correlated only with joint attention abilities. Responding to joint attention was associated with the ability to respond to requests, and responding to requests correlated with initiating social interaction. Mother and father reports of their child's autism symptoms were highly correlated at this time point.

	IJA	RJA	IBR	RBR	ISI	RSI	CA	MA	IQ	VABS T.	VABS C.	VABS DL	VABS SO	VABS M.
IJA	1.00													
RJA	.37	1.00												
IBR	.19	.36	1.00											
RBR	.28	.52*	-.19	1.00										
ISI	.25	.23	.07	.65*	1.00									
RSI	.66**	.73**	.46	.29	.33	1.00								
CA	-.05	.08	.16	.13	.32	.22	1.00							
MA	**.71****	**.68****	.22	.51	.42	**.81****	.22	1.00						
IQ	**.76****	**.68****	.18	**.52***	.27	**.77****	-.04	.96**	1.00					
VABS T.	**.71****	**.59***	.15	.51	.39	**.68****	.32	.94**	.88**	1.00				
VABS C.	**.66****	**.71****	.17	.51	.32	**.73****	.18	.97**	.95**	.95**	1.00			
VABS DL.	**.64***	.43	.18	.43	.45	**.58***	.46	.84**	.73**	.95**	.82**	1.00		
VABS SO.	**.76****	**.53***	.07	.51	.45	**.64***	.28	.88**	.85**	.96**	.89**	.90**	1.00	
VABS M.	**.58***	.49	.12	.44	.21	**.52***	.38	.77**	.68**	.91**	.79**	.91**	.85**	1.00

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. CA= Chronological Age; MA = Mental Age; IQ = Intelligence Quotient;VABS.T = Vineland Adaptive Behaviour Scales, Composite (Total) Score; VABS.C = Vineland Adaptive Behaviour Scales Communication Skills; VABS.DL = Vineland Adaptive Behaviour Scales, Daily Living Skills; VABS.SO = Vineland Adaptive Behaviour Scales, Socialization Skills; VABS.M = Vineland Adaptive Behaviour Scales, Motor Skills; IBR = Initiating Behaviour Regulation (ESCS); RBR = Percentage of Responding to Behaviour Regulation trials correct (ESCS); ISI: Total number of Social Interaction Initiations; RSI = Total number of Responses to Social Interaction bids. Significant correlations between ESCS and outcome variables are highlighted in bold.

Table 5.9a Correlations among 24 month follow-up CA, MA, IQ, VABS, and ESCS Variables

	IJA	RJA	IBR	RBR	ISI	RSI	ASQ M	ASQ F	DBC M	DBC F
IJA	1.00									
RJA	.23	1.00								
IBR	.26	.32	1.00							
RBR	.10	.38*	.18	1.00						
ISI	-.18	.16	-.19	.21	1.00					
RSI	.10	.47**	.23	.34*	.16	1.00				
ASQ M	**-.57***	-.03	.08	-.39	-.44	-.32	1.00			
ASQ F	**-.91****	-.44	-.07	-.50	-.39	**-.63***	.91**	1.00		
DBC M	-.45	**-.58***	-.06	**-.55***	-.47	-.46	.59*	.81**	1.00	
DBC F	**-.76****	-.41	.36	-.45	-.45	-.42	.66*	.83**	.87**	1.00

Note. * p < .05 two-tailed, ** p <.01 two-tailed. ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention (ESCS); RJA: Total number of Responses to Joint Attention Bids; IBR: Total number of behaviour regulation bids; RBR: Percentage of responding to Behaviour Regulation trials; ISI: Presence of Social Interaction Initiations (dichotomous variable); RSI = Total number of Responses to Social Interaction bids. ASQ M: Mothers' Total score on the Autism Screening Questionnaire; ASQ F: Fathers' total score on the Autism Screening Questionnaire; DBC M: Mothers, Autism Screen Score on the Developmental Behaviour Checklist; DBC F: Fathers' Autism Screen Score on the Developmental Behaviour Checklist.

Table 5.9b **Correlations among 24month follow up parent reported autism symptomology, and ESCS variables**

5.8 LONGITUDINAL ASSOCIATIONS BETWEEN ESCS VARIABLES AND CHILD FUNCTIONING

Another hypothesis addressed in this research was that infant joint attention would predict follow-up cognitive, developmental status, or adaptive behaviour, above the variance accounted for by these skills at baseline assessment or language and intellectual disability.

The Pearson correlations between ESCS predictors at baseline and child outcome at 24 month follow-up are presented in Table 5.9. The relations between infant joint attention and related social communication skills and the cognitive, adaptive behaviour, and language measures at 24 month follow up were assessed when the children were between 48 and 56 months of age. Correlational analyses were performed for parametric data, while non parametric analyses were used for

the dichotomous variables. All of the baseline IQ, MA, and VABS scores that were assessed between 30 and 42 months of age correlated with 24 month follow up assessment scores. Therefore, partial correlations were also computed with the variance attributed to the baseline variables removed for each longitudinal analysis of these data (e.g., baseline IQ was controlled for when looking at the long term predictive value of IJA on 24 month follow up IQ).

5.8.1 THE EFFECTS OF EARLY SOCIAL COMMUNICATION VARIABLES ON THE DEVELOPMENT OF IQ, MA, AND ADAPTIVE BEHAVIOUR

Simple and partial correlations were conducted to assess the longitudinal and predictive value of baseline ESCS variables for 24 month follow-up child outcome variables. The aim was to investigate the predictive validity of the nonverbal communication skills of these young children with autism. The extent to which individual differences in social communication abilities between 30 and 42 months of age predicted later cognitive and language competencies was also investigated. The baseline ESCS variables of total IJA, RJA, IBR, RBR, and RSI, and 24 month child functioning variables of IQ, MA, and VABS scores, were entered into a simple correlation matrix. Subsequently, individual partial correlations were conducted for each variable, removing any effects of baseline IQ, MA, or VABS scores. Once more, the correlations for ISI are point biserial correlations as ISI was a dichotomous variable.

The Predictive Validity of Joint Attention: For the simple correlations, IJA at baseline was primarily associated with the VABS Composite and the adaptive skill domains of Daily Living and Motor abilities at 24 months. When the contribution of baseline scores were partialled out, baseline IJA was significantly correlated with IQ and MA at 24 months. Responding to joint attention was correlated with all of the child outcome variables for the simple correlations. However, when the baseline score was partialled out, only VABS Communication and Motor skills remained significant, along with a marginally significant effect for IQ ($p = .051$). Other significant social communication skill correlations can be found in Table 5.10.

	ESCS Variables at Baseline					
24 Month Follow Up Outcome	**IJA**	**RJA**	**IBR**	**RBR**	**ISI**	**RSI**
IQ	.34	**.53***	.38	.35	-.04	.13
partial correlation	**.63***	.51	**.69***	.31	-.27	.24
MA	.43	**.62***	.35	.42	-.03	.18
partial correlation	**.53***	.46	**.66***	.28	-.39	.17
VABS Composite	**.50***	**.57***	.31	.47	-.06	.22
partial correlation	.14	.49	.42	.34	-.17	.18
VABS Comm.	.37	**.56***	.30	.45	-.05	.19
partial correlation	.30	**.62***	.49	**.60***	.06	.38
VABS Daily Liv.	**.60***	**.51***	.22	.40	-.06	.17
partial correlation	.27	.27	.20	.05	.18	-.03
VABS Social	.45	**.53***	.40	.43	-.05	.23
partial correlation	.16	.19	.38	.07	.13	.04
VABS Motor	**.57***	**.54***	.27	**.54***	-.12	.33
partial correlation	.34	**.63***	.23	**.58***	-.06	.24

Note: * = significant at the $p < .05$ level. ISI values are point biserial correlations

Table 5.10 Simple and Partial Correlations between Baseline ESCS Variables and Child Outcomes at 24 Month Follow Up

ESCS scores at baseline were also used to predict ability to access items on the Reynell Comprehension and Expressive language scales. Because there were too few scores on the Reynell to control for any of its variance from the baseline assessment, and because scores on the Reynell had to be categorized into dichotomous variables, a point biserial correlation was conducted between the ESCS scores at baseline and the Reynell Comprehension and Expressive subscales at 24 month follow up (See Table 5.11). The only ESCS variable to

reach significance in its ability to predict access to Reynell items was the ability to respond to requests (RBR) with both the Comprehension scale; r = .68; n = 16; p < .01, and the Expressive scale; r = .51; n = 16; p < .05.

	ESCS Variables					
24 Month Follow Up Outcome	**IJA**	**RJA**	**IBR**	**RBR**	**ISI**	**RSI**
Reynell Comprehension Scale (n = 16)	.05	.33	-.05	**.68****	.28	.31
Reynell Expressive Scale (n = 16)	.12	.29	-.09	**.51***	.31	.17

Note: * = significant at the p < .05 level; ** = significant at the p < .01 level.

Table 5.11 Point Biserial Correlations between ESCS and Language Variables

5.9 DISCUSSION

The identification of predictors of later childhood developmental and behavioural outcomes is an important goal for both basic and applied research for children with autism specifically, and developmental psychology more generally. Several exploratory analyses were conducted, and five hypotheses about the data were made. The first hypothesis was supported: even though the frequency of joint attention increased over time, relative joint attention skills remained stable at the group level. Correlations between baseline, 12, and 24 month follow up assessments of both initiating and responding to joint attention were significant. Thus, the current study demonstrates that more change occurs with regards to social communication skills in the earlier part of the preschool years, than in the latter stages.

The second hypothesis, that IJA and RJA would reflect distinct processes, was not supported. Instead, correlations were observed between IJA and RJA

measures, indicating that frequency measures of IJA and RJA skills, in part reflect a common or single source of variance, leading to deficits in both skill areas. This is inconsistent with previous research of typically developing and at-risk children, which did not find correlations between IJA and RJA (Mundy & Hogan, 1994; Mundy et al., 1992; Mundy & Neal, 2000; Vaughn et al., 2003). Thus, the joint attention deficit seen in children with autism may share a common source of variance. While this is only one study with a small sample, this finding may raise questions for theory and research on joint attention in typical and atypical development because many recent paradigms and theoretical arguments regard initiating and responding to joint attention as distinct processes.

Changes over time in social communication abilities were also assessed in the third hypothesis. This study showed that responding to joint attention skills and responding to requesting improve significantly across the preschool years. Additionally, there was an improvement in initiation of joint attention between baseline and 12 month follow up, although no additional benefit in skill development between the 12 and 24 month assessment was found.

Fourthly, associations between ESCS variables and cognitive, adaptive, and behavioural skills, as well as autism symptoms, were made at each testing point. It was hypothesized that joint attention would be positively correlated with cognitive and adaptive skills, while autism symptoms and behavioural difficulties would be negatively correlated with joint attention. These predictions were partially supported: at the baseline assessment, initiating joint attention and responding to joint attention correlated only with adaptive behaviour skills and not cognitive abilities. With regards to behaviour, only responding to joint attention was associated with mother reported autism symptoms on the Autism Screening Questionnaire (ASQ). At the 12 month follow up, both initiating and responding to joint attention were correlated with all of the child outcome variables, including adaptive and cognitive skills. This time, only initiating joint attention was associated with autism symptomology, while responding to joint attention lost significance over time. Finally, at the 24 month follow up assessments, initiating and responding to joint attention remained positively correlated with child outcome variables. Parent report variables also gained significance: initiating joint attention was associated with mother and father report of autism symptoms and father reported behavioural problems, while

responding to joint attention correlated only with father report of behavioural issues. Thus, positive associations between child joint attention characteristics and cognitive and adaptive skills increase over time and were stable between the ages of 3 and 4 years of age in this sample of children. Also, by their 5th birthday, parent report of the preponderance of autism symptoms ad problem behaviour was negatively correlated with the amount of joint attention skills displayed by these children.

The final hypothesis investigated in this study was that joint attention skills at the baseline assessment would predict 24 month follow up cognitive, behaviour, and language measures, even after removing the variance accounted for by the baseline assessment of these skills. Among the ESCS measures administered at baseline, initiating and responding to joint attention were associated with 24 month mental age and IQ. Thus, the more able the children were developmentally and cognitively, the better able they were to initiate joint attention bids, and respond to the bids of others. Furthermore, joint attention skills measured at baseline were able to predict IQ and mental age at the 24 month follow up, above and beyond the variance associated with these factors at baseline. Early social communication abilities also predicted self help skills, with responding to joint attention and behaviour regulation being associated with later self help skills. Being able to respond to others' bids for attention, as well as request assistance, seemed to correspond to the development of more enhanced self help skills.

The present findings extend those of previous studies by examining longitudinal associations between early social communication skills and later cognitive, adaptive behaviour, and language outcome in a group of preschool aged children with autism. Consistent with Ulvund and Smith (1996), joint attention was related to measured intelligence. However, inconsistent with previous reports (e.g., Charman et al., 2003; Mundy et al., 1990; Sigman & Ruskin, 1999) which have found the greatest number of associations between joint attention and language skills, the only ESCS variable to reach significance in its association with the ability to access the Reynell Comprehension and Expressive scales in this sample was responding to behavioural requests. However, given the use of the new version of the Reynell which has significant floor effects for young children with autism, many of whom are non-verbal and

non-communicative, these results may not be reliable. Consequently, the generalizability of these results may be limited due to those children who were able to access the measure. Five children who participated in the original SCAmP study did not complete the ESCS measure due to inattention, behavioural, or other difficulties that have not been identified. This systematic difference between those who were able and those who were unable to complete the ESCS may limit any conclusions drawn from the data to those children who could access the test.

Finally it is important to highlight the issue of power in these analyses. The sample sizes, while relatively good for a study of children with developmental disabilities, are nonetheless small for the amount of analyses conducted and ability to detect significant results in the data. These limitations must be kept in mind while reviewing the data, and will be discussed in greater detail in the final discussion chapter.

6. DOES EARLY INTENSIVE BEHAVIOURAL INTERVENTION (EIBI) AFFECT THE DEVELOPMENT OF JOINT ATTENTION AND SOCIAL COMMUNICATION IN CHILDREN WITH AUTISM?

6.1 CHAPTER AIMS

This chapter reports on the comparison of early social communication skills in a preschool aged group of children with autism who received two years of early intensive behavioural intervention, with a group of children who received Local Educational Authority (LEA) provision treatment as usual (see Chapter 5). This study provides the opportunity to test some of the theories discussed in Chapter 3: namely the effects of early intensive behavioural intervention on the development of joint attention. Additionally, a test of the core hypothesis of this thesis will be conducted: early intensive behavioural intervention is hypothesized to promote and increase the development of the initiation and response to joint attention in an early Intervention group relative to a treatment as usual Comparison group. Group comparisons will be made to identify whether, after two years of early intervention delivered within a social context, the Intervention group displayed better joint attention and social communication skills than their peers. Following, patterns in joint attention development will be analysed at the individual level. A final analysis will then be conducted to identify whether joint attention is a pivotal skill in autism and mediates the effects of intervention on IQ. If joint attention is indeed a pivotal skill, change in this area will be a necessary precursor to any observable intervention effects.

6.2 METHOD

6.2.1 DESIGN AND DATA ANALYSIS STRATEGY

Chapter 5 focused on the associations between developmental and ESCS variables across the preschool years in a group of children with autism receiving local educational authority treatment as usual. The present chapter is concerned with identifying any group differences between those Comparison children, and a second group of Intervention children who received early intensive behavioural intervention. To test for any group differences, the ESCS data were first analysed with a repeated measures ANOVA with a between subject variable of Group, and

a repeated measures factor of ESCS variables over time. Any significant group interactions suggest that one group is performing differently from the other over time. However, because children were not randomly allocated group membership, a more conservative approach was also taken to analyse the data. In these analyses of covariance (ANCOVA), the variance associated with the children's baseline score on the individual measures was removed. Additionally, chronological age was also covaried for any ESCS variable that was correlated CA at baseline. For these analyses a main effect would suggest that there are significant differences between the Intervention and the Comparison Groups at the 12 and 24 month follow ups. If there are no early social communication skill differences between the Intervention and Comparison groups, we will fail to see any group differences.

6.2.2 PARTICIPANTS

The participant characteristics for the children in the ABA Intervention and the Comparison groups are shown in Table 6.1. The measures and procedures used to collect the outcome data were the same as those discussed in Chapters 4 and 5. T-tests did not identify any statistically significant differences between the Intervention and Comparison groups on any of the outcome measures at baseline.

		Baseline		12 Month Follow Up		24 Month Follow Up	
		ABA (n = 21)	Comp (n=16)	ABA (n = 21)	Comp (n=16)	ABA (n = 21)	Comp (n=16)
CA	Mean	35.8	36.6	49.0	50.1	61.6	62.4
	SD	4.1	4.3	4.1	4.9	4.3	5.3
	Range	28 – 44	28 – 45	42 – 59	40 – 58	54 – 71	51 – 72
MA	Mean	21.9	22.6	33.2	30.7	43.8	39.2
	SD	6.8	6.8	10.5	10.2	16.6	17.9
	Range	9 – 35	9 - 35	16 – 50	13 – 51	19 – 73	14 - 80
IQ	Mean	60.7	61.7	67.5	61.2	71.8	62.6
	SD	16.5	17.4	20.9	20.0	27.3	27.6
	Range	30 – 87	30 - 89	33 – 107	27 – 95	31 – 120	22 - 119
VABS Total (Raw)	Mean (raw) SD (raw) Range	59.8 (115.1) 5.9 (27.1) 49 – 74 (76 – 203)	58.5 (113.0) 6.6 (28.0) 49 – 74 (74 – 203)	62.5 (168.4) 12.8(49.6) 45 - 94 (94 - 284)	58.1 (146.8) 11.8(50.1) 47 – 84 (83 – 240)	61.4 (201.8) 15.8(64.3) 40 - 92 (106-326)	54.9 (182.3) 12.2(61.5) 42 – 83 (97 – 292)
VABS Communication (Raw)	Mean (raw) SD (raw) Range (raw)	61.2 (23.8) 7.8 (12.2) 52 – 79 (9 - 51)	60.1 (22.8) 8.7 (11.9) 50 – 81 (7 – 51)	66.7 (42.8) 25.0(23.7) 45 - 82 (19 – 75)	58.0 (33.9) 11.8(18.6) 47 – 89 (9 – 67)	67.7 (55.6) 25.0(23.7) 30 - 11 (20 - 91)	60.8 (46.3) 19.6(24.1) 42–110 (12 – 95)
VABS Daily Living (Raw)	Mean (raw) SD (raw) Range (raw)	62.8 (23.7) 5.2 (7.6) 53 - 74 (14 - 49)	62.0 (23.8) 6.3 (8.6) 53 - 85 (11 – 50)	62.2 (38.3) 9.4 (14.4) 45 - 82 (19 - 75)	58.6 (33.4) 9.7 (15.7) 47 – 77 (14 – 66)	59.2 (49.8)12.0 (17.0) 38 – 85 (22 – 92)	53.6 (43.8) 12.5(18.1) 36 – 82 (21 – 80)
VABS Socialization (Raw)	Mean (raw) SD (raw) Range (raw)	62.6 (29.0) 6.6 (6.6) 52 – 77 (14 – 47)	61.5 (23.8) 7.5 (7.1) 52 - 87(14 - 51)	64.0 (38.0) 11.5(13.0) 51 – 95 (20 – 71)	60.3 (34.6) 10.5(11.8) 52 – 85 (21 – 60)	64.3 (43.6) 14.6(16.6) 50 – 92 (21 – 77)	60.9 (42.3) 13.5(14.8) 39 – 91 (21 – 71)
VABS Motor (Raw)	Mean (raw) SD (raw) Range	73.2 (37.6) 11.2 (6.6) 52 – 94 (24 – 56)	70.3 (37.4) 10.9 (6.0) 52 - 94 (24 – 56)	71.7 (48.6) 14.4 (7.0) 50 – 98 (35 – 64)	64.4 (44.8) 12.7 (8.1) 52 – 96 (27 – 95)	65.6 (54.0) 17.1 (9.4) 50 – 108 (37 – 70)	59.6 (49.9) 11.9 (7.8) 48 – 93 (40 – 65)
Reynell Comprehension (Raw)	Accessing Test (n) Mean SD Range	19% (4) 3.0 6.7 0 - 20	19% (7) 2.7 6.0 0 - 20	81% (17) 19.1 17.0 0 - 46	63% (10) 15.1 15.6 0 - 53	90% (19) 30.6 19.7 0 - 56	63% (10) 22.3 20.5 0 – 56
Reynell Expressive (Raw)	Accessing Test (n) Mean SD Range	10% (2) 0.9 2.9 0 - 10	8% (3) 0.8 2.7 0 - 10	71% (15) 9.4 7.8 0 - 22	44% (7) 22.3 20.5 0 - 56	90% (19) 17.1 12.9 0 - 41	56% (9) 12.4 13.3 0 - 43

Table 6.1: Characteristics of the Intervention and Comparison Groups

6.2.3 CHILD INTERVENTIONS AND SCHOOLING FOR THE INTERVENTION GROUP

All of the children in the Intervention group received Applied Behaviour Analysis (ABA) based therapy for approximately two years. One child switched to an ABA school after 18 months of a home programme; the rest of the children received instruction at home. On average, children received 25.6 hours per week (SD = 4.8, range = 18.4 – 34.0) of one-to-one ABA based tuition, delivered by trained tutors and parents. Thirteen of the 21 programmes were run by the Southampton Childhood Autism Programme (SCAmP). The remainder were delivered through other UK service providers: four were run through PEACh, a parent charity, one through London Early Autism Programme (LEAP), one through UK-Young Autism Programme (UK-YAP), and one through East Sussex LEA using outsourced LEA employed supervision and consultancy. One child spent nine months with PEACh, nine months with a private consultant, and six months in an ABA school.

None of the children in the ABA Intervention group were attending school at their baseline assessment. By their 12 month assessment, twelve children were at school on a part time basis while nine continued solely with home tuition. At the 24 month assessment, all but one were attending school for some portion of the week. At the 12 month assessment, 57 % of children (12) were in a mainstream environment for an average of 5.9 hours per week, and the remaining nine children received only home based early intervention. By their 24 month assessment, 71% (15 children) were in mainstream school and 24% (4) were in a special needs school. One child continued with home based intervention as his sole educational setting. Because all of the children were simultaneously running home programmes and attending school, school hours were somewhat lower than those of the comparison children at the 12 and 24 month follow up assessments.

Speech Therapy: Apart from early intervention and schooling, many children in the Intervention group also received speech therapy provided by a speech and language pathologist with 62% of children accessing these services at the baseline assessment, 24% at the 12 month follow-up, and 24% at the 24 month follow up.

TEACCH: The Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) programme uses work stations, visual schedules and timetables to help support the learning process of children with autism. Parents reported usage of TEACCH principles (43% at the 12 month follow up, dropping to 24% at the 24 month follow up).

Alternative Communication Systems: The most frequently reported alternative communication systems used for nonverbal children with autism were the Picture Exchange Communication System (PECS) and Makaton signs. PECS involves the use of symbol cards exchanged between children and caregivers to communicate requests whereas Makaton is a signed system of language. These symptoms were used in conjunction with the child's intervention programme. PECS was used for 43% of the sample at the 12 month follow up and 19% at the 24 month follow up, while and Sign Language or Makaton communication systems were in use for 48% of the sample at the 12 month follow up and 33% at the 24 month follow up. While PECS and signs may have formed part of an ABA programme, it is likely that the frequency of alternative language communication systems usage reduced over time as the children receiving early intervention were more likely to acquire spoken language systems.

Dietary Interventions: Dietary interventions (typically gluten and casein restrictions) were also commonly reported. These were also significantly more prevalent in the Intervention than the Comparison group with 52% (11) children having had dietary restrictions at baseline, χ^2 (1) = 4.37; $p < .05$; 67% (14) at their 12 month follow up, χ^2 (1) = 8.40, $p < 005$; and 57% (12) of children at their 24 month follow up χ^2 (1) =3.42, $p = .065$. However, t-tests revealed no group differences between the children in the Intervention group who were on restriction diets, as compared to those who were not on diets, on any of the outcome variables.

Parents also reported the use of medication and homeopathic interventions (see Table 6.2 for details).

	ABA Baseline Assessment (Time 1)	Comp Baseline Assessment (Time 1)	ABA 12 Month Follow Up (Time 2)	Comp 12 Month Follow Up (Time 2)	ABA 24 Month Follow Up (Time 3)	Comp 24 Month Follow Up (Time 3)
School Placement	n/a	n/a	Mainstream: 57% (12) Home Tuition 43% (9)	Mainstream: 37.5% (6) Special Needs: 50% (8) Combination : 12.5%(2)	Mainstream: 71% (15) Special Needs: 24% (5) Home Tuition 5 % (1)	Mainstream: 50% (8) Special Needs: 50% (8)
Hours Spent in School Placements	n/a	n/a	Mainstream: 5.9	Mainstream: 13.92 Special Needs: 15.75 Combination : 14.75	Mainstream: 16.7 Special Needs: 9.2	Mainstream: 24.06 Special Needs: 24.5
Speech Therapy	62% (13)	56% (9)	24% (5)	75% (12)	24% (5)	50% (8)
PECS	n/a	n/a	43% (9)	69% (11)	19% (4)	75% (12)
Signs/ Makaton	n/a	n/a	48% (10)	24% (4)	33% (7)	50% (8)
TEACCH	n/a	n/a	10% (2)	44% (7)	14% (3)	50% (8)
Sensory Integration	0	6% (1)	0	13% (2)	10% (2)	19% (3)
Dietary Intervention	52% (11)	19% (3)	67% (14)	19%(3)	57% (12)	31% (5)
Routine Prescription	5% (1)	6% (1)	19% (4)	25% (4)	5% (1)	25% (4)
Vitamin Therapy	29% (6)	n/a	43% (9)	19% (3)	43% (6)	31% (5)

Table 6.2 Schooling and Supplementary Interventions for Comparison Children

6.3 PROCEDURE

6.3.1 MEASURES

The measures used for the Intervention group are the same as those used for the Comparison group. Specific details regarding the measurement and recruitment procedures can be found in Chapters 4 and 5, respectively.

6.3.2 HYPOTHESES

The analyses presented in this chapter were designed to assess whether a two year intensive early intervention programme would lead to a positive effect on the development of joint attention and social communication in young children with autism. The aim for the children was to develop a repertoire of functional behaviour in terms of their cognitive, linguistic, daily living and socialization skills that may not have been acquired without the therapy. Additionally, because the intervention was provided regularly, intensely and delivered within a social interaction framework, it was predicted that it would ameliorate the neurodevelopmental disturbance linked to attenuated social interaction in the early years of life (see Chapter 3 for further discussion) (Mundy, 1995; Mundy & Crowson, 1997). Therefore, it was predicted that, as a result of their individualised and intensive therapeutic and educational history, the children in the Intervention group would have significantly greater levels of joint attention and social communication skills than the children in the Comparison group, whose data were presented in Chapter 5. Finally, it was also hypothesised that if children in the Intervention group were making significantly greater changes with regards to their joint attention skills, then those joint attention abilities may be driving the cognitive effects of the intervention.

6.4 RESULTS

The results section will be presented in the following format: 1. Descriptive statistics of ESCS variables will be presented, 2. Analysis of Variance and Covariance (ANOVA, ANCOVA), along with non-parametric tests for variables with non-normal distributions, will be presented to identify if, at the group level, children in the Intervention group had better developed joint attention and social communication skills than those in the Comparison group, 3. Reliable Change

Index (RCI; Jacobson & Truax, 1991) data will be presented to graphically look for patterns of joint attention change at the individual level, and 4) a mediation analysis will be presented to identify whether changes in joint attention skills drove cognitive improvements for the Intervention children.

The Descriptive Statistics for ESCS variables are presented in Table 6.3. The only baseline variable that was significantly different between the groups was initiating behavioural regulation (IBR), with the Comparison group initiating a larger number of behavioural requests; $t = -2.48$, $df = 35$, $p < .05$.

ESCS Variables		ABA Time 1 (n = 21) (Baseline)	Comp Time 1 (n = 16) (Baseline)	ABA Time 2 (n = 21) (12 month follow up)	Comp Time 2 (n = 16) (12 month follow up)	ABA Time 3 (n = 21) (24 month follow up)	Comp Time 3 (n = 16) (24 month follow up)
Total Initiating Joint Attention	Mean SD Range	3.3 4.4 0 - 18	3.6 4.9 0 - 14	7.7 7.5 0 – 20	6.2 8.8 0 – 30	11.8 9.4 0 - 31	11.2 13.9 2 - 50
Total Responding to Joint Attention	Mean SD Range	5.3 3.6 0 - 14	5.9 3.9 0 - 12	9.0 4.2 0 – 14	7.1 5.2 1 – 14	11.3 3.5 2 - 14	10.1 5.0 1 - 14
Total Initiating Behaviour Regulation	Mean SD Range	7.1 5.3 1 – 21	14.7 12.8 1 – 51	10.1 4.9 0 – 17	11.5 6.4 0 – 24	9.5 4.8 1 - 20	11.9 4.7 4 - 16
Responding to BR (percent Correct)	Mean SD Range	57.2% 36.3 0 – 100	46.2% 44.7 0 – 100	86.0% 24.3 17 - 100	78.6% 28.1 0 – 100	96.4% 6.9 76 - 100	88.1% 23.3 10 - 100
Initiating Social Interaction	Mean SD Range	0.0 0.0 0 – 0	0.2 0.5 0 – 2	1.0 0.8 0 – 2	1.0 0.9 0 – 2	0.9 0.8 0 - 2	1.3 0.8 0 - 2
Responding to Social Interaction	Mean SD Range	9.1 8.8 0 – 31	10.9 6.4 0 – 20	12.0 8.9 0 - 27	13.2 8.3 2 – 33	13.8 10.0 0 - 33	14.6 9.1 4 - 31

Table 6.3 Descriptive Statistics of Early Social Communication Scales (ESCS)

6.4.1 TESTING FOR NORMALITY OF DISTRIBUTIONS

The Kolmogorov-Smirnov Test for goodness-of-fit was used to check for normality of distribution for the ESCS variables at all three assessment time points for the Intervention group. Significant Kolmogorov-Smirnov Z statistics for particular variables would indicate that the sample had not been drawn from the normal distribution, thus indicating that non-parametric tests would be required to analyse any further data. For the Intervention group, two variables met significance: These variables were Responding to Behavioural Regulation (RBR) at the 12 month follow up, Kolmogorov-Smirnov $Z = 1.51$; $p < 05$, and at the 24 month follow up assessment, Kolmogorov-Smirnov $Z = 1.89$; $p < .01$. This non-normal distribution of data occurred because the majority of children on intervention programmes in this sample were able to respond to behavioural requests with greater accuracy by their 12 and 24 month follow ups. In subsequent analyses, RBR variables were treated with non-parametric statistical methods.

6.4.2 TESTING FOR ESCS GROUP DIFFERENCES AT BASELINE

Two children from the original SCAmP Intervention group (S1 and S2) did not participate in this ESCS study. S1 did not participate as his parents refused permission for him to be videotaped and S2 did not participate owing to inattention factors. As the number of non participating children is too few to conduct formal statistical analyses (e.g., Mann Whitney tests), the means and standard deviations of baseline child variables are presented in Table 6.4 for the group of children who completed the ESCS. To categorize any differences between the two children in the SCAmP Intervention group who did not partake in the ESCS study, scores that were one standard deviation from the mean of the ESCS group are highlighted. Table 6.1 shows that the two children who did not participate in the ESCS study did not differ to any great degree from the mean level in the ESCS group, and scores were never more than one standard deviation above the group mean score. Where there were differences, the child who did not participate has a better or higher, rather than a lower score, than the mean ESCS group score.

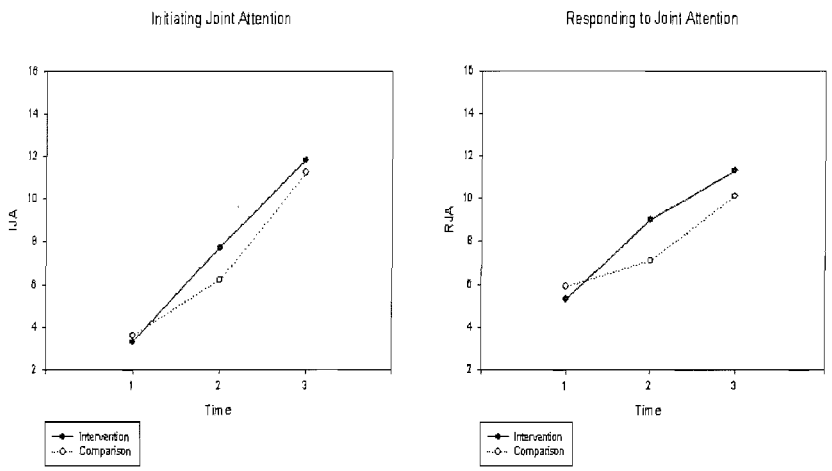
Variable		S1	S2
	Mean (SD)	Score	Score
CA	35.8 (4.1)	34	36
MA	21.9 (6.8)	29 (+ 1 SD)	19
IQ	60.7 (16.5)	85 (+ 1 SD)	53
VABS Standard Total	59.8 (5.9)	64	65
VABS Standard Communication	61.2 (7.8)	62	68
VABS Standard Daily Living	62.8 (5.2)	73 (+ 1 SD)	64
VABS Standard Socialization	62.6 (6.6)	69	73 (+ 1 SD)
VABS Standard Motor	73.2 (11.2)	72	78
VABS Raw Total	113.4 (27.7)	123	135
VABS Raw Communication	23.2 (11.7)	22	32
VABS Raw Daily Living	23.7 (7.6)	32 (+ 1 SD)	25
VABS Raw Socialization	29.0 (6.6)	34	38 (+ 1 SD)
VABS Raw Motor	37.6 (6.6)	35	40

Note: S1 and S2 refer to the two non-participating children in this study

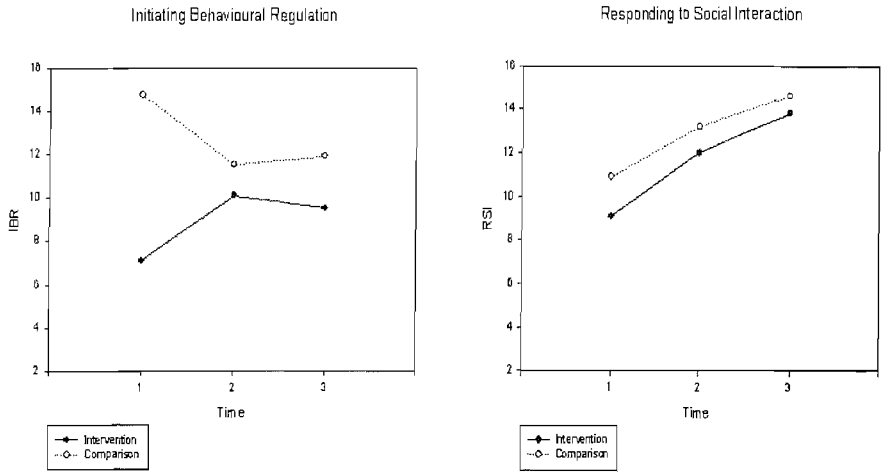
Table 6.4 **Mean and Standard Deviations of Intervention Group (n = 21) Versus Two Non-Participating Children**

6.4.3 ANALYSIS OF VARIANCE

The group design of this study was centred on the hypothesis that children who, in the preschool years, had two years of early intensive behavioural intervention, tailored to their individual needs and delivered by trained tutors would have significantly more advanced joint attention and social communication skills. With the exception of Initiation of Behavioural Regulation (IBR), these repeated measures analyses of variance revealed no significant interaction effects: The children who had undergone 24 months of intensive intervention had no better joint attention and social communication skills than their peers who were receiving predominantly unstructured, non-intensive, LEA provision. Regarding IBR, a marginally significant interaction result was found for the Comparison group, indicating that they may have better developed abilities to initiate requests than their peers who received ABA. However, the cause of the interaction effect may more likely be due to the seven point discrepancy in means between the Intervention and Comparison groups at baseline. Graphical representations of the repeated measures analysis of variance can be found in Figure 6.1.



IJA: F (1.51, 52.56) = 0.20; p = 0.82 RJA: F (2, 70) = 1.96; p = .15



*IBR: F (1.62, 56.70) = 2.98; p = .057 RSI: F (2, 70) = 2.19; p = .94

Figure 6.1: Graphical Representations of ESCS Variables for Repeated Measures Analysis of Variance.

Non-parametric tests were used to identify any changes in Responding to Behavioural Regulation (RBR) and Initiation of Social Interaction (ISI) as these two variables were found to have non-normal distributions of data for either the Intervention or the Comparison group. Mann-Whitney tests were used to look at group differences on these variables at each time point. Thus, no significant group differences at baseline were predicted, with emerging differences between groups at the 12 and 24 month follow ups. At Baseline, the intervention children showed the same frequency of joint attention behaviours as the comparison children. For Responding to Behavioural Regulation (RBR), a trend towards significant was found in favour of the Intervention group for the 12 month follow up, Mann Whitney U = 112.00; p = .086, and a statistically significant result for the 24 month follow up, Mann Whitney U = 80.5; p < .01. No significant group differences were found for Initiation of Social Interaction (ISI).

6.4.4 ANALYSIS OF COVARIANCE

When the variance associated with baseline scores was controlled in an analysis of covariance (ANCOVA), Responding to Joint Attention (RJA) was the only social communication variable to achieve significance. Children in the Intervention group at 12 and 24 months were better able to respond to the joint attention bids of others, relative to the children in the Comparison group, F (1,

34) = 4.15; $p < .05$. As children were not randomly assigned to groups, and chronological age (CA) was correlated with some of the ESCS variables, additional ANCOVAS were conducted where both baseline score on the variable and CA were controlled for. With CA controlled for, RJA showed a trend towards significance, $F(1, 34) = 3.55$, $p = .068$. All of the other ESCS variables remained non-significant.

ESCS Variables		ABA (n = 21)	Comparison (n = 16)	Baseline Score Covaried		Baseline and CA Covaried	
				F	P	F	P
Total Initiating Joint Attention	12 month follow up	7.82	6.04	0.22	0.64	.20	.66
	24 month follow up	11.87	11.04				
Total Responding to Joint Attention	12 month follow up	9.19	6.82	4.15	.049*	3.55	.068
	24 month follow up	11.44	9.86				
Total Initiating Behaviour Regulation	12 month follow up	10.87	10.55	0.19	0.66	.13	.72
	24 month follow up	9.85	11.44				
Responding to BR (percent Correct)	12 month follow up	85.10	79.74	1.09	0.31	1.71	.20
	24 month follow up	96.28	88.32				
Responding to Social Interaction	12 month follow up	12.38	12.63	0.001	0.97	.00	.99
	24 month follow up	14.35	13.92				

Table 6.5 Adjusted Means for the Analysis of Covariance

6.4.5 ANALYSIS OF INDIVIDUAL CHANGES

As responding to joint attention was the only ESCS variable with some evidence of change as a result of intervention, comparisons were made to identify whether there was an association between good progress across two years, and ESCS scores. As the data reported in the preceding sections were at the group level,

important individual variability and changes may have been masked. To explore these data at the level of the child, the Reliable Change Index (RCI) was used (Jacobson & Truax, 1991). The reliable change index is a statistic that identifies whether an individual's follow up score has changed sufficiently from his or her initial score in that the change cannot be accounted by external factors such as measurement error. This formula allows one to identify whether changes that occurred over the course of time or an intervention exceeded a threshold that allowed factors such as measurement error or chance to be confidently dismissed. This threshold is a function of the initial standard deviation of the measure used to assess change, and its reliability. The formula to calculate reliable change is:

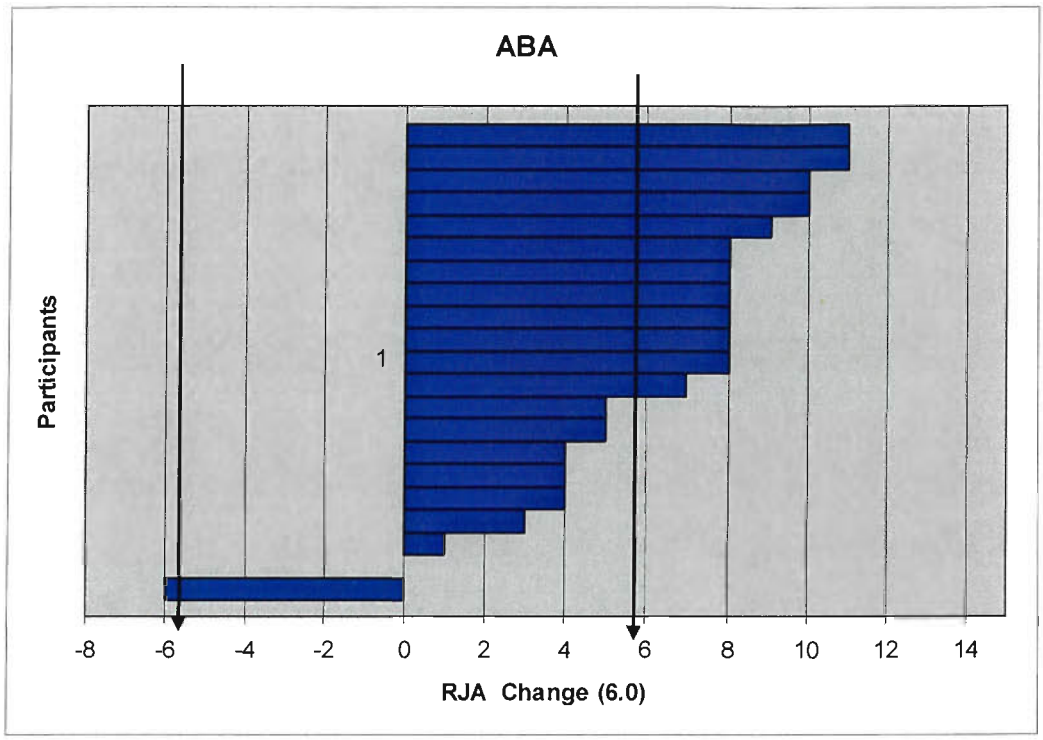
$$RC = \frac{X1 - X2}{Sdiff}$$

where X1 is the subject's pretest score, X2 is the subject's post test score, and Sdiff is calculated from the standard error of measurement:

$$Sdiff = \sqrt{2(S_E)^2}$$

6.4.6 RESPONDING TO JOINT ATTENTION RELIABLE CHANGE SCORES

Responding to joint attention was entered into a reliable change analysis. Based on the data, children had to have gained six points on the responding to joint attention (RJA) measure over the course of two years to cross the threshold for reliable change (Please see Appendix C for detailed working of the formula). In the Analysis of Covariance (ANCOVA), RJA was found to have increased significantly over time for the Intervention group. The individual graphs show how the group results were achieved. Twelve children in the Intervention group met criteria for reliable change, while only six children in the Comparison group met the threshold to qualify for reliable change (see Figure 6.2).



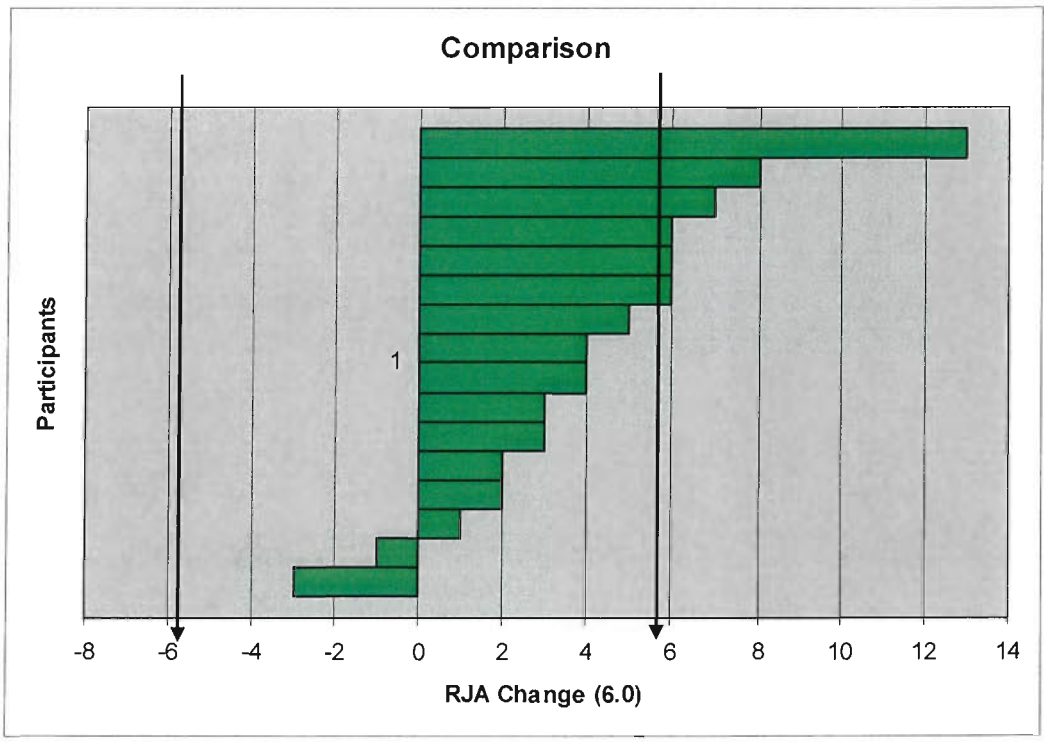


Figure 6.2 **Responding to Joint Attention Reliable Change Index Analysis**

6.4.7 IQ CHANGE

In the SCAmP Early Intervention study, a strong main effect of Group for IQ was found for a 2 x 2 ANCOVA model where baseline score was covaried and the dependent variable was outcome at 24 months. Children in the Intervention group (n = 23) had significantly higher IQ scores relative to their peers in the Comparison group (n = 21), F (1, 41) = 7.72, p = .008 (Remington et al., submitted). This finding remained significant for the children participating in the ESCS study: children in the Intervention group (n = 21) had significantly higher IQ scores than the children in the Comparison group (n = 16), F (1, 34) = 4.71, p = .037. Following from this, IQ was also used to identify individual children who changed reliably. IQ is a popularly used statistic to measure change in intervention studies with children with autism as it is typically derived through a standardized measure. Based on the data in this sample, children who achieved IQ change scores of 22.0 points or greater could be said to have IQs that changed "reliably" (Please see Appendix C for a detailed working of the formula). As can be seen by the graphs, five children in the Intervention group achieved reliable change scores above 22 points, whereas only two children in the Comparison group changed reliably. Moreover, the vast majority of children's scores increased over time in this group. None of the children in the Intervention group lost enough IQ points to suggest a reliable deterioration. Conversely, two children in the Comparison group regressed in IQ to a reliable level, and more children in this group appear to be losing IQ points over time than gaining IQ points.

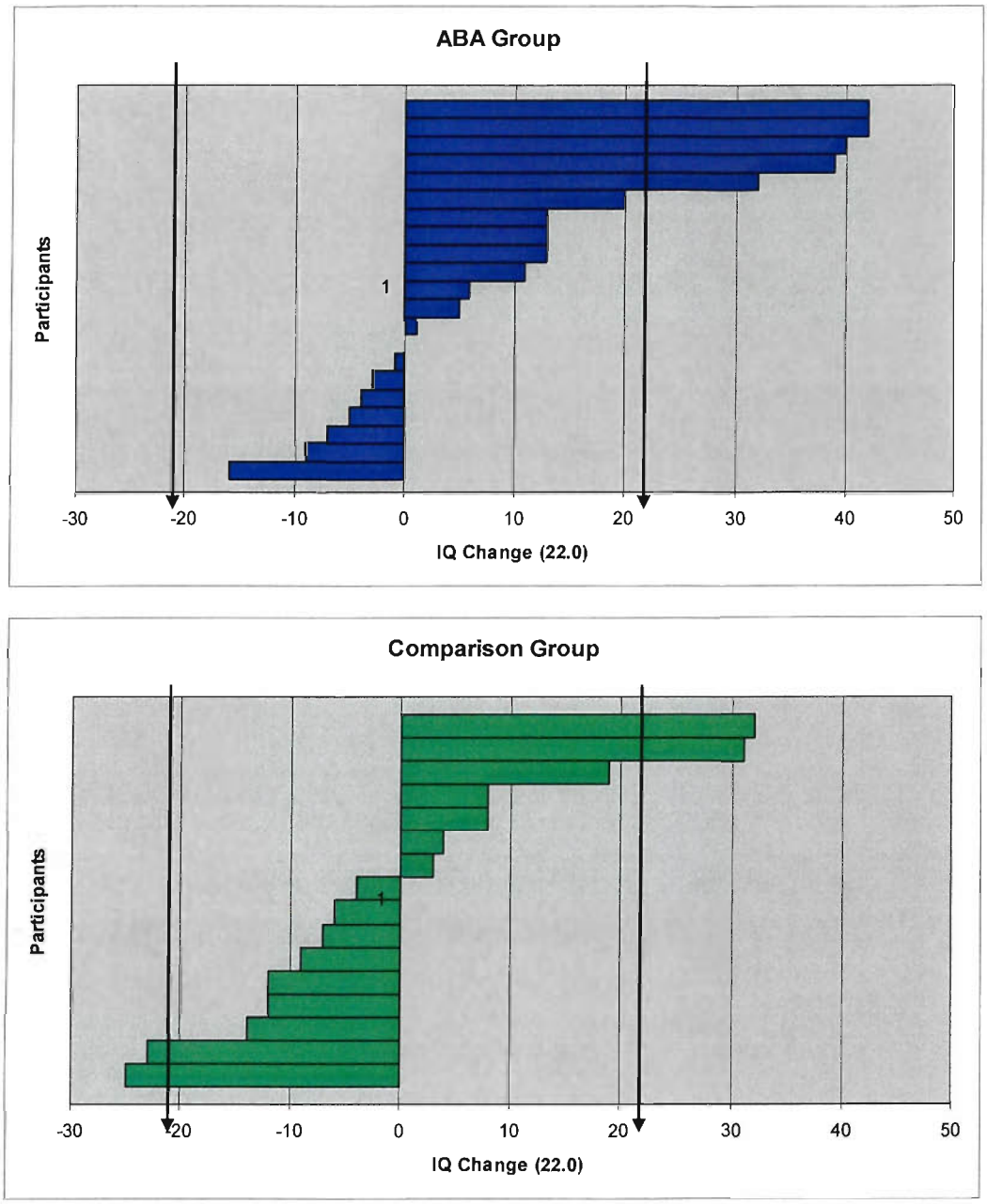


Figure 6.3 **Reliable Change Index for IQ Scores**

6.4.8 ARE GAINS IN IQ ASSOCIATED WITH GAINS IN JOINT ATTENTION?

Tables were created to identify whether those children whose increases in IQ were also the ones who's initiating and responding to joint attention skills increased. At the group level, the Intervention children showed no significant correlations between IQ change and IJA or RJA change. A significant correlation was found between IQ change and IJA change for the Comparison group however, $r\ (16) = 0.59, p < .05$. There were no significant associations between RJA change and IQ change for the Comparison group (See Table 6.6).

	Intervention Group	**Comparison Group**
	IQ Change	**IQ Change**
IJA Change	.07	.59*
RJA Change	.12	.09

Note: * = significant at the p < .05 level;

Table 6.6 Correlations between IQ change and IJA and RJA Change

Analysing the data in Tables 6.7 and 6.8 using a 3 x 3 chi squared statistical analysis was considered because, in principle, the data fit in a 3 x 3 matrix. However, the cell values are small with some zero scores, and thus would violate the assumptions of the chi square. While cell categories are sometimes combined to increase the cell value for chi square analyses, this was not possible for these data. 'No Change' and regression of IQ scores are conceptually different categories with very different meanings. To maintain an IQ score across two years, one would have to continue to develop cognitively. Conversely, a drop in scores would indicate that the person has failed to develop, or that any cognitive development made was not sufficient to maintain a score across time.

However, another way of analysing these data as to drop the 'No Change' category from analysis and conduct a 2 x 2 Fisher Exact test to identify whether any statistically significant changes existed between the two groups. For the IQ x IJA and IQ x RJA analyses only two children were removed from the Intervention group, and no children were removed from the Comparison group. These analyses showed that no statistically significant relationships exist for this

sample between children who made IQ positive or regressive IQ change and those who made positive or regressive IJA (Intervention Group: Fisher Exact = 21.81, p = .43; Comparison Group: Fisher Exact = 26.98, p = .35), or RJA change (Intervention Group: Fisher Exact = 25.45, p = .45; Comparison Group: Fisher Exact = 16.07, p = .20).

Descriptively, at the individual level, three of the five reliable IQ changers in the Intervention group also made reliable IJA change. However, the two children in the Comparison group who made reliable IQ change did not also make reliable IJA change (see Table 6.7 for the association between IQ and IJA or RJA Change for the full sample). When looking at the combined changes between IQ and RJA, four of the five children in the ABA Intervention group who had reliable change for IQ also had reliable RJA change. Neither of the two children who made reliable IQ change in the Comparison group also made reliable RJA change (see Table 6.8 for the associations between IQ and IJA and RJA Change for full sample).

Intervention Group

		IQ		
		Regression of Scores	No Change[4]	Positive Change
Initiating Joint Attention	Regression of Scores	1	0	1
	No Change	1	0	0
	Positive Change	5	1	12

Comparison Group

		IQ		
		Regression of Scores	No Change	Positive Change
Initiating Joint Attention	Regression of Scores	2	0	1
	No Change	0	0	0
	Positive Change	7	0	6

Table 6.7 Associations between IQ Change and IJA Change

[4] No Change is defined as maintaining an IQ score across time and thus, an actual change of 0 IQ or joint attention points over time.

Intervention Group

		IQ		
		Regression of Scores	No Change	Positive Change
Responding to Joint Attention	Regression of Scores	0	0	1
	No Change	1	0	0
	Positive Change	6	1	12

Comparison Group

		IQ		
		Regression of Scores	No Change	Positive Change
Responding to Joint Attention	Regression of Scores	0	0	2
	No Change	0	0	0
	Positive Change	9	0	5

Table 6.8 Associations between IQ Change and RJA Change

6.5 A TEST OF THE PIVOTAL SKILLS HYPOTHESIS

As responding to joint attention increased significantly over time in the analysis of covariance in the Intervention group, a final analysis was conducted to address the causal point of whether changes in IQ were driven by changes in RJA over time. The hypothesis was that responding to joint attention may be mediating the intervention effects in the ABA programme. This model suggests that intervention has a primary effect on the ability to respond to joint attention, and following this, on IQ and other developmental areas.

A mediating relationship requires one variable to causally affect the relationship between two other variables. In this case, responding to joint attention may mediate the relationship between intervention effects and IQ change. Baron and Kenny (1986) propose several requirements that must be met before a mediating relationship may be concluded. See Figure 6.4.

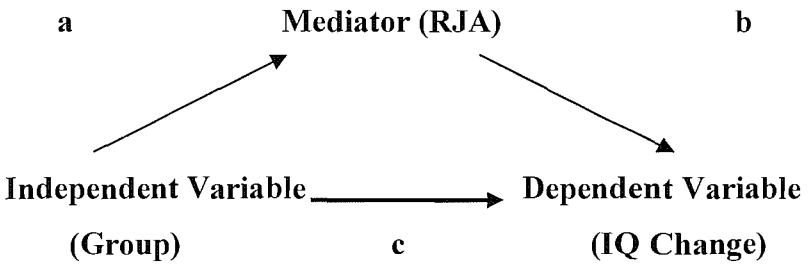


Figure 6.4 The Mediating Relationship

For these data, the independent variable refers to the Group status (Intervention versus Comparison), the dependent variable is the change in IQ after 24 months, and the mediating variable would potentially be responding to joint attention. Baron and Kenny (1986) argued that to claim a mediating relationship, a significant relationship between the independent variable and the mediator must be shown (if the mediator is not associated with the dependent variable, then it would be unable to mediate anything). This was supported: children in the Intervention group achieved greater frequencies of responding to joint attention behaviours than their peers in the Comparison group ($F(1, 41) = 4.15$, $p < .05$). Secondly, a relationship between the mediator and the dependent variable should be shown. This was not supported by a correlation between RJA change and IQ change, $r(37) = .18$, $p = .30$. Thirdly, a relationship between the independent and the dependent variable must be present. This was shown as the Intervention group achieved higher IQ scores at the 24 month follow up relative to the children in the Comparison group, $F(1, 41) = 7.72$, $p = .008$ (Remington et al., submitted). The final step consists of demonstrating that when the mediator (RJA) and the independent variable (Group) are used simultaneously to predict the dependent variable (IQ), the previously significant path between the independent and dependent variables is insignificant or greatly reduced.

To analyse these data, two separate one-way ANCOVAs were conducted; one was used to compare 12 months scores, and the second for 24 month follow up IQ. In each ANCOVA model, baseline IQ and the change in RJA from baseline to 12, or baseline to 24 month follow up were controlled for. In these analyses, IQ at either 12 or 24 months was the dependent variable, while baseline IQ and either RJA change from baseline to 12, or baseline to 24 months (depending on which time point was being analysed), was covaried. If changes in responding to joint attention drove changes in IQ as demonstrated by the Intervention group, we would expect the significant group difference on 12 and 24 month follow up IQ to become non-significant as the effect of changes in RJA would be partialled out. If this were the case, we could say that changes in RJA were mediating the effect of IQ. These analyses were also conducted in the reverse order, that is: 12 and 24 month RJA were entered into individual ANCOVAS whilst simultaneously controlling for baseline RJA and IQ change from baseline to 12 or 24 month follow up. If the opposite effect occurred, i.e., changes in IQ were driving changes in RJA, we would have expected the significant group difference for RJA to lose its significance.

No significant main effects for RJA change as a covariate between baseline and 12 month follow up, $F(1, 33) = 0.65$, $p = .43$, and baseline and 24 month follow up, $F(1, 33) = 0.21$, $p = .65$ were found. Conversely, the main effect of group for IQ showed a trend towards significance at 12 months $F(1, 33) = 3.79$, $p = .06$, and at 24 months $F(1, 33) = 3.42$, $p = .07$.

IQ was not found to significantly drive changes in RJA over time between baseline and 12 month follow up, $F(1, 33) = 0.02$, $p = .88$, however RJA almost reached significance between baseline and 24 months, $F(1, 33) = 4.04$, $p = .053$, suggesting that positive changes in children's ability to respond to joint attention may be mediated by some increases in their general cognitive skills over two years.

6.6 DISCUSSION

The results presented in this chapter suggest that responding to joint attention improved after two years of Early Intensive Behavioural Intervention (EIBI) relative to a Treatment as Usual (TAU) Comparison group when baseline levels of RJA were controlled. There were no significant differences between the

groups in terms of their ability to initiate episodes of joint attention. Initiating joint attention may not have improved over time as it may be a more difficult skill to teach, and also more challenging for children with autism to use effectively and spontaneously. Thus, while engaging with adults in social communication episodes for 20 and up to 40 hours per week may increase children's changes of responding to the social bids of others, it still renders them no more likely to initiate joint attention bids for social communication means. A more detailed discussion of these points will be presented in Chapter 7 in the main Discussion portion of this thesis.

These group results were then explored at the individual level using a Reliable Change Index (RCI) analysis (Jacobson & Truax, 1991). Given the difference in group sizes, children in the Intervention group may have appeared to be making more progress in IJA over time with seven children meeting criteria for reliable change; five children from the Comparison group also met this criterion. The reliable change figures for RJA are good examples of what the significant group effect looks like at the individual level. Twelve children in the Intervention group met criteria for reliable RJA change with several others following suit, while only six children in the Comparison group made such progress. While five children in the Intervention group made reliable IQ gains over time, only two children from the Comparison group changed reliably. However, these changes in general cognitive ability did not correlate with changes in more social joint attention behaviours. Many children who gained IQ points over time failed to gain RJA skills and vice versa. This may be due to at least partially separate developmental pathways between cognitive and social communication skills as many children with autism show higher IQs and cognitive skills, relative to their ability to function socially.

A final analysis was conducted to help clarify this issue, as well as the pivotal skills hypothesis which claims that one skill, or set of related skills (e.g., joint attention) is responsible for intervention effects. The pivotal skill changes first, allowing for a greater or more general range of abilities to be acquired. For these data, this was not found to be the case. The change in baseline to 12, and baseline to 24 month IQ was not mediated by any changes in children's development of RJA. Conversely, a trend towards significance was found in the opposite direction: changes in IQ over the course of two years may be supporting

and promoting a change in RJA. While the population is small and the analyses exploratory, this may be one piece of evidence to refute a pivotal skills hypothesis such as Mundy's Social Orienting Theory which claims that changes in joint attention may mediate intervention effects. It would seem that, for these data at least, changes in general cognitive ability may have been responsible for any changes seen with regards to social communication.

7. GENERAL DISCUSSION

7.1 INTRODUCTION

Joint attention bids refer to the coordination of attention between the self, another person, and an object or event. The function of joint attention must be to share interest or comment (rather than to request), and both parties must be aware that they are attending to a common focus. Behaviours classified as joint attention include alternating eye gaze between an object and a person, pointing out or showing an item of interest, and responding to these bids from others. Typically developing children start to use these behaviours at approximately 12 months of age, and this marks the beginning of their ability to shift attention between people and objects and direct the attention of others. As noted by Tomasello (1995), first words emerge within joint attention interactions with adults and involving objects. As children also learn that adult labels for objects may refer to items outside of their attentional focus, they begin to understand that others can have thoughts or perspectives that differ from their own. Thus, joint attention is a vital ingredient in the development of language, communication, and social competence.

Children with autism are impaired in their development of joint attention. These impairments are present when compared with typically developing children, or with children with intellectual disabilities. This evidence comes from several sources, including first year birthday videos. Osterling and Dawson (1994) showed that reduced levels of pointing, eye contact, and showing behaviours at 12 months were predictors of children later diagnosed with autism. Charman and colleagues (1997) reported that children who showed fewer gaze shifts between an adult and an activated object at 20 months of age were also more likely to receive a diagnosis of autism in early childhood. Deficits in pointing and showing behaviours are evident in natural social situations with caregivers (Sigman, Mundy, Sherman, & Ungerer, 1986), are predictive of later language delays such that children with lower levels of pointing and showing have greater language difficulties (Mundy, Sigman, & Kasari, 1990), and are associated with functioning level such that children with lower mental ages are less likely to point to or show items of interest (Mundy, Sigman, & Kasari, 1994). With these findings in mind, it is difficult not to consider joint attention as

a pivotal skill for persons with autism. If joint attention is indeed a pivotal skill, then positive changes in joint attention would be necessary and sufficient to lead to an improvement in the expression of the disorder. Thus, if improvements in joint attention were to occur as a result of early intervention, one may hypothesize that it is these changes that allow children to respond to the therapy and in turn, produce positive changes with regard to general cognitive or adaptive skills.

7.2 SUMMARY OF MAIN FINDINGS

In Chapter 5, the results of a developmental study were reported. The study focused on the assessment of change over time in the early social communication skills of children with autism who were not receiving intensive intervention over the preschool years. Several hypotheses were explored with the data. The first hypothesis was concerned with whether there was any longitudinal stability between joint attention skills. It was predicted that joint attention skills would remain stable over time in terms of correlations between baseline and 12 and 24 month follow up data. This hypothesis was supported, even though responding to joint attention increased significantly between 3 and 5 years of age. Thus, while a child's initial preschool level of joint attention skills was indicative of joint attention abilities one and two years later; other social communication skills did not show stable correlations and may therefore be more adaptable over time.

Secondly, it was hypothesized that initiating and responding to joint attention would reflect at least partially distinct processes as evidenced by a lack of correlation between these variables at any given testing point. This prediction was only partially supported: correlations between initiating and responding to joint attention were not present at individual testing points. However, correlations existed between initiating and responding to joint attention over time (e.g., IJA at baseline with RJA at 12 months), perhaps reflecting a common or single source of variance. These results were inconsistent with previous research on this area with samples of typically developing, or 'at-risk' populations (Mundy & Hogan, 1994; Mundy et al., 1992; Mundy & Neal, 2000; Vaughn et al., 2003). Replication of this finding with other groups of children with autism is necessary before any conclusions may be drawn as the results may be limited to this small sample.

Also investigated were associations between ESCS variables and child cognitive, adaptive, and behavioural skills, as well as parental report of autism symptoms. It was hypothesized that better joint attention skills would be correlated with higher IQ and adaptive behaviour. Some partial correlations were found such that initiating and responding to joint attention were correlated only with adaptive skills at baseline, while responding to joint attention was associated with mother reported severity of autistic symptoms. At the 12 month follow up, both initiating and responding to joint attention were correlated with both IQ and adaptive skills, and initiating joint attention was associated with autism symptomology. By the 24 month assessment, joint attention remained positively associated with child outcome, and it was also negatively associated with parental report of autism symptoms and behavioural difficulties. These results highlight the link between increased social ability measured by joint attention skills, and its relationship with higher IQs, adaptive skills in children, and reports of lower frequencies of autism symptomology and behavioral disturbances.

The final hypothesis was concerned with the identification of early social communication predictors of later cognitive or language skills. Joint attention skills at the baseline assessment were investigated to see whether they predicted cognitive, behavioural or language skills at 24 month follow up. Baseline initiating and responding to joint attention and responding to requests were found to predict 24 month follow up IQ, mental age, and self help skills as measured by the Vineland Adaptive Behavior Scales. These results suggest that early social communication skills may function as good substitutes for assessing cognitive and language skills in early development, when children are preverbal. Because language and cognition are difficult to assess in young children with autism, early social communication skills may provide an assessable skill base that may be predictive of later abilities.

In Chapter 6, comparisons were made between changes that occurred in the development of joint attention and social communication skills in a group of children with autism who received early intensive behavioural intervention, and a Comparison group of children in the South of England who received Local Educational Authority (LEA) treatment as usual. An ABA based early intervention was chosen as children spend at least 20 and up to 40 hours per

week, 50 weeks per year in one-to-one interactions delivered within a social context. ABA is intensive, and requires adults and children to engage in social communication which aims to help children gain and maintain focus on the educational material. Thus, one would expect children who received such intensive, structured, and individualized intervention to make greater improvements in joint attention skill, relative to a Comparison group of children who received less intensive and individualised support. This hypothesis was partially supported in the present study. Children in the Intervention group made greater gains in terms of their ability to respond to the joint attention bids of others when initial baseline score was covaried. However, they were no more likely than a group of children who did not receive such intervention to initiate bids of joint attention.

These data were then explored at the individual level to identify children whose scores changed reliably over time according to the reliable change index (RCI, Jacobson & Truax, 1991). When looking at the change scores, it was clear that more children in the Intervention group had IQs that changed reliably relative to their peers in the Comparison group. Moreover, a greater number of Intervention children responded to joint attention more frequently and demonstrated reliable change. These change scores were found to be unrelated, however: change in IQ did not necessarily correlate with change in responding to joint attention. This may be due to partially separate developmental pathways between cognitive and social abilities.

To clarify this issue, a causal analysis was conducted to identify whether responding to joint attention was a pivotal skill. If joint attention was a pivotal skill, an improvement in joint attention skills would mediate the effects of intervention and in turn, lead to positive changes in IQ. This hypothesis was not supported; in fact, the reverse effect was found and thus gains in IQ over time may actually be responsible for the increases in response to joint attention in this population. It would seem then, for this sample of children with autism, EIBI may have worked first to bring forth positive global cognitive changes, and only once these changes occurred did responding to joint attention increase in frequency. As the mediation analysis was merely exploratory, these results must be replicated before any firm conclusions may be drawn from these data. Moreover, as the p value was close to .05 for the responding to joint attention

effect (p = .049), introducing IQ change as a covariate in the ANCOVA analyses reduced the degrees of freedom and thus the power to detect an effect.

7.3 THEORETICAL CONCLUSIONS

Mundy and colleagues (Mundy, 1995; Mundy & Neal, 2001; Mundy & Crowson, 1997) theorized that the dynamic interplay between an initial biological insult and subsequent transactions with the environment may play a central role in the joint attention and social communication deficits seen in this population. They believe that a neurological disturbance is present in children with autism from birth, limiting their ability to prioritize social information, and it is this deficit that leads to an inability to develop a fully functioning central nervous system. Without the necessary social input required to support optimal social development, children with autism deviate further and further from the normal path. Secondary behavioural symptoms ensue, and a negative feedback system arises from a lack of stimulation from initial neurological structures and the ongoing central nervous system.

However, they also thought that this secondary disturbance, resulting from non-typical interactions between the child and his environment, may have the potential to be ameliorated through early intensive intervention that takes place within a social context and involves structured social interaction. In this model, early intervention was seen to provide a scaffolding effect. Continued and intensive social input should combat the negative effects of this secondary neurological disturbance that leads to increasingly deviant neural architecture. Early intervention would maximise the chances of children making developmental gains. The observation that joint attention behaviours develop and increase in frequency over the preschool years in both groups of children is consistent with reports that children with autism make progress on all types of nonverbal social communication skills with growth in mental development (Mundy, 1995; Mundy & Crowson, 1997). As most early intervention takes place within the context of social engagement and joint attention episodes, an intervention that made maximum effect of social interaction would likely have the most positive effects.

In the present study, only responding to joint attention increased significantly following two years of intensive early intervention in the ANCOVA

analysis. Moreover, a causal analysis showed that change in responding to joint attention did not mediate the positive IQ change seen in children who received EIBI. There are several factors which may account for this finding. Perhaps responding to joint attention was acquired by children in the Intervention group as an operant under reinforcement control. That is, the form that responding to joint attention takes under testing situations (as in the ESCS) and in therapeutic situations (under therapist control) may be different from responding to joint attention as displayed by typically developing children. It may be that children with autism who have undergone many hundreds of hours of intervention in which tutors direct their attention, simply learn to look where someone else points because this action may carry information as to what is expected of the child. It may not serve the same function that it does in mainstream children, i.e., following the attention of others to share their interest or excitement. As early intervention did not improve children's ability to initiate joint attention, Mundy and Crowson's (1997) argument was not supported. This suggests that initiating joint attention deficits in children with autism may not be altered as readily as initially thought. This may be due to limited access to joint attention behaviours resulting from a neurological deficit in social-emotional responding as Mundy initially proposed (Mundy, 1995)

7.4 IMPLICATIONS OF THE PRESENT FINDINGS

As previously stated, Mundy and Crowson's (1997) theory that any early intervention delivered in a social context and in an intensive manner should promote joint attention skills was only partially supported by this study. While responding to joint attention increased over the course of two years in children with autism, and increased to a greater and statistically significant degree in children in the Intervention group, initiating joint attention showed only a trend towards increasing with age for both sets of children, and no group differences. Additionally, the results of the mediational analysis do not support a pivotal skills hypothesis whereby responding to joint attention would have been responsible for the intervention effects.

There are several possible factors that may explain these findings including the age at which children started their intervention programme, the

ecological validity of the intervention, and the probability that initiating joint attention may be extremely difficult to learn as a corollary of other skills.

7.4.1 AGE OF INTERVENTION

One of the factors which may explain why children in the Intervention group did not make greater progress with regards to their initiation of joint attention development concerns the age at which they began intervention. On average, children were 36 months of age. It may be that any sensitive period for gaining joint attention skills and closing the social-communication gap between typical and atypical development through early intervention may have ended. Perhaps, intervention that begins around a child's first birthday may provide more of a social scaffold, early on in life. We know that behaviours associated with a later diagnosis of autism are present from the first 12 months of life in some children (Osterling & Dawson, 1997). Of course, any intervention that begins at such an early age would be open to criticism regarding the ambiguities inherent in early diagnosis of autism. However, diagnoses at earlier ages are becoming increasingly reliable (e.g., CHAT, PL-ADOS), prevalent, and accepted. Moreover, joint attention interventions need not be as intensive at 12 months as a typical EIBI programme; they may only require a short amount of training per day if targeted effectively. Clearly, only an empirical study would answer the question of whether targeting joint attention skills in children at risk for later diagnosis of autism in the first 12 months of life would improve these skills relative to a Comparison group. However, the negative consequences of training joint attention early on in children who do not go on to receive diagnoses of autism (false negatives), would likely be much fewer (if any) than not attempting to teach and target those who do go on to receive an autism diagnosis. Again, this would require effective joint attention training programmes that are valid in that they teach joint attention and not merely requesting skills, and reliable in that they are effective across differing ages, contexts, and other child characteristics.

7.4.2 THE ECOLOGICAL VALIDITY OF EARLY INTENSIVE BEHAVIOURAL INTERVENTIONS

A second factor that may influence outcome in interventions is its ecological validity. This refers to the integrity of the intervention, and how often effective,

developmentally appropriate techniques are used to produce successful outcomes for children (Peterson, Homer, & Wonderlich, 1982). Because the tutors who work on home programmes are often inexperienced (e.g., college students) supervision of practice, assessment of staff, manualisation of the intervention, and certification of behaviour analysts become all the more crucial. Procedural fidelity is also a crucial piece of the puzzle. This refers to the degree to which guidelines are adhered to, and interventions are accurately implemented by tutors, as intended by supervisory staff or consultants (Peterson et al., 1982; Mowbray, Holter, Teague, & Bybee, 2003). If intervention techniques are ineffectively implemented by tutors, this would render the intervention less powerful, and may fail to produce positive results.

Although all of the children in the Intervention group in the present study received ABA based early intervention, the intervention was delivered by multiple providers, with various levels of experience, and the curriculum was not fully manualised. Moreover, each intervention programme is specific to the needs and ability level of the child, removing the possibility of a standardized programme for all of the children. While all of the providers in the current study report the use of incidental and environmental teaching in their programmes (teaching and generalizing skills to the 'real world' across many different contexts, environments, and persons), it may be that some of the programmes were more heavily discrete trial based. More rigid approaches that do not employ incidental teaching methods may lack the qualities necessary to aid generalization of the taught skills into multiple environments, and with multiple people. Moreover, some programmes may have overemphasized the development of child responses that are predefined by an adult. If so, the capacity of children to initiate acts for their own social ends may not have been a prevalent goal. This may be why only responding to joint attention significantly improved in the Intervention group, while initiating joint attention bids did not increase significantly following two years of therapy compared to the level of their peers.

7.4.3 ISSUES WITH TEACHING JOINT ATTENTION

Teaching joint attention skills to children with autism may be possible, and a few key research programmes have evidence to support increased joint attention

skills following targeted intervention (cf. Dube et al., 2006; Kasari, Freeman, & Paparella, 2006; Whalen & Schriebman, 2003). However, several issues arise in how joint attention may be taught and generalized that must be taken into consideration: 1) can a skill that is so inherent to human interaction, and requires an excellent understanding and desire for social reciprocity, be taught? and 2) if joint attention behaviours are demonstrated by children with autism following tuition, are they also generalized to a degree that they are demonstrated across people, contexts, and situations. Is joint attention initiated by children for the sole purpose of engaging socially and reciprocally?

A potential barrier to the generalization of joint attention skills outside of the teaching laboratory may be that they are particularly difficult to observe and reinforce because they tend to occur much less frequently in children with autism. Moreover, deficits in the initiation of these bids may involve a gap in the inherent social motivation system of the child (Mundy, 1995). Hence it may be harder, though perhaps not impossible, for intervention programmes to target the initiation of joint attention skills. Perhaps direct targeting and intervention on the initiation of joint attention skills may be necessary to promote effective and positive change. The present study is the first attempt to measure whether joint attention skills increase as a corollary of intensive intervention, relative to a Comparison group. It may be that the findings of the current study are attributable to the fact that the outcome of joint attention increase was not necessarily related to the treatment goals. Specific targeting of joint attention for improvement may be the only means of increasing these skills in young children with autism (cf Kasari et al., 2006).

The question thus becomes: how can we increase the variation of joint attention bids to make reinforceable instances of joint attention more likely to occur? It is unknown, and perhaps even unlikely that a truly spontaneous desire to share attention could be taught to children with autism. A spontaneous initiation gesture is defined as one that derives from the child, unprompted by an adult or other child, and the function of the bid is solely to share one's interest for social purposes and not to request an item of desire. If initiation of joint attention was specifically taught through an ABA programme, it is unknown which reinforcers would prove effective in this regard. If a child is rewarded with a tangible item for each initiation of a joint attention bid, it would cease to be a

natural 'social' response and may function as an indirect request for reinforcement. Recall, that a child may use social behaviours (eye contact, smiling, pointing) with an adult to request access to an item, rather than for the sole purpose of sharing interests. Alternatively, responding to joint attention may be more easily reinforced in children with autism, as the adult is able to lead the interaction with the child, and the child must only respond.

If initiation of joint attention was targeted directly and taught in sequence, it may also fail to generate the natural presentation of joint attention as is seen in typically developing children. Joint attention, in its untaught natural form should be spontaneous in nature: teaching social communication skills in a rote fashion may go against the premise that joint attention is a spontaneous naturally occurring social behaviour. However, in theory, once these skills are taught and reinforced over a period of time, a programme or several programmes can be put in place to generalize joint attention across people and contexts, as well as to reduce the amount of environmental control over these skills until they may be displayed spontaneously. If children are given less tangible reinforcement for joint attention bids and can learn to be motivated and reinforced by naturally occurring social attention, then joint attention has a better chance of becoming concrete and remaining in the child's behavioural repertoire.

Nevertheless, one would hope that any good ABA programme delivered currently capitalizes on any existing social communication abilities in young children with autism, and uses techniques to increase children's motivation to communicate for social means. For example, Verbal Behaviour (VB) programmes, while based on ABA theory, seek to pair reinforcement with an adult as its initial step in therapy. This serves to introduce the adult as a conditioned reinforcer for the child, and the child learns that they will be reinforced in the adult's presence. If social attention can become reinforcing during VB training by fading out tangible reinforcers, perhaps a child can learn to initiate joint attention bids. The question of whether these bids would be sustained outside of the teaching context, or generalized to other people and places remains unanswered. The 'motivation' of a child to communicate purely for social means may be quite difficult to teach however, particularly in a population of children with autism where a cardinal symptom of the disorder is a lack of social and communicative reciprocity with others.

There are only a small handful of studies that have attempted to teach children with autism to initiate joint attention. Dube and colleagues (Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004) have been training joint attention behaviours in young children with autism for the last few years. They interpret joint attention in a behaviour analytic model, arguing that a child's gaze shift in joint attention initiation may be characterized as an observing response (Dube et al., 2004). In this analysis, the child who is attending to an object would observe an adult's visual orientation to determine whether the adult was currently aware of the object or event of interest. This in turn requires the child to make an accurate discrimination of the adult's gaze direction and follow the gaze to see whether the adult's focus was the same or different from the child's.

As children with autism have deficits in following the joint attention bids of others, Dube and colleagues (2006) attempted to train gaze direction discrimination as a precursor to joint attention in two preschool aged children with autism, with the goal of generalizing this skill into a spontaneous response to joint attention in the future (Dube, Klein, MacDonald, O'Sullivan, & Wheeler, 2006). Gaze discrimination was taught by pairing the activation of a toy with an adult's gaze shift towards the target, such that by the end of training, toy activation occurred only when a child followed the adult's gaze shift towards the object. Thus, an adult alternated her gaze to look at an interesting object, and when the child followed the adult's gaze, he was rewarded by the activation of the object. However, in this example, the children were not initiating joint attention. They were either following the eye gaze of another person and thus responding to joint attention, or they were simply looking at an interesting object of their own accord (e.g., as a coincidence and irrespective of the adult's gaze focus), with no intention of sharing that interest with others. A child would need to engage the adult to share the experience of the activated toy to truly initiate joint attention. It is this motivation to share one's experience spontaneously that is more difficult to instruct and generalize.

There is also some evidence in the literature that prescribed treatments containing elements of incidental teaching and discrete trial training have facilitated generalized initiation of joint attention in children with autism (Kasari, Freeman, & Paparella, 2001; Pierce & Shreibman, 1995; Whalen & Shreibman, 2003). In the Whalen and Shreibman (2003) study, joint attention was explicitly

targeted through ABA methodology, and the researchers ran trials which they then saw generalized to other settings. Also, in the Kasari, Freeman and Paparella (2001) study, joint attention skills targeted for intervention on one child, were specified using baseline measures of the ESCS, among other measures. Treatment success was measured by an increase in frequency of initiation behaviours on the ESCS and generalization measures were also included. Although the child's targeted goals increased over the course of intervention, he did not improve in any non-targeted joint attention skill (see chapter 3 for a more in depth review of these studies). Finally, in a randomized controlled intervention study where three groups were provided with three different interventions, Kasari, Freeman, and Paparella (2006) found that when intensity and type of intervention was controlled, the specificity of the intervention delivered was critical. Only those children who received joint attention or play interventions showed increases in these skills over time. Those who did not receive individualised targeted therapy to increase joint attention showed no change over time. And importantly, like the present study, only responding to joint attention increased through their intervention. Initiation of joint attention remained stable.

All of the methodologies used in the reviewed studies have potential difficulties in practice. Firstly they assume that attention from an adult is rewarding for a child with autism, which is crucial to sustaining joint attention in the long run. While this may be the case for some children, it is certainly not the case for many children on the spectrum. They also assume that the act of teaching a child to respond to certain items by gaining the attention of an adult to share it with, would generalize across people, contexts, and items, and also result in the child initiating bids of his own. None of the studies have reported on whether sharing attention was exhibited as a learned behaviour in response to certain stimuli (e.g., only the person who taught the behaviour or only in the presence of certain items). To gauge how effective these programmes are, it would be imperative to know whether the child, once he learned to gain the attention of another when he saw an exciting event, would have been satisfied if the adult did not respond by sharing his attention. That is, was the child's goal to share his experience with another person, or was it a learned response in which

he attempted to gain another's attention in the presence of specific stimuli or events?

7.5 CONCLUSIONS REGARDING THE ESCS

As the ESCS was the only tool used to measure joint attention in this study, it is important to evaluate its use, applicability, and suitability to this sample of children with autism. The ESCS will be evaluated in terms of its measurement of joint attention, and its reliability and validity.

7.5.1 THE CONSTRUCT OF JOINT ATTENTION AS MEASURED BY THE ESCS

In evaluating whether the construct of joint attention is indeed appropriately defined and used within the ESCS, a good beginning is to ask what joint attention looks like, outside of a structured measure. While the ESCS was developed to be an ecologically valid measure in that it seeks to create interactions with young children where joint attention can be displayed and measured, it is important to critically evaluate the extent to which the measure meets this goal. To begin with, joint attention has to be differentiated in terms of what it consists of, how it is achieved, and by what criteria it is judged. As discussed throughout this dissertation, joint attention is much more than gaze following or simultaneous looking. It gets to the root of what we consider to be social behaviour as it takes into account the role of 'intention' to communicate and share experiences with others. Specific behaviours are classed as joint attention behaviours, and these involve pointing, showing, alternating eye contact, and even using affect to share experiences with others. The ESCS uses a similar definition of joint attention and is careful to differentiate between the function of joint attention bids and requests:

> The function of these behaviors is to share attention with the interactive partner or to monitor the partner's attention. They differ from Requesting bids in that they do not appear to serve an instrumental or imperative purpose. Rather, their function seems to be more social sharing or declarative in nature. A "show" gesture is prototypical of this type of behavior. These behaviors are most often observed during active object spectacle presentation, during the child's examination of mechanical toys, and during the Book and Look trials. However, they may also be observed when novel events spontaneously occur during testing (e.g., a sound is distinctly heard outside the testing room or a toy breaks). (Mundy et al., ESCS manual, p. 9).

All of the behaviours coded for joint attention during the presentation of the ESCS are operationally defined, and the rule of thumb is to not give credit if the coder is uncertain of the function of the behaviour. The ESCS thus has a good grasp of joint attention, and sets up situations in which joint attention may be displayed, allowing for a more naturalistic presentation of the given behaviour.

7.5.2 THE RELIABILITY AND VALIDITY OF THE ESCS

Broadly defined, the reliability of a measure refers to the consistency or repeatability of the measurement of some phenomena. If the ESCS is reliable, it should measure the same constructs (joint attention, requesting, and social interaction) more than once or using more than one method and yield the same result. Several tasks that seek to elicit the same behaviours are repeated throughout the ESCS administration. This allows for the measurement of multiple instances of a given behaviour, across varying tasks. While there will always be some error of measurement depending on the child's performance on a particular day, a similar score should be presented across short periods of time, within a given confidence interval. As the children in the present study were assessed with the ESCS every 12 months, it is not possible to critically evaluate test-retest reliability for this population. Inter-rater reliability, a measure of homogeneity, was calculated however. For this study, two people rated a proportion of children's ESCS tapes (24%) to determine the amount of agreement between them. Reliability levels ranging between .94 and 1.00 were found indicating excellent inter-rater agreement on the codings of various behaviours, throughout the ESCS.

The validity of the ESCS is a much more interesting question. To be valid, the ESCS must actually measure joint attention and other social communication skills accurately. With widespread use across many research groups, and the inclusion of studies with multiple populations of children (typically developing, intellectually disabled, and at-risk), the ESCS has proven itself a valid measure for the construct of joint attention. Furthermore, Mundy is currently running a study investigating the validity of a live coding version of the ESCS (ESCS-L) with a parent report measure of joint attention (Pictorial Infant Communication Scale – PICS). Using multiple respondents and sources of

information (child observation, parent ratings, tutor or teacher ratings) would help improve the reliability and validity of this measure.

However, more significantly for this study, was the ESCS a valid measure to use with the current population: a group of preschool aged children with autism of varying levels of ability? As the tasks all involved moving, buzzing, or colourful toys, the children all displayed interest and enjoyed the tasks. Moreover, some of the tasks were so appealing, the children continued to use them as reinforcers for the psychoeducational assessments (IQ, language). The children also requested repeated displays of various tasks, and these instances were coded with the ESCS (i.e., the same toy was used for two trials rather than introducing a new toy if it was highly reinforcing). Another issue in evaluating the validity of the ESCS is concerned with whether the ESCS was an appropriate measure to use to evaluate changes in joint attention over time. It is this latter point that is particularly relevant in assessing the results of the present study. Children in the Intervention group were found to have increased their levels of responding to joint attention after 24 months of early intensive behavioural intervention. However, no corresponding increases in the initiation of joint attention were found. This may be because the ESCS failed to measure the more advanced and 'natural' forms of joint attention that the more high functioning children in the Intervention group were displaying. For instance, many of the more able children were able to comment on the toys used in the ESCS evidencing the joint attentional ability of sharing thoughts or interests with another person. However, the ESCS, a non-verbal measure of joint attention, was not developed to measure verbal behaviour. Moreover, while the toys and tasks used in the ESCS interested and excited the vast majority of children at the baseline and 12 month follow up assessments, some children may not have been as interested at the 24 month follow up. At the final assessment, children were between the ages of 4 years, 6 months and 5 years, 6 months and thus a proportion of them may have outgrown any fondness or interest in wind up toys, or some of the other objects. In future, if using this measure with older children, it would be important to modify the tasks to make them more age appropriate.

7.6 LIMITATIONS OF THE CURRENT STUDY

The present study had several limitations that need to be considered in the interpretation of the findings. The data for the Comparison group were drawn from a population of preschool aged children with autism who were subject to a heterogeneous range of interventions that may have lacked any specific, intensive, or individualised instruction. Therefore, the findings may be limited to this or related populations of children with autism receiving regional services in the south of England. Additionally, the sample used in this study was small, limiting the power to detect more modest effects and further limiting generalizability by affecting the stability of the findings.

While the analyses reported in Chapters 5 and 6 are exploratory, it must be recognized that the large number of comparisons made increases the risk of Type I errors. However, the samples involved were the only practical resources available for this study with current, part time, post graduate resources. Consequently, the effects that emerged may be limited to this sample of children.

A further limitation was that the formal language measure used was not sufficiently sensitive. A more sensitive measure may have gleaned a fuller data set across three testing points. Although the Reynell was attempted with each participant at each testing point, nearly the entire sample fell below the basal age equivalent of 21 months at baseline, and many continued to do so at the 12 and 24 follow ups resulting in the inability to perform lagged correlations between initial social communication and follow up language skills. While unexpected and disappointing, this reflects a more general difficulty of using formal language measures with children with autism at very young ages. Charman and colleagues (2003) also had similar difficulties using the Reynell in a population of young children with autism in their study, finding that the floor of the test was too high (See Chapter 4). Additionally, many language measures require that the child possess adequately developed joint attention and imitation behaviours to succeed, and are thus beyond the grasp of many children with autism, particularly those at young chronological or low mental ages. Until autism specific measures are developed, this problem may be one faced by professionals working both clinically and academically with this population.

7.7 CONCLUSIONS

Despite the limitations discussed above, the present findings add to the literature in several ways. This is the first ABA based outcome study to measure ecologically based joint attention and social communication skills across two years. There is considerable debate as to whether an incidental approach or a discrete trial approach is better suited to developing joint attention skills in children with autism and a comparison of these two approaches would be extremely beneficial in this regard. The findings of the current study suggest that initiation of joint attention, as well as other social communication skills, do not increase simply as a result of engaging in EIBI, perhaps due to a lack of direct targeting of these skills. Given the reported success of EIBI programmes, it was disappointing not to see stronger effects in terms of the children's development of social communication skills over the course of intervention. However, responding to joint attention does increase, and this may be due to the nature of more traditional ABA intervention programmes that require the child to respond to an adult. One goal of future studies may be to incorporate specific programmes of joint attention and social communication training in EIBI programmes, and compare the skill level relative to children who have not had specific instruction of social communication skills.

It is widely agreed that joint attention and other social communication skills are important targets for intervention efforts as they set the stage for language development and social relationships (Bondy & Frost, 1995; Charman et al., 2003; Mundy, 1995; Mundy & Crowson, 1997). These skills can be targeted directly or indirectly through various intervention programmes that are commonly used for children with autism. To clarify the issues, however, we need to both refine our measurement of these skills, and to adopt controlled treatment designs with larger samples of children. Studies of this nature will enhance our understanding of the features, the time course, and the underlying mechanisms of change that characterize autism spectrum disorders.

8. APPENDICES

APPENDIX A: THE MANUAL FOR THE EARLY SOCIAL COMMUNICATION SCALES

A Preliminary Manual for the Abridged

EARLY SOCIAL COMMUNICATION SCALES (ESCS)

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1996 PRELIMINARY MANUAL FOR RESEARCH WITH THE ABRIDGED

EARLY SOCIAL COMMUNICATION SCALES (ESCS)

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1. BACKGROUND

The Early Social-Communication Scales (ESCS) is a videotaped structured observation measure that requires between 15 to 25 minutes to administer. The version described in this document has been designed to provide measures of individual differences in nonverbal communication skills that typically emerge in children between 8 and 30 months of age. It may be used with children with typical development within this age range or with children with developmental delays whose verbal age estimates fall within this range.

The ESCS was originally designed as a comprehensive clinical measure based on two organizing constructs: 1) a cognitive, Piagetian, stage-related orientation to early development which provided a means for analyzing specific behaviors' developmental complexity; and 2) a pragmatic-functional orientation which provided a means for analyzing specific behaviors' interpersonal or communicative goal (see Seibert, Hogan, & Mundy; 1982, 1984). A set of 25 semi-structured eliciting situations were developed to encourage interaction between an adult tester and the child; approximately 110 child behaviors were noted as possible occurrences. From videotaped records, behaviors were then coded, and summarized according to a) developmental stage (simple, complex, conventional, or symbolic); b) communicative goal (to achieve social interaction between partners, to achieve joint attention to an entity or event, or to regulate the partner's behavior for assistance or compliance); and c) whether the child initiated the interaction or responded to the tester's bid. Thus, a social-communicative profile resulted which indicated the child's highest levels across the various communicative functions.

By reducing the number of items in the ESCS, this abridged version has been designed as a more practical research instrument, as well as a clinical tool. Furthermore, the scoring of the abridged version emphasizes frequency data, rather than the ordinal or four-stage related measures of early social communication development emphasized in the original ESCS (Seibert et al. 1982). The complexity construct is now reflected by the designation of lower vs. higher level behaviors. Finally, the theoretical framework of the abridged ESCS has been broadened so that the measures of the ESCS are now viewed as reflecting self regulatory and affective process, as well as epistemological and basic process elements of early social cognition (see Mundy, 1995; Mundy & Willoughby, 1996; Mundy & Gomes, 1997; Mundy & Sheinkopf, in press).

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2. GENERAL ADMINISTRATION GUIDELINES:

During the administration of the ESCS the tester sits across from the child at a table with a variety of toys in view, but out of reach to the child. A video camera is used to record a three quarter to full face view of the child, while also capturing a profile view of the tester (see reliability videos for examples). Children may be tested with or without their parents present and may be tested seated in their parents laps, or seated in a chair. To maintain appropriate attention to the tester, the latter is preferred.

During ESCS administration, the tester performs a variety of tasks with natural but minimized verbal interaction with the child. A reduction in tester verbalization allows for clearer differentiation of communicative bids that are initiated by the child.

The tester presents a variety of objects and tasks to a child that have been designed to provide observations of the tendency to both initiate social and communicative bids with a tester, and respond to the tester's social and communicative bids.

The videotape recordings of the ESCS enable observers to classify children's behaviors into one of three mutually exclusive categories of early social-communication behaviors. The function of these categories of behaviors may be briefly described as follows. Joint Attention Behaviors refer to the child's skill in using nonverbal behaviors to share the experience of objects or events with others. Requesting Behaviors refers to the child's skill in using nonverbal behaviors to elicit aid in obtaining objects or events. Social Interaction Behaviors refer to the capacity of the child to engage in playful, affectively positive turn-taking interactions with others. (For additional description of these dimensions see Bates, 1979; Bruner & Sherwood, 1983; Mundy et al. 1988; Mundy, 1995; Seibert, et al. 1982, 1984).

Behaviors are also classified as to whether they are child initiated bids or responses on the part of the child to a tester's bid. Thus, Initiating Joint Attention (IJA) refers to the frequency with which a child uses eye contact, pointing and showing to initiate shared attention to objects or events. Responding to Joint Attention (RJA), refers to the child's skill in following the tester's line of regard and pointing gestures.

Initiating Object Requesting (IOR), refers to the child's skill in using eye contact, reaching, giving or pointing to elicit aid in obtaining an object, or object related event. Responding to Requesting (RR), refers to the child's skill in responding to the tester's gestural or verbal simple commands to obtain an object or action from the child. Initiating Social Interaction (ISI), refers to the child's skill at initiating turn-taking sequences and their tendency to tease the tester. Responding to Social Interaction (RSI) refers to the frequency of eye contact, gestures, and turns-taking exhibited by a child in response to turn-taking interactions initiated by the tester. Finally, a measure of SOCIAL COMMUNICATION IMITATION may also be obtained from the ESCS by summing the number of times the child imitates the pointing and/or clapping gestures displayed by the tester.

The toys and other materials used in the ESCS have been selected because of their potential to elicit social interaction, joint attention, and/or requesting behavior. The toys included: a) three small wind-up mechanical toys, b) three hand-operated toys including a balloon, c) a small car and a 'nerf' ball that will roll easily across the table, d) a book with large distinct pictures on its pages, e) a toy comb, hat, glasses, and e) colorful posters positioned on the walls to the left, right and behind the child. These should be at least two feet beyond the arm's length of the tester during ESCS administration. All toys used in the ESCS are positioned within view but out of reach of the child and the toys are presented one at a time during the administration of this measure. Examples of the toys, their positioning, and the posters are provided in the accompanying reliability tapes.

Specific task situations are presented in the ESCS and there is a recommended order of task presentation (see below). **However, it is most important to keep in mind that a valid and optimal assessment of social communication skill development is dependent on the responsiveness of the tester to the communicative bids of the child.**

The ESCS may begin with the tester referring to the toys that are out of reach with an open hand gesture and stating to the child "Would you like to play?". The tester then may wait for a silent count of three seconds, and if the child does not initiate a bid the tester chooses a toy to present (see below). In the course of testing the tester should be ready to put aside his or her own order of task presentation to follow the lead of the child. This is especially important in the first half (ten minutes) of testing while rapport is building. In the second ten minutes of testing, the need to present the remainder of all items may lead the tester to redirect the child more persistently and quickly back to the remaining items requiring presentation, while maintaining a responsive testing posture.

Throughout the specific task guidelines provided below inter-task or task presentation interval estimates are provided. The tester **should not** attempt to rigidly adhere to these

time estimates using a watch or clock. Rather, the tester should simply use a silent time count (e.g., subvocalizing "one second" "two seconds", "three seconds") to approximate times. After numerous ESCS presentations this will allow the tester to develop the appropriate sense of pacing for all tasks. Strict measurement of times of presentation would likely interfere with the validity of the social interactive nature of ESCS presentation. For example, some children may be particularly hesitant or "shy" in interaction with unfamiliar adults; we have seen this type of behavior in children with and without developmental delays. In such circumstances, the tester may need to provide slightly longer pauses initially.

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2. SPECIFIC TASK ADMINISTRATION GUIDELINES:

An attempt is made in the ESCS to follow specific task administration guidelines. However, unlike other experimental or clinical tasks, absolute standardization of presentation may violate the ecological validity of a social interaction measure such as the ESCS. Thus, some variation from the guidelines may be expected in the administration of the ESCS for a given child. For example, children may develop favored items, and demonstrate high frequencies of communicative bids with these items. Consequently, preferred items may be presented more times or for longer durations than is indicated in the guidelines. This is an acceptable variation in the presentation of the ESCS. Variation in presentation is acceptable providing that **all** the ESCS items are presented appropriately during the course of an administration. Numerous examples of testing with children from multiple testing contests have been provided on the reliability tapes so that you may develop an appreciation of the variability in ESCS presentation that is typical and acceptable across children.

THE TASKS

I. Object Spectacle Tasks. [Target behaviors: Initiating Joint Attention; Initiating Requesting; Responding to Requesting]. Three wind-up mechanical toy spectacles and three hand-held mechanical toys (balloon, squeeze toy, bellows toy - see video examples; for balloon, see additional note on page ?15) are presented. In each presentation the tester winds up a toy and activates it on the table in front, but out of reach of the child. The tester remains silent but attentive to the child during the toy-active-spectacle to allow the child to initiate joint attention bids vis-a-vis the spectacle. However, if the child initiates a bid (e.g., alternates eye contact between the object spectacle and tester) the tester should provide a natural but brief response (e.g., "Yes, I see!"). The child may also bid to obtain the toy and the tester should respond to that bid by moving the toy within reach. If the toy ceases and the child has not bid for the toy the tester places the toy within reach of the child. The child is then allowed to play with the toy for approximately 30 seconds, or until the child gives the toy to the tester. If the child does not give the toy spontaneously, the tester verbally requests the toy twice ("Give it to me!"). Then, if necessary, the tester uses both a palm-up 'give it to me' gesture stating "Give it to me!" two times. If the child does not respond, the tester gently retrieves the toy. The tester then follows this sequence of activation, presentation and retrieval of the toy two more times. Hence, each object spectacle, whether it is a wind-up mechanical toy or hand held mechanical toy is presented to the child three times in this fashion.

II. Turn-Taking Tasks. [Target behaviors: Initiating & Responding to Social Interaction]. Two turn-taking tasks are presented in the ESCS. In these tasks the tester places either the toy car or nerf ball within the child's easy reach and then the tester places his or hands apart on the table in a posture ready to catch the ball or car if the child rolls it or throws it two the tester (see video examples). The tester should remain in this posture for about 10 seconds. If the child does not initiate a turn-taking game the tester should

request and/or retrieve the toy and roll it to the child while making an appropriate playful sound (e.g. "brrrrrm" or "wheeeee"). If the child responds by rolling/throwing the ball or car to, or away form the tester, the tester retrieves the ball and again rolls it to the child. This turn-taking activity continues until the child stops throwing the ball/car or the child has taken 10 turns (e.g. throws the ball to or away from the tester). If the child fails to roll/throw the ball or car to the tester the tester retrieves the toy and rolls it to the child again. If the child does not respond to this tester-turn taking bid two times in a row the turn-taking trial is discontinued.

III. Social (tickle) Interaction Task. [Target behavior: Responding to Social Interaction]. This task is presented at two different times during testing. Here the tester removes all toys form the table and begins the task by saying to the child "Let's play a game". Then the tester sings a few bars of a simple child song (e.g."Baby bumble bee", "Itsy-bitsy spider"). Regardless of the tester's vocal talent an attempt is made to sing with some gusto and humor. After approximately 10 seconds of song the tester gently runs his or her fingers across the table while softly saying "whee" or "zipp" and touches or tickles the child. (A decision with regard to touch or tickle is made on the basis of how tolerant the child may be for this potentially slightly invasive task. The object here is to engage in a song and physical interaction game that the child enjoys.) The tester then returns his or her hand to the tester's side of the table and attends to the child for approximately 5 seconds. This allows the child time to bid for the tester to "do it again" by hitting the table, making eye contact. wiggling their fingers on the table, etc. After the five second interval, or a child bid, the tester repeats the procedure of running their fingers across the table and touching or tickling the child and returning to a rest position. After a five second interval, or a child bid, this procedure is repeated a third time. Hence, three tickle trials are provide at two different times during the ESCS.

IV. Look or Gaze Following Task. [Target behavior: Responding to Joint Attention]. This task is typically presented immediately after a set of tickle trials to insure that the child is looking at the tester's face at the beginning of the "Look" trial. This trial must begin with the tester obtaining the child's attention to their face. If not in conducted in conjunction with tickle trials, this usually may be accomplished if the tester will tap the table, or gently touch the child, and then touch their own nose.

The look trials involve a sequence of the tester looking and pointing to targets to the left, right and behind the child while emphatically stating the child's name. The tester begins with the left and right trials first. On all trials the tester obtains the child's attention, then visually orients to a target while pointing to the target. To reduce the likelihood that arm movement will affect the child's behavior, the tester should always point with the elbow of the pointing arm in contact with his or her side. This forces the tester to display a "short-arm point". (Note that some of the video tape examples of pointing are incorrect "long-arm pointing"). During the pointing trial the tester says the child's name three times increasingly emphatically ("John", "John!", "JOHN!!") and the tester does not look back at the child until after stating the child's name for the third time. Allow approximately 2 seconds between each enunciation of the child's name. Hence, each pointing episode is maintained for at least 6 second. This is to insure that developmentally immature children have enough time to process the social information presented to them. Finally, on Behind Trials, the tester should lean slightly forward and to the left or right of the child as if they see something interesting directly behind the child. However, the pointing finger of the tester should always be at least two feet distant from the child. Two sets of three pointing trials are presented at different times during the ESCS.

V. Response to Invitation Task. [Target behaviors: Initiating and Responding to Social Interaction]. In this task the tester presents either the hat, comb or glasses to the child. Each toy is presented at different times throughout the ESCS. Hence, the three trials in this task are distributed throughout the ESCS presentation.

In this task the toy is placed directly in front of the child and the child is allowed to play with the toy for approximately 15 seconds. If the child uses the toy in a socially

conventional fashion (i.e. hat on head, glasses on face, comb to hair) the tester leans forward, shakes his or head gently while saying " [child's name] Can I play?". This question is stated three times with a 2-second interval between repetitions, or until the child places the hat, comb or glasses to the tester's head. If the child does not spontaneously use the toys in a conventional fashion the tester should place the hat or glasses on the child or comb their hair briefly and then invite the child to play as stated above. Some children will not tolerate the tester putting the hat, comb or glasses on their head. In this case, after attempting to place the toy to the child's head, the invitation to play is stated three times.

VI. Book Presentation Task. [Target behaviors: Initiating & Responding to Joint Attention]. In this task the picture book is opened and presented on the table within reach of the child. Several distinct pictures should be displayed on the pages of the book. The tester says "What do you see?". The tester should allow the child to examine the book for approximately 20 seconds. If the child points to pictures spontaneously the tester should respond briefly, but naturally ("Yes, I see"). After a 20 second interval the tester should begin pointing to pictures in the book regardless of whether the child has pointed or not. The tester should say the child's name as he or she points to a picture. The tester should then point to a new picture on the same open pages, but at some distance from the first picture. This procedure is repeated with a third picture. Then a page is turned and the procedure is repeated with pointing to three picture. A page is turned again and a final set of three pictures is indicated by the tester.

VII. Plastic Jar Task. [Target behaviors: Initiating & Responding to Requesting]. This task is presented once during the ESCS. The tester displays a transparent plastic jar with a sealed lid and two novel wind up toy inside to the child. The tester then unscrews the lid and "pours" the toys onto the table. Before the child can play with the toys the tester returns them to the jar and seals the lid sufficiently well to insure that a small child will not be able to unscrew the lid. The tester then gives the jar to the child and waits for approximately 30 seconds, or until the child gives the jar to the tester. If the child does not give the jar, the tester requests the jar verbally and, if necessary, with a palm up gesture and verbal request. If the child does not respond the tester gently retrieves the jar. The tester then opens the jar, pours out the toys, returns them and seals the jar and gives it back to the child. The tester again waits 30 seconds or until the child has given the jar. The tester then retrieves the jar as above opens the jar and gives it to the child.

If the child spontaneously gives the jar, the tester should open the jar and give the child one toy. After the child has played with the toy for approximately 20 second the tester should give the child the sealed jar with the remaining toy inside. If the child gives the jar again, the tester opens the jar, gives the toy and places the open jar and lid by the child.

Once the child has both toys and the open jar allow the child to play with the toys and jar for approximately 1 minute or until the child gives the jar and toys to the tester.

VIII. **Social Imitation Task**: During the Book, Look and Song/Tickle tasks, the tester either points or claps his/her hands. Often children will respond by spontaneously imitating the tester's pointing or clapping behavior. Each display of imitative behavior may be observed and recorded. Little data is available on this potentially useful measure. However, reliability data on observations of Points in Imitation have been provided in Table 1.

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3. Order of Task Presentation

While there is a suggested order in which the tasks can be presented, the main goal is to keep the child interested and engaged. Therefore, testers may deviate from this order depending upon the specific requests and interests of the child. For example, if a child

voices a preference for a particular toy upon entering the room, that toy may then be introduced first. The suggested order is based on several considerations. First, one of the mechanical toys should be the first or second toy presented since they are attractive and, thus, typically effective in gaining the child's attention and interest. Another toy that may be presented first or second is the ball or car, since the turn-taking involved in its presentation may help to build rapport and cooperation with the child early on in the testing. Pointing, invitation, and tickling tasks may be more effective once rapport has been clearly established - *e.g.*, after four or five other items have been successfully administered. It is also important to vary task demands to keep the child's interests, and to obtain a valid assessment. For example, it is necessary to present the ball and the car at two different moments in the testing in order to obtain two semi-independent samples of turn-taking behavior.

POSSIBLE ORDER OF PRESENTATION:

1. Mechanical (wind-up) Object Spectacle #1

2. Ball - Turn-taking task

3. Hand Operated Object Spectacle #1

4. Song-Tickle Game

5 First Pointing (Look) trials

6. Glasses - Invitation task

7. Book task

8. Hand Operated Object Spectacle (balloon) #2

[ESCS Mid-point, half of all items presented in approximately 10 minutes]

9. Mechanical Object Spectacle #2

10. Car - Turn-taking task

11. Mechanical Object Spectacle #3

12. Hat Invitation task

13. Song-Tickle Game

14. Second Pointing (Look) trials

15. PLASTIC JAR

16. Comb Invitation Task

17. Hand Operated Object Spectacle #3

ADDITIONAL PROCEDURAL COMMENTS:

1) All of the toys should be presented at least three times to the child, so that they have a chance to respond to them. The examiner may choose to present a toy more than three times if a child requests to see that toy again. However, all the items of the ESCS need to be presented appropriately within the 15-20 minute testing session.

2) In all cases, the tester should reinforce effort, not necessarily success. In addition, the tester should insure that they have the child's attention when they begin each new trial.

3) Presentation of Balloon. For the balloon, the tester blows it up and, holding it to their side in the direction of the camera, lets the air out slowly so that the balloon squeaks. The tester then hands another balloon of the same color to the child (for hygienic purposes). Be careful that the very young child does not place the whole balloon inside his or her mouth. This is repeated two more times. Note that some children may be afraid of balloons, in which case this item is not presented three times.

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4. GENERAL SCORING GUIDELINES:

Scoring is typically conducted via observations made from videotape. However, reliable ratings on many ESCS behaviors may be made live by a second person in the testing room or observing through a one way mirror. Basic scoring consists of noting the frequency of occurrence of Requesting, Joint Attention, and Social Interaction behaviors that occur. These behaviors are presented and defined below.

Although operational definitions have been provided, raters should attempt to classify behaviors on the basis of perceived function (see function definitions below). Most people have had a life time of experience in observing and classifying the function of social-communicative bids, be these nonverbal or verbal. This well practiced ability should be capitalized on in order to yield adequate rater reliability. In looking at an interaction, the coder should, first, classify the function; second, decide who initiated the function (to establish if the child's behavior is Initiating or Responding; and third, identify the particular behavior code. This sequence of judgments is important to note as individual behavioral forms (e.g., "points") are scored by behavioral function rather than just behavioral topography. Examples of scoring forms have been provided in this packet.

In addition to frequency coding, the coding of duration of behaviors is possible with videotaped scoring, as is computer integrated coding of ESCS behavior with other behavior modalities (e.g., affect, vocal behavior). Finally, it is important that the total length of time involved in an ESCS presentation be recorded. In research application the length of presentation time must be carefully matched across children or groups. In clinical application very short (less than 15 minutes) or very long (more than 25 minute) presentations need to be considered in interpreting the ESCS. Rating of the state of the child throughout the ESCS is also advisable. Indeed, current work in our laboratory is beginning to move toward viewing the ESCS as a platform both for early social-communication skill observations and temperament observations (e.g., inhibited vs noninhibited vs impulsive/active children).

Joint Attention

The function of these behaviors is to share attention with the interactive partner or to monitor the partner's attention. They differ from Requesting bids in that they do not appear to serve an instrumental or imperative purpose. Rather, their function seems to be more social sharing or declarative in nature. A "show" gesture is prototypical of this type of behavior. These behaviors are most often observed during active object spectacle presentation, during the child's examination of mechanical toys, and during the Book and Look trials. However, they may also be observed when novel events spontaneously occur during testing (e.g., a sound is distinctly heard outside the testing room or a toy breaks).

Initiating Joint Attention

Lower Level Behaviors:

1) Eye Contact: the child makes eye contact with the tester while manipulating or touching an inactive mechanical toy. Note: The video recording of the ESCS should enable coders to reference the general position of the tester's eyes and reliably determine when the child is looking at the upper orbital region of the tester's face (the definition of eye contact) as opposed to looking at the lower portion of the tester's face (see videotape examples).

2) Alternating (referencing): the child alternates a look between an active object spectacle and the tester's eyes. Each example of this bid is recorded. This is typically recorded when an object is active on the table or in the tester's hand, but is also recorded if the child looks up to the tester after an object becomes active in their own hands.

Higher level behaviors:

3) Pointing: the child points to an active toy, or pictures in the book before the tester has pointed, or to wall posters before the tester has pointed. Pointing may occur with or without eye contact.

4) Showing: The child raises a toy upward toward the tester's face. This behavior may be difficult to distinguish form Giving in the young child (see Requesting coding). If the tester responds to a show gesture as though it were a give and attempts to retrieve the object the child may resist giving, albeit briefly. Observations of resistance to giving may be used in rating this behavior. Shows are typically are brief bids with the child quickly retracting the proffered object.

Scoring: Three scores are typically obtained: a) the Total Frequency of Joint Attention bids, b) the Frequency of High Level Joint Attention Bids and c) the Ratio of High Level to All Joint Attention Bids.

Responding to Joint Attention

Lower level behavior

1) Following proximal point/touch: In the Book presentation task, the tester points to 6 pictures in the book. The child gets credit if s/he orients head and eyes to the picture. A

score of 1-6 is generated or a percentage correct score is generated if a variable number of trials are presented across children.

Higher level behavior

2) Following line of regard: On left and right trials the child gets credit if they turn their eyes or head sufficiently to indicate that they are looking in the correct direction and beyond the end of the index finger of the tester. This rule has been established because, when the tester points past the toys that are visible during the ESCS, young children will often not follow the pointing beyond the toys. In some situations the tester's index finger may not be observable in which case a definitive head and eye turn is necessary to receive credit. On Behind trials the child must display a head turn of sufficient degrees to indicate looking in the general vicinity behind the child.

Scoring: scoring may either be presented as the number of correct trials (0-6) or the percentage of trials on which a correct response was observed.

Requesting

The function of these behaviors is to elicit supportive action or aid from the partner in obtaining objects and events. They differ from Joint Attention behaviors in that they serve more of an imperative or instrumental rather than social-sharing function. Giving in order to obtain aid in opening or activating an object is a prototypical behavior. The Initiating Requesting behaviors are most often observed when the child directs his or her attention to toys that are out of reach, or after an object spectacle has ceased moving on the table, or after a child has attempted to reactivate a mechanical toy or open the plastic jar. However, they may also be observed during Look, Book, Tickle or Invitation trials when the child redirects attention away from the presented task to request some other object or event. Responding to Requesting may occur throughout the session when the tester asks the child to give a toy or the jar (i.e., the various Object Spectacle tasks and the Plastic Jar task).

Initiating Requesting

Lower level behaviors:

1) Eye Contact: the child makes eye contact with the tester after an object spectacle has ceased or the tester has removed and object from the child.

2) Reach: the child extends their arm toward an out of reach toy. This behavior is not scored if the child simply reaches and obtains a toy. If the child gets out of his or her seat to reach for a toy on the table this behavior is only scored if the child is attempting to obtain an object from within the tester's grasp. A reach bid ends when the child retracts their arm for more than two seconds, or lays their arm on the table with hand closed for more than two seconds. Interruptions and reinitiations of a reach gesture with less than a two second interval are coded as one bid.

3) Appeal: the child combines eye contact with reaching. The eye contact may be a brief event superimposed on a longer period of reaching. However, the eye contact and gesture may be simultaneous at some point during the bid.

Higher level behaviors

4) Give: the child pushes an object toward the tester or holds and object out toward the tester. Typically the latter is toward the tester's hands or body as apposed to up toward the tester's face as in a Joint Attention Show. Giving may be rated as occurring with or without eye contact.

5) Point: the child uses an extended index finger to indicate a desired object or event. In some instances a child may reach and then turn the reach into a point or visa-versa. Typically credit is given only for the highest level behavior displayed within one bid (e.g. a point versus a reach). However a more micro-analytic coding orientation may want to explore these types of transitions form lower to higher level bids. Pointing to request may be rated as occurring with or without eye contact.

Scoring: Three scores are typically obtained on this scale: a) the Total Frequency of Requesting bids, b) the Frequency of High Level Requesting Bids and c) the Ratio of High Level to All Requesting Bids.

Responding to Requesting

1) Responds to "Give it to me": The child gives the requested object to the tester in response to the verbal command, or to the combined verbal+gestural command. [note: Testers should be careful to use a clear "command" tone of voice when making these requests (rather than a polite or playful "Can you give it to me?"). The use of a more directive tone of voice is important to convey the imperative function (rather than a playful or joint attention bid).]

Scoring: A single score is typically obtained which reflects the total Frequency of correct responses.

Social Interaction

The function of these behaviors is to elicit or maintain a physical or turn taking game with the interactive partner. Communicative bids in this category refer to objects less than in Joint Attention or Requesting and instead focus on regulating face to face interaction that may involve objects but do not involve a focus on or reference to the objects. These behaviors are most often observed in the Song/Tickle game, Turn-Taking sequences or on the Invitation task. However, Teasing (see below) may occur any time during the ESCS administration. Lower versus higher level behaviors are not rated for Initiating Social Interaction, but are rated for Responding to Social Interaction.

Initiating Social Interaction

1) Initiates turn-taking: Upon receipt of the car or the ball the child roles the car or ball back to the tester. This must occur before the child has witnessed the tester rolling the ball or car to the child.

2) Teases: The child engages in a prohibited act (e.g. holding an object away from the tester after a "Give it to me" request) while displaying positive affect toward the tester. Only one tease is recorded for the period a child is continuously engaged in the act. However, if the child releases the object and the re-obtains the object (e.g. gets the object back after throwing it across the room as a tease) or obtains a new object, a another tease may be recorded.

3) Initiates Song/Tickle: This behavior may only be rated after the first Song/Tickle task has been presented and at least one additional task has been presented. In this the child makes eye contact and runs his or her fingers across the table, or makes a tickle gesture, or claps or sings.

Scoring: The child may get credit for initiating turn taking with the car and/or the ball. Hence the child may obtain a score of 0,1, or 2 on this item. This score is added to the total frequency of Teases and Initiates Song/Tickle. The score on this measure typically is quite low.

Responding to Social Interaction

Lower Level Behaviors

1) Eye contact: The child makes eye contact with the tester after the tester has tickled the child and moved back to pause before the next tickle episode.

2) Act: The child vocalizes or bangs the table or reaches to the tester after the tester has tickled the child.

3) Appeal: The child combines an Act with Eye Contact.

Higher Level Behaviors

4) Maintains turn-taking: The highest number of consecutive turns (i.e., throwing the car or ball in interaction with the tester) is scored.

5) Responds to Invitation: The child receives a positive score for each item correctly placed on or toward the adult's head (hat, comb & classes) in response to the tester's invitation ("Can I play"). Thus, the child may receive a score of 0-3 on this item.

Scoring: The total frequency, or score, for each item is summed to yield the total Response to Social Interaction Score.

A higher level behavior score may also be generated. However, a ratio score of higher to lower level behavior is not appropriate in this scale.

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5. RELIABILITY AND VALIDITY

Much of the information on reliability and validity of the abbreviated ESCS is available in 4 papers that accompany this provisional procedures manual (Mundy et al. 1988, 1994, 1995, Mundy & Gomes, submitted). Additional information, including data on expected ages scores across the second year of life, will be available in the next 24 months with the conclusion of three ongoing longitudinal studies.

To provide some sense of ESCS scores the following mean, standard deviations and inter-rater reliability data are provided from 14 normally developing children between 14-17 months of age (Table 1). These children comprise a subsample of a high SES group who recently participated in a short term longitudinal study (Mundy & Gomes, submitted). Scores in Table 1 vary from those in the previous research articles with regard to the frequency of Requesting (Behavior Regulation) because the latter did not include a measure of Requesting Eye

Contact in the relevant scores.

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Table 1

Descriptive Statistics and Rater Reliability of ESCS Data for 14-17-Month-Old Children (N=14) ESCS Measure Rater #1 Rater #2

Initiating Joint Attention: Total	18.30(08.30)	17.80(09.00)	00.84
IJA High	03.10(02.90)	03.60(03.60)	00.89
IJA High Ratio	00.19(00.17)	00.21(00.19)	00.91
Responding to Joint Attention	00.65(00.29)	00.71(00.29)	00.86
Points in Imitation	01.60(01.70)	01.30(01.70)	00.86
Initiating Requesting Total[a]	33.80(14.40)	31.60(11.90)	00.78
Requesting High	17.70(09.90)	17.60(08.70)	00.76
Request High Ratio	00.51(00.18)	00.56(00.20)	00.94
Responds to Requests	05.60(02.10)	04.40(02.80)	00.61*
Initiates Social Interaction	01.40(00.85)	01.30(00.82)	00.91
Responds to Social Interaction	11.50(03.30)	11.90(03.50)	00.88

* The difference between rater mean scores approched significanse for this variable ($p < .08$), but the reliability estimate was significant ($p < .02$). In all other case the difference between mean rater scores was not significant and the relaibility estimates were signifcant ($p < .002$).

APPENDIX B: ESCS SCORE SHEETS

Early Social Communication Scales - Coding Sheet

Muudy et al., 2003, University of Miami

Subject Number: _____ Date Administered: _____ Date Scored: _____ Tape Number: _____

Age: _____ Tester: _____ Rater: _____ Counter: _____

Initiating Joint Attention

	1 5 10 15 20	Sum
Eye Contact (EC)		
Alternate		
Lower-Level Total:		
Point		
Point & EC		
Show		
Higher-Level Total:		
IJA Total:		

Bid to Caregiver

Responding to Joint Attention

	1 5 10 15 20
Follows Point	

Line of Regard

	Left	Back Left	Right	Back Right
Trial 1				
Delayed	O	O	O	O
Trial 2				
Delayed	O	O	O	O

% Correct: _____

RJA Total:

Initiating Behavioral Requests

	1 5 10 15 20	Sum
Eye Contact (EC)		
Reach		
Appeal		
Lower-Level Total:		
Point		
Point & EC		
Give		
Give & EC		
Higher-Level Total:		
IBR Total:		

Bid to Caregiver

Responding to Behavioral Requests

	1 5 10 15 20
Without Gesture	
Pass	
Fail	
With Gesture	
Pass	
Fail	

% Correct: _____

RBR Total:

Point in Imitation

Notes:

Initiating Social Interaction

Initiates Turn-Taking

Car ☐ *Ball* ☐ *Neither* ☐ Turn-Taking Score: ____

	1	5	10	15	20	*Sum*
Low-Level Tease	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____
High-Level Tease	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____

Tease Score: ____

ISI Total: ☐

Responding to Social Interaction

Social Interaction	1	5	10	15	20	
Eye Contact	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____
Act	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____
Appeal	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____

Total: ____

Turn-Taking

Car	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____
Ball	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐					____

Total: ____

Response to Invitation

Comb ☐ *Hat* ☐ *Glasses* ☐ *None* ☐ Total: ____

RSI Total: ☐

Language

Joint Attention

1 word ☐☐☐

2 words ☐☐☐

Behavioral Requests

1 word ☐☐☐

2 words ☐☐☐

Summary Scores

APPENDIX C: RELIABLE CHANGE CALCULATIONS

The reliable change index measures whether people who have underwent an intervention changed sufficiently, such that the change is unlikely to be due to simple measurement unreliability. 'Reliable' change is defined as greater change than the unreliability of the measure would suggest might happen for 95% of participants. This reliable change is determined by seeing whether baseline and follow up scores differ by a certain level. This level is a function of the initial standard deviation of the measure, and its reliability. Test-retest reliability was used in this case as it includes not only simple unreliability of the measure, but also any real changes in joint attention or IQ over time. Using a test-retest reliability correlation introduces a sort of historical control, i.e. the number showing reliable change can be compared with the 5% that would have been expected to show that much change over the retest interval *if there had been no intervention.*

The formula for the standard error of change is:

$$Sdiff = \sqrt{2(S_E)^2}$$

where *Sdiff* is the spread of the distribution of change scores that would be expected if no actual change occurred.

S_E is the standard error of measurement which is calculated by

$$SE = SD_1\sqrt{1 - rel}$$

Where SD_1 is the initial pooled standard deviation of the Intervention and Comparison groups and *rel* indicates the test retest reliability of the measure for the baseline and 24 month follow up scores.

The formula for criterion level, based on change that would happen less than 5% of the time by unreliability of measurement alone, is:

$$Reliable\ Change\ Criterion = 1.96 \times Sdiff$$

where 1.96 is one standard error of change for z scores. Change exceeding 1.96 times this standard error is unlikely to occur more than 5% of the time by unreliability of the measure alone

1. RESPONDING TO JOINT ATTENTION

The pooled standard deviation for both the Intervention and Comparison groups at baseline was .376

The reliability of responding to joint attention scores between baseline and 24 month follow up scores for the Comparison group was .67. The Comparison group was chosen as their scores over time are judged to be what would be expected as a rate of development, without intensive intervention.

Thus:

$$SE = SD_1\sqrt{1 - rel}$$
$$SE = 3.764\sqrt{1 - .67}$$
$$SE = 2.16$$

$$Sdiff = \sqrt{2(S_E)^2}$$
$$Sdiff = \sqrt{2(2.16)^2}$$
$$Sdiff = \sqrt{9.3312}$$
$$Sdiff = 3.058$$

$$RC = 1.96 \times Sdiff$$
$$RC = 1.96 \times 3.058$$
$$RC = 5.993$$

Change scores above 5.993 (or 6) points can be considered to have changed reliably.

2. IQ

The pooled standard deviation for both the Intervention and Comparison groups at baseline was 17.75

The reliability of responding to joint attention scores between baseline and 24 month follow up scores for the Comparison group was .80

$$SE = SD_1\sqrt{1-rel}$$
$$SE = 17.75\sqrt{1-.80}$$
$$SE = 7.94$$

$$Sdiff = \sqrt{2(S_E)^2}$$
$$Sdiff = \sqrt{2(7.94)^2}$$
$$Sdiff = \sqrt{126.0872}$$
$$Sdiff = 11.23$$

$$RC = 1.96 \times Sdiff$$
$$RC = 1.96 \times 11.23$$
$$RC = 22.01$$

Change scores above 22.01 points can be considered to change changed reliably.

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