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Mother-Infant Interaction: The Case of Infant Siblings of Children with ASD at 9, 12 and 18 Months.

A dissertation submitted for the award of Doctor of Philosophy

in Psychology to the University of Dublin, Trinity College, 2015

By Catherine Hughes

Supervisor: Dr. Jean Quigley

Declaration:

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Summary

This dissertation is a longitudinal, observational study of the interactive behaviours of mother-infant dyads where the infant is more likely to receive an autism diagnosis (SibsA), as they have an older sibling who has already received a diagnosis, and a control comparison group of typically developing (TD) dyads. Interactions were videotaped when the infants were 9, 12 and 18 months. The aim of the study is to paint a picture of the interactive environment experienced by SibsA infants. The theoretical framework acknowledged the bidirectional, intersubjective nature of the interaction, and the mother and infant's active role in shaping the exchange on a moment-by-moment basis.

The dissertation contains ten chapters. The first presents a literature review of areas of research that serve as a foundation for the study. The reader will gain an understanding of mother-infant interaction in TD dyads, and its importance for later infant development. They will gain an understanding of the characteristics of autism that may impact on infant social behaviour, as well as an understanding of patterns of behaviour that are common to mother-infant interactions that are affected by autism. The second chapter details all of the methods used to recruit dyads, and to record, edit and analyse their interactions.

The remainder of the dissertation is divided into a number of separate studies. Chapter Three examines the global patterns of socio-communicative behaviour. Chapter Four examines the responsive behaviour of mothers and infants, while Chapters Five to Eight examine the language produced during interaction, focusing on the function and syntax of maternal utterances and the prosody of maternal utterances and infant vocalisations. Each of these communicative behaviours have an extensive literature in their own right. For this reason, they are presented separately.

Each section begins with a literature review, followed by an examination of the communicative behaviour as it is displayed by the dyads in the study. This approach was chosen as it allows for a large amount of very detailed information to be presented in a coherent, linear

fashion. Chapter Nine presents individual case studies of each of the SibsA dyads, while Chapter Ten offers conclusions drawn from all studies.

The study found that while SibsA infants did show a decrease in social engagement and they produced fewer advanced vocalisations than TD infants, the majority of differences in behaviour were found between the maternal groups. Mothers of SibsA infants were less sensitive, were less likely to provide a structured learning environment and were increasingly negative toward their infants. They were found to favour utterances that functioned to gain infant attention, producing exaggerated prosody and shorter, less syntactically diverse speech. However, both maternal groups were responsive to their infants, with mothers of SibsA infants particularly responsive to their infants' emotional vocalisations, suggesting that they are actively aiding infant regulation in a manner that is not occurring for TD infants. SibsA infants were more likely to respond to their mothers than were TD infants. Further, maternal directive behaviour was positively associated with SibsA infant socio-communicative outcomes, suggesting that these infants may be uniquely benefitting from maternal behaviour that directs them toward the interaction. The case studies of each SibsA dyad revealed the unique pattern of initiation and response created by both infant and mother, and reinforced the potential beneficial effects of directive maternal behaviour. This study is the first known research to examine mother-infant interaction in SibsA dyads in such detail.

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Chapter One: Introduction

Overview

An infant's relationship with their mother is typically the first and, arguably, the most influential relationship that they will experience during their life. This study examines mother-infant interaction in dyads where the infant has a sibling with autism. The first part of this introduction will present the theoretical framework upon which it is founded. It will then describe face-to-face mother-infant interaction, emphasising the bidirectional nature of the relationship. There will be a detailed description of vocalisation, facial expression, gaze and touch within the interaction, and there will be a focus on the impact that the mother-infant relationship has on infant development.

The second part of this chapter will focus on mother-infant interactions that are affected by autism. There will be a description of the autism phenotype and behaviours related to autism that may be apparent during infancy. There will be a discussion of how autism and the broader autism phenotype may specifically affect the mother-infant interaction. There will be an exploration of the particular risk sensitivity to elements of the social environment that may be specific to individuals with autism. Finally, this chapter will present a discussion of mother-infant interaction in SibsA dyads.

Theoretical Framework

This study focuses on the intimacy of mother-infant interaction. Mothers and infants spend much of their time engaging in face-to-face, reciprocal interaction (for example, Beebe et al., 1985; Stern, 1985; Trevarthen, 1978, 1979). Through subtle changes in vocalisation, touch, movement and facial expression mother and infant engage in an intuitive dance in which they read and anticipate the actions of their partner (Stern, 1977; Trevarthen, 1979). Indeed, typical mother-infant interaction has been compared to an improvised jazz performance with both partners co-creating a spontaneous, unique and harmonious rhythmic pattern of initiation and response (Schogler, 1998). Such analogies are helpful in highlighting the important theoretical framework that is central to the present study: Intersubjectivity. At the heart of this approach is the acknowledgement of both mother and infant as active agents within the interactive exchange.

In this study, intersubjectivity describes an infant's awareness of and reception to the subjective states of their interactive partners (Trevarthen & Aitken, 2001). From birth, infants show a capacity for communication and coherent rhythmic purposeful consciousness, whereby their spontaneous movements and vocal behaviours occur as one coherent, integrated Self (Trevarthen, 1999). Through these behaviours they draw their caregiver into synchronised negotiations of actions through a variety of provocative, humorous and even teasing behaviours (Reddy, 2008; Zeedyk, 2006). In this way, the infant demonstrates an awareness of their caregiver's feelings and intentions and acts upon that knowledge. This interpretation of intersubjectivity focuses on communication created *between* partners. Intersubjectivity is created through the timing, form and intensity of maternal and infant responsive behaviours, with contingent behaviours such as smiles, gaze and changes in vocal pitch forming proto-conversations shared by both mother and infant. Typically, mothers adapt their socio-communicative behaviours to suit the multi-modal perceptual

readiness of their infant (Trevarthen, 1993). The infant shows both an awareness of and preference for the contingent responses of their mother, and mother and infant display a matching of time, form and intensity of their behaviours across modalities. Trevarthan suggested that this correspondence of form, timing and intensity allows infants to coordinate their sense of self as it impacts on other - a level of intersubjectivity defined as 'primary'. At 9 to 12 months, infants make a critical shift allowing them to intercoordinate self, other and object based on the cooperative exchange of socio-communicative behaviours that they share with their mother. This shift to secondary intersubjectivity sees the infant develop a cooperative awareness of persons and objects, allowing them to share joint attention between mother and object.

Understanding the interaction from an intersubjective perspective acknowledges the infant's active awareness of their role in the interaction and the shared creation of the exchange. The present study furthers this by emphasising the unique pattern that may be created by acknowledging the individual differences within each dyad (be they genetic, environmental or cultural), and the moment-by-moment adaptations that are actively made by both parties in response to the socio-communicative input that they receive. Within such a transactional model the mother-infant interaction is viewed as a complex system, with each member influencing and being influenced by the other (Sameroff & Chandler, 1975). Such an approach appreciates both the individual differences of those involved, and their active role in shaping the exchange, while also acknowledging consistent within-group behaviours that may be expected (Brazelton, 1962; Sameroff & Chandler, 1975). Developmental outcomes are viewed as a result of the continuous and dynamic exchange between initiation, response and the environmental factors that may influence both mother and infant (Sameroff & Chandler, 1975).

Within the present study, a Learning Theory (Bandura, 1977; Skinner, 1948, 1957) approach is taken to explain the role that environment plays in shaping the behaviours displayed by both mothers and infants. Through the examination of observable target behaviours displayed by mother and infant during the intricate dance of interaction, it may be possible to break down a chain of events in order to examine the antecedent and consequential behaviours that may precede and follow a target behaviour. For example, an antecedent stimuli may be that an infant is disengaged from the interaction, a mother may, in response, produce the target behaviour of calling the infant's name, and as a consequence the infant may re-engage in the interaction. As such, this maternal name calling behaviour may be reinforced as it was rewarded with the desired behaviour of infant re-engagement. Alternatively, name calling behaviour may cause the infant to cry. This punishing consequence may decrease the chances of maternal name calling behaviour in the future. In this way, maternal and infant behaviours are shaped or adapted by the reinforcing responses of the interactive partner.

During interaction, even typically developing (TD) dyads are not in perfect synchrony, as they cyclically shift from moments of engagement to moments of disengagement. Through the trial and error of these exchanges mother and infant learn about themselves and each other, adapting to each other's behaviour and learning to self-regulate, co-regulate and mutually-regulate. Challenges to the synchrony within the interaction for TD dyads can impact upon a mother's sense of self-efficacy and competence, which can in turn impact upon parental functioning (Duch & Rodriguez, 2010; Hess, Teti & Hussey-Gardner, 2004; Raikes & Thompson, 2005).

Atypicalities in socio-communicative behaviour are a feature often noted in both SibsA and infants with autism. As such, mothers may face even greater challenges to their sense of self-efficacy and competence as they shape their behaviour in response to atypical infant input. In an

effort to offer the reader a detailed understanding of intricate patterns of initiation and response during interactions as they occur between SibsA infants and their mothers, the next section will present, as a foundation, a review of the literature examining TD dyads.

Mother-Infant Interaction

We are all familiar with the sight of a mother and her infant joyfully looking into each other's eyes. This may seem like an ordinary, relatively unremarkable exchange, but something extraordinary is happening between them. Through tiny changes in behaviour, such as a smile, a frown, a sound, a touch or a look away, both mother and infant are sharing in the creation of the interaction. Equally extraordinary is the fact that the interactions that infants experience with their caregivers are essential for their linguistic, cognitive, emotional and social development. The well-reported stories of infants kept in situations of severe social and physical neglect in orphanages attest to the essential nature of caregiver interaction in the development of cognitive abilities, attachment relationships, social interest, linguistic abilities and even healthy hormone levels (Eluvathingal et al., 2006; O'Connor, Bredenkamp & Rutter, 1999; Smyke, Dumitrescu & Zeanah, 2002; Wismer-Fries et al., 2005).

The first half of this chapter will describe the mother-infant interaction, addressing the questions: 1) Why are mothers and infants driven to interact?; 2) What are mothers and infants doing during interaction?; and 3) Why is mother-infant interaction so important? The second half of this chapter will focus on mother-infant interaction in dyads affected by autism, and will address the questions: 1) What are the characteristics of autism?; 2) How does autism impact on the mother-infant interaction?; 3) How do we explain the social interactions of infants with autism?; and 4) What do we know about SibsA infants' interactions with their mothers?

Part One: Mother-Infant Interaction

Why are mothers and infants driven to interact?

Primed by hormonal changes and experiencing a surge of the neuropeptide 'bonding hormone' oxytocin during birth, new mothers are particularly attuned to the cries, movements and smells of their infants. MRI studies have shown that first-time mothers experience a dopamine release when simply looking at a photograph of their infant (Strathearn et al., 2007). The universal human attraction to infantile traits ensures that infants receive maternal responsive behaviours. Lorenz (1951, 1971) first identified the unique infant traits that adults find charming: relatively large head; large, low-lying eyes; pudgy cheeks; thick extremities and clumsy movements. Even amongst undergraduate students with no children of their own, infants who displayed a higher level of these *kinderschema* infantile qualities were rated as more appealing (Alley, 1983). The above findings suggest that the mother-infant interaction is a naturally occurring process. However, the near-endless variation of maternal and infant traits (such as temperament and genetic endowment) and environmental contexts (such as Socio-economic Status [SES] and birth-order) highlight the bioecological nature of the interaction (Bronfenbrenner, 2004), with the individuals and their responsive behaviours influenced by their own biological inheritance as well as the micro- and macrosystems in which they occur.

It is not only mothers who show a preference for interaction. From birth, infants show an ability to socially relate to their caregivers, with a different set of reactions displayed when interacting with humans as opposed to inanimate objects (Tronick & Brazelton, 1980). When infants were introduced to a toy monkey that was moved on a wire, they responded with excitement and

attempts to explore the toy. However, when they engaged with their mothers they displayed much more social behaviours by making eye contact, looking away and looking back and by smiling.

Within the first few minutes of life, newborns will preferentially look at shapes collected in a face-like structure as opposed to shapes randomly presented. They also attempt to make eye contact with social partners immediately after birth (Field, Cohen, Garcia & Greenberg, 1984). Infants also show an innate preference for their own mother's voice, with infant brain waves changing in response to vocalisations from their own mother as opposed to another female speaker (Field et al., 1984). When infants are given the opportunity to control the voice that they hear by altering their sucking rate on a teat, infants paced their sucking rate such that they heard their mother's voice as opposed to that of a female stranger (De Casper & Spence, 1986). Thus infants actively controlled their environment to be closer to their mother. This preference for the maternal voice is less apparent in infants of depressed mothers (Field et al., 1984). The interactions of infants and depressed mothers will be discussed in greater detail later in this chapter.

At birth, if there has been limited medical intervention and the infant has not been washed, they will guide themselves toward their mother's breast using their legs to push themselves forward. Unaided, the infant can find their mother's nipple and begin feeding (Klaus, 1998). Smell is central to this process, with one study finding that infants are primed to recognise their own mother's smell. Macfarlane (1975) found that when placed in a cot with the scent of their own mother's breast milk on one side and the scent of another mother's breast milk on the other side, infants will strain towards their mother's scent. When the sides are switched, infants will turn and strain, following their mother's scent. This study is important as it highlights that an infant's response to their mother is not simply innate. It illustrates that infants will actively adapt their behaviour in response to a desire to remain close to their mother.

It has been found that if an infant is fed by its mother within the first hour of life, the mother will spend a daily average of 100 minutes more interacting with the infant, in comparison to those who have not fed within their first hour (Widström et al., 1990). This physical closeness and feeding promote a release of hormones such as vasopressin and oxytocin which produce joyful feelings and promote bonding for both mother and infant. As such, both mother and infant experience an immediate benefit from active engagement in the interaction.

The Chemistry of Mother-Infant Interaction. Oxytocin is a hormone present only in mammals, which aids bonding and lowers maternal susceptibility to stressors (Carter & Keverne, 2002). It is released during pleasurable moments in life such as falling in love, having sex, getting a massage and breastfeeding. Oxytocin is more prevalent in monogamous mammals, which highlights its active role in bonding. A higher level of maternal oxytocin during pregnancy is associated with better bonding between mother and infant, more affectionate touch and positive gaze (Leng, Meddle & Douglas, 2008). Feldman et al (2010) found that parents who used high levels of tactile contact had raised levels of oxytocin following fifteen minutes contact with their infant. Gordon et al (2010) found that oxytocin-increase was associated with affectionate parenting behaviours, with mothers showing raised oxytocin in connection with the expression of positive affect, affectionate touch and the unique form of speech produced in interaction with infants called Infant Directed Speech (IDS). Paternal oxytocin is correlated with the degree of stimulatory parenting behaviours, including proprioceptive contact, tactile stimulation, and object presentation.

One study proposed that as the display of maternal behaviour and the amelioration of social stress are both influenced by oxytocin levels, early infant experiences may play a role in the long-term expression of oxytocin, and in turn, the transmission of social affiliations (Feldman et al., 2010). In order to investigate the cross-generation transmission of oxytocin in humans, they

examined the oxytocin levels of mothers and infants prior to and following interactions, and they also examined the level of synchrony displayed by each dyad. They defined synchrony based on the work of Feldman and Eidelman (2004), focusing on: 1) the co-occurrence of infant directed speech (IDS) and positive infant vocalization; 2) joint gaze; and 3) parental touch accompanied by infant eye contact. Feldman et al (2010) found that when parents and infants interacted for 15 minutes, they had strongly correlated oxytocin levels. They also found that those dyads that displayed high synchrony displayed higher oxytocin levels following interaction, and their oxytocin levels were more strongly correlated. Feldman et al. (2010) suggest that this highlights a bio-behavioural feedback loop of oxytocin, parenting, and social competence: between maternal oxytocin and maternal parenting behaviours, between maternal behaviour and infant oxytocin expression, and between infant oxytocin and the infant's life-long capacity for social affiliation, stress management and adaptation to social groups.

What are mothers and infants doing during interaction?

From birth, infants are innately driven to seek out social engagement (Trevarthen & Aitken, 2001). From 1 to 14 weeks infants actively attend to their mothers during face-to-face interaction, with the greatest proportion of communication conveyed through eye contact (Lavelli & Fogel, 2002). As infants age and their perceptual, communicative and motor abilities increase, infants spend more time actively focusing their attention on their caregiver (Trevarthen & Aitken, 2001; van Wulfften Palthe & Hopkins, 1993). Conversely, infants can actively disengage from the interaction through turning their head, closing their eyes and looking away, thus regulating the flow of interaction and regulating their emotions (Cohn & Tronick, 1989; Tronick, 1989). Through these gestures the infant can communicate with their caregiver that they are reaching a point of over-stimulation. In response, a mother may lower the level of stimulation or she may display a more

intrusive response such that she persists in attempting to gain infant attention, resulting in infant over-stimulation and further withdrawal. In this sense, infant withdrawal is a typical and necessary part of face-to-face mother-infant interaction. However, more sustained withdrawal has been noted in dyads impacted by specific challenges such as maternal depression (Field, 1984), infant autism, non-organic failure to thrive, chronic pain or post-traumatic stress disorder (Guedeney, 1997). Depression in infants is a controversial issue, but researchers have indicated that sustained and/or severe withdrawal may be a key symptom (Guedeney, 1997, 2004; Herzog & Rathbun, 1982).

Researchers have also focused on mothers' abilities to adjust their behaviour, interventions and initiations in response to infant mood, state and interests (Ainsworth et al., 1978; Biringen & Robinson, 1991). Mothers may be defined as intrusive if they interrupt or prevent the infant's ongoing activity, or if their behaviour is guided by their own interests, rather than following those shown by the infant. Conversely, mothers may be deemed remote if they are unresponsive, unavailable, and physically distant and if they provide limited social structuring to guide the infant in engagement. These extremes in parenting style have been noted repeatedly in mothers affected by postnatal depression. Some depressed mothers are unresponsive and remote, while others are intrusive, hostile and physically over-stimulating (Field et al., 1990; Jones et al., 1997; Tronick & Weinberg, 1997). Changes in EEG-activity and biochemical markers specific to withdrawn and intrusive parenting styles have been noted amongst depressed mothers (Field et al., 2003). Depression in mother-infant interaction is discussed in greater detail later in this chapter.

An approach that may be considered opposite to intrusiveness is sensitivity, which researchers have attempted to define by examining a number of aspects of maternal behaviour during face-to-face interaction. Sensitivity can be defined as an awareness of the infant's bids, accuracy in

interpreting those bids, a promptness in response and an appropriateness of response (Ainsworth et al., 1978). Even within these definitions, researchers have chosen to focus on particular elements of behaviour such as genuine and congruent positive affect (Biringen & Robinson, 1991), enjoyment, mirroring, structuring, connectedness and mediating the environment on behalf of the infant (Kivijärvi et al., 2001). Mothers' ability to see things from their infant's point of view has also been emphasised, with such behaviour termed 'mind-mindedness' (Meins et al., 2001), 'insightfulness' (Oppenhein & Koren-Karie, 2002) and 'mentalising' (Fonagy, 1998).

The abundance of studies examining maternal sensitivity suggests it is a central aspect of maternal behaviour within interaction. However, the concept has been defined in so many different ways that it would be useful to examine the construct from a range of perspectives rather than a single perspective as is often the case. Indeed, when the construct is examined as a range of variables, a high internal consistency is found across variables, indicating that they are elements of a broader phenomenon (Kivijärvi et al., 2001).

Communicating vocally. Just as mother-infant interaction is central in establishing an infant's social understanding of their environment, so too is it essential in infant language acquisition. While the next chapters will present a detailed account of the components of maternal language and their impact upon the infant, this section will present an overview of maternal vocalisations. When speaking to infants it is common for mothers to use a distinctive style of speech known as Infant Directed Speech (IDS). This has specific characteristics: speech is higher pitched, a greater number of repetitions are used, pauses are shorter, and longer hyperarticulated vowels are used. Long before infants can use or even fully understand the speech to which they are exposed, they display interest in the unique rhythm, prosody and tempo of IDS. It is not only mothers who use IDS: fathers, close relatives and even children as young as 4 years have been found to address

infants in this unique manner (Fernald, 1985). The coming chapters will examine in detail the function, syntax and prosody of IDS.

Communicating via facial expression. Infants are provided with a unique set of vocal stimuli by their caregiver. However, interaction is a multi-modal process which means that infants are exposed to a broader range of stimuli. While a large amount of research has examined the vocalisations that infants hear as they grow, fewer studies have examined maternal facial expression. Infants are aware of caregiver facial expressions and can imitate them from very early in infancy (Meltzoff, 1985, 1990). Indeed, the facial expressions used by mothers in interaction with their infants have been compared to IDS, as the expressions tend to be more exaggerated, slower and longer in duration than those directed towards adults (Stern, 1974). Just as IDS is a largely cross-cultural phenomenon, the exaggerated nature of maternal facial expressions can also be seen cross-culturally, with three distinct, exaggerated affective expressions used in interactions with infants (Chong, Werker, Russell & Carroll, 2003). So nuanced is the use of facial expression within the interaction, that it has been found that mothers and fathers will use different types of smiles when interacting with their infant, depending on the sort of activity that they are engaged in (Dickson, Walker & Fogel, 1997).

Naturalistic studies have helped to establish the influence that maternal facial expression can have on infant behaviour. Studies have found that parents both lead and imitate their infant's actions, using their facial expressions to communicate affect as well as maintaining infant attention and emotional regulation (Murray & Trevarthen, 1985; Reddy et al., 1997). Experimental studies have shown that infants attend more to interactive faces as opposed to still faces (Cohn & Elmore, 1988) and that they favour an exaggerated expression over a neutral expression (Kuchuk et al., 1986). Further, infants smile more in response to an active face but grimace more at a still face

(Stack & Muir, 1992). Within the first 6 months of life, infants are capable of discriminating between facial expressions (La Barbera et al., 1976; Young-Brown et al., 1977) and of categorizing facial expressions (Nelson, 1987). They also look preferentially at videos that match facial expression with vocal affect (Walker, 1982).

Given the bidirectional nature of interaction, it is unsurprising that it is not only mothers who communicate meaning through their facial expressions. Naturally, infants are displaying affect as they exhibit a variety of facial expressions, but it has also been suggested that they are able to express interest through their use of facial expressions. Through the use of anticipatory smiles, infants appear to communicate positive affect by smiling at an object and then smiling at their caregiver. This communication of intent in relation to the object and future play has been found to increase between 9 and 12 months as infants engage in increasing amounts of joint attention interaction. The use of such anticipatory smiles has been linked to infant social expressivity at 30 months (Parlade et al, 2009). Such studies highlight the active role that both mother and infant facial expression plays within the interaction. It communicates both affect and intent and helps to build the shared, intersubjective pattern of initiation and response that is the foundation of mother-infant interaction.

Communicating via gaze. Alongside facial expression and vocalisation, an individual can also influence a social exchange through the pattern of looking that they choose to use. Eye contact may elicit or maintain engagement, while disengaging from eye contact may put an end to a social exchange. From birth, it appears that typical infant looking behaviour is primed for social engagement. At 2 days old, infants have been found to preferentially look at their mother's face over that of a stranger (Bushnell et al., 1989). Even on videotape, with the distractions of smell and sound removed, an image of the mother's face is preferable to that of a stranger (Walton et al.,

1992). Given that infants generally prefer to look at novel stimuli, this finding suggests that the need to gaze at their mother's face overrides their preference for novelty.

Such findings have led to the suggestion that typically developing (TD) infants are born with an innate face recognition mechanism (Morton & Johnson, 1991). In support of this, one study found that infants that are just hours old have been found to visually track stimuli that are similar to faces as opposed to stimuli with features randomly placed in a non-face like structure (Morton & Johnson, 1991). However, it has been found that those infants who are given a longer time to interact with their mother will spend a greater amount of time gazing at their mother's face as opposed to a stranger's, which suggests that the social environment plays a role in influencing gaze preference (Bushnell, 2001). Furthering this idea, Turati et al. (2002) found that newborns display a preference for looking at stimuli with elements placed at the top, whether they are face-like or not. They suggest that this preference may lead infants to attend to faces, which in turn may help to create neurons that specialise in face recognition. Hence, infants are primed for face recognition, but it is through social interaction that they develop a preference for gazing at familiar faces.

It is not simply preference that guides infant looking behaviour. Infants communicate with their caregivers through a cross-modal pattern of behaviour that includes gaze. For example, by the end of their first year, infants will gaze at their mother prior to crying in an effort to convey their distress (Gustafson & Green, 1991). Indeed, by as early as 14 weeks, infants can coordinate their gaze, facial expression, gesture, vocalisation and posture in face-to-face interaction with their mothers (Lavelli and Fogel, 2005).

In a study of infants aged 4 to 10 months, it was found that infants rarely made eye contact with their mother while displaying a blank facial expression, with eye contact predicting a smile (Lin & Green, 2009). Similarly, infant eye contact with their mother was typically coupled with vocalisation

at 7 and 10 months, but not at 4 months. Equally, they looked away from and vocalised less with an unfamiliar adult, as compared to interactions with their mothers (Lin & Green, 2009). Such findings illustrate the developing communicative content within infant gaze behaviour that not only influences maternal behaviour, but is also influenced by maternal behaviour. Indeed, maternal cardiac response has been found to increase even in response to a video simulation of eye contact with their infant, while disengaged eye contact saw a decrease in cardiac response (Leavitt & Donovan, 1979). Just as patterns of maternal vocalisation have been found to change over time, maternal eye gaze has also been found to change in response to infant development. As infants reach 8 months, mothers decrease the amount of eye contact that they share with infants in response to 'warm' and 'neutral' infant emotions; however, they use a similar pattern of eye contact in response to infant 'cold' emotions. Within the study it was also found that infants decreased their looking behaviour in response to maternal 'neutral' emotion, but remained at a fixed rate in response to maternal 'warm' emotions (Slee, 1984). Such findings highlight the important functional adaptedness of both maternal and infant gaze, with signalling, information seeking and expression all associated with eye contact.

Communicating via touch. Touch is integral to infant development, contributing to social awareness (Lamb & Hwang, 1982) and identity formation (Koester et al., 1989). The benefits of caregiver touch have been documented in various areas, not least in relation to infant health. Premature infants who receive gentle tactile stimulation show increased weight-gain and calorific intake (Watt, 1990). Similarly, Rey and Martinez (1983) have found that infant-caregiver touch following birth increases breastfeeding, reduces infant respiratory distress, and results in synchronised body temperature. Touch also contributes to the neurological development of newborns; for example, Glover, Onozawa and Hodgkinson (2002) found that training depressed

mothers to massage infants resulted in infants experiencing increased levels of the stress-relieving hormone oxytocin. This early exposure to oxytocin leaves infants neurologically primed with the hormone, such that they can experience higher levels with greater ease. This study also focused on infants who received intermittent/aggressive touch. These children had raised levels of the hormone Cortisol, which is associated with stress. Orbach (2009) posits that such infants are biologically and psychologically predisposed to experiencing greater levels of stress in later life.

While the impact of maternal touch on infant development has been well-established, the role of infant touch in mother-infant interactive exchanges is not so well understood. Prior to (and, indeed, following) the development of vocal communication, touch is a central part of the infant's communicative repertoire. Infants typically spend 85 per cent of their time engaged in touch behaviours (Moszkowski & Stack, 2007). Weinberg & Tronick (1994) suggest that infant communication is enhanced by using touch alongside other communicative behaviours, with individual behaviours reflecting only a portion of the complexity of infant communication. As such, they suggest that infants combine non-verbal behaviours to communicate their needs and desires. In order to examine this assertion, Moszkowski et al. (2009) investigated infants' use of touch as it occurs in relation to other behaviours (gaze and affect), when interacting with their mothers in normal and perturbed situations during the Still Face procedure (Tronick et al., 1978). This procedure sees mothers exhibit emotional unavailability towards their infant for a brief Still Face (SF) phase, which follows and precedes two phases of normal face-to-face interaction (FTF1 and FTF2). Infants reliably exhibit increased neutral to negative affect and gaze aversion during the SF phase, with a carry-over effect into FTF2. This suggests that infants respond to maternal emotional availability, and that they change their own behaviour to regulate their arousal.

Moszkowski et al. (2009) found that during the Still Face procedure, infants adapt touch, gaze and affect within the interactive context, changing their behaviour in response to their partner's behaviour and allowing touch to play a communicative, regulatory or exploratory role. Once again, this demonstrates not only the multimodal nature of mother-infant interaction, but also the important role that one interactive partner plays in influencing the behaviour of the other.

Why is mother-infant interaction so important?

Mother-infant interaction and infant language acquisition. The coming chapters will offer a detailed description of the function, syntax and prosody of IDS in mother-infant face-to-face interaction. Alongside this, they will present the role that these speech characteristics play in gaining the infant's attention, highlighting the structural elements of speech and conveying caregiver emotion, all of which contribute to language acquisition. A more general discussion of language acquisition will be presented in this section.

Vygotsky (1962) emphasised the important role of social factors in shaping development, suggesting that interaction with a primary caregiver allows the infant to internalise their culture and ways of thinking and being. Tomasello (2003) suggested that this developing intersubjectivity allows the infant to understand their caregiver's intentions, allowing them the opportunity to develop joint attention and social referencing. In one study, Tomasello (2003) found that infants were able to associate a nonsense verb with a particular action when they were able to read the intentionality that accompanied the word. This highlights both the important role of the interactive partner in aiding language development, but also the necessary ability to acknowledge and interpret the intentions of others.

In a similar experiment, Tomasello (2003) asked an adult to tell children that they were looking for an object with a nonsense name. They then reacted to objects unfamiliar to the child with

disappointment (indicating that they had not found the object) or excitement (indicating that they had found it). The children quickly learned to associate the nonsense word with the object that elicited excitement. Thus children were learning language through their ability to understand and attend to the intentions of their interactive partner.

Adapting IDS to Infant Needs. As infants become more adept at vocalising, mothers naturally adapt their responses to infant behaviours. For example, Gros-Louis et al. (2006) examined the relationship between infant vocalisation and maternal vocal response in a sample of 7 to 10-month-olds. They found that 70 per cent of infant prelinguistic vocalisation was contingently responded to by mothers. Maternal response differed depending on the type of vocalisation used by the infant, with a distinction drawn between vowel-like and consonant-vowel vocalisations. In general, mothers responded to infant vocalisations with acknowledgements. However, in response to vowel-like sounds, mothers produced an equal number of acknowledgements and play vocalisations. When infants produced consonant-vowel like vocalisations, mothers responded with acknowledgements three times as often as the next most frequent category, imitations. Vowel-like vocalisations were likely to gain a response of play-vocalisation significantly more often than were consonant-vowel vocalisations. Consonant-vowel vocalisations from infants were significantly more likely to gain an expansion or imitation than were vowel-like vocalisations. Gros-Louis et al. (2006) suggest that this pattern highlights the important role of IDS in providing feedback to the infant. In selecting specific responses for particular types of vocalisations, mothers are providing information about the meaning of infant vocalisations. Mothers appear to treat vowel-like vocalisations as more expressive, responding in turn with play. In contrast, consonant-vowel vocalisations are more developmentally advanced vocalisations and they result in more expansion or imitation, suggesting

that such sounds are considered meaningful by the mother and through her response she is encouraging repetition of such infant vocalisations.

These acknowledging responses from mothers following infant consonant-vowel vocalisations also provide a more conversation-like structure to the interaction. This provision of early linguistic scaffolding allows for the introduction of age-appropriate changes in interaction that help to develop the infant's emerging cognitive abilities. Infant vocal behaviour, alongside social structures such as joint attention and turn-taking, elicit specific responses from caregivers that in turn facilitate the infant's learning that the production of certain socio-communicative behaviours are linked to caregiver response (Locke, 1996). The ability of mothers to provide contingent and responsive interactional exchanges serves to facilitate the infant's ability to understand the adult as intentional agents within the interaction (Tomasello, 1995).

It is not simply through a caregiver's use of words that an infant learns language. Beebe et al. (1997) emphasised the important role that more subtle elements of dyadic interaction play in infant learning. The pauses, timing and exchanges of eye contact that make up the early proto-conversations of mothers and infants set the scene for more advanced conversations as infants age, with the rhythm of the early mother-infant interaction helping infants to understand how conversational dialogue is structured.

Mother-infant interaction and infant social development. It has been suggested that early maternal and infant behaviours can impact on the later social behaviours of infants (Gerhold et al., 2002). Social withdrawal in childhood has been linked to internalised behaviours such as depression and anxiety in later life (Rubin and Lollis, 1988). Infants who become socially withdrawn in later childhood show low levels of eye contact, less smiling and less positive vocalisation when in interaction with their mothers. Similarly, mothers of infants who would later become socially

withdrawn showed atypical patterns of behaviour, with less facial responsiveness and more motor responsiveness during interactions with their infant. This, again, displays the importance of the interactive relationship on infant development, with both parties playing an active role in the exchange.

Gergely and Watson (1999) proposed a Contingency Detection Model in which infant development is founded upon the detection of contingencies, first contingencies based on their own actions and their impact upon the world around them, followed by an awareness of the contingency of response from their interactive partner. Gergeley and Watson (1999) posit that at 3 months of age, infants become aware of the contingent responding of their interactive partner, and that this heralds the establishment of intersubjective connections, and the ability to interpersonally communicate. Certainly, contingent responding has been found to have a strong impact on the behaviour of both infant and mother. Murray and Trevarthen (1985) found that dyads could interact contingently while separated, but watching each other's behaviour on a live feed. However, when they were shown a video of their partner responding, but in a non-contingent manner, communicative responding changed, with infants becoming distressed and avoidant, and mothers becoming more self-focused, controlling and critical. Trevarthen suggests that mother-infant proto-conversation requires a mutual awareness and active, deliberate responses from both partners, which highlights the importance of the intersubjective experience for both interactive partners.

Mother-infant interaction and infant self-regulation. The regulation of emotion and behaviour is a key aspect in development, allowing for (amongst other things) the delay of gratification, sustained attention, motor control and the ability to exert cognitive control and think before acting. In early infancy, gaze aversion and fussiness are two of the limited strategies of self-regulation that

are available to infants. At 6 months, infants are more likely to use these strategies over self-soothing or self-distraction regulatory strategies (Mangelsdorf, Shapiro & Maltzolf, 1995). Environmental factors have been linked to the development of self-regulatory behaviours in infancy, and chief amongst these is the interaction between mother and infant.

A link has been found between sensitive contingent maternal responding when sharing joint attention with their child, and a 2-year-old's ability to use self-distraction as a regulatory strategy when waiting to receive a gift (Raver, 1996). Similarly, when parents employ positive guidance methods such as praise, encouragement and physical affection, children use better coping strategies when engaged in frustrating activities (Calkins & Johnson, 1998). Mothers who are negative, intrusive or hostile when interacting with their infant are more often linked to infants who show negative behaviours and who, with age, show greater levels of externalising behaviour (Marchand, Hock & Widaman, 2002). The developmental outcomes of the infant are linked to behaviours of both partners in the interaction. The intersubjective co-construction of the interaction allows for the development of infant self-regulation, and the responsive behaviours of the parent impact upon the child's longer term self-regulatory responses.

Mother-infant interaction and infant attachment. It has been established that caregivers play an essential role in healthy infant development. They also play a central role in the pattern of interaction that their infant will display throughout their life. As such, the pattern of warmth and consistency with which mothers interact with their children becomes a blueprint for the manner in which the children develop attachments in future relationships, even into adulthood (Bowlby, 1969; Ainsworth et al., 1978). The establishment of attachment styles are beneficial to the infant, as they offer a means for the infant to maintain closeness to their caregiver. Infants actively adapt their behaviour in response to caregiver behaviour patterns, with secure children comfortable to

explore their environment in the knowledge that they have a secure base to return to, while insecurely attached children learn to monitor their unpredictable parent or limit the amount of emotion that they express, to better maintain a close relationship.

Bowlby (1969) first theorised that infants develop *internal working models* to make sense of relationships, with the relationship with their primary caregiver acting as an unconscious template whereby an internal representation of relationships is formed and applied to future relationships in order to predict the responses of others. In a more recent study, Beebe et al. (2010) found that differing patterns of contingent behaviours were early markers for infant attachment style. The research suggested that self-contingency (the individual's own rhythmic pattern of behaviour) at 4 months played a strong role in attachment development at 12 months. Similarly, infant interactive contingency (the pattern of infant response to the mother) was also highly predictive of attachment style. While, traditionally, attachment literature has focused on maternal responding and its role in attachment development, Beebe et al. (2010) found that maternal contingent response was less predictive, with both high *and* low levels of contingency responding from the mother at 4 months linked to insecure attachment at 12 months. They suggest that these findings present a strong case for the bidirectionality of infant attachment development, with infant response playing an active role in the co-construction of the relationship.

Part Two: Autism and Mother-Infant Interaction

Given the impact that Autism Spectrum Disorder (ASD) may have on the socio-communicative behaviours of those diagnosed, it is reasonable to speculate that such behaviours may also impact upon the form that the mother-infant interaction takes. The next section will offer a description of the autism phenotype, with a specific focus on atypicalities that may be apparent in infancy. It will examine how the mother-infant interaction is affected by autism. It will also review the literature focusing on SibsA infants.

The characteristics of autism

The disorder/condition was first described by Kanner (1943) and Asperger (1944/1991), who independently chose the term 'autism' to describe children who showed a limited interest in engaging with others and displayed by a lack of eye contact and touch, as well as a reluctance to be close to others and a preference for playing with objects rather than people. Kanner grouped these behaviours with the term 'autistic aloneness'. A second feature identified was 'a desire for sameness', which focused on the desire of children with autism to maintain routine in their actions and environment. More recently, The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5*)* criteria for diagnosis focused on similar specific areas:

- Social communication and interaction deficits – specifically in social-emotional reciprocity, nonverbal communications and in developing, maintaining and understanding relationships.
- Restricted and/or repetitive behaviours or interests – specifically, stereotyped motor behaviours, inflexible adherence to routines, restricted and intense interests and hyper/hypoactivity to sensory input.

Behaviours associated with ASD during infancy. While behavioural markers are often noticed in infancy, the average age of diagnosis is still between 2 and 3 years (Barbaro & Dissanayake, 2009). A number of methods have been used to try to establish behaviours that may be associated with autism during infancy.

Home movie studies. In retrospective studies of infants prior to their first birthdays, reviews of home movies of infants later diagnosed revealed that infants displayed different patterns of socialisation as compared to TD infants. Specifically, they preferred to spend time alone, they made little eye contact, they displayed poor social interaction and they tended to ignore people. They were also found to display differences in communicative abilities, with a lack of vocal expression, gesture, social smiles, imitation and appropriate facial expressions (Adrien et al., 1991, 1992, 1993). One study found deficits in social smiling and eye contact in infants as young as 6 months (Clifford & Dissanayake, 2008).

In further studies that focused on home movies of infants' first birthdays, it was found that four behaviours could be used to differentiate 90 per cent of the sample of infants later given an ASD diagnosis from those not diagnosed: a lack of eye contact, a lack of communicative pointing, a lack of object presentation and a lack of orientation in response to the calling of their name (Osterling & Dawson, 1994, 1999; Mars, Mauk & Dowrick, 1998). Using the same methods, it has also been found that at 1 year of age, infants later given a diagnosis display a significant amount of stereotyped behaviours as compared to TD infants. However, the study did emphasise that a similar pattern of stereotyped behaviour was found in infants with intellectual disability and therefore such behaviours may not be specific to ASD (Werner & Dawson, 2005).

Studies utilising home movies are beneficial as they allow the study of early infant behaviour in a natural and familiar setting, while also providing the opportunity for trained, unbiased

researchers to objectively examine the behaviours displayed. However, the single-camera nature of home videos would make it difficult to capture in detail the behaviours of both mothers and infants during interaction. Equally, the typical, every day, face-to-face interaction of mothers and infants may not have been the focus of recording when home videos were being made. Rather, parents were more likely hoping to preserve memories of particular special occasions.

Questionnaire and self-report studies. A further method used by researchers to examine the early behaviours of infants later diagnosed with ASD is parental questionnaires. One study found that parents reported significantly lower communication and social attention in infants aged between 12 and 18 months. Specifically, as compared to TD infants, infants who later gained a diagnosis displayed lower levels of physical affection seeking, imitation, pointing at objects, checking for their parents, engaging with other children, playing peekaboo and waving goodbye spontaneously (Vostanis et al., 1998). In a study of 153 parents who had a child with ASD, it was found that before the age of 2, infants displayed poor social awareness, rarely shared enjoyment and made low levels of eye contact. They also spent little time engaging in joint attention with parents or peers (Young et al., 2003).

Parental questionnaires examining infant behaviour are useful as parents have the advantage of being able to observe their infant's behaviour over time and across a variety of settings. However, parents may not be in a position to accurately examine the intricate and subtle behaviours associated with ASD as well as trained researchers conducting a systematic assessment (Stone et al., 1994). Similarly, parents may (consciously or unconsciously) use compensatory behaviours to elicit particular responses from their infants, and their reports may not reflect these subtle differences in infant response (Baranek, 1999). Further to this, such reports are dependent upon parental memory of interactions prior to diagnosis. As such, memories may be influenced by the

diagnostic status of the infant, as, for example, behaviours that are associated with ASD may appear more salient in the memories of parents whose infants received a diagnosis.

Case studies. Case studies of infants with autism have also offered insight into the intricate pattern of behaviours that are co-constructed between mother and infant. In a study following an infant born in the United States (Dawson, Osterling, Meltzoff & Kuhl, 2000), the first 6 months were largely notable for a range of physical atypicalities: poor oral motor coordination, poor muscle tone, poor state regulation and hypersensitivity to touch. Interestingly, during the first 6 months, the infant vocalised and responded to face-to-face interaction with smiles and cooing. However, from 6 to 12 months, motor difficulties continued, hypersensitivity increased, sleep became irregular and motor stereotypies began. Difficulties in social interaction began to become apparent, alongside decreased levels of eye contact and a failure to imitate physical and vocal behaviours. By the time he had reached his first year, the infant met the criteria for an autism diagnosis, with impairments in social interaction and verbal and non-verbal communication and a display of stereotyped motor behaviours. In interaction he failed to engage in reciprocal social exchanges, which included communicative vocalisations, social imitative play and response to or initiation of joint attention. Interestingly, by 1 year of age the infant showed no impairments in working memory, speech perception or response inhibition (Dawson, Osterling, Meltzoff & Kuhl, 2000).

Case studies, by their nature, lack generalizability, and as such any findings produced may not match those of the general population. However, they do offer insight into the experiences of the individual, allowing the researcher an opportunity to take a detailed look at behaviours that may not be possible in a larger sample.

Prospective studies. In prospective studies, researchers identify those infants more likely to be diagnosed with autism. A common area of research focuses on infant siblings of children who have

received a diagnosis (SibsA infants), as prevalence of the disorder in this cohort is reported to range from 8 per cent to 20 per cent, compared to 1 per cent within the general population (Ozonoff et al., 2011; Sumi et al., 2006). A number of studies have suggested that birth order may be linked to the likelihood that a sibling will receive a diagnosis, with Turner et al. (2011) suggesting that the likelihood of a diagnosis increases with each sibling born. Further studies have suggested that close intervals between births increased the likelihood of a diagnosis (Cheslack-Postava et al., 2011; Martin & Horriat, 2012). A more recent study found that second born children may be most likely to receive a diagnosis, with likelihood decreasing with subsequent births (Cheslack-Postava et al., 2014).

In a study of 150 infant siblings of children with autism, Zwaigenbaum et al. (2005) found that an abnormal pattern of eye contact, visual tracking, orienting to name, imitation, social interest, social smiling, reactivity sensory-orienting behaviours and disengaged visual attention were linked to diagnosis at 24 months. However, it is unclear whether such behaviours are associated specifically with ASD or whether they may be found in other developmentally disabled infant groups.

A further study followed nine of the diagnosed infants in the above Zwaigenbaum study. Two subgroups were found, with one displaying a profound decrease in cognitive abilities from 12 to 24 months, while the other maintained average or near-average cognitive abilities. All displayed impairments in socio-communicative abilities (Bryson et al., 2007). In both the Zwaigenbaum and Bryson studies, no statistically significant differences were found between TD and later-diagnosed infants at 6 months. This pattern was found in a further study of siblings of children with autism and TD infants at 6, 14 and 24 months. They noted 'developmental worsening' between 14 and 24 months on motor skills and linguistic abilities (Landa & Garrett-Mayer, 2006).

Another prospective study sought to investigate the joint attention behaviours of infant siblings at 14, 24, 30 and 36 months. Three groups were identified: 1) those who were not given a diagnosis; 2) 'broader autism phenotype' (BAP) – those who displayed delays in linguistic or social functioning but had not received a diagnosis at 3 years; 3) those infants who did go on to receive an autism diagnosis. Deficits in infant response to joint attention (RJA) were noted at 14 months for both BAP and diagnosed infants. However, by 24 months, large improvements were noted for the BAP and TD infants, but diagnosed infants were still displaying deficits in response to joint attention. Further to this, infant RJA at 14 months was predictive of later language abilities and diagnostic status (Sullivan et al., 2007).

Other studies have also examined the socio-communicative abilities of infant siblings, with one study finding that by 12 months, siblings of infants with autism display fewer high level communicative behaviours (making eye contact, pointing, offering toys). By 15 months they were displaying lower levels of joint engagement and by 18 months they were displaying lower levels of RJA (Cassel et al., 2007). Differences in gestural communication have also been noted in infant siblings, with fewer gestures occurring at 12 and 18 months as compared to TD infants. They also displayed fewer phrases at 12 and 18 months, alongside poorer understanding of phrases and words at 18 months (Mitchell et al., 2006). Beyond socio-communicative impairments, prospective studies have allowed for the identification of other differences in the behaviour of infant siblings of children with autism. These 'SibsA' infants display higher levels of spinning, rotating and unusual visual exploration of objects (Bryson et al., 2008). They also display impaired motor control, behavioural reactivity and difficulty with transitions (Ozonoff et al., 2008).

In the main, prospective studies have been used to identify characteristics that may function as early markers for autism diagnosis (for example, Landa & Garrett-Mayer, 2006; Zwaigenbaum et al.,

2005). Other SibsA studies have compared SibsA and TD infants over a variety of domains, but infants were not followed longitudinally and no information regarding diagnosis was gathered (Bedford et al., 2012; Merin et al., 2007; Stone et al., 2007).

Another focus of prospective studies has been to examine early signs of BAP, in which infant development is tracked and those who receive an autism diagnosis are removed such that the focus of the study is SibsA infants who do not gain an autism diagnosis. Such studies have highlighted differences in non-diagnosed SibsA infant behaviour in comparison to TD infants, finding poorer response to joint attention at 14 months (Sullivan et al., 2007), poorer social referencing at 18 months (Cornew et al., 2012) and differences in temperament at 7 (Clifford et al., 2013) and at 14 months (Garon et al., 2009). At 18 to 27 months non-diagnosed SibsA infants displayed lower scores on measures of receptive and expressive language skills, overall IQ, adaptive behaviour and social communication skills (Toth, Dawson, Meltzoff, Greenson & Fein, 2007). In a study that followed 170 SibsA infants who did not receive an eventual diagnosis, 19 per cent were found to have elevated scores on the Autism Observation Scale for Infants at 12 months, and this subgroup was found to have low scores on independent social-communication and cognitive measures (Georgiades et al., 2013). Taken together, the above studies suggest that developmental and behavioural features consistent with the BAP emerge early in infancy, and that even when infants are not given an autism diagnosis, they may nonetheless display atypical behaviours.

The above research highlights the beneficial role that prospective structured video-based studies of autism can play, with the early behaviours of infants and/or their mothers accurately captured and studied prior to diagnosis. Further, in prospective studies, trained researchers can analyse maternal and infant behaviour, thus removing any bias or deficit in memory that could have occurred through parental reports.

Retrospective Self-Report. While the above findings suggest that behaviours associated with ASD are apparent in infancy, a cohort of children seem to develop typically up to 15 to 21 months of age. These infants achieve social and linguistic milestones as would be expected of TD infants, but then appear to 'lose' these skills. This 'regression' typically occurs between 13 and 18 months (Goldberg et al., 2003; Kurita, 1985; Interactive Autism Network [IAN] Research Report, 2008; Volkmar, Stier & Cohen, 1985; Volkmar, Cohen & Hoshino, 1988; Werner & Dawson, 2005). There is debate as to the prevalence of this form of development, with occurrence estimates ranging from 20 per cent to 49 per cent (Davidovitch, Glick, Holtzman, Tirosh & Safir, 2000; Filipek et al., 1999; Hoshino et al., 1987; Kurita, 1985; Siperstein & Volkmar, 2004). Incidents of regression appear to be more common in children who are given a diagnosis of autism as opposed to those who are diagnosed with Asperger Syndrome or Pervasive Developmental Disorder – not otherwise specified (PPD-NOS) [IAN research Report, 2008]. The typical trajectory of regression sees infants initially display a loss of language abilities followed by a decrease in social skills (Davidovitch, Glick, Holtzman, Tirosh & Safir, 2000; Goldberg et al., 2003; Siperstein & Volkmar, 2004). It should be noted that children who display a regression in socio-communicative abilities often display poorer language abilities than TD infants prior to regression (Brown & Prelock, 1995; Siperstein & Volkmar, 2004).

The Broader Autism Phenotype and mothers. Familial studies of autism have demonstrated the genetic component involved in autism, with concordance rates for diagnosis amongst monozygotic twins close to 36 per cent (Bailey, Palferman, Heavey & Le Couter, 1998), while the concordance rate amongst dizygotic twins is at around 10 per cent (Bailey et al., 1998; Greenberg, Hodge, Sowinski & Nicoll, 2001). Amongst parents of children with autism, higher rates of social deficits, repetitive behaviours and communication impairments have been reported (Bolton,

Pickles, Murphy & Rutter, 1998; Piven et al., 1997). While some individuals may not possess enough atypical characteristics to warrant a diagnosis, parents may possess a set of social deficits, communication impairments and stereotyped behaviours, which have been collectively termed the *Broader Autism Phenotype* (BAP) (Folstein & Rutter, 1977). Such behaviours are not only found at higher rates in siblings of individuals on the spectrum, but also parents (Bolten et al., 1994; Piven et al., 1997) and extended family members such as aunts, uncles and grandparents (Piven et al., 1994, 1997).

Individuals fitting the BAP profile are often described as aloof, less tactful and less demonstrative (Piven et al., 1994). Parents with BAP are often described as anxious, preoccupied with specific details and suspicious (Landa et al., 1992; Piven et al., 1997). They are also often more tense and hypersensitive (Piven et al., 1997). Parents showing BAP traits tend to be shy, less responsive, more self-conscious in social situations and they often have fewer friends than those who do not have BAP traits (Piven et al., 1994, 1997; Wolff et al., 1988). Individuals with BAP traits may also be more irritable, impulsive and aggressive (Murphy et al., 2000) and they are less interested in social engagement and less motivated to be in social environments (Duarte et al., 2005; Landa et al., 1992).

In order to examine traits that may be specific to BAP, rather than simply to personality variation, a number of studies have compared traits displayed by parents of TD children to those of parents of children with autism who themselves displayed some autistic traits. It has been found that BAP parents were more aloof and rigid and they had difficulties with pragmatic language, social skills and general communication (Bishop et al., 2004; Hurley et al., 2007). In order to examine whether BAP traits may emerge from the stressors of raising a child with a developmental disorder, a number of studies have examined BAP traits displayed by parents of children with

autism and parents of children with other developmental disorders, finding that parents of children with autism display more rigidity, fewer friendships, abnormal speech, social withdrawal and a 'difficult' temperament (Murphy et al., 2000; Piven et al., 1997).

How does autism impact on the mother-infant interaction?

It has been established that, while an autism diagnosis may not be received until a child is well into toddlerhood or older, differences in behaviour may be apparent from earlier in infancy. It is the parents of such infants who are often the first people to take note of these atypicalities. While early attempts at understanding autism focused on a unidirectional, mother-focused model that emphasized the mother's effect on the child's behaviours (for example, Kanner, 1943), more recent research in mother-infant interaction has focused on the bi-directional nature of the interaction, with an emphasis on the pattern of initiation and response that is co-created between mother and infant (for example, Ainsworth et al., 1978; Beebe et al., 2010; Goldstein, King & West, 2003; Tomasello, 1995).

Having examined the unique social, affective and gaze behaviours of children with autism in interaction with their mothers, Dawson, Hill, Spencer, Galpert & Watson (1990) suggested that these behaviours may have a negative impact on the behaviours of others. Indeed, it has been suggested that early atypicalities in social communication can influence maternal response and dyadic mutuality such that early susceptibilities for atypical behaviour may be amplified to shape a trajectory of atypical social development over the long-term (Dawson, 2008; Elsabbagh & Johnson, 2007, 2010).

In comparison to mothers of intellectually disabled and TD infants, mothers of children with autism have been found to display a higher frequency of controlling strategies in response to child behaviour (Kasari, Sigman, Mundy & Yirmiya, 1988). It has been suggested that this controlling form

of parenting may result from mothers' well-intentioned efforts to encourage more 'desirable' social behaviour, which may inadvertently lead to an increasingly directive form of interaction. High levels of directive behaviour have been associated with a decrease in infant social engagement (for example, Lussier, Crimmins & Alberti, 1984). However, children with autism have been found to respond preferentially to maternal directives as opposed to maternal suggestions (Sigman, Mundy, Sherman & Ungerer, 1986), which may highlight that different strategies of maternal behaviour may be necessary to engage with infants on the spectrum. In another study, this pattern of maternal directive behaviour has also been noted in comparison to language impaired, intellectually disabled and TD infants. Mothers of children with autism used more nonverbal prompts, increased physical proximity and more attention-getting behaviours as compared to other mothers. Children with autism within the study were found to be more avoidant and less compliant, with greater compliance associated with maternal verbal prompts (Lemanek, Stone & Fishel, 1993).

In a study of pre-school aged children, it was found that those mothers who are adept at synchronizing their attention with their infant's were more likely to have infants who displayed better language and attention abilities over time (Siller & Sigman, 2002, 2008). Similarly, in structured interventions focused on promoting parent-child synchrony and joint attention, improvements on the children's social reciprocity and expressive language were noted as a function of treatment (for example, Aldred et al., 2004; Drew et al., 2002).

Such findings highlight the variation in parenting strategies that may exist between mothers in response to the behaviours of their children, and also the unique responses to maternal behaviour that may be displayed by infants and children on the spectrum. A degree of variation exists between the verbal abilities displayed by children on the spectrum, and when this is considered, the bidirectional nature of the interaction is particularly evident. One study found that mothers of

nonverbal children with autism used a high degree of directive behaviours and spent much of their time in interaction initiating engagement, whereas this pattern was less apparent for mothers of verbal children with autism (Konstantareas, Zajdeman, Homatidis & McCabe, 1988).

While mother-infant interaction is a co-created bidirectional exchange of behaviours, the vast majority of studies examining the potential impact of autism on early social engagement have focused solely on infant *or* maternal behaviour. A smaller number of studies have examined the co-constructed pattern of mother *and* infant behaviours. Doussard-Roosevelt, Joe, Bazhenova & Porges (2003) sought to examine not just maternal behaviour, but also its immediate impact on infant behaviour. They found that mothers of children with- and without autism initiated engagement at a similar frequency, but, in keeping with previous findings, mothers of infants with autism used more physical contact, more high-intensity behaviours and fewer verbal approaches. Interestingly, although infants with autism displayed lower contingent responding to maternal initiation, they did display greater responsiveness to initiations that increased physical proximity and/or focused on non-verbal object use. Despite the employment of different methods, mothers of children with- and without autism were successful in encouraging their infants to engage in the interaction.

In a study of early home movies of infants who later went on to develop non-regressive autism, Muratori et al. (2011) examined the behaviour of both mother and infant in comparison to the behaviour of TD and intellectually disabled infants. They examined videos from the first 18 months of the infants' lives, dividing them into three semesters. Differences in infant behaviour were apparent between TD infants and the ASD and intellectually disabled groups. In the first 6 months TD infants displayed significantly more contingent affective responding to their mother's affective behaviours. In the second 6 months, TD infants were significantly better at maintaining social engagement and accepting invitations to engage with their mothers as compared to the other

infant groups. Only ASD infants displayed significantly low levels of orienting to their name. Within the 12 to 18 month semester, TD infants displayed significantly higher referential gaze, soliciting of maternal attention, accepting invitations to engage and meaningful vocalisations as compared to the other infant groups. Only the ASD group displayed significantly lower maintenance of social engagement as compared to the TD group. It is interesting to note that Muratori et al. highlight the importance of examining the duration of infant behaviours as, while frequency rates may be similar across groups, qualitative abnormalities may present in the duration of the behaviours used. This study highlights a growing pattern of atypicalities in infant responsive and initiative behaviours, with the suggestion that differences in infant behaviour can be identified between ASD infants and both TD and intellectually disabled infants between 12 and 18 months.

Given this subtle but detectable difference in infant behaviour, it makes sense that differences in maternal behaviour would also be detected. Within the study, infants with autism received less maternal attempts to calm their mood and lower infant arousal as compared to both groups, particularly intellectually disabled infants. This was interpreted with the assumption that infants with autism are less likely to enter a dis-regulated state requiring the mother to attempt to calm them. Further to this, the study found that mothers used a similar amount of attention-directing solicitations as those used by the other maternal groups (Muratori et al., 2011). This finding was interpreted with the assumption that infants who later develop ASD do not present any early need for parental solicitation. As such, the study suggests that early maternal behaviour may not function as a predictor of later diagnosis.

How do we explain the social interactions of infants with autism?

Theories of social interaction in autism. The above findings highlight the unique pattern of behaviours displayed by infants who later receive an autism diagnosis and the impact that such

behaviours may have on the mother-infant interaction. A number of models have been created in an attempt to explain neurological underpinnings of the social-communication disturbance associated with autism. The *Theory of Mind model* (for example, Baron-Cohen, Leslie & Firth, 1985) focused on impairments to the frontal cortex systems, with a suggestion that impairments are primarily related to social functioning. The *Executive Functioning Model* also emphasised impairments to the frontal cortex with resultant impairments of executive functioning, compromising the ability to select appropriate goal-directed behaviours from the array of competing potential behaviours (for example, McEvoy, Rogers & Pennington, 1993; Pennington & Ozonoff, 1996).

Another theory proposes that individuals with autism may have a dysfunction within their subcortical areas. This *Polyvagal Theory* proposes that infants are born with a *Social Engagement System* (Porges, 1998, 2001), which facilitates social interaction. The system has two components: autonomic and somatomotor. Mediated by the myelinated vagus, the autonomic component promotes calm behavioural states and reduces fear. The somatomotor component is mediated by the visceral efferent pathways, which are linked to the striated muscles that control head and face movement. As such, the somotomotor system is typically involved in a variety of socio-communicative functions such as eye gaze, vocalisation, head turning, gestures and hearing. These muscles are involved in both active engagement in social interaction and filtering information that limits social stimuli.

According to the *Polyvagal Theory*, when the autonomic state is controlled by the myelinated vagus, anxiety is inhibited and social engagement behaviours are spontaneously expressed. As such, it is proposed that infants who have difficulties in state regulation may simultaneously display behaviours that impact upon their social engagement. As such, Porges (in press) emphasised that

the difficulty with self-regulation that has been associated with autism alongside the atypical social behaviours may be related to deficits in the neural regulation of the Social Engagement System. Given the bidirectional nature of the mother-infant interaction, neurophysiological difficulties that impact upon an individual's ability to coordinate social engagement would not just impact on *their* behaviour, but also on that of their interactive partner.

Moderation models of infant 'risk' and mother-infant interaction. A number of theories have been put forward to help to explain the model of interaction and response that may be at work in interaction between mothers and their infants with autism. This section will present these models, from the early unidirectional model of interaction to the more nuanced, evolving understanding of the bidirectional interaction. The research presented in the above section highlights the impact that certain characteristics of mother or infant behaviour may have on partner behaviour. Early theories that focused on the ability of 'risk' status to moderate relations between the parent and infant highlighted a form of diathesis stress model, which focused on the ability of a biological risk to make children more vulnerable to negative environments (see Baker, 2010 for a review).

More recent thinking has focused on a less uni-directional impact, with the suggestion that certain types of 'risk' may be linked to differential susceptibility to environmental influence that may present as either positive *or* negative (Belsky et al., 2007). As such, the 'risk' status of infants on the spectrum may be positively influenced by parenting that fosters competence, or negatively affected by an interactive environment that exacerbates risk. This theory has been supported by a number of studies across a range of child risk situations (Blair, 2002; Baker et al., 2007; Feldman et al., 1999; Klein Velderman et al., 2006; Landry et al., 2001). Such a theory is appealing in that it emphasises the dynamic nature of infant development, even in risk situations, which allows for the

potential of beneficial input through caregiver adaption or more structured interventions (Dawson, 2008; Wallace & Rogers, 2010).

Interactive Specialisation Theory suggests that the social experience of the infant can influence the localization and specialisation of the infant's developing social brain. TD infants have a tendency to prefer social stimuli, and such biases in attention help to shape the developing social brain. Autism is often defined by difficulties in social engagement and joint attention, which may suggest that there may be an irregularity in the social orienting bias that is associated with typical development. As such, it may be assumed that risk sensitivity effects would not be observed as infants are both less focused on and less influenced by their partner's behaviour, no matter how sensitive and positive that behaviour is. Indeed, a differential susceptibility model of infant development would suggest that the biological challenges associated with the development of autism may make these children less susceptible to variations in the mother-infant interaction. In this sense, an atypical trajectory may be amplified by the infant's social environment, leading to the pattern of symptoms associated with eventual ASD diagnosis.

A more in-depth discussion of risk sensitivity in relation to autism will be presented in Chapter Three. However, in the present section it is important to note that contradictory findings have been reported, with one study suggesting that difficulties in social cognition are a better predictor of infant social development than any environmental factors (Travis et al., 2001). Conversely, it has been found that the likelihood that an infant may be diagnosed with autism appears to mediate the effects of sensitive parenting. As such, while mothers of TD children and children with autism may display similar patterns of sensitive responding, this sensitivity is linked to improved social and linguistic development only for children on the spectrum (Baker et al., 2010). A more recent study focused on developing an early intervention for use with infants that are more likely to be

diagnosed with autism, given that they have a sibling who has been given a diagnosis. The study focused on increasing maternal responsivity during face-to-face interaction (Green et al., 2013). While the scope of the study was too small to establish whether this intervention may provide a more positive environment specifically tailored to the needs of an infant on the spectrum, it is worth including in the present review as it highlights the change in thinking that is occurring in relation to the specific positive or negative impact that maternal responding may have on infant development.

What do we know about SibsA infants' interactions with their mothers?

While a reasonably large number of studies have examined mother-child interaction in autistic samples, a smaller number of studies have examined the interactions of mothers and their infants who are more likely to be diagnosed with autism. In longitudinal studies of these SibsA infants, it has been found that joint attention behaviours and requesting skills between 14 and 24 months may be indicators of later diagnosis (Cassel et al., 2007; Landa et al., 2007; Mitchell et al., 2006; Sullivan et al., 2007; Toth et al., 2007; Yirmiya et al., 2006). However, suggestions as to specific ages at which group differences may emerge have differed across studies.

Four studies have used the Still Face paradigm to examine the social responding of infants more likely to be diagnosed with autism (Cassel et al., 2007; Ibanez et al., 2008; Merin et al., 2007; Yirmiya et al., 2006). In response to caregiver disengagement within the procedure, infants typically display a decrease in eye contact and smiling and their affect becomes increasingly negative (for example, Adamson & Frick, 2003). This change in infant behaviour is interpreted as an understanding that social expectations have been violated and that the shared, co-regulated interaction has been disrupted (Hains & Muir 1996; Tronick & Cohn 1989). In comparison to TD age-

matched 6-month-olds within the procedure, SibsA infants smiled significantly less prior to maternal withdrawal and they displayed significantly more neutral affect upon resumption of maternal engagement (Cassel et al., 2007). SibsA infants also displayed a lower level of gaze shifting to and from their mother (Ibanez et al., 2008). Further to this, SibsA infants were found to spend a large amount of time gazing at their mother's mouth as opposed to making eye contact during the procedure (Merin et al., 2007). It was also found that at 4 months, SibsA infants displayed a significantly higher level of neutral affect as compared to TD infants (Yirmiya et al., 2006).

These findings have been interpreted to suggest that, while SibsA infants apparently display different patterns of social responding, it appears that both TD and SibsA infants can perceive and respond to a break in maternal responsive behaviour. It should be noted that only one infant in the Yirmiya study was later given a diagnosis, while diagnostic information was not obtained for either the Cassel or Ibanez samples. Within the Merin sample, none of the infants who preferentially gazed at their mother's mouth were given a diagnosis. These findings suggest that while there may be no diagnosis, SibsA infants may still display atypical behaviours during interaction.

In a large scale, longitudinal study of infant siblings' social behaviour, Rozga et al. (2011) divided their participants into distinct groups: infant siblings who did receive an ASD diagnosis and infant siblings who did not, alongside a control comparison group of TD infants. This functioned to examine behaviours that may be specific to siblings that would later be given a diagnosis as compared to those of siblings that would not. They found that at 6 months of age, no socio-communicative differences were noted between groups during mother-infant interaction. However by 12 months, infants who would later receive a diagnosis were found to display lower levels of duration and frequency of gaze, smiles and vocalisations toward their mothers and deficits in joint attention behaviours. Those infant siblings who did not receive a diagnosis showed no differences in socio-communicative behaviours when compared to TD infants. It is interesting to note that all

infants responded with diminished smiling and gazing at their mother when the Still Face procedure was used.

The main focus of Rozga et al.'s study was to establish areas of infant behaviour that may be used as a behavioural marker to aid early detection of autism. However, they also emphasised the important social impact that differences in infant behaviours may have for the mother-infant interaction and, in turn, for the developing infant. They highlighted the central role that joint attention behaviour plays in the infant's developing understanding of the needs and intentions of those around them (Baldwin 1995; Tomasello 1995; Tomasello et al., 2005). Thus, deficits in joint attention displayed at 12 months may impact on the pattern of social experiences that an infant can co-create with their mother.

While the above study emphasised the typical pattern of development that was associated with those infant siblings who did not receive an eventual diagnosis, other studies have offered conflicting evidence as to the trajectory of development for these infants. It has been found that infant siblings who do not eventually receive a diagnosis display lower rates of high level requesting behaviours at 12 (Cassel et al., 2007) and 14 months (Yirmiya et al., 2006). They also have been found to display a lower overall rate of communication and a limited use of distal gestures (Toth et al., 2007), while Landa et al. (2007) suggested that deficits were more likely to be found in infant siblings who did not receive a diagnosis but did display language delay or social impairments.

In a study that examined the behaviours of both mother and infant siblings aged 6 to 8 months, Wan et al. (2012) observed six minutes of free play, face-to-face interaction of infant siblings and TD infants. They found that, in comparison to TD infants, SibsA infants were less lively. This mirrors the findings of Saint-George et al. (2011) who analysed the early home movies of infants later given a diagnosis. Similarly, parent-rated low infant activity at 6 months has been associated with diagnosis by 24 months (Zwaigenbaum et al., 2005).

Secondly, within the Wan study, it was found that parents were less sensitive and displayed higher levels of directiveness. This also mirrors the findings of Saint-George et al. (2011) who found that in a video analysis study of maternal directive behaviour (specifically, parental touching to elicit a response), higher rates were used with 6-month-old infant siblings of children with autism as compared to TD infants. It is proposed that atypicalities of infant engagement may result in different patterns of maternal behaviour, as compared to those that may be displayed during typical face-to-face interaction (Trevarthen & Aitken, 2001). As maternal directiveness was associated with lower maternal sensitivity and lower dyadic mutuality, it was suggested that such maternal directive behaviour may not be beneficial for the infant's development (Wan et al., 2012).

The Current Study

It has been established that mother-infant interaction plays a central role in the development of infants across an array of social, emotional and even physical dimensions. It has also been established that both infant and maternal behaviour is essential in actively shaping the type of interaction that is shared. Given the unique pattern of social behaviour associated with ASD, and the high prevalence of ASD in the infant siblings of children who have already been diagnosed, an examination of the socio-communicative behaviours of mothers and SibsA infants during face-to-face free play allows for an understanding of the unique pattern of exchange that may be occurring.

The present study will employ a top-down approach to the investigation of the interaction, in order to closely explore the components that together make up the social exchange. A global measure will offer insight into the tone of the interaction, while there will also be an examination of social responding and vocal behaviour exhibited. In relation to maternal vocal behaviour, the

study will further examine the function, syntax and acoustic quality of vocalisations. The study will also offer an examination of the responsive behaviours between mothers and their infants. Given the high level of variation in social and linguistic behaviour that exists between individuals who have been given an autism diagnosis, there will also be an examination of the interactions of individual dyads in the form of case studies. Interactions will be examined at 9, 12 and 18 months, allowing the opportunity to trace changes that may be occurring in infant or maternal behaviours. Infant social and communicative outcomes will be examined in order to investigate any association between early maternal social behaviours and later infant linguistic, cognitive and social abilities.

Chapter Two: Methodology - Structured Observation

Study Design

This is a longitudinal, prospective, observational study of mother-infant interaction. The study focused on the naturalistic, face-to-face interactive behaviours of a group of mothers and their infants when the infants were aged nine, twelve and eighteen months. The study employed a comparative design whereby the behaviours of mothers and their SibsA infants were examined alongside those of mothers and their TD infants. The longitudinal approach was adopted as it allowed for an investigation of the developmental trajectory of infants at a time when there should be an observable development of social and linguistic abilities. All interactions were video recorded for the purpose of conducting a detailed examination of both mother and infant behaviour. Video allowed for observation in a nonintrusive context as dyads could be left alone during filming.

Observation. In order to fully capture the mother-infant interaction, a systematic and direct observation of behaviour was required. While the process of generating coding schemes for observation, and of the training observers, is time-consuming, observation offered a replicable method that provided a rich description of behaviour that could yield more useful data than other research methods.

Structured observation. It was considered most appropriate to use structured observation in the present study. As the study focused on interaction at three time points, and because it contained a comparison group, it was essential that the data produced was standard and comparable across time and across groups. As such, the systematic and controlled nature of structured observation was necessary. This controlled approach to observation required that the purpose of research was clearly articulated prior to beginning the observations, as were any hypotheses to be addressed.

Such a structured design allows for the gathering of data that can be assessed for quality through interobserver comparisons. As such, this structured observational approach allowed for the reduction of complex, mother-infant interactions to a number of observable and measurable behavioural variables, which could be used to produce data that could examine frequency, duration and the relationship between target events. Thus, from observing the complex exchanges of initiative and responsive behaviours displayed by mother and infant, it was possible to produce a qualitative description of the exchange.

Participants

Using the term 'SibsA'. Throughout this study, infant siblings of children with an ASD diagnosis are referred to as 'SibsA'. This is a term that has been used previously in the literature (for example, Landa et al., 2012; Ben-Yizhak et al., 2011, Gamliel et al., 2009, Yirmiya et al., 2006); however, it is not the most common term used to describe such infants. Typically, studies have described infant siblings as 'at-risk' or 'high risk' in relation to the likelihood that they may be 'at risk' of receiving an autism diagnosis.

Given that one of the aims of the study is to take an inclusive approach by examining the experiences of infants more likely to be diagnosed with autism, it was not deemed appropriate to use the term 'risk' in relation to an autism diagnosis as it brings with it negative connotations that may function to exclude people who have been given such a diagnosis. As such, SibsA was considered a more neutral and inclusive term.

Recruitment. All participants were recruited as part of a larger study of mother-infant interaction funded by Irish Research Council for Humanities and Social Sciences (IRCHSS). The study involved two dyad groups containing either SibsA or TD infants. Nineteen dyads took part in total. The majority of participants joined the study when infants were aged between three and six months, while one SibsA dyad joined the study when the infant was nine months, and two SibsA dyads joined the study at twelve months. All of the SibsA infants had at least one older sibling who had previously been given a diagnosis of ASD by a trained clinical psychologist. Due to their age when joining the study, none of the SibsA infants had been formally screened for ASD, but they were being monitored by early intervention teams.

Mothers of SibsA infants were recruited through clinical health services, where a poster (A4 size) was displayed explaining that mothers and infants were being sought for a videotaped study

of mother-infant interaction in families where an older sibling had already received an ASD diagnosis (see Appendix One). It proved difficult to recruit mothers with SibsA infants and it was necessary to continue recruitment attempts over a number of months to ensure that an appropriate number of dyads were involved.

As with any study it is necessary to consider the motivations of the mothers taking part. As they already had one child diagnosed with ASD it may have been the case that they were motivated by concerns that their infant was displaying behaviour that may be associated with ASD. It is hoped, given that the majority of SibsA infants were recruited by nine months of age, that such behaviours may not have been apparent and motivating to mothers. Equally, the purpose of the study was to capture maternal and infant behaviours as they occurred naturally. Whether maternal behaviours were motivated by expectation/concern relating to a potential diagnosis, or whether they occur purely in response to actual infant behaviours displayed, the behaviours being recorded are those experienced by the infant, and as such, they are worthy of study regardless of maternal motivation. Mothers of TD infants were recruited through a national parenting website.

All dyads were of lower to middle SES. None of the mothers had been given an ASD diagnosis themselves and they had no history of depression. However, a number of studies have suggested that caregivers of children on the spectrum display higher levels of stress and more depressive symptoms than caregivers of TD infants (Abbeduto et al., 2004; Baker-Ericzen, Brookman-Frazee & Stahmer, 2006). As such, it may be expected that despite having no diagnosis, mothers of SibsA infants may show higher levels of symptoms associated with depression, given that they are parenting at least one child with autism. Fathers were present in each of the households. The participation of both groups of mothers was voluntary.

It was explained to both groups of mothers that the study involved videotaping face-to-face interaction of mother and infant at four week intervals until infants reached twelve months, with a further session at eighteen months. Mothers were also informed that on two occasions they would be given a brief questionnaire to measure early infant communication. Mothers were informed that the purpose of the study was to examine how mothers and infants interact and respond to each other during natural interactions.

Upon agreeing to take part in the study, mothers received a letter thanking them and providing further information relating to the theoretical foundations of the study and the microanalysis that would be conducted on the interaction videos. It was explained that all information that they provided and all videotaped material would remain confidential. The letter and study information are included in Appendices Two and Three. Mothers knew that the study was not clinical in nature and that no diagnostic information could be offered by the researchers.

Mothers. Eighteen mothers took part in the study. Nine were mothers of TD infants and 9 were mothers of SibsA infants (one was a mother to monozygotic SibsA twins). All mothers spoke English as their primary language and were educated to secondary school level or above. The average age of mothers of SibsA infants was 36, while the average age of mothers of TD infants was 35. Two of the mothers of SibsA infants were employed outside the home, while the remaining seven were full time mothers. Six mothers of TD infants worked outside the home, while the remaining three worked full time in the home (see Table 1 for full demographic information).

Table 1. Demographic information for mothers and infants in the SibsA and TD groups.

Dyad	Infant Gender	Group Status	Diagnostic status of the infant at 3 years	Mother's age during filming	Mother's Occupation
Dyad 1	M	SibsA	Possible ASD	41	Paediatric Nurse
Dyad 2*	F	SibsA	Possible ASD	36	Full Time Mother
Dyad 3*	F	Sibs A	Possible ASD	36	Full Time Mother
Dyad 4	M	Sibs A	ASD/ADHD	38	Full Time Mother
Dyad 5†	M	TD/SibsA	ASD	37	Full Time Mother
Dyad 6	M	Sibs A	Language Delay/ Possible ASD	39	Full Time Mother
Dyad 7	F	SibsA	Severe Language Delay	38	Full Time Mother
Dyad 8	M	TD	None	40	Full Time Mother
Dyad 9	M	TD	None	33	Full Time Mother
Dyad 10	M	SibsA	None	28	Full Time Mother
Dyad 11	F	TD	None	37	Pharmacist
Dyad 12	F	TD	None	37	Full Time Mother
Dyad 13	M	TD	None	30	Accountant
Dyad 14	M	TD	None	32	Language Therapist
Dyad 15	F	TD	None	38	Television Producer
Dyad 16	F	SibsA	None	36	Full Time Mother
Dyad 17	F	TD	None	36	Psychotherapist
Dyad 18	F	SibsA	None	34	Nurse Assistant
Dyad 19	M	TD	None	36	Actuary

*Contains a monozygotic twin

†Contains the assumed-to-be TD infant who was diagnosed as being on the autistic spectrum.

Infants. Nineteen infants took part in the study. Ten infants belonged to the SibsA group, while nine belonged to the TD group. Five SibsA infants were male and five were female. Five TD infants were male and four were female. Two female SibsA infants were monozygotic twins. When originally recruited to the study, TD infants ranged from 3 to 5 months of age and SibsA infants ranged from 4 to 11 months of age.

It would have been preferable to have had all infants begin filming at the same age in order to have ensured that they were all equally comfortable with the filming process, and certainly, it would have been preferable to have had all infants involved in the study when they were nine months of age. However, it proved difficult to source SibsA dyads at such a young age, so it was considered appropriate to include the two SibsA dyads from 12 months onwards as their participation would still offer useful information regarding the nature of mother-infant interaction and the changes that may occur from 12 to 18 months. One of the mothers was not available when her SibsA infant was 18 months old, and as such the data from her next filming session (when the infant had just turned 20 months) was used.

The unique case of Infant 5 and his mother. Infant 5 and his mother joined the study having seen the advertisement on a popular parenting website. The dyad was recruited as part of the TD group, however at 18 months of age Infant 5 was given an ASD diagnosis by a trained, clinical psychologist. For this reason, all data pertaining to the dyad is included as part of the SibsA datasets. The rationale for including this dyad within the SibsA group is that the focus of the study is to better understand the early socio-communicative experiences of infants that may be displaying the unique patterns of social and linguistic behaviour that have been identified in both SibsA infants and infants who are eventually given an ASD diagnosis.

As such, the main difference between the SibsA infants who eventually received a diagnosis and the TD infant who eventually received a diagnosis may have been maternal anticipation of and experience with ASD diagnosis. Given that atypical behaviour has been noted in both SibsA infants and infants that are later diagnosed with ASD, the pattern of initiation and response experienced by such dyads would be impacted by infant behaviour, whether mothers were anticipating a diagnosis or not. The ethical implications of dealing with the dyad are discussed later in this chapter.

The comparison group. The study also examines the interactive exchanges of dyads containing mothers and their TD infants. Throughout the literature, comparison groups have been used to establish behaviours that are specific to autism. In order to identify these unique behaviours, comparison groups of TD infants and infants diagnosed with language delay, developmental delay or Down Syndrome have often been included (see Meadan et al., 2010 & Zwaigenbaum et al., 2007 for reviews). This method has been used particularly often within studies aiming to identify early behaviours that may be used to aid diagnosis.

The purpose of the present study was not purely to examine the unique behaviours that may be associated with infants with autism; rather it is to describe and analyse the interactive environment experienced by infants more likely to display traits associated with autism. A comparison of TD dyads offers a better understanding of how the SibsA interactive environment may differ from that of TD infants'. Further, presenting case studies of the interactive exchanges of dyads in which the infant did eventually receive a diagnosis allows for a descriptive comparison with those SibsA infants who were not diagnosed upon completion of the study.

Video Collection and Editing Procedure

Filming of dyads took place when the infants were 9, 12 and 18 months. This section will present all information relating to the filming procedure. It will provide information relating to the setting of filming, all testing that occurred, and it will detail steps taken to overcome observer effects that may have been influencing participant behaviour. It will also detail the choices made in editing the filmed interactions and the steps taken to analyse the acoustic properties of mother and infant vocalisation displayed during interaction.

Filming of Interactions. Mothers and infants were filmed in naturalistic interaction when the infants were aged 9, 12 and 18 months. As first contact with all of the mothers was made by the PI of the larger study, it was considered appropriate that she conduct the filming, while the present researcher attended a number of sessions in order to meet the mothers and infants and discuss any questions that the mothers may have about the current study. This choice was made because mothers and infants were comfortable with the PI and it was thought that they would be less likely to feel self-conscious during the filming process if they were dealing with her.

Setting. Filming was conducted in the homes of the participants or in an office in Trinity College. Preferred location was chosen by the mothers. The majority of filming was completed in the homes of the mothers and infants taking part. This was beneficial as it was an environment in which they were comfortable and which contained the infant's own toys. All filming occurred in the infant's homes at 9 and 12 months, however at 18 months four mothers of TD infants chose to have their in the college. On such occasions every effort was made to make both mother and infant comfortable.

Infants were allowed to explore the office. Toys and refreshments were provided and child-friendly posters were placed on the walls. Staff in the surrounding offices were informed that the

filming was taking place and they were asked to keep quiet for the duration in order to limit distraction. While the novelty of the office may have slightly impacted upon the interaction, it was thought that the efforts made to limit this were appropriate and successful.

Filming procedure. Two Sony HDR-SR12 (HD/AVCHD) handy-cams were set up on tripods. One camera framed the infant's face, while the second framed the mother's face. This ensured that the behaviours of both mother and infant could be optimally captured. As such, mothers were asked to try to remain in shot, and to try to keep their infants in shot once filming started. The mothers chose the position of the infants, with some preferring to hold their infant on their knee, and others placing their infants in high chairs or buggies. Mothers were asked, if possible, to refrain from feeding their infants or giving them soothers during the filming process as this would impact on infants' ability to vocalise. It was explained to them that they would be left alone with their infant and they were asked to interact as they normally would. In this way, mothers and infants could interact without the added distraction of having a researcher in the room with them. Mothers were made aware that they could stop the filming procedure at any point for any reason should they choose to. Equally, if it was felt that the infant was becoming overly distressed (crying/fussing for thirty seconds) the participants would be asked if they would like to take a break. Mothers and infants were filmed for an average of twenty minutes. Once sufficient footage had been shot, the PI returned to the room and turned off the cameras. During all filming sessions, mothers were offered a chance to ask any questions that they may have and to contribute any observations they had relating to the filming.

Addressing observer effects in the filming process. In order to limit the impact that the observer may have on mothers and infants, the same researcher conducted the filming process with each dyad at each time, so as to minimise the self-consciousness that may result from having

to go through the process with different researchers. Dyads were left alone while interacting to create an environment as similar to natural interaction as possible. Steps were taken to ensure that participants were comfortable and that procedures were followed in the same way, whether observations took place in participants' homes or in Trinity College. Further to this, mothers were given control over the filming process in the sense that they could stop at any point and they were encouraged to actively engage with the process through asking questions and making suggestions to improve their experience. This approach was taken in order to help mothers feel less like individuals simply being observed, and more like active and valued participants.

In order to keep infants in shot during filming mothers either held the infant on a surface/their knees or they strapped them into a high chair or buggy. While this was the only way to ensure that the infants remained in place, it did potentially impact on the interaction and what behaviours could be accurately studied within the interaction. At times during filming, some of the infants wanted to have more freedom than was allowed by the seating arrangement. Instances of prolonged fussing or distress (twenty seconds or more) relating to the seating position were not included in the footage used for analysis.

A second concern presented by this seating arrangement was the impact that it may have on the natural use of touch displayed by both mother and infant. Those mothers who were holding infants on their knees were not able to use gesture or touch as they would have if infants had not needed to remain in shot. Similarly, infants who were in high chairs or buggies were at a distance from their mothers and, as such, were not able to use touch as they might under normal circumstances. Certainly, touch is an important element of mother-infant interaction. Prior to the development of vocal communication, touch and gesture are very important elements of the infants' communicative repertoire (Moszkowski & Stack, 2007). It would have been interesting to

examine the touch and gesture of mothers and infants as they co-occur with other communicative behaviours during face to face interaction; however, as allowing completely free movement would have made it impossible to film the interaction in detail, the choice was made to exclude touch and gesture from the analysis. Gestures were taken into account within the Early Social Communication Scales (ESCS) (discussed in the next section), as infant ability to follow gestures and to engage with gestures are included within the measurement scales.

Infant testing. At 12 and 18 months the social, cognitive and communicative abilities of the infants were examined through the administration of the ESCS (Mundy et al., 2003) and the *Bayley Scales of Infant Development—Third Edition* (BSID-III, Bayley, 2006). Given the deficits in linguistic, social and cognitive functioning that are often associated with individuals on the spectrum, the scales are particularly useful in examinations focusing on individuals that may receive an autism diagnosis. On the initial visit, naturalistic filming and the ESCS testing were conducted. The BSID-III was conducted on the second visit.

ESCS procedure. Once the initial filming was completed, the infant was seated at a table next to his/her mother, while the researcher sat opposite them. This is in accordance with the ESCS procedure. A single video camera was set up at the table either in the participant's home or in an office in Trinity College. The researcher conducted the range of toy-based tasks with each infant, examining the infant's ability to initiate and respond to interaction and share joint attention. Elements of the ESCS included examining the infant's ability to follow pointing gestures and the infant's joint attention abilities through rolling a toy car or ball across the table. The procedure took roughly twenty minutes, with breaks taken if the infant began to fuss or become distressed. Mothers were present throughout the procedure, but they were asked to remain silent, if possible, and sit at a slight distance from the table so as not to distract the infant.

The ESCS has been successfully used amongst TD infant samples and those affected by ASD and Down Syndrome (Mundy et al., 1996). Reliability and validity of the ESCS has been established through a series of studies focusing on both TD and developmentally delayed children (For example, Mundy, Sigman, Ungerer & Sherman, 1986; Mundy, Sigman & Kasari, 1990; Mundy, Kasari, Sigman & Ruskin, 1995). Upon completing training, the current author rated each ESCS with a trained coder. Reliability of the current ESCS is discussed later in this chapter.

Training for scoring of the ESCS took the form of detailed discussions relating to each behaviour involved in the rating procedure. Given the length of time it takes to conduct the ESCS and the time demands that this places on both researchers and dyads, it was not possible to provide additional training footage. For this reason, summary level agreement checks were conducted on the first 10 per cent of videos coded (k=.85) and later summary level checks were conducted during the coding process on a further 10 per cent to ensure that observer drift had not occurred (k=.87). Table 2 shows the abbreviations used in reporting the ESCS.

Table 2. Abbreviations of the variables measured by the ESCS

IBR	Initiate behavioural request
IJA	Initiate joint attention
RJA	Response to joint attention
RBR	Response to behavioural request

Bayley Scales of Infant Development procedure. During a separate session, the Bayley Scales of Infant and Toddler Development (BSID-III) were administered by the PI who had been trained in the procedure. The procedure takes between 45 and 60 minutes and parents were asked to remain present with their child, but to stay as silent as possible throughout the procedure. Breaks were taken if the infant fussed or became distressed. The researcher was provided with a set of toys that

are used within the standardised play-based tasks of the BSID-III. They range from simple tasks (such as tracking a toy with their gaze) to more complex tasks (such as finding a hidden toy).

The BSID-III features a battery of tests which measure cognitive, language, and motor abilities. As part of the procedure, parents were also asked to complete standardised questionnaires relating to their infant's social-emotional development and adaptive development. The PI rated the infant's score on each task and rated scores on the parent questionnaires. The BSID-III scales are known to have high reliability and validity.

The mental and motor scales have high correlation coefficients (.83 and .77 respectively) for test-retest reliability (Laberge, 2006). Table 3 describes the procedures that occurred when the infants were 9, 12 and 18 months.

Table 3. Procedures conducted during observations at nine, twelve and eighteen months.

Infant Age	Face-to-face interaction	ESCS	BSID-III
9 months	✓	-	-
12 months	✓	✓	✓
18 months	✓	✓	✓

Video Editing. Editing of the video footage was conducted by the author using Adobe Premiere Pro. This is an editing system that allows for the exact matching of footage from both cameras, which ensures that the timing of initiative and responsive behaviours can be examined accurately. Training in the use of Premiere was conducted by a professional film editor. Each recorded interaction was edited down to five minutes. A number of considerations were taken during the editing process. Firstly, it was preferable that as few edits were made during the five minutes as possible. The reasoning behind this was to ensure that the pattern of initiation and response is accurate to the interaction and did not reflect an edit in which one individual displays a behaviour and an edit then gives the impression that the partner has (or has not) responded. To further

ensure this, all edits were made between sequences of vocalisation. This meant that all edits began and ended when neither mother nor infant were vocalising. While attempts were made to ensure that infants and mothers were not eating during the sessions, if this did occur it was not included in the footage edited for analysis. Similarly, if infants placed toys in their mouths, this footage was not included as potential vocalisations could not be identified accurately.

Reactivity is a concern within any observational study, as it has been suggested that people will react differently in a social setting when they are aware that they are being observed. In particular, it has been broadly suggested that people's behaviour can change during an observation, with behaviour at the start of the observation differing because participants are self-conscious and behaviour at the end of the observation differing because they are fatigued (Yoder & Symons, 2010). A number of studies have refuted claims that behaviour is affected by observation (Fulton & Rupiper, 1962; Johnson & Bolstad, 1975; Jacob et al., 1994). Nevertheless, as a precaution within the present study the choice was made to avoid using footage from the first five minutes and last five minutes of each video session, in an attempt to limit issues of reactivity.

Audio Sampling of Maternal and Infant Vocalisations. Using Premiere Pro, audio samples were extracted from the filmed material into wav. format. A trained sound designer was recruited to extract maternal and infant samples using Soundtrack Pro. Praat vocal analysis software was then used to analyse the audio samples (Boersma & Weenink, 2000). This software has been designed to aid the study of the acoustic properties of language. Through sounds recorded directly with the program or (as in the present study) files of pre-recorded material the programme generates a spectrogram representing intensity, intonation and volume of vocalisations. Through Praat it is possible to isolate sound bites or filter frequencies for study. The use of this software is in line with

research examining the acoustic properties of vocalisations produced by children with autism (for example, Nadig & Shaw, 2012; Sharda et al., 2010; Diehl et al., 2009; Green & Tobin, 2009).

Audio samples were taken from the five minute edited footage. They were processed in order to remove overlap of speech between mother and infant. All possible steps were taken to reduce noise interference across audio samples. Gaps between utterances were a maximum of three milliseconds in order to reduce environmental interference. In order to reduce variance between samples, a maximum of twenty second samples of infant vocalisations were used (twelve months mean: 15.17sec; eighteen months mean: 18.44sec).

This decision is in keeping with previous research (for example Sharda et al., 2010). Infant vegetative sounds were removed from analysis as they offered no information regarding the deliberate, conscious vocalisations of infants. All maternal vocalisation samples were twenty seconds in duration. Using PRAAT software, audio samples were analysed by applying the 'To Pitch' automated algorithm setting for vocal pitch analysis, under the 'Analysing Periodicity' options. Samples were examined for mean pitch, pitch range and utterance intensity.

Generating Data

Coding

Coding design and adaptation. While identifying and coding behaviours for analysis may seem like a very simple and transparent process, many decisions were made in the design and implementation of the codes. Prior to deciding upon the codes that would be used to examine the behaviours of mothers and infants, a research question was established with the codes then chosen to ensure that the question could be accurately answered. That question was simply: will SibsA dyads display a different pattern of vocal and social behaviour than that displayed by TD dyads? In response to this, it was possible to apply a simple count coding approach with a list of mutually exclusive target behaviours established to describe maternal and infant vocal and social behaviours and facial expression. As the focus of the study is the naturalistic, face-to-face interaction of mothers and infants, at the lowest level it was necessary to apply a coding scheme that simply described the behaviours being observed. With these observable target behaviours defined, it was possible to create a picture of mother-infant interaction based on stable definitions of behaviour that are easily generalizable. Beyond this, it was possible to examine broader psychological constructs by grouping these target behaviours.

Types of coding variables. When conducting a structured observation, it is essential to establish the system of measuring or coding the target variables prior to observation commencement. Two types of variables were used within the present study. The majority of codes generated or adapted specifically for the study were descriptive and 'physically based' (Bakeman & Gottman, 1997). The advantage of this type of variable is that the observer needs to make little inference relating to the behaviour that they are viewing, which generally leads to a more reliable result (Borg & Gall, 1989). This very detailed approach to categorisation allowed for an accurate picture of the intricacies of

mother and infant behaviour, without a need for the coder to infer meaning relating to the behaviours observed. Such an objective approach was chosen to reduce observer effects.

Conceptual-based codes were chosen to further examine the utterances of mothers. Two sets of mutually exclusive codes were used to examine the directive and appropriate nature of maternal utterances. Each coding category had only two options. As these codes were context-dependant, research assistants were provided with conceptual definitions alongside examples that included context-specific information (see Appendix Four). It is more difficult for RAs to code a context-dependant behaviour as they have to make a choice based on a unique set of circumstances when applying each code. However, given the clear conceptual definitions provided and the small number of codes for both categories, it was considered appropriate that they could be used to accurately capture elements of maternal behaviour.

The number of codes per category. A further consideration focused on the number of codes within each scheme. Yoder's optimum category size for coding schemes suggested that they should contain between two and five codes to ensure that code placement is as accurate as possible during an observation (Yoder & Symons, 2010). This small coding scheme size was considered preferable for the present study. In relation to both mothers and infants, all audible vocal behaviour was coded. The two schemes were initially based on exhaustive sets of mutually exclusive codes. These subordinate codes were then regrouped to capture the range of potential maternal and infant vocal behaviours.

The codes generated could be used at each time point. For infants, the codes described a range of vocal behaviours from basic to advanced. Similarly, the maternal utterance coding scheme could be used at each time point as they captured a range of vocal behaviours from directive to

conversational. Coding schemes were also generated to code facial expressions and social engagement. The maximum number of codes used was five.

Validity of codes. Within any observational study it is essential that the data being recorded is an accurate representation of the underlying behaviour of interest. As such, a number of steps were taken to ensure that the coding schemes being used were an accurate description of the behaviours being displayed by mothers and infants during interaction. Firstly, the very detailed coding scheme used to categorise maternal utterances was adapted from a taxonomy of maternal functional utterances devised by Paavola et al. (2005). This was beneficial as it offered the opportunity to use a scheme that had already undergone repeated testing. Similarly, the other schemes used within the study were created using terms that are consistently used within the literature. In this way it was possible to provide clear, brief and precise definitions of each code used. Examples of each code were also provided to ensure that coders had a clear understanding of each behaviour of interest without the need for inference.

Further to this, before RA training began, the present author sourced examples of each code from within the recorded footage and confirmed with experts in the field that each behaviour was appropriately represented by the chosen code. As such, the definition of each code was sourced from the literature and the application of each code was confirmed by trained experts. These steps were taken to ensure that the codes used were as accurate as possible, as per the recommendations of Yoder and Symons (2010).

The Coding Process

Automated coding. Once the above codes had been chosen as the most appropriate to capture the maternal and infant behaviours of interest, the choice was made to conduct micro-second

analysis of the videos using the Observer XT 7 – Noldus Information Technology observational software package. This software allows for the micro-second analysis of multiple behaviours on multiple videos; as such it was possible to examine both mother and infant videos simultaneously in order to investigate the pattern of socio-communicative exchange that they co-constructed. The software allows for continuous timed event sampling, with the duration of each behaviour recorded from the onset to the offset.

Paper Coding. Further coding was conducted on paper on occasions when the duration and temporal nature of the behavioural variable were not so relevant to the study. The maternal utterance and infant vocalisation codes discussed above were also applied through paper coding in order to examine maternal behaviours as they occurred in response to infant vocalisations. Further to this, the directive and appropriate nature of maternal utterances were also coded. Coding schemes used are presented in Tables 4 – 7.

Table 4. The gaze behaviour of mothers and infants coded in Observer XT.

Gaze Behaviour
Eye Contact
Eyes Closed
Looking Away
Looking at Object
Looking Unknown

Table 5. The facial expressions of mothers and infant coded in Observer XT.

Facial Expression
Blank
Smile
Frown
Other
Animated Play Face*

*behaviour specific only to mothers

Table 6. The functional categories of maternal vocalisation, which were coded in both Observer XT and on paper.

Behaviour	Description	Examples
Mand Model	Requests a specific structure and then provides a model	'What's this? Your parrot!'
Question	Including 'Wh' questions, intonation, yes/no questions and tags.	'What will we do?' 'Ball?' 'That's your giraffe, isn't it?'
Description	Statements describing a person's behaviour, actions, feelings, etc., or an object or an event.	'You're hugging him.'
Attention Device	Statements eliciting the child's attention.	'Look!' 'Catherine!'
Commands	Statements directing or inhibiting the child's physical behaviour	'Give that to me.' 'Put the ball in the box.'
Social Play	Interacting with the child in a playful manner	'Peek-a-boo!' 'Oink, oink!'
Conventional Social Expression	Polite, conventional expressions used in social interactions	'Thank you.' 'Bless you.'
Labelling	Utterances containing one word or the word preceded by a demonstrative	'That's a ball.' 'Ball.'
Imitation – faithful	Faithful imitation of child's vocalization	
Imitation – Expansion	Expansion of child's vocalization	
Affirmative	Statements that agree with a previous utterance or action of the child	'Yes.' 'Mmm-hmmm.'
Compliment	Giving explicit positive feedback on the behaviour of the child	'Good boy!' 'Great job!'
Negation	Statements denying the child's previous utterance or action or giving explicit negative feedback on the behaviour of the child	'No, that's not how it works!' 'Ah-ah, that's bold.'
Filler	Words not conveying any referential meaning and appear to be used as automatic responses	'Now...' 'So...'
Non-speech Vocalisation	Vocalisations with no functional content.	Sneeze, cough, eating, gasp
Song / Story / Rhyme	Singing, reading or reciting rhyme to infant.	
Inaudible	Mother's utterance is inaudible.	
Speech to Other	Mother speaks to someone off camera	
No Vocalisation	Mother stops speaking	

Table 7. Infant vocalisation type and vocal complexity coded in Observer XT and on paper.

Vocalisation Type	Examples
Type 1	Vegetative sound (burp, cough, other); Fixed vocal signal (cry, laugh, shriek, other); Atypical (grunts, squeals, growls); Isolated vowels; Bilabial trills.
Type 2	CV (e.g., ka); CVCV (e.g., tata); Reduplicated babble (e.g., mamamama); Variegated/diverse babble (e.g., badaba); Jargon; Intonation.
Type 3	Dipthong/Vowel glide; Attempt at word; Word.
Type 4	Infant imitations of maternal vocalisations.

Coders. Six research assistants were recruited to work on coding. All were Higher Diploma students within the School of Psychology. A further Psychology graduate from Trinity College was recruited to transcribe all of the videos. To ensure an absence of bias, the RAs were not aware of the purpose of the study beyond its function as a study of mother-infant interaction.

They were given a number of papers to read prior to commencing training to ensure that they understood the bidirectional focus of the study (Goldstein, Schwade & Bornstein, 2009; Lorenzo & Longa, 2009; Paavola et al., 2005; Gratier, 2003). In order to ensure that coders remained unaware that they were observing interactions that may, potentially, have been atypical, none of the papers focused on autism or atypical samples.

Choosing videos for research assistant training. Training videos of mother-infant interaction were used in order to allow the RAs to gain experience in coding/rating/transcribing before they began working on the target nine, twelve and eighteen month videos. It was necessary to provide separate videos so that they would not become over-familiar with the target videos and so that discussions about the videos would not bias the coding/rating/transcribing process. As age-related changes may be expected in the vocalisations of infants, it was considered necessary to provide the

RAs with videos that featured a range of ages so as to ensure that they saw examples of all vocalisation types. Further to this, it was possible that different patterns of behaviour may have been displayed between groups, and as such the RAs were trained on an equal number of SibsA and TD videos. As there may have been an effect of gender, RAs were also trained on videos evenly divided by gender.

Training coders. Six of the RAs were trained in the use of Observer XT. Due to the functionality of the software it is possible to individually code multiple layers of behaviour in a single video. As such, it is possible to clearly segment the categories of behaviours coded, with the coder focusing on one behaviour category at a time during each coding pass. In this way, the coder does not have to, for example, consider both infant social engagement and facial expression at the same time. Further, as the behaviours coded through automated coding have physical attributes, it was possible to accurately code each behaviour from beginning to end simply based on what was on screen. As all coding was mutually exclusive, each new behaviour was coded as soon as the target participant changed their behaviour.

Coders were initially trained through four group workshops lasting 1 – 1.5 hours. This ensured that they all were given the same definitions for each code, so that no discrepancies would develop. There were then three individual training sessions on the use of the software and scales, alongside two further group sessions. All of the RAs went through a phase of paper coding sample videos, with their codes then compared across the group to ensure that there was a matched understanding of the codes and their use.

Some of the RAs struggled with the use of Observer XT, and an acceptable IR level could not be established for all six individuals. One challenge arose from the blind coding process (discussed in greater detail later in the section). While such a practice is the norm in comparison group research,

the RAs in the present study were challenged by the lack of knowledge that they brought to the process, despite having been provided with reference papers. In the absence of detailed information relating to the specific nature of the project, a number of RAs made assumptions regarding which behaviours of mothers and/or infants may have been of particular importance. If there were no codes to explicitly name the behaviours that they thought were important, they chose to add a code to the coding scheme, or left out the observed behaviour entirely. They were reluctant to use the neutral code 'Other' and they often overlooked seemingly inactive behaviours such as 'No vocalisation' or 'blank' facial expressions.

Multiple group and individual training sessions were conducted in an attempt to improve the IR scores. Each time this re-training occurred, initial coding was conducted on paper. Interestingly, the RAs had no difficulty with paper coding. It appears that, because they could physically add behaviours into the Observer XT coding scheme, they felt that this might be appropriate. However, when given a printed, paper coding scheme from which to choose, they found it simpler to find an appropriate definition from those codes. As such, using a paper coding scheme would be recommended for future studies. Ultimately, three RAs who had excelled throughout training were tasked with coding all videos.

Interrater reliability. In order to ensure that the coding was as accurate as possible, a number of approaches were taken to confirm reliability. Prior to the commencement of coding, both point-by-point agreement and summary level agreement checks were conducted. This early point-by-point agreement checking allowed for multiple discussions about the coding schemes, while the summary level agreement checks allowed for identification of RAs who were struggling with the coding schemes. When particular behaviours presented as ambiguous of confusing for the RAs, it

was possible to source exact examples of these behaviours from videos not being coded in order to establish a criterion coding standard (Sharpe & Koperwas, 2003).

Once coding commenced, point-by-point agreement continued to be checked with the current researcher checking each code placed by the RAs at the end of a coding session. This allowed for an assurance of both the content of the coding and the timing at which each code was placed. It also encouraged a constant dialogue between the RAs and the current researcher. At the halfway point in coding, further summary level agreement checks were conducted, with the current researcher producing output in Observer to which the RAs' output could be compared. This was conducted in an effort to identify any observer drift that may be occurring. A potential concern with this process may have arisen from the fact that the RAs were blind coding, while the current researcher was not. While there was concern that this difference in knowledge may impact on coding, a high level of reliability was achieved (with a Cohen's Kappa (k) ranging from .81 to 1.00). The remaining videos were coded with continued point-by-point agreement checks conducted on every single code placed. This was a hugely time-consuming process and would not be recommended for future studies. However, it was considered the most appropriate way to ensure the accuracy of coding. The coding process, from initial training to producing data for analysis, took three months.

Addressing observer bias in automated and paper coding. As discussed, a central concern within observational studies is that the observation may be influenced by the observer. A number of steps were taken to overcome this within the coding procedure. All RAs were blind as to the nature of the study, which ensured that they were not biased by information relating to participant groups, research design, hypotheses or expectations. Further to this, to ensure that RAs were able to accurately capture all behaviours of interest, they coded only one behaviour at a time so as to

remove distraction. All but one coding scheme was descriptive, which limited the amount of subjective evaluation required from the observer.

Beyond this, observer drift is a common problem within observational studies as observers work through the observation material and gradually redefine the behaviours being viewed such that they do not match the original definitions. Further, they may become less reliable in their definition of behaviours as monitoring and motivation decrease. These concerns were addressed through strict reliability checks.

Data produced from coding. The use of automated and paper coding produced both frequency and durational data. All responsive behaviours, maternal utterances and infant vocalisations were measured as a proportional rate. For example, if a mother produced 100 utterances and 20 of those were descriptions, it was recorded that 20 per cent of vocalisations during a particular recording session were descriptions. This was considered most appropriate as an examination of the duration of these behaviours would not be meaningful and may simply offer information relating to the different speeds at which mothers spoke.

Conversely, the social engagement and facial expressions of both mother and infant and the Delight and Distress vocalisations of infants were recorded as durations. As with the decision to use proportions, this choice was informed by the research question being addressed. While it is beneficial to know, for example, the proportional rate at which infants hear mothers use descriptions, it is less useful to examine the number of times a mother becomes socially engaged. Rather, it is interesting to examine the amount of time a mother spends socially engaged with their infant over the five minute interaction. Similarly, little information can be gained from examining how many times an infant vocalises with Distress, but investigating the amount of time that they

spend distressed during the five-minute session offers more interesting information. All data was then entered into IBM SPSS Statistics 20.

Transcription of maternal utterance. All audible maternal utterances directed toward the infant were transcribed longhand by an RA and then entered into the CHAT system (CHILDES, MacWhinney, 2000). This system provides a standardised format for producing computerized transcriptions of face-to-face interactions. The system was designed for use within both typical and atypical samples, and it offers the potential for both basic discourse transcription as well as detailed phonological analysis.

Within the present study, the main unit of transcription and analysis was taken to be an utterance based on prosodic features and pauses, as is standard across the literature. A recent psychology graduate was recruited to transcribe each of the five-minute videos. Initial training was conducted using video footage of infants at different time points. Each video was watched at full speed and each audible maternal utterance directed to the infant was transcribed using the CHAT system (CHILDES, MacWhinney, 2000) and its most recent protocols. Once each maternal utterance was transcribed, the research assistant then re-listened to the maternal utterance to ensure that it had been correctly entered. Upon completion, each transcription was reviewed by a second researcher who ensured that each maternal utterance had been correctly transcribed. The transcription process took a month for RAs to complete. Once this was complete, data produced in CHAT (CHILDES, MacWhinney, 2000) was transferred to SPSS.

The reliability of transcriptions. During the training process, the transcriptions produced by the RA were examined for accuracy both in capturing the interaction as it occurred and following the transcription protocol of the CHAT (CHILDES, MacWhinney, 2000) system. These checks were performed by both the current author and PI. When coding commenced, each transcription was

checked for accuracy as it was produced. As such reliability was achieved through consensus. Once again, this was a somewhat time-consuming approach, but it was considered the most effective method to ensure the accuracy of transcriptions.

Global scales of mother-infant interaction. In order to examine the overall pattern of behaviour within the mother-infant interaction, a global scale was used. The patterns of interactive exchange at nine and twelve months were examined using Cox and Crnic's (2003, revised 2006) 'Qualitative ratings for parent-child interaction at 3-15 months of age'. This was an adaptation of the 'NICHD Study of Early Child Care Mother-Infant Interaction Scales' (Owen, 1992). In order to examine the behaviour patterns of mothers and infants at eighteen months, an adapted version of the Cox and Crnic scale was used (*Mother-Child Structured Interaction Qualitative Rating Scales*, Baker et al., 2007). Although slight differences exist between the scales, they provide an assessment of a range of maternal behaviours, infant behaviours and dyadic mutuality. The scales provide a detailed description of each behaviour type, as well as the specific behavioural requirements that should be observed in order for a score to be awarded.

The eighteen-month scale has previously been used to examine the interactions of mothers and their SibsA infants (Baker et al., 2010). Further to this, the scales were chosen because they provide a broad ranging assessment of maternal and infant behaviours, with a particular examination of the sensitive and directive behaviours of mothers, which have been a focus of debate within the literature (for example Wan et al., 2012; Baker et al., 2010) and are of particular interest in the present study.

The scales also provide a good measure of the social engagement and attentional behaviour of infants, which is of particular interest to examine amongst a sample of infants that may be effected by autism. The measure of dyadic mutuality is also interesting as it allows for the examination of

the synchrony and shared experience between mother and infant, which may be of particular interest within samples where one interactive partner is displaying atypicalities in social responding, as may be the case with SibsA infants. Any mention of autism was removed from the scale prior to providing it to the RAs so as to ensure they remained blind to the purpose of the study. This did not in any way affect the integrity of the measure.

As is often the nature of rating scales, evaluative judgements were used to examine the tone of the interaction, with observers required to provide ratings based on inferences made from maternal and infant behaviour. While this approach offers rich data, it is typically less reliable than simply using descriptive variables, and as a result observers were provided with detailed descriptions and examples of behaviours being rated, as per Borg & Gall's (1989) recommendations.

Rating maternal and infant behaviour using the Global Scales. All six RAs worked on scoring the Global Scales of Interaction. Prior to commencing, four group meetings were held to discuss every element of the scale and to work through examples of interactions to ensure that all of the coders had a full and matched understanding of the scale. The group was divided into teams of two and they were assigned videos divided by group status, age and gender. They watched each five-minute video multiple times, reading the detailed outline provided before deciding on a rating. Once each group had rated their assigned videos, all six RAs watched the videos together to ensure group agreement on each score. Training and rating of the scales occurred over a week.

The reliability of the Global Scales. Certain phenomena are associated with the use of evaluative judgements; for example, observers have been found to display an error of leniency, whereby they tend to choose more favourable ratings for behaviours observed. Similarly, observers may make an error of central tendency whereby they tend to make most ratings at the centre of

the scale. These concerns were addressed throughout the rating process, which was conducted via consensus coding. Following initial training on videos that were not going to be coded, the RAs were divided into teams of two and they each coded one third of the videos. This was followed by meetings during which all of the RAs watched the videos and discussed whether they agreed with the scores that had been given. The present researcher attended these meetings in order to ensure that all RAs were continuing to accurately follow the rating scales. Little to no input was required by the present researcher, as all RAs were comfortable with the rating process and consensus was easily achieved. In this way, it was possible to ensure that ratings were not produced as errors of central tendency or leniency, and that they were, instead, an accurate measure of the behaviours of interest.

Statistical Analysis

Quantitative data was generated from all of the above procedures. This data was then entered into SPSS 20 for analysis. This section will detail the decisions made when conducting the analysis. Given the small sample size, all analysis was non-parametric and, unless otherwise indicated, two-tailed. The main aim of the study was to accurately describe the interactive world of the SibsA infants and their mothers. As such, Wilcoxon Signed Rank tests were employed to examine within-group changes over time. Mann-Whitney U tests were used in order to examine different patterns in interaction between groups. In examining the responsive behaviours of mothers and infants following particular partner behaviours, yoked variables were created that included the antecedent partner behaviour and the responsive target behaviour. For example, if an infant vocalised with Distress and a mother Disengaged from the interaction the exchange was recoded as Distress-Disengaged. Using this data it was possible to examine changes in within-group responding over time and differences between the patterns of response displayed by SibsA and TD dyads.

Ethical Considerations.

This section will present the ethical considerations made in relation to the study. It will examine how general ethical concerns relating to observation participation, such as confidentiality and consent were addressed. It will then examine the ethical considerations made relating to potential parent concerns about the diagnostic status of their infant. Finally, it will present the ethical considerations relating to participating in a longitudinal study.

The ethics of observation. The overall study design of the larger study was approved by the Ethics Committee of the School of Psychology, Trinity College Dublin on the 13th of November, 2008, while use of the data for the present study was approved on the 5th of April, 2012 (see Appendix Five). All video footage collected was encrypted to ensure the anonymity of the participants and any data relating to the dyads could not be connected to participants. Mothers were informed both verbally and in writing that their participation would be confidential. Further to this, a conscious choice was made to maintain an open dialogue between mothers and researchers, so as to ensure that mothers felt comfortable to ask questions, make comments and offer suggestions throughout the process. This was done to ensure that mothers felt comfortable with their involvement in the filming sessions and that their experience within the process was acknowledged as meaningful, as per the recommendation of Holloway and Jefferson (2000). In this way, the provision of written informed consent by the mothers in a single session was not the sole opportunity for mothers to gain information; rather it was acknowledged that the informational needs of mothers may shift during the process of data gathering, with the researcher answering questions to ensure that a safe context was created for participating mothers.

Parental concerns. At the outset of the filming process, mothers were made aware that the research was not a clinical study and it would not be within the capabilities or ethical interests of

researchers to offer information regarding their opinions relating to participating infants' ASD status. All mothers who were participating as part of the SibsA group were in contact with clinical staff with whom they could discuss any concerns. Were they to address such concerns with the present researcher, they were listened to and advised to contact the clinical staff with which they had been working.

A particular ethical concern arose in relation to the assumed-to-be TD infant who later received an ASD diagnosis. As the editor of all of the infant footage, it became apparent to the present researcher that the infant was displaying some behaviour that may be associated with ASD. However, given that we had informed the mothers that we could not provide a diagnosis, this topic was not broached with the mother in question. The infant was formally diagnosed shortly after the atypical behaviours were noted by the present researcher.

Long-term commitment. Participating in a longitudinal study is a significant commitment for anyone, particularly a new mother. Before they agreed to participate, mothers were made aware that the study was longitudinal and that they would be filmed over a number of months. Once they agreed to take part they were made aware that they could withdraw from the study at any point without prejudice. Further efforts were made to ensure that the process of filming consistently occurred in a safe and comfortable environment for mothers and infants. Taping sessions were arranged well in advance and the PI ensured that she was timely upon all visits. Other safeguards were put in place to ensure the tenets of good observation practice were upheld, such as informing mothers that they could take a break from filming or reschedule filming if they needed to.

Mothers were aware that the present researcher was available should they need to discuss the project at any time. Further, when the present researcher was joining the filming sessions, mothers were informed days in advance and given the option to refuse the visit without prejudice. Once

there, the present researcher encouraged and answered all questions from mothers. All of these measures were taken in response to Watillon's (2002) assertion that individuals being observed in longitudinal studies experience an often unconscious sense of intrusion. Hindle and Klauber (2006) recommended that maintaining a more approachable and familiar role in the research may be enough to avoid this. Further to this, in order to make the process more pleasant for mothers and infants, infants were given a Trinity College teddy bear on their birthday and mothers were provided with an edited video, set to music that captured fun moments of mother-infant interaction from each visit. All mothers reported having enjoyed the experience and stated that they found the process interesting.

Chapter Three: Global Patterns of Mother-Infant Interaction

Overview

The patterns of behaviour displayed by SibsA and TD dyads at 9, 12 and 18 months were examined using a global scale of mother-infant interaction. Few differences in behaviour were found between infant groups, although SibsA infants did show patterns associated with lower social engagement. More differences in behaviour were displayed by mothers, with significantly higher levels of directive behaviour found for SibsA mothers. This differing pattern of maternal behaviour was associated with more positive outcomes for SibsA infants, suggesting that mothers may be intuitively adapting their behaviour to meet their infant's differing socio-communicative needs. SibsA and TD infant social and linguistic abilities were linked to different patterns of maternal behaviour, which may tentatively suggest that SibsA infants are biologically influenced by a unique form of social functioning, with this risk sensitivity preventing them from accessing the beneficial effects of some maternal behaviours, but allowing them to access other forms of maternal adaptive responding that may present a more positive environment.

Introduction

Intersubjectivity in Mother-Infant Interaction

As has been established in the first chapter, the trajectory of typical infant socio-communicative development is founded upon interaction with the caregiver. While the interactive exchange between mother and infant may be largely without words on the part of the infant; it does follow a conversation-like structure. Trevarthan (1993) found that in interaction with their mother, infants typically are attentive to their partner's face and they respond with coos and smiles. Their gestures and mouth openings are synchronised with a broad range of emotions. Mothers will typically respond by speaking to their infant in a high-pitched voice, with repeated name calling serving as an attention device. They will respond to specific infant behaviours with smiles and vocalisations, attuning what the infant has done with enhanced mimicry (Papoušek & Papoušek, 1989; Snow, 1977; Trevarthen, 1977).

Mothers (and fathers) also provide an important role by ascribing meaning to infant utterances, and interpreting the meaning within non-verbal infant behaviours (Trevarthen, 1999). This allows infants the opportunity to see the affective, environmental changes that their behaviour can elicit, allowing them the intersubjective view of 'self' as it impacts on 'other'. As infants age, these proto-conversations develop, with structure becoming more complex and timing tightening (Rochat et al., 1999). It has been suggested that the simple, repetitive structure of the IDS used by caregivers gives the infant a clear opportunity to link the emotional content of the language input they receive, with motivated content of the language they hear (Powers, 2008). This interaction is regulated by both parties, with the adult taking more cues from the infant's behaviours (Trevarthen, 1977). In this way, a chain of turn-taking is established, with brief infant behaviours eliciting a pattern of reply and address from the adult (Trevarthan 1993b). Through this pattern of

behaviour and response, the infant can, once again, see their agentic role within the interaction, giving them an intersubjective view of 'self' and its impact upon 'other'.

Trevarthen suggested a developmental pathway of infant intersubjectivity. Within the first few months of life, infants display *Primary Intersubjectivity*, whereby they are motivated to interact with and attend to their primary caregivers. Trevathen and Aitken (2001) suggest that at this stage infants are capable of consciously appreciating the communicative intentions of their interactive partner and they are capable of responding immediately. At around the ninth month stage, infants display what Trevarthen has termed *Secondary Intersubjectivity*. At this stage, the infant can also actively turn their attention to their wider environment. They use objects and focus on other's use of objects. Through contingent responding, interactive partners become a source of information about object use for the infant and the infant's communicative focus shifts to include joint attention (Legerstee, 2001; Tomasello, 1988; Trevarthen, 1994; Trevarthen & Hubley, 1978).

In a more recent study, Beebe et al. (2010) found that differing patterns of contingent responses were early markers for infant attachment style. They suggest self-contingency (the individual's own rhythmic pattern of behaviour) at 4 months played a strong role in attachment development at 12 months. Similarly, infant interactive contingency (the pattern of infant response to the mother) was also highly predictive of attachment style. While, traditionally, attachment literature has focused on maternal responding and its role in attachment development, Beebe et al. (2010) found that maternal contingent response was less predictive of attachment style, with both high *and* low levels of contingency responding from the mother at 4 months linked to insecure attachment at 12 months. They suggest that these findings present a strong case for the intersubjectivity of infant attachment development, with infant response playing an active role in the co-construction of the relationship.

Tomasello (1995) suggested that following the 'Nine month social-cognitive revolution', infants develop and strengthen their understanding of 'self' and 'other' allowing them the ability to interpret the actions of others as intentional. This approach assumes that TD infants have had enough experience interacting with their caregivers and observing the behaviours of others, to allow them to develop an understanding that the actions of others are intentional and that their own behaviours have resultant consequences upon the behaviours of others. Some have argued against such an early infant ability to understand their own communicative intent; however there is consensus that the behaviour of the caregiver is essential in reinforcing joint attention and the shared interactive experience (for example, D'Entremont & Seamans, 2007). As such, early infant socio-communicative behaviours are seen to function as an enhancement of the interaction, with, for example, infant gaze and pointing behaviour providing a basis for maternal response. Caregiver behaviour is suggested to provide a gradual understanding of personal intentionality for the infant founded upon repeated observations of caregiver responses to the infant's communicative behaviours (D'Entremont & Seamans, 2007). Both Tomasello (1995) and D'Entremont and Seamans (2007) highlight the importance of maternal responsive behaviour, and many studies have examined the role of contingent maternal responding in the development of vocal and linguistic behaviours (see Chapter Four). In this sense, the different behaviours of mothers, elicited in response to infant behaviour, may be seen to significantly shape the course of the infant's developmental path.

This naturally occurring, bidirectional pattern of influence is apparent from birth. Infant distress and maternal response to it, exist as a natural source of bi-directional regulation established by both partners within the dyad. The cries of the infant elicit strong alarm-distress responses in caregivers, alongside a drive to intervene and provide the infant with immediate regulatory support

through physical contact, gentle physical stimulation and calming vocalisations. The infant, in turn, calms in response to the caregiver's efforts, which reduces caregiver arousal and increases self-efficacy. This intuitive parenting response provides emotional security and protection for the infant, with a longitudinal effect on infant secure attachment and stress regulation (see Papousek, 2011).

The process of typical interaction in general is regulated by psychobiological preparedness on the part of both mother and infant. The infant benefits from maternal provision of intuitive regulatory and emotional support, while the mother profits from the infant's provision of feedback and solicitation of interaction. Thus, in response to infant assurances, the mother experiences raised levels of self-efficacy and self-confidence. This cycle of mutual regulatory support functions to provide reward for the infant, the parent and the changing parent-infant relationship (Emde & Sorce, 1983). Transient perturbations of the mother-infant interaction in typical dyads may be overcome as a result of this cycle of co-regulation.

Emphasis has been placed on the manner in which difficult infant temperament may be overcome if mothers provide alternative, compensatory regulation, thus parents create a responsive environment fitting to the regulatory needs of the individual infant (Thomas & Chess, 1980). Similarly, should responsive parenting be momentarily hampered by exhaustion or mild depression, infant initiating bids may function to revive parents' responsiveness (Cohn & Tronick, 1989). This highlights the intersubjective, bidirectional nature of the mother-infant interaction, as well as the plastic nature of early infant development, with parental behaviours reinforcing and subsequently shaping the behaviours of the infant.

Differential Susceptibility to Environmental Influences. Belsky et al. (2007) argued that much of the focus of research conducted in relation to infant development in situations of risk focuses unnecessarily on the negative impact of child and caregiver characteristics. Building on

Bronfenbrenner and Crouter's (1983) model of *person-process-context*, which assumes that processes of child development may function differently in different ecological niches, with matched experiences impacting on different people in different ways, Belsky (1997, 2005) argued for an evolutionary understanding of child susceptibility to parenting influences. He suggested that, parents cannot, consciously or unconsciously, know which parenting strategy will maximise reproductive fitness. Thus developmental processes are selected to vary children's susceptibility to their environment to avoid all children being directed by parental influence that may not be beneficial.

Belsky questioned how differential susceptibility should best be conceptualized. He questioned whether some children may be highly plastic in their development, while others are not; or whether plasticity is discrete for some factors (with some children influenced and others not), or whether some susceptibility factors may be more continuous. While differential susceptibility may explain differing outcomes in infant development, it does not explain the mechanisms by which such differences are created. For example, infants who are 'uptight' may benefit from their timidity as they are given an opportunity to observe their environment (Suomi, 1997). This suggestion may be given strength by the findings linking attentional abilities and the dopamine system (Bakermans-Kranenburg & Van IJzendoom, 2007). These findings are fitting with Belsky's (2005) suggestion that infant negativity is linked to a highly sensitive nervous system against which environmental experience may present a powerful response. When caregiver behaviour does not aid regulation, this response is negative, but if co-regulation occurs, positive outcomes may be expected. Belsky (2005) suggests that this assertion is, perhaps, strengthened by the findings of Boyce and Ellis (2005), which propose that later susceptibility may result from prenatally programmed hyperreactivity to stress.

Intersubjectivity in Mother-Infant Interaction in Atypical Samples. A number of studies have examined mother-infant interaction in samples where social impairments are present. In a study of mothers and their intellectually disabled children, it was found that those mothers initiated almost twice as many interactions as mothers with TD infants and almost 3.5 as many directives were displayed by mothers of intellectually disabled children (Eheart, 1982). Infants with intellectual disability responded to just over 50 per cent of maternal initiations, whereas TD controls comparisons responded to over 75 per cent. Similarly, in an observation of infants with Down Syndrome (DS) in interaction with their mothers, it was found that mothers exhibited a greater frequency of vocal directives, vocal praise and supportive objective behaviour, as compared to mothers of typically developing intellectually- and age-matched infants (Roach et al., 1998). Again, in a DS sample, an examination of the behaviours of mother and infant found that DS mothers displayed higher levels of intrusiveness (defined as a breaking of infant attention as a result of parental directiveness), while infants displayed lower levels of sustained engagement within the interaction (Cielinski et al., 1995).

In an examination of the interactions of mothers and their developmentally delayed infants, mothers tended to be more directive in interaction as compared to mothers of TD children (Marfo, 1992). However, while maternal intrusiveness was associated with lower levels of dyadic mutuality, directiveness was not. In an examination of the impact of maternal directiveness on later infant outcomes, Mahoney and Powell (1998) proposed that a nonresponsive interaction style (one lower in maternal directiveness) was less effective in promoting the development of disabled children. A more nuanced approach to the understanding of directiveness has also been highlighted (Moore, Saylor & Boyce, 1998). Through such an approach, it has been found that in high-risk, medically fragile infants, directiveness was associated with less favourable developmental outcomes and

lower IQ scores in later childhood. However, directiveness that is appropriate to the infant and of a high quality was associated with higher IQ scores. This suggests that maternal adaptations in response to infant atypical behaviour may serve to promote improved outcomes for 'high risk' infants. With this in mind, it has been emphasised that interaction styles that may be considered negative in typical contexts may function to benefit a child with a developmental disability (Doussard-Roosevelt et al., 2003). Far from being associated as a cause of the disability/atypicality, the differing maternal interaction style may be more appropriate in the context of atypical infant socio-communicative displays. Indeed, Pine (1992) called for a new understanding of maternal directive behaviour in such sampless, stating that these behaviours may need to be re-framed in a more positive light.

When examining the interactions of children with developmental delay, Baker et al. (2007) found that maternal behaviour was a stronger predictor of child social abilities at 6 years, than were any child behaviours. Specifically, maternal provision of scaffolding (in this instance defined as an ability to co-regulate and structure their child's experience through emotional regulation, motivation maintenance and facilitating technical skill) was found to predict positive social outcomes for children. While this study focused on the interactions of developmentally delayed 4-year-olds and their mothers, it pointed toward a fruitful area of study for ASD researchers. Specifically, it would be beneficial to examine the potential importance of the role that the social environment may also play in fostering resilience in communities of infants more likely to receive an autism diagnosis. As such, it may be worth considering a model of potential ASD status and interaction based upon the assumption that certain forms of 'risk' may be positively and negatively moderated by environmental factors (as proposed by Belsky et al. (2007). In this sense, a form of

risk-sensitivity or differential susceptibility may be at play, with maternal and infant behaviour having a greater influence in cases of child risk.

Intersubjectivity in Mother-Infant Interaction in Autistic Samples. Belsky's work on infant differential susceptibility has, thus far, focused on the function of specific genes, phenotypic temperamental characteristics and endophenotypic characteristics, without a specific focus on autism. With these factors reframed from vulnerabilities to plasticity factors, whereby some infants are more susceptible than others to both negative and positive influences within the environment, it may be appropriate to examine autism within this framework.

With the wealth of studies focusing on the role of parent-child interaction in fostering positive outcomes for infants, it is worthwhile to investigate the role that interaction plays in fostering positive outcomes for infants more likely to be given an autism diagnosis. While early studies of the development of infants with autism focused on a unidirectional pattern of behaviour (with emphasis solely on maternal behaviour) (for example Kanner, 1943), further studies have focused on the bidirectional, intersubjective nature of interaction, with clear evidence establishing ASD infants' ability to develop selective functional attachments to their caregivers (Dissanayake & Crossley, 1996, 1997).

Autism is characterized by (amongst other things) atypicalities in responsive social behaviour and communicative patterns before the age of 3 (American Psychiatric Association, 1994). Through direct observation and retrospective home movie examinations, numerous studies have attempted to establish patterns of ASD-related behaviour prior to the third year. While some studies have found similar patterns of social interest, gaze and orienting to voice in ASD infants during the first 18 months (see Palomo et al., 2006, for a review), other studies have found differing patterns of infant behaviour (Landa & Garrett-Mayer, 2006; Landa, Holman & Garret-Mayer, 2007; Ozonoff et

al., 2010; Zwaigenbaum et al., 2005). By 18 months, infants later diagnosed with ASD have been found to display limited expressions of emotion, limited gaze at face and limited response to name (Saint-George et al., 2010).

By the second year, more signs of differing socio-communication are apparent, with limited development of language and a continued lack of emotional expression and inter-subjective abilities (Landa & Garrett-Mayer, 2006; Landa, Holman & Garret-Mayer, 2007; Ozonoff et al., 2010; Zwaigenbaum et al., 2005). In comparison to infants with intellectual disability, characteristics specific to autism include limited positive facial expression, limited joint attention, fewer gazes toward the interactive partner and a lower quality and quantity of eye contact (Muratori et al., 2010; Palomo et al., 2006; Saint-George, 2010) with a lack of orientation to name, responding to social invitations and maintaining social engagement apparent by the first year (Muratori et al., 2010). However, the above studies paid little or no attention to the bi-directional, mutual nature of the interactive experience. Given that social impairment is a central element of ASD interaction, an approach that focuses on the interaction holistically may produce a fuller picture. Unlike investigating infant social functioning or maternal responsiveness alone, examining the bi-directional nature of the interaction, allows for an understanding of each partner's behaviour as it shapes that of the other.

The unique set of infant behaviours associated with ASD may call into question the role that the interactive environment can play. With limited social interest, joint attention and expression of affect in infants, it may be more difficult for mothers to beneficially effect change within the interactive environment. Indeed, Dawson et al. (1990) suggested that the atypicalities of socio-communicative behaviour displayed by infants with autism may actually impact negatively on their caregiver's behaviours. This may suggest a model of differential susceptibility, whereby certain

deficits in ASD may be biologically produced, leaving children less susceptible to different parenting styles.

This model of biological constraint was highlighted by Travis et al. (2001), who found a link between child interactive behaviour and social understanding in ASD children as compared to children with developmental delay. This may indicate that biological limitations in social understanding may limit the role that environment can play in shaping the quality of social interaction displayed by children with ASD. However, the study examined interaction in the context of play with peers and within a lab setting. The role of the parent and more structured interaction in a natural environment were not examined.

If a bidirectional, intersubjective approach to understanding the interaction is taken, then it may also be productive to examine how infant atypical socio-communicative behaviours impact upon the nature of the interaction, in spite of biological constraints that may be shaping those behaviours. Early atypicalities associated with autism may result in the display of infant behaviour that may differ from TD infants in relation to how they interact with their environment. Thus mothers may be receiving a unique set of behaviours from their infant, which in turn produce a unique set of responses. In turn, infants may be biologically predisposed to engage with certain forms of environmental stimuli.

While biological deficits may impact upon infant ability to avail of elements of the interactive environment, maternal behaviour has been linked to infant outcomes. In particular, structured adaptations to the environment of children with ASD have been shown to produce positive outcomes. Interventions focusing on fostering joint engagement and increased parent-child synchrony have reported improvements in infant expressive language and social reciprocity (Aldred et al., 2004; Drew et al., 2002). Equally, the level of synchronization with their infant displayed by

mothers has been found to predict later language and sustained attention abilities (Siller & Sigman, 2002, 2008).

Intersubjectivity in unstructured SibsA and ASD interaction. While the Aldred and Drew interventions focus on adapting maternal behaviour within a dyad where an ASD diagnosis has already been given, it is also productive to examine the unstructured responses of mothers prior to the provision of a diagnosis. A review of infant-siblings literature found evidence supporting the plasticity of SibsA infant development, but found a limited amount of work focusing on the specifics of the interactive environment that may influence this plasticity (Rogers, 2009).

One study that did examine maternal interactive behaviour in SibsA dyads, focused on synchrony in mother-infant freeplay at 4 months, finding links with later infant outcomes in relation to language and social abilities (although no direct predictions could be made from maternal synchronous behaviour). A quarter of SibsA infants were found to display lower levels of synchronous behaviour in infant-led free play. One interpretation may be that mothers struggle to interpret their infants' affective behaviour, thus producing lower levels of synchronous responding (Yirmiya et al., 2006).

More recently, Saint-Georges et al. (2011) examined the interaction of mother and ASD infant as a whole, allowing for the investigation of the antecedents and consequences of interactive behaviours, and for an examination of patterns of behaviour that may facilitate or hamper social interaction within the dyad. In a comparison of developmentally delayed infants and TD infants, they found that developmentally delayed infants displayed an initial delay in intersubjective and object-related behaviour, but this behaviour increased to match the levels of TD infants. In contrast, ASD infants displayed low levels of social interest, with only a limited increase over time. When social engagement did occur, it was found that infants with ASD displayed a more passive

form of interaction, with a limited display of social initiation, which, in turn, may have impacted upon the infant's ability to engage with and respond to others. Similarly, ASD infants displayed a decrease in interaction with objects, which afforded them limited opportunity to establish patterns of joint attention with their caregiver.

Caregiver behaviour differed for mothers of infants diagnosed with ASD and mothers of children with developmental delay, who spent more time regulating their child's behaviour in order to sustain attention. This pattern of high infant stimulation continued for parents of children with ASD, presumably because such infants continue on a trajectory of limited social engagement. A lower number of ASD caregiver responses, as compared to those of mothers of typically or developmentally delayed infants, may be linked to the lower display of intersubjective, joint-attention behaviours often displayed by infants with ASD. While there are similarities in the pattern of mother-infant interaction across groups, it appears that even prior to diagnosis, mothers of infants later diagnosed with ASD are adapting their initiative and responsive behaviours to the differing patterns of social behaviour displayed by their infant.

Saint-Georges et al. (2011) emphasised that this ability to adapt to infant needs points strongly to the intuitive understanding that mothers have in relation to the socio-communicative abilities and needs of their child. While the above study highlighted the holistic nature of the interaction, it was based on retrospective home movie studies. This footage offers the opportunity to examine candid, real world interactions, but the circumstances of filming may not be optimal for fully capturing all behaviours displayed by mothers and infants. Equally, the occasions that are chosen by caregivers as worthy of filming may not represent typical interactive exchanges.

A range of differences have been found in relation to dyadic interactive exchanges that suggest that mothers are responding to specific characteristics of infant autistic behaviour, and that these

maternal responses are producing positive outcomes for infants. Kasari et al. (1988) found that a higher level of maternal control strategies were being employed within interaction with an child with autism, as compared to caregivers interacting with TD children. Children with autism themselves show a higher level of response to these directive behaviours as opposed to maternal suggestions (Sigman et al., 1986). Siller and Sigman (2002) found that a greater level of mother-infant synchrony, as well as a greater level of attentional focus displayed by the infant, were linked to better child communicative outcomes in autistic samples. A further study found a differing pattern of maternal behaviour for mothers of infants with autism as compared to language impaired, intellectually delayed and TD children, with mothers of children with autism displaying higher levels of control, higher usage of attention devices, higher levels of nonverbal prompts and increased physical proximity (Lemanek et al., 1993). While infants with autism were less compliant than any other infant group, increased compliance was associated with maternal verbal prompts. However, the study focused on infant performance of specific tasks, which may have constrained the natural flow of maternal and infant response.

One study examining mother-infant interaction in dyads in which children had been given an ASD diagnosis, found that mothers of children with autism used higher intensity methods to engage with their children and they used more physical approaches (Doussard-Roosevelt et al., 2003). In turn, children with autism displayed greater degrees of low-level social withdrawal (with Doussard-Roosevelt et al. hypothesising that such withdrawal requires a more passive, less socially engaged level of interaction as compared to high levels of social withdrawal, which involves an active acknowledgment of the partner from whom they are withdrawing). However, children with autism displayed higher levels of social responding when mothers engaged them with physical interaction. Again, the findings of Kasari, Doussard-Roosevelt, Lemanek, Sigman and colleagues point toward a

differing pattern of mother-infant responding that is necessary to maintain the interaction, with this differing pattern presenting a unique influence on the developing socio-communicative behaviours of the infant. Interestingly, when mothers of children with autism were observed interacting with a typical, control child and their own, TD control child, few differences were found in the manner in which mothers interacted (Doussard-Roosevelt et al., 2003). This highlights the unique rhythm of the mother-infant interaction in dyads affected by autism, and it also highlights the strong role that both maternal and infant response play in shaping that interaction.

Taking a closer look at the parental role and its potential to foster positive outcomes for infants diagnosed with ASD, one study found that maternal sensitivity was not predictive of infants' development of secure attachment, with less severe social deficits more closely associated with such an attachment style (van IJzendoorn et al., 2007). Again, this may suggest that those individuals experiencing less severe social deficits may be better able to avail of the positive interactive environment provided by parents. However, van IJzendoorn et al.'s (2007) study employed a broad interpretation of maternal sensitivity. A more nuanced definition that defined elements of sensitivity such as positive regard, cognitive stimulation and respect for infant autonomy, may offer a better understanding of the environmental factors that are most salient to the development of infants with ASD.

Baker et al. (2007) emphasised the importance of examining concepts such as Sensitivity in a more detailed fashion, as given the range of deficits displayed by infants on the spectrum, it may, for example, be more difficult for parents to display both emotional supportiveness and structuring behaviour to stimulate cognitive development. Indeed, a study of mothers interacting with their child who had been given an ASD diagnosis, found that when sensitivity was examined as a number of elements, the maternal behaviour of Limit Setting was the only one found to impact upon

subsequent child behaviours, with fewer behaviour problems associated with higher levels of Limit Setting (Osbourne et al., 2008). This study focused on children aged between 5 and 16 years. It would be interesting to examine maternal behaviour and infant response at a younger age, when social and linguistic development is more rapidly occurring.

In a further examination of the structured nature of parent-infant interaction, in a comparison of caregivers' interactions with their child with autism, and caregivers' interactions with their child diagnosed with intellectual disability, Kasari et al. (1988) found that ASD caregivers provided similar levels of control over their child's behaviour, with higher levels of physical restraint employed. Similarly, it has been found that parents of children on the spectrum displayed lower levels of authoritative parenting in comparison to non-clinical groups (Rutgers et al., 2007).

In examining the global patterns of behaviour in SibsA and TD mother-infant interaction, Wan et al. (2012) found that SibsA infants were less active compared to TD infants. Also, mothers of SibsA infants were found to display a higher level of directiveness (defined in terms of negative, intrusive direction as opposed to sensitive structuring) and Maternal directiveness was found to have strong associations with low levels of sensitive responding and dyadic mutuality, with Wan et al. (2012) interpreting these findings to suggest that maternal directiveness was unlikely to provide a positive function within the interaction. They do speculate that the behaviour of mothers with SibsA infants may be influenced by their previous interactions with the older, diagnosed sibling, and also with a higher level of stress that may be experienced by mothers of SibsA infants who already have at least one child who has been given an ASD diagnosis. The study focused solely on infants at one time point, between 6 and 10 months. It would have been interesting to examine changing patterns that may have occurred as infants aged.

A similar approach was taken by Baker et al. (2010), who also undertook a macro-analytical method in examining mother-infant interaction, with a focus on SibsA infants aged 18 months. They found a positive link between maternal sensitivity and SibsA infants' later language development, with maternal stimulation of cognitive development (or 'sensitive structuring' as it is also called) showing a particularly positive outcome. However, no significant differences were found between the global score of maternal sensitivity between SibsA and TD groups, and no significant link was found between TD maternal sensitivity and later language outcomes. This may suggest risk-sensitivity effects for the SibsA group.

The findings of the Baker et al. (2010) study highlight the importance of examining maternal behaviour in a nuanced fashion, with constructs such as sensitivity and responsivity perhaps better examined through a multifaceted approach. Further evidence of the nuanced nature of the mother-infant interaction comes from the finding that maternal sensitivity was associated with fewer behaviour problems amongst infants who did not gain an eventual diagnosis, but a contrastive effect was seen for infants who later gained a diagnosis. It is suggested that this may result from maternal efforts to engage their infants, which may frustrate and produce behavioural difficulties in the infants in the short term, but those maternal efforts may produce positive results over time.

The Current Study

The current study will examine the maternal, infant and dyadic behaviours displayed during a five minute, unstructured play period amongst SibsA and TD dyads. A macro-analytical approach will be taken, allowing for the study of the association between global measures of interaction and infant outcomes in relation to social and communicative abilities. Unlike the above studies by Baker et al. (2007) and Wan et al. (2012), this study will apply a longitudinal approach, with dyadic interaction measured at 9, 12 and 18 months, allowing for a study of the effect of potential ASD

status on dyadic behaviours, alongside changes in those behaviours and their associations with later outcomes.

Based on previous research, the objectives of this study are to examine if global patterns of maternal, infant and dyadic behaviour differ between SibsA and TD groups and if these patterns continue as the infant and the dyadic relationship develop. Further, the study aims to investigate maternal sensitivity in a variety of forms, examining whether mothers of SibsA infants display differing patterns over time and whether different types of sensitivity displayed at different times are associated with beneficial infant outcomes for the SibsA group. Further, as the study emphasises the bidirectional nature of the interaction, this chapter will also examine whether infant social and linguistic abilities may be associated with later maternal behaviours.

Scales will be used to examine a variety of maternal behaviours associated with sensitivity and directiveness (sensitivity, intrusiveness/respect for autonomy, detachment, and stimulation of cognitive development), mood (positive regard and negative regard/hostility) and in the 9 and 12 month scales, maternal animation. The infant behaviours examined will be associated with mood (positive mood/enthusiasm and negative mood), social abilities (affection, sustained attention at 9 and 12 months, persistence, social interest and social competence at 18 months) and activity level at 9 and 12 months. A final scale of dyadic mutuality will examine reciprocal behaviours between mother and infant.

Hypothesis One

SibsA infants will display different patterns of social engagement as compared to TD infants, resulting in a gradual decrease in social engagement over time for SibsA infants.

Hypothesis Two

Mothers of SibsA infants will display different patterns of interaction as compared to mothers of TD infants; specifically, they will display higher levels of directive, intrusive behaviour towards their infant.

Hypothesis Three

Associations will be found between maternal interaction styles and infant social and linguistic abilities.

Methods

Participants

The same dyads as previously described participated in the present study.

Procedure

The same five-minute video footage for each dyad at each time point was also sampled for the present study.

Global Scales. Each video was rated for global patterns of behaviour at each of the three time points. The global scales used were adapted from the NICHD Study of Early Child Care Mother-Infant Interaction Scales of sensitivity (Owen, 1992). A full description of the scales used can be found in Chapter Two. The scales themselves and the necessary coding sheets can be found in Appendix Six to Nine.

Six research assistants were recruited and trained to rate mother-infant interaction using the global scales. They were divided into three pairs and conducted separate sessions in which scales were rated. The pairs then reached a consensus on the ratings given. Finally, all six members of the RA team watched the videos together to ensure group consensus was reached for each interaction that was rated.

Outcome Measures. Each child was administered the cognitive and language subscales from the *Bayley Scales of Infant Development—Third Edition* (BSID-III) at 12 and 18 months. Non-verbal communication was assessed using the Early Social Communication Scales (ESCS) (Mundy et al., 2003). The procedure used is described in the previous chapter.

Results

Key Findings

Mothers of SibsA infants displayed significantly lower levels of sensitivity and positive regard, as well as higher levels of intrusiveness at 9 months. At 12 months, mothers of SibsA infants displayed significantly lower levels of stimulation of cognitive development and animation, and higher levels of detachment. At 18 months mothers of SibsA infants were displaying significantly higher levels of hostility toward their infants. Of the infant behaviours, only one was significantly different, with SibsA infants displaying higher levels of negative mood at 9 months. In general, between-group differences for both mothers and infants decreased over time, with groups showing similar patterns at 18 months.

Maternal directive behaviour was associated with more positive outcomes for the SibsA group as compared to the TD group. Infant linguistic ability was associated with more positive maternal responses for the SibsA group. Dyadic mutuality in the SibsA group was given a lower rating at each time point, as compared to the TD group.

Group Differences

Within-Group Differences

No significant differences were found within groups over time on any of the behaviour measures.

Between-Group Differences

Across all three time points, only one significant difference was found between infant scores, with SibsA infants displaying significantly higher levels of negative mood at 9 months ($U[17]16.5$, $p<0.028$, $r=0.532$).

A larger number of differences were found between maternal behaviours. At 9 months, SibsA mothers displayed significantly higher levels of intrusiveness ($U[17]12$, $p<0.021$, $r=0.604$) and significantly lower levels of both sensitivity ($U[17]6$, $p<0.004$, $r=0.704$) and positive regard ($U[17]17$, $p<0.044$, $r=0.49$).

At 12 months, SibsA mothers displayed significantly lower levels of animation ($U[19]$ 20, $p<0.026$, $r=.51$) and stimulation of cognitive development ($U[19]$ 19.5, $p<0.024$, $r=.52$). With one TD outlier removed from the dataset, a Mann Whitney test revealed a significantly higher level of SibsA detachment as compared to the TD maternal group ($U[18]24$, $p<0.05$, $r=0.461$).

At 18 months one outlier was identified in the TD group on the hostility scale. When it was removed, Mann Whitney tests revealed that SibsA mothers displayed significantly higher levels of hostility as compared to TD mothers ($U[18]24$, $p<0.05$, $r=0.461$). See Tables 8 and 9.

Table 8. Nine and twelve month maternal, infant and dyadic median scores, standard deviation, U score, significance and effect size.

Global Behaviours	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Sensitivity	7 (.67)	4.75 (.75)	8	.004*	.704	6.25 (.94)	5.5 (.9)	35.5	.412	-
Intrusiveness	1 (.05)	3.25 (.94)	12	.021†	.604	2.5 (1.5)	2.5 (.84)	32.5	.288	-
Detachment	1 (.05)	2.5 (1.12)	18	.057	-	1 (0)	2.5 (1)	24	.050*	0.461
Positive Regard	5.5 (.75)	5.5 (.67)	17	.044*	.49	5.5 (.83)	5.5 (.75)	24	.064	-
Negative Regard	1 (0)	1 (0)	36	1	-	1 (.16)	1 (.15)	44.5	.939	-
Animation	4 (.33)	4 (.94)	34.5	.870	-	7 (1)	5.5 (.6)	20	.026*	.51
Stimulation of Cognitive Development	4 (1)	4 (.94)	34	.837	-	5.5 (.67)	4 (.6)	19.5	.024*	.52
Positive Mood	5.5 (.67)	4 (.75)	31	.597	-	5.5 (.6)	4 (.75)	23	.055	-
Negative Mood	1 (.05)	2.5 (.18)	16.5	.028*	.532	2.5 (.83)	2.5 (.75)	44	.926	-
Activity	5.5 (.67)	4 (.75)	27	.341	-	4 (1.17)	4 (.75)	39	.603	-
Sustained Attention	4 (.67)	4 (.79)	31	.587	-	5.5 (0)	5.5 (.75)	35	.342	-
Dyadic Mutuality	5.5 (0)	4.75 (1.25)	22	.142	-	5.5 (.84)	4.75 (1.2)	31	.229	-

(* 2-tailed significance, † 1-tailed significance)

Table 9. Eighteen month maternal, infant and dyadic median scores, standard deviation, U score, significance and effect size.

Global Behaviours	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Sensitivity	6 (1)	6 (1)	42.5	.830	-
Respect for Autonomy	3 (.67)	3 (.37)	41	.723	-
Stimulation of Cognitive Development	5 (.88)	5 (.08)	36.5	.466	-
Detachment	2 (.88)	2 (.08)	44.5	.966	-
Positive Regard	6.5 (.63)	6 (1)	40.5	.698	-
Hostility	1 (0)	1 (.6)	24	.050*	0.461
Enthusiasm	6 (.22)	6 (.05)	36	.367	-
Negative Mood	2 (.67)	1 (.7)	41.5	.754	-
Persistence	5 (1)	5.5 (.8)	39.5	.631	-
Affection	6 (1)	5 (.8)	30	.199	-
Social Interest	6.78	5 (.9)	24	.078	-
Social Competence	6 (.44)	6 (.07)	37	.483	-
Dyadic Mutuality	6 (1.1)	5 (.9)	36	.439	-

(* 2-tailed significance, † 1-tailed significance)

Global Scale and Later Infant Outcomes

Associations between global behaviour patterns and later infant socio-communicative abilities were examined in two ways: 1) Mother – Infant and 2) Infant – Mother. Kendall's Tau tests for correlation were conducted for each.

1) Mother – Infant. This section describes the relationship between global patterns of maternal behaviour and later infant outcomes. Kendall's Tau tests revealed only one significant correlation for the TD group, with maternal Sensitivity at 9 months positively associated with infant RBR at 18 months ($r[9] = .662$, $p=0.038$).

A number of associations were found for the SibsA dyads. Positive associations were found between infant outcomes and maternal Intrusiveness at both 9 and 12 months. Intrusiveness at 9 months was positively associated with infant cognitive abilities ($r[8] = .656$, $p=0.047$), while maternal Intrusiveness at 12 months was positively associated with both infant IBR ($r[10]= -.567$, $p=0.049$) and IJA ($r[10]=.676$, $p=0.020$) at 18 months.

Further associations were found between global patterns of maternal behaviour at 12 months and 18 month SibsA outcomes (see Table 10).

Table 10. Correlations between maternal behaviour at 12 months and SibsA infant abilities at 18 months.

	IJA 18m	RBR 18m	RJA 18m
Detachment 12m	-.548*	-.541	-.056
Animation 12m	-.032	-.031	-.653*
Sensitivity 12	.265	.630*	.130
Positive Regard 12m	.481	.588*	.138

(*= p<0.05, **= p<0.01 2-tailed significance)

2) Infant – Mother. This section describes the relationship between infant abilities at 12 months and global patterns of behaviour shown by mothers at 18 months. For TD infants, only cognitive abilities were positively associated with later maternal Stimulation of Cognitive Development (r[6] = .802, p=0.046). For SibsA infants, a larger number of abilities were associated with later maternal behaviours (see Table 11).

Table 11. Correlations between SibsA 12 month infant Language Abilities and 18 month maternal behaviour.

	Positive Regard 18m	**Sensitivity 18m**	**Hostility 18m**	**Detachment 18m**
Receptive Language 12m	.794**	.770*	-.523	-.300
Expressive Language 12m	.451	.420	-.700*	-.084
Cognitive Abilities 12m	.519	.645	-.378	-.806*

(*= p<0.05, **= p<0.01 2-tailed significance)

Discussion

Autism is associated with atypicalities in socio-communicative functioning. By 18 months, infants that are later diagnosed with ASD may be displaying less looking towards their caregiver, less response to name and less expression of emotion (Palomo et al., 2006; Saint-George, 2010). Within the present study, it was hypothesised that these micro-behaviours may be detectable on a macro level, leading to apparent global differences in the social interaction of SibsA infants.

Infant Behaviour

Few differences in behaviours were found between the patterns displayed by TD and SibsA infants. Where a difference was found, it was in keeping with predictions relating to limited/difficult social responding in SibsA infants. Beyond statistical significance, the data does reflect a differing pattern of social responding on the part of SibsA infants, with SibsA infant mood, activity levels and social abilities all found to be lower than that of TD infants. This apparent limitation in prosocial infant behaviour may result from the limited levels of infant social engagement associated with ASD. However, given the intersubjective nature of the interaction, it is necessary to examine the behaviours of mothers at each time point, in order to examine what influence maternal behaviour may be having.

Maternal Behaviour

In line with findings by Wan et al. (2012) mothers of SibsA infants showed lower levels of global sensitivity. Mothers of SibsA infants also displayed a higher level of intrusive, directive behaviour at 9 months. This behavioural phenotype may result from the maternal stress of having an infant already diagnosed with ASD (Hamlyn-Wright et al., 2007; Kuhn & Carter, 2006; Tomanik et al.,

2004), which could impact upon the level of emotional availability displayed by mothers of SibsA infants. However, without a measure of parental stress, this is a question for a future study.

The importance of considering the potential presence of the broader autism phenotype (BAP) in mothers, has also been highlighted in research examining maternal behaviour (Wan et al., 2012). Such mothers may themselves display social impairments such as detachment, rigidity and difficulty processing social cues (Dalton et al.; Piven et al., 1997). This study did not measure maternal BAP. However, there was a measure of maternal detachment employed within the global scale, which may further illuminate whether mothers are displaying signs associated with BAP. Certainly, mothers of SibsA infants showed higher levels of detachment at 9 months and 12 months compared to mothers of TD infants, but the decreasing levels of detachment over time, and a levelling off with the TD mothers would suggest that maternal detachment levels are relatively fluid. Indeed, the decreasing levels of detachment and the elevating levels of sensitivity over time would suggest that mothers of SibsA infants are becoming increasingly responsive to their infants. It may also be possible that infants are displaying high levels of atypical behaviour, but over time mothers of SibsA infants learn to adapt their natural responses to better fit the needs of the interaction. A more detailed study of the basic components of infant behaviour should help to illuminate this (as will be presented in the following chapter).

Maternal directive behaviour has been found to be higher in a variety of atypical infant samples, including those diagnosed with ASD (for example, Lemanek, 1993; Mahoney and Powell, 1998; Sigman et al., 1986,). In the present study, mothers of SibsA infants were less sensitive at each time point and more intrusive at 9 months. While maternal sensitivity was associated with later positive social and communicative outcomes for SibsA and TD infants, intrusive, directive behaviour was exclusively linked to positive outcomes for SibsA infant. This may highlight the different

requirements of infant groups, given the differing patterns of social-engagement associated with each group. Saint-George et al. (2011) emphasised the maternal ability to adapt responsive behaviours to best suit the needs of the infant in situations of risk. Certainly, in response to SibsA behaviours it would appear that more directive and less traditionally sensitive patterns of responding are providing some beneficial function. It may be that higher levels of intrusiveness serve to direct the attention of SibsA infants, who themselves may be displaying divergent patterns of micro-behaviours associated with poorer socio-communicative function In this case, a more structured, focusing environment may serve to benefit the infant.

The fact that mothers of SibsA infants displayed different patterns of directive/sensitive behaviour as compared to mothers of TD infants, would suggest that they may be responding to different patterns of behaviour exhibited by the infant. It may be the case that they are responding to subtle differences in infant socio-communicative behaviour. Indeed, the different functionality of maternal directive behaviour may be hinted at in the associations between directive behaviour and later infant outcomes. An absence of later positive outcomes for TD infants, but positive social and cognitive outcomes for SibsA infants, may highlight the important regulatory role being played by mothers of SibsA infants, which may be less central to the interaction of mothers and their TD infants.

A behaviour that would appear to be the opposite maternal directiveness, is maternal detachment, with a withdrawal from the interaction removing the opportunity for mothers to provide direction. In examining this opposite behaviour, it may be possible to shed some further light on the role that maternal directive behaviour plays. Furthering the suggestion that mothers of SibsA infants are playing an important regulatory role, is the finding that detachment from the interaction is not associated with TD infants' later outcomes, but is negatively associated with

outcomes for SibsA infants. It could be the case that as SibsA infants may be less inclined to engage with the interaction, mothers are providing a focus that is central to infant interaction. Thus, the more time that they spend detached from the interaction, the more difficult it is for the infant to engage with and benefit from the social exchange. On the contrary, given the TD infant's natural ability to engage socially, such infants do not require this constant, active encouragement to become involved in the interaction, allowing them to attend to the world around them whilst also engaging in the interaction, in line with Trevarthen's Secondary Intersubjectivity phase (Trevarthan & Hubley, 1978).

While Baker et al. (2010) suggested that mothers of SibsA infants may be showing divergent patterns of sensitive responding and sensitive structuring of the infant's environment (in the form of maternal 'Stimulation of Cognitive Development'), the present study produced mixed findings. At 9 and 12 months mothers were displaying lower levels of emotional sensitivity, but only at 12 months did they display lower levels of sensitive structuring. This pattern may suggest that mothers are struggling to interact sensitively, perhaps in response to a display of atypical, disengaged behaviour from the infant. Nevertheless, the pattern of sensitive responding by mothers of SibsA infants increases to a level close to that of TD mothers by 18 months, suggesting that both groups of mothers are adapting to their infants' behaviours, or that SibsA infants may be adapting to the styles of maternal of response.

Certain maternal interactive behaviours appear to have differing effects on later infant outcomes. While directive behaviour was associated with positive outcomes for SibsA infant socio-communicative abilities, these same behaviours were not associated with outcomes for infants in the TD group. It may be that SibsA infants are uniquely predisposed to requiring more stimulative behaviours during interaction, and thus they are differently susceptible to maternal behaviours that

provide this structure (see Kitamura & Lam, 2009). In a similar vein, maternal animation, positive regard and detachment, as well as an overall synchronous dyadic interaction were associated with different outcome patterns for infant groups. This, again, may suggest a distinctive pattern of infant environmental requirements, with more stimulative patterns of maternal response uniquely necessary for SibsA infants to benefit from the interaction.

The above findings highlight that, on a global level, mother-infant interaction in SibsA samples may be showing some divergences from typical patterns by 9 months of age, with differing patterns of behaviour related to differing patterns of outcome for infants. Specifically, from 9 months, mothers of SibsA infants are showing less sensitive and more directive interactive behaviour. Pine (1992) argued for a reframing of our definitions of maternal behaviours. Specifically commenting on directive behaviour, he suggested that different forms of maternal directiveness function to display different kinds of communicative intentions. It may be the case that such reframing is essential within interactions where a partner is displaying atypicalities of responsive behaviour. If sensitive responding is seen as an appropriate response to the behaviours of a partner, and this responding is linked to a positive outcome for that partner, then in this context it may appear that maternal directive behaviour could be considered sensitive.

Consistent with the findings of Saint-George et al. (2010), mothers of infants more likely to receive a diagnosis are faced with a different pattern of infant behaviour, to which they must respond with a different, but perhaps more appropriate, pattern of behaviours. The present group of mothers of SibsA infants were found to display lower levels of traditional sensitive responding; however it would appear that elements of maternal sensitivity and directive behaviour were nevertheless uniquely associated with positive outcomes for SibsA infants, as opposed to TD outcomes.

Such findings highlight the bidirectional nature of the interaction, which may be reinforced by the associations found between infant abilities and later patterns of maternal behaviour. It is unsurprising that better TD infant cognitive abilities are associated with higher levels of maternal stimulation of cognitive development. Such infants are more likely to profit from this form of maternal behaviour, and thus may be more likely to elicit such behaviours from their mothers. More interesting is the finding that early SibsA infants' linguistic ability is associated with more engaged, positive and sensitive maternal responding. It is possible that this association may be related to maternal concerns about their infant's potential diagnosis. As such, it may be that as linguistic ability is often impaired in infants who have autism, mothers are more likely to respond positively to infants who produce more advanced vocal behaviour. Alternatively, it may simply be the case that if an infant shows more advanced receptive and expressive language skills, mothers have more opportunity for sensitive, positive exchanges with their infant.

Limitations

The Global Scales used in this study were chosen as they have been adapted for use with SibsA infants. It would have been useful to have three scales that matched exactly, to allow for a clear comparison. However, the differences in the scale were minimal and were not thought to impact on findings. Further, some of the terms used within the scale (such as 'Hostility' or 'Intrusiveness') would generally be considered negative descriptions. It would be beneficial to have more neutral terms to apply to the groups of behaviours being observed, particular given that different behaviours may function positively or negatively in different contexts.

While the global scale offers insight into the general tone of the interaction as a whole, it does not offer information on the specific components of the interaction, and how socio-communicative

behaviours may differ in terms of form and function. For this, a micro-analytical approach is required. This process will begin in the next chapter.

Chapter Four: Responsivity in Mother-Infant Interaction

Overview

This chapter examines the responsive behaviours of mothers during the taped interactions with their infants. Naturally, for a behaviour to be a response, there must be an antecedent behaviour eliciting it, in this case, a behaviour displayed by the infant. For this reason, the chapter initially presents a general examination of the social and linguistic behaviours of SibsA and TD infants. This is then followed by an in-depth examination of maternal responsive behaviour.

It was found that SibsA infants produce less advanced vocalisations, and they displayed increasing levels of distress and disengagement from the interaction. At 12 months, they displayed poorer cognitive and language abilities as compared to TD infants, while at 18 months, they displayed poorer language and social abilities.

An examination of maternal vocal responses revealed that both maternal groups responded contingently and appropriately to their infant's vocalisations; however subtle differences were noted, with mothers of SibsA infants displaying non-intrusive responses to infant emotional expression. It is suggested that mothers of SibsA infants are tailoring their responses to infant vocal and social behaviour in order to avoid over-stimulation of their infants and to aid infant self-regulation.

Introduction

The mother-infant interaction is a bidirectional pattern of exchange that sees a combined set of modalities used to establish an intricate 'dance' of communicative bids and responses. Through face-to-face, playful exchanges, both mother and infant build a familiarity with their partner's interactive rhythms and behavioural repertoire (Feldman, 2007). These temporally structured sequences of interpersonal exchange are typified by high levels of positive arousal and are unlike the rest of the infant's daily life (Beebe, 1982; Feldman, 2007; Fogel, 1993; Stern, 1977; Tronick, 1989; Trevarthen, 1979).

Such co-constructed interaction allows the infant an opportunity to develop social expectancies and provides the essential environmental input required for social development and self-regulation (Feldman, 2003; Dunham & Dunham, 1995). This is achieved through the pattern of contingent responsivity displayed by mother and infant, which is founded upon a regulatory framework of initiation and response that is temporally governed ensuring clear and timely responses to partner behaviours.

To create this responsive environment, mothers must monitor their infant's focus of visual and physical attention, and subsequently respond promptly in a contingent and appropriate fashion (Ainsworth, Bell & Stayton, 1974). In turn, the infant plays an active role within the exchange, with even prelinguistic infants attempting to convey information through their early vocalisations. In turn, mothers interpret these signals and give them meaning. As such, infants gain knowledge about the requirements of interactive social exchanges and they develop the ability to express their intentions (Bates 1976, 1979; Bruner 1981, 1983). It has been suggested that this maternal contingent responding is particularly important to infant development as the infant makes the transition from prelinguistic vocalisations to referential speech (for example, Barrett, Harris &

Chasin, 1991; D'Odorico, Salerni, Cassibba & Jacob, 1999; Menyuk, Liebergotts & Schultz 1995;Saxon 1997; Snow 1977).

Responsivity or Sensitivity – Defining Maternal Behaviour. Heavily associated with literature focusing on attachment theory, maternal sensitivity was defined by Ainsworth et al. (1974) as a maternal ability to accurately perceive infant signals and respond promptly, contingently and appropriately. More recently, the definition of maternal sensitivity has varied, with a lack of consensus on the part of researchers as to which elements are required to constitute maternal sensitivity (Meins, Fernyhough, Fradley & Tuckey, 2001). Some studies emphasise, for example, emotional availability, affect mirroring, responding to infant cues, anticipating infant behaviours and structuring the environment in response (Kivijärvi et al., 2001). Others have focused on the maternal ability to cognitively guide the child and encourage play (Silvén, Niemi & Voeten, 2002). Other research has also focused on cognitive guidance, with maternal ability to respond appropriately to infant developmental needs emphasised (Stevens, Blake, Vitale & MacDonald, 1998). Further studies have provided rating scales of maternal sensitivity that include a wide variety of maternal behaviours including emotional availability, encouraging infant independence, enjoyment of shared interaction (Laakso, Poikkeus, Katajamäki & Lyytinen, 1999), maintaining topic focus, refocusing disengaged infants and noticing infant signals (Baumwell, Tamis-LeMonda & Bornstein, 1997). Within the present study, a measure of sensitivity focused on the mother's ability to be emotionally present when interacting with her child, with a consistent and genuine attunement to her infant's emotional cues (Baker et al., 2007; Cox & Crnic, 2003).

Maternal sensitivity and responsivity are often not differentiated within the literature (De Wolff & van IJzendoom, 1997). However, in a large number of studies, 'responsivity' is a term used to describe contiguity of maternal response, or, more specifically, frequency of maternal response to

infant behaviours with limited qualitative information as regards the appropriateness of the responses (Paavola, 2006). The present study will offer a more detailed set of information regarding the maternal behaviour that occurs in response to a variety of infant behaviours. The study will be unique in that it will include information about the temporal, functional, contingent and appropriateness of maternal responses, as well as information about infant behaviour following certain maternal responses. As such, the term 'responsivity' will be used as a means to define a variety of both sensitive and responsive behaviours. As with the previous chapter, a multifaceted approach to examining maternal sensitive, responsive behaviour is in keeping with Baker et al.'s (2007) suggestion that some elements of maternal sensitivity may be compromised during interaction with an infant affected by autism. In such instances, it may be possible for a mother to sensitively respond in some ways, but not all.

Maternal response to TD infant behaviours. Infants have demonstrated an ability to recognise the contingent responding of their mothers from a very young age (Bigelow, 1998; Bornstein, Tamis-LeMonda, Hahn & Haynes, 2008; Goldstein, Schwade & Bornstein, 2009; Millar & Watson, 1979). It is thought that contingent maternal responding to infant social cues offers infants the chance to view the consequences of their actions and to develop an understanding of the contingent nature of communication (Goldstein & Schwade, 2008). It has been suggested that the variability that exists in the timing of TD infant language development may, at least in part, result from differences in the quantity and form of the social input received by infants (Gathercole & Hoff, 2007). In particular, input that serves to focus infant attention has been associated with an optimum language learning environment (Bloom, 1993, 1998; Carpenter, Nagell, & Tomasello, 1998; Tamis-LeMonda, Bornstein & Baumwell, 2001). When infants receive a verbal response to their prelinguistic communicative bids, mothers can match words or phrases to the infant's

attentional focus, thus providing scaffolding for language learning (Carpenter et al., 1998; Tomasello & Farrar, 1986).

In a longitudinal study, maternal verbal responsiveness to their 13-month-old's prelinguistic vocalisations was found to be associated with later infant verbal abilities. Specifically, those infants who heard a higher rate of maternal responses spontaneously expressed words, achieved a fifty-word expressive language and produced combinatorial speech earlier than children of less responsive mothers (Tamis-LeMonda et al., 2001). It should be noted that not all maternal responses have a matched positive impact on infant development. While maternal expansions and repetitions can positively impact upon infant social development (Girolametto, Weitzman, Wiigs & Pearce, 1999; Tamis-LeMonda et al., 2001), maternal directive responses have been found to have negative associations with later infant language abilities (Tomasello & Todd, 1983).

The majority of studies have examined maternal responsiveness to infant vocalisation, but a small number have also examined maternal response to infant gesture. When an infant points, mothers will typically translate the gesture in order to give it meaning (Golinkoff, 1986; Masur, 1982). It has been found that when a mother verbally translates an infant's deictic gesture, the verbal equivalent of that gesture is more likely to enter the child's vocabulary than if the gesture had not been translated (Goldin-Meadow, Goodrich, Sauer & Iverson, 2007). Further to this, the infants whose mothers produced the highest levels of verbal translations of gestures were found to be the first to produce two-word utterances. This highlights not only the important role that maternal response plays in language development, but also the readiness of infants to learn from maternal responses long before then can produce speech themselves.

While the above studies appear to emphasise the active role of the mother within the interaction, it should not be forgotten that the exchange is bidirectional, with the infant also

playing an active role in the dynamic and non-linear exchange. Indeed, infant developmental status has been found to influence maternal responsiveness. During naturalistic play sessions, mothers are more likely to respond contingently to infant non-word vocalisations that contain more speech-like elements as compared to those that contain more immature, vowel-like structures (Gros-Louis, West, Goldstein & King, 2006). Similarly, in response to infant gestures one study found that Japanese nursery staff were more likely to respond verbally to infant point as opposed to infant gesturing (Kishimoto, Shizawa, Yasuda, Hinobayashi & Minami, 2007). Mothers are more likely to respond by labelling an object of interest to the infant if the infant is pointing at it or showing it as opposed to reaching for it (Masur, 1982). However, it should be noted that the difference in frequency of maternal labelling was not significant in response to infant showing and infant reaching. These findings suggest that mothers may favour more developmentally advanced infant behaviours (whether vocal or gestural) than less-advanced when contingently responding to their infants.

The active role of the infant. As newborns, infants can be seen as active participants within the interaction (see, for example, Trevarthen & Aitken, 2001 for a review). This innate intersubjectivity was first described by Trevarthen (1979), who suggested that from birth infants are driven to respond to their caregivers' socio-communicative behaviours as an active participant within the exchange. This social-pragmatic stance on infant development suggests that through these early experiences of social interaction, infants gain knowledge about the behaviours required for social interaction (Bates 1976, 1979; Bruner 1981, 1983). Infant intentionality within the interaction develops along a continuum, with children gradually displaying more sophisticated and adult-like forms of communication (Bates, 1976; Bloom & Lahey, 1978; Bruner, 1981, 1983; Tomasello, 1995; Leezenbaum, 2011). This process occurs as the mother follows the infant's focus of attention and

interprets early infant signals and gives meaning to them. As such, while maternal behaviour plays an essential role in infant social development, so too do infant socio-cognitive abilities and behaviours contribute to development (Tomasello, 1995).

In infancy, the face-to-face interactions of mothers and infants are typically characterised by a mutual regulation of interests and affective states in a subtle and intricate pattern that includes vocalisations, facial expressions, gestures and imitation; with infants displaying a conscious awareness of their mother's communicative intentions from as early as 2 months of age (Trevarthen, 1979). From 6 months of age infants are generally displaying an increasing awareness of and interest in the objects around them, coupled with a developing ability to communicate with their caregivers (see Trevarthen & Aitken, 2001). By 9 months of age the infant is typically communicating intentionally, with an awareness of the impact that their gestures and vocalisations will likely have on their caregiver's behaviour (Bates 1979; Bruner 1981; Wetherby, Cain, Yonclas & Walker, 1988).

It has been suggested that by 12 months of age, infants display intentionality through displays of behaviour regulation, which refers to infant behaviour that causes the caregiver to act in such a way that deliberately changes the infant's environment. The infant also develops an ability to direct their caregiver's attention to sharing the focus on an event or object, which requires a use of socio-communicative behaviours to coordinate their own and their caregiver's attention (Bruner, 1981). As such, as they age, infants develop from following, to sharing, to directing the attention and behaviour of others (Carpenter, Nagell & Tomasello, 1998).

Infant intentionality is not just evident in behaviours that shape caregiver responses, it can also be seen when infants respond to breakdowns in communication (Alexander, Wetherby & Prizant, 1997; Wetherby & Prizant, 1993). Infants must exhibit both emotional control and communicative

skills to repeat or modify the communicative signals that did not receive the desired response. This would suggest that infants typically use their understanding of the intentions of others when engaged in an interaction. However, debate exists as to when exactly such awareness arises, with Dunham and Dunham (1995) suggesting that an understanding of the mental state of the partner does not emerge until well into the second year of life

Maternal response to infant behaviours – SibsA infants and children with ASD. Given that maternal responsive behaviour has been linked to later language development, and that atypicalities in language development have been associated with some infant siblings of children on the spectrum, as well as infants later given a diagnosis of autism, it makes sense to examine the pattern of responsive behaviours exhibited within dyads affected by autism. Certainly it appears that some differences exist in the pattern of response that is created between mother and child when the child has ASD. Temporal differences have been found in maternal responses to children, with mothers of children with ASD using longer utterances in response to communicative bids as compared to mothers of TD children (Warlaumont et al., 2010). Similarly, adults interacting with children with ASD have been found to rely less strongly on traditional responsive behaviours that would encourage joint attention when interacting with a child, such as words and pointing. Rather they couple these conventional behaviours with more overt attention-directing bids, such as banging or animating a toy to gain joint attention (McArthur & Adamson, 1996). It was suggested that such bids were necessary as children with autism are less inclined to monitor their mother's behaviour for interactive stimuli and attentional interest (McArthur & Adamson, 1996; Mundy, 1995).

One study found that mothers of boys with autism were less likely to respond to their child's social behaviours than were mothers of TD children. When they did respond, a different set of

functions were apparent, with mothers of children with autism spending less time commenting on objects. Further to this, a higher level of non-traditional responses were used to gain and maintain infant attention (Adamson et al., 2001). The above findings suggest that as children with autism may display different patterns of engagement, mothers must be sensitive to the child's current attentional focus and interests, while also attempting to guide infant attention.

Just as maternal responsivity acts as scaffolding for infant joint attention and social abilities in TD dyads, mothers of children with autism may need to create 'adaptive scaffolds' (Adamson et al., 2001) that are designed to both sustain infant attention and locate topics of mutual interest. While infants in the Adamson study were found not to respond to adaptations in maternal behaviour, it was proposed that further study would find that mothers use adaptations of behaviour that best facilitate infant engagement and communication.

Maternal stress and responsivity. It has been proposed that parenting stress may impact on maternal responsive behaviours to a particularly high degree amongst dyads in which an infant sibling has already been given a diagnosis. Worries about infant communicative abilities are those most frequently reported by parents of TD infants (Hess & Landa, 2012), and parents of SibsA infants have been found to voice significantly more concerns about their infant's development as opposed to parents of TD infants (Ozonoff et al., 2009). Such findings have implications for how a parent might respond to their infant if they suspect that an autism diagnosis may be likely. Specifically, as a result of concern about atypical infant development, mothers may provide a greater level of structure and scaffolding than may be present in the interactions of mothers and their TD infants.

In an examination of free- and semi-structured play sessions, Leezenbaum (2011) found that at 18 months, SibsA infants were displaying less advanced communicative bids (both vocalic and

gestural) and that mothers of SibsA infants responded less to their infants prelinguistic ('non-word') vocalisations than mothers of TD infants. Both maternal groups responded by labelling the referent of developmentally advanced gestures, but this was less common in response to earlier emerging gestures. These findings were interpreted as evidence that both maternal groups provide richer responses to more developmentally advanced infant bids. However, given that differences were found in maternal patterns of responding, and that SibsA infants displayed less advanced vocalisations than TD infants, it is suggested that delays and expectations may lead to a situation where mothers alter their responsive output such that infant language development may be impacted by a cascade of effects.

What infant behaviours are mothers responding to in dyads affected by ASD? It has been established that mothers adapt their responses to infant behaviour, so the next section will examine infant behaviours that typically occur within the interaction and those that are specific to dyads affected by ASD. Numerous studies have examined the typical trajectory of infant language development, with consonant-like productions appearing at 4 to 6 months. Canonical babbles (consonant-vowel, speech-like syllables [Oller et al., 1999]) typically appear at 6 to 10 months. Closed syllables (consonant-vowel-consonant) are typically heard by the twelfth month [For reviews, see Oller et al. (1999); Stark (1980); Stark, Bernstein & Demorest (1993); and Locke (1993)].

Studies have shown that early infant vocal production predicts later language abilities, with canonical babbling within the second six months associated with early word development (Oller, Wieman, Doyle & Ross, 1976; Schwartz & Leonard, 1982; Stoel-Gammon & Cooper, 1984; Vihman, Ferguson & Elbert, 1986), while babbling at 12 months predicts later speech and language production for both TD infants (Jensen, Boggild-Andersen, Schmidt, Ankerhu, & Hansen, 1988;

Leonard, Schwartz, Morris & Chapman, 1981; Menyuk, Liebergott & Schultz, 1986; Stoel-Gammon, 1998; Storkel & Morrisette, 2002; Vihman & Greenlee, 1987) and infants displaying language delay (Paul & Jennings, 1992; Roberts, Rescorla, Giroux & Stevens, 1998; Thal, Oroz & McCaw, 1995).

In a study of SibsA infants at 6, 9 and 12 months, it was found that SibsA infants produced fewer speech-like vocalisations and more non-speech vocalisations as opposed to age-matched TD children. They also produced fewer consonant-type vocalisations and fewer canonical babbles, particularly at 9 months. SibsA infants did not show a different frequency of vocal production, as compared to TD infants; rather the form that those vocalisations took differed (Paul, Fuerst, Ramsay, Chawarska & Klin, 2011).

It is suggested that such differences are a reflection of delays in the acquisition of age-appropriate sounds and syllable shapes within the first year, coupled with a difficulty in transitioning from the broad array of speech sounds produced in early infancy to more sophisticated, speech-like sounds. The study also found that SibsA infants produced a higher level of non-speech vocalisations at each time point, although both infant groups did show an overall decrease over time. SibsA infants displayed slower progress in moving from one phase of speech development to the next, with a lower frequency of canonical babbles produced at 9 months. At 12 months, both infant groups were showing similar patterns of syllable and consonant-use, although SibsA infants produced these vocalisations less frequently and they produced a higher proportion of other kinds of vocalisations, which do not contribute to the development of first words (for example delight or distress vocalisations). This slower transition through language phases was linked to the typical infant ability to begin matching their vocal production to the ambient language to which they are exposed (Schoen, Paul, Chawarska, Klin & Volkmar, 2008).

It is suggested that SibsA infants appear to discriminate less between the sounds that they hear within the first year of life and they appear less likely to use the speakers within their environment as models for speech development. As a result, the transition to speech is a slower process (Paul, Fuerst, Ramsay, Chawarska & Klin, 2011). Further, it is proposed that as SibsA infants are spending less time babbling, they are not gaining the 'practice' of producing the motor patterns associated with later speech production, and they may not be gaining the experience of shared proto-conversations that are such a feature of mother-infant interaction in TD dyads (Paul, Fuerst, Ramsay, Chawarska & Klin, 2011).

In a study of maternal responses to the vocalisations of 18-month-old SibsA infants, it was found that mothers of SibsA infants were less responsive to their infant's vocalisations as compared to mothers of TD infants. However, this responsiveness was influenced by the type of vocal output produced. Specifically, mothers of SibsA infants were more responsive to their infant's developmentally advanced vocal output (words) as opposed to less advanced vocalisations, whereas mothers of TD infants respond to their infant vocalisations at a similar rate (Butler, Leezenbaum, Northrup, Campbell & Iverson, 2011). Such findings suggest that mothers of SibsA infants may be particularly focused on the quality of infant vocal output. The above study may have benefitted from a longitudinal approach, which would have allowed for the study of maternal response to infant vocalisation from a younger age when less advanced vocalisations are also a feature of TD infants' vocal repertoire. It would also have been worthwhile to examine how early maternal responses may influence later infant communicative development. It would also have been worthwhile for the study to have examined the socio-communicative behaviours of both infants and mothers in greater detail, as it would be useful to know more about the type of infant

vocalisation being uttered beyond 'word' or 'non-word', just as it would be useful to know the function of maternal response to infant vocalisation.

The Current Study

Maternal responsive behaviour is the focus of this chapter, specifically, the sensitive and directive nature of maternal responses. The study will examine when and how mothers respond to their infants. As this is a bidirectional study of interaction, solely looking at the responsive behaviour of the mother would not be meaningful as it would not capture the infant behaviours that mothers are responding to, nor the impact of maternal responses on infant behaviour. As such, the study will examine maternal responses as the target behaviour, while also examining the antecedent infant behaviour. Where possible, the infant behaviour that occurred in consequence to the target maternal behaviour will also be examined. This will present a picture of the cause and effect of maternal responsive behaviours.

To begin with, there will be a full examination of infant behaviour, with a focus on vocalisations, social engagement and facial expression. This will offer an understanding of any atypical patterns of behaviour that SibsA infants may be exhibiting. This will be followed by an examination of the vocal responses of mothers, which will be presented through three phases of analysis.

1) There will be an examination of the **sensitive and directive utterances** of mothers in response to infant vocalisation. Specifically, maternal responsive utterances will be examined in relation to their function, contingency, language expectancy and appropriateness.
    i) Hypothesis: *TD and SibsA mothers will produce different patterns of sensitive and directive utterances.*
2) As directive maternal behaviour is a focus of study in SibsA literature (for example Baker et al., 2007; Wan et al., 2011) and has already been found to be of interest in the previous chapter,

there will be an examination of each instance of maternal directive **Attention Device** utterances during freeplay sessions, as well as the antecedent and consequential infant behaviours. This will allow for an understanding of what infant behaviours mothers are responding to when they use Attention Devices, and also the impact that these Devices may have on infant behaviour.

i) Hypothesis: *Mothers of SibsA and TD infants will use Attention Device vocalisations in response to different infant behaviours.*

ii) Hypothesis: *SibsA and TD infants will show different patterns of response to maternal Attention Devices*

3) There will be an examination of maternal responses to infant vocal displays of emotional expression. **Maternal engagement patterns following infants' Distress and Delight vocalisations** were analysed as they may offer insight into how mothers respond when their infants display high levels of emotional arousal.

i) Hypothesis: *Mothers of SibsA and TD infants will differ in their response to infant vocal expressions of emotion (distress and delight).*

Each maternal responsive behaviour studied has been selected to examine the pattern of directive and sensitive responding shown by mothers in order to investigate whether maternal responsive behaviours are attention getting or attention giving.

Responsivity Studies

This section will present three studies examining the responsive behaviours of mother and infant, but first, Study One will present the socio-communicative behaviours displayed by infants in order to offer an understanding of the potential atypical behaviours to which mothers may be responding. Within the three remaining studies, the mother's response was the target behaviour. To contextualise these behaviours, the infant behaviours to which she is responding were examined, as were certain infant behaviours that occurred following target maternal behaviours.

Infant antecedent behaviours were those that occurred or were occurring during the three seconds prior to a target behaviour. Infant behaviours that occurred as a consequence of the maternal target behaviour were coded if they occurred during or within three seconds of offset of the maternal target behaviour.

Study Two will examine maternal responses to infant vocalisations. Study Three will examine the context in which mothers attempt to gain their infants' attention, and the subsequent responses displayed by infants. Study Four will investigate maternal responses to infant vocal emotional expression.

General Methods

Participants

The same dyads as previously described participated in the present study.

Procedure

The same five minute video footage for each dyad at each time point was also sampled for the present study.

Coding

All coding was completed by research assistants blind to the nature of the study. All audible maternal and infant vocalisations, social engagement states and infant facial expressions were identified and coded for onset and offset. Some coding was completed using Observer XT 7, which is a time-linked, computer-based video interface system. Each video was watched by the research assistants at full speed to ensure that they were accurately seeing and hearing the behaviours. Codes were then input at half speed to ensure that they were accurately placed to capture the timing of the behaviour. The rest of the coding was conducted on paper. To complete this, research assistants watched the video footage and extracted each target behaviour. Observer XT coding was conducted to categorize maternal and infant social engagement, infant vocal Delight and Distress and maternal Attention Devices. All other coding was completed on paper.

Research Assistant Training

Research assistants were trained to a high level of reliability on all codes. Initially, a separate set of five-minute training videos, featuring the same dyads but at different time points, were used in order to ensure that the research assistants would not be biased by any over-familiarity or discussion relating to behaviours displayed in the videos. A full description of the RA training procedures used can be found in Chapter Two.

Reliability

Observer XT7. When the research assistants and the author reached consensus on all paper coding, the research assistants were then given extensive training in the use of Observer XT (for a full description of the procedures, see Chapter Two). Once a high level of inter-rater reliability had been achieved (with Cohen's Kappa [k]) ranging from .81 to 1.00), the research assistant began

coding the 9, 12 and 18 month videos. Consensus was then reached between RAs and the author for each code placed.

Paper coding. Two coders blind to the purpose of the study coded all audible infant vocalisations and maternal vocal responses. Each infant vocalisation was identified and any subsequent maternal vocal response that occurred within three seconds of the offset of the infant vocalisation was recorded. Coders were trained to a high level of reliability on maternal and infant utterances: (k= .83 – 1.00). Each code placed was reviewed by the current author in order to ensure an accurate description of events. Reliability checks were also performed on randomly selected videos across ages and group status later during the coding: reliability k=.77.

Study One. Infant behaviour

Methods

Vocalisation. All audible infant vocalisations were coded. Where an infant vocalised in bouts with perceptible silences of more than one second, they were coded as separate vocalisations. A total of 1,577 infant vocalisations were categorised into four mutually exclusive types of vocalisation (see Table 12). Too few infant communicative vocalisations were produced at nine months to warrant inclusion.

Table 12. Infant vocalisation type and vocal complexity

Vocalisation Type	Examples
Type 1	Vegetative sound (burp, cough, other); Fixed vocal signal (cry, laugh, shriek, other); Atypical (grunts, squeals, growls); Isolated vowels; Bilabial trills.
Type 2	CV (e.g., ka); CVCV (e.g., tata); Reduplicated babble (e.g., mamamama); Variegated/diverse babble (e.g., badaba); Jargon; Intonation.
Type 3	Dipthong/Vowel glide; Attempt at word; Word.
Type 4	Infant imitations of maternal vocalisations.

Social engagement. Infant social engagement states were coded according to three mutually exclusive categories: Engaged, Disengaged and Triadic (see Table 13 for a description).

Table 13. Codes for infant social engagement prior to maternal Attention Device

Engaged	Infant is making eye contact with mother.
Disengaged	Infant is looking away from mother.
Triadic	Infant is looking at object, or from object to mother.

Facial Expression. Three mutually exclusive facial expressions were recorded: Smile, Blank and Frown; with a third code, 'Other', applied for the few instances when the above codes were not appropriate or when the infant's face was obscured from view.

Outcome Measures. Each child was administered the cognitive and language subscales from the *Bayley Scales of Infant Development—Third Edition* (BSID-III) at 12 and 18 months. Non-verbal communication was assessed using the Early Social Communication Scales (ESCS) (Mundy et al., 2003). The procedure used is described in Chapter Two.

Results

Infant Vocalisations. Infants' spontaneous communication directed toward their mothers was investigated by recording the frequency of vocalisation types at twelve and eighteen months; and the duration of distress and delight vocalisations at nine, twelve and eighteen months. Primary analysis examined within-group changes in infant communication from 12 to 18 months. As the majority of infant vocalisations were Type 1, a breakdown of the proportion of these vocalisation types is included with the descriptive statistics. As few vocalisations beyond distress and delight were produced by either group during the nine month sessions, infant vocalisation types at nine months were not considered appropriate for analysis. This was followed by analyses exploring the between-group differences in mother-directed infant communication.

Within-group differences. To examine within-group changes from 12 to 18 months in infant vocalisation types, a Wilcoxon signed-rank test was conducted. For both SibsA and TD infants, the median number of Stage 1 vocalisations decreased from 12 to 18 months, with a statistically significant decrease for both groups (SibsA: Z=-2.666, p=.008; TD: Z=-1.988, p=.047). No other statistically significant changes in vocalisation Type were found.

A Wilcoxon signed-rank test revealed that SibsA infants displayed a significant increase in the duration of time spent expressing distress between 9 and 12 months (Z=-2.035, p=.042), whereas TD infants displayed a significant decrease in distress from 12 to 18 months (Z=-2.184, p=.029). Neither group displayed changes in the duration of delight vocalisations produced between 9, 12 and 18 months.

Between-group differences. To assess between group (SibsA vs TD) differences in infant vocal behaviour and social engagement, Mann-Whitney *U* tests were conducted. At 12months, SibsA infants were producing a significantly lower proportion of Stage 2 vocalisations (U=21, p=.05,

r=0.45), while at 18 months they were producing significantly more Type 1 atypical vocalisations, specifically, growls (U=16, p=.017, r=.55). See Table 14.

Table 14. Descriptive statistics for infant vocalisation Type at 12 and 18 months: Median proportion and average deviation (AD).

Infant Vocalisation Type	12 Months		18 Months	
	TD	SibsA	TD	SibsA
Stage 1	73.7 (10.3)	77.9 (12.4)	31.6 (22.3)	59.2 (19.7)
Vegetative sounds	12.1 (6.1)	21.2 (8.9)	2.6 (4.7)	5.8 (5.5)
Fixed Vocal Signal	33.3 (7.9)	24.3 (11.8)	17.4 (13.5)	16.4 (18.6)
Growl	5.2 (4.8)	6.2 (2.9)	1.6 (2)	5.2 (3.5)
Vowel	18.4 (6.3)	21.7 (12.8)	9.3 (9.3)	8.9 (7.1)
Stage 2	14.3 (5.8)	4.3 (7.7	10 (7.3)	10.9 (13.9)
Stage 3	5.3 (8.4)	5.1 (9.8)	39.6 (24.5)	24.3 (13.9)
Stage 4	0.0 (.36)	0.0 (1.25)	0.0 (2.8)	0.0 (3.3)

No effect of group was found in relation to the delight or distress vocalisations produced by infants (see Tables 15 and 16). SibsA infants did display a significant increase in distress from 9 to 12 months (Z=-2.035, p=.042), while TD infants displayed a significant decrease from 12 to 18 months (Z=-2.184, p=.029).

Table 15. Median duration of infant distress and delight vocalisations at 9 and 12 months, average deviation, U score, significance and effect size.

Infant Emotional Expression	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Delight	10 (13)	11 (10.9)	36	1	-	15 (9.2)	7 (7.6)	26.5	.130	-
Distress	8 (8.7)	2.5 (3.5)	22	.176	-	15 (9)	15.5 (13.1)	45	1	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Table 16. Median duration of infant distress and delight vocalisations at 18 months, average deviation, U score, significance and effect size.

Infant Emotional Expression	18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Delight	7 (7.8)	1.5 (9.1)	34	.364	-
Distress	4 (4.4)	9 (6.4)	35.5	.435	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Infant Social Engagement

Infant social engagement was investigated by recording the amount of time that each infant spent attempting to make eye contact with their mother. See Tables 17 and 18 for full infant social engagement data.

Between-group differences. No effect of group status was found in relation to infant social engagement. SibsA infants spent more time socially engaged at 9 and 12 months and less time socially engaged at 18 months than TD infants.

Table 17. Median duration of infant social engagement at 9 and 12 months, average deviation, U score, significance and effect size.

Infant Behaviour	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Social Engagement	60 (46)	126 (46.9)	23	.211	-	72 (61.3)	112 (29.9)	29	.191	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Table 18. Median duration of infant social engagement at 18 months, average deviation, U score, significance and effect size.

Infant Behaviour	18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Social Engagement	45 (37)	26.5 (30.8)	31	.252	-

Within-group differences. No significant changes were noted in the social engagement for TD infants, although a significant decrease in social engagement was noted for SibsA infants (Z=-2.295, p=0.022) from 12 to 18 months.

Facial Expression

No effect of group or age was found in relation to the facial expressions displayed by infant groups. See Tables 19 and 20 for full infant facial expression data.

Table 19. Median duration of infant facial expression at 9 and 12 months, average deviation, U score, significance and effect size.

Facial Expression	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Smile	36 (15.9)	36 (37.8)	34	.847	-	53 (28.7)	42.5 (27.6)	44	.935	-
Frown	1 (9.2)	1.5 (3.6)	35.5	.961	-	10 (9.5)	23.5 (15.1)	32.5	.305	-
Blank	169 (28.6)	161.5 (24.5)	23	.211	-	199 (25.1)	156.5 (37.4)	28.5	.178	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Table 20. Median duration of infant facial expression at 18 months, average deviation, U score, significance and effect size.

Facial Expression	18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Smile	32 (17.3)	42 (24.6)	44	.935	-
Frown	0 (9.6)	3 (4.9)	36.5	.462	-
Blank	232 (34.1)	215 (52.3)	43.5	.902	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Infant Outcomes

Between-group differences. At 12 months, SibsA infants displayed significantly poorer cognitive abilities as compared to TD infants (U=7, p=.004, r=.66). They also displayed significantly poorer language abilities at 12 months (U=13, p=.024, r=.52). At 18 months, SibsA infants continued to display significantly poorer language abilities (U=4, p=.002, r=.71), specifically, receptive language abilities (U=4, p=.002, r=.70). SibsA infants also displayed significantly fewer responses to joint attention at 18 months (U=12.5, p=.007, r=.62).

Within-group differences. TD infants displayed a significant increase in their response to joint attention from 12 to 18 months (Z=-2.521, p=.012). SibsA infants displayed a significant increase in initiation of joint attention (Z=-2.193, p=.028) and a significant decrease in receptive language (Z=-2.047, p=.041). See Table 21 for full infant outcome scores.

Table 21. Median infant scores on the ESCS and BSID-III at 12 and 18 months, average deviation, U score, significance and effect size.

Infant Outcomes	12 months					18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Cognitive Abilities	110 (2.8)	97.5 (7)	7	.004**	.66	100 (4.4)	95 (6.5)	21.5	.150	-
Language Abilities	100 (5.2)	92.5 (8.5)	13	.024*	.52	103 (5)	86 (8.3)	4	.002**	.71
Expressive language	11 (1.2)	10 (1.9)	17.5	.068	-	11 (1)	9 (1.8)	21	.140	-
Receptive Language	8 (1.6)	7.5 (1.8)	29.5	.521	-	10 (1.3)	6.5 (1.4)	4.5	.002**	.70
TIJA	18 (7.3)	14.5 (4.2)	33.5	.437	-	18 (7.8)	10.5 (7.3)	25	.102	-
TRJA	46 (22.2)	43.5 (13.1)	30	.220	-	94 (8.8)	52.5 (19.9)	12.5	.007**	.62
TIBR	29 (13.9)	20 (7.8)	22.5	.066	-	40 (14)	31 (14.4)	32.5	.307	-
TRBR	42 (23.3)	39 (18.6)	35	.414	-	44 (27.8)	45.5 (24.3)	36	.462	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Maternal Behaviour

The responses of mothers were examined in relation to infant vocalisations and infant social engagement.

Study Two. Maternal Responsive Utterances.

Methods. Maternal vocal responses to infant vocalisations were examined. Each infant vocalisation was identified and any maternal vocal response recorded. Four mutually exclusive codes were initially used to categorise the function of maternal utterances (see Table 22). The 'function' of maternal utterances is defined based on the communicative content of each utterance produced. In line with Paavola's (2005) definition of utterance function, each category is defined based on the communicative intent of an utterance and how it may influence infant behaviour. As the focus of the study is to examine the sensitive and directive responses of mothers, maternal utterances that were sensitive (Information-salient) and directive (Regulatory) were chosen as a focus.

Table 22. Maternal functional utterance categories

Vocal Function	Description
Information-salient:	Utterances that follow infant interest and expand on that interest.
Affect-salient:	Affectionate, playful utterances
Regulation:	Utterances that function to direct or change infant behaviour
Interrogation:	Questions directed toward the infant

Maternal utterances that followed infant vocalisations were further classified as language-expectant, contingent or appropriate (examples are included on the next page). 'Language-expectant' utterances were those most likely to lead to a reciprocal vocal exchange, while 'Non-expectant' utterances were those unlikely to lead to such an exchange. Contingent utterances were classified as 'Follow-On' (FO) if they followed or expanded on an infant's vocalisation or attentional focus, 'Redirective' if the mother changed the focus of the interaction, and 'No Response' if the mother did not respond. 'Appropriate' utterances were temporally contingent and meaningful to the situation and to the infant's attentional focus. An 'Inappropriate' response was not temporally contingent, contextually meaningful and/or did not follow the infant's interest.

As such, any single maternal utterance could be classified according to four categories (Function, Language Expectancy, Contingency and Appropriateness). For instance, if a mother says 'Stop that!' in response to her infant pulling the cat's tail, that utterance would be coded as Regulation (as it is a command), language non-expectant (as it is not encouraging vocal exchange), contingent (as it is contingent upon the infant's prior behaviour) and appropriate (as the cat's tail should not be pulled). Equally, if the infant is playing with a ball and the mother says 'Is this your giraffe?', this may be coded as Regulation (as she is attempting to direct infant attention), language-expectant (as it is a question), non-contingent (as it is not following infant's attention) and inappropriate (as it is not contextually appropriate). All maternal utterances examined could be described as either sensitive or directive, as shown in Table 23. Only five maternal utterances were coded as inaudible.

Table 23. Maternal utterances categorised by Sensitivity and Directiveness.

Utterance Type	**Sensitive Utterances**	**Directive Utterances**
Function:	Information Salient	Regulation
Language-expectancy:	Language-expectant	Language non-expectant
Contingency:	Follow-on	Redirect
Appropriateness:	Appropriate	Inappropriate

Results. The majority of infant vocalisations were responded to by all mothers (77 per cent on average) and similar patterns of maternal utterance were displayed between groups (see Table 24 for Descriptive Statistics). At 12 months, mothers of SibsA infants responded most often with Affect-salient utterances, while mothers of TD infants responded most often to infant vocalisation with Information-salient utterances. At 18 months both maternal groups responded most often to infant vocalisation with Affect-salient utterances.

Information-salient Utterances. Closer examination of the sensitive, Information-salient utterances of mothers revealed both within- and between-group differences. Wilcoxon Signed-rank

tests revealed a significant decrease in Information-salient utterances produced by mothers of TD infants from 12 to 18 months (Z=-2.67, p=0.008).

Mann-Whitney *U* tests revealed that mothers of TD infants produced a significantly lower proportion of Information-salient utterances at 18 months, as compared to mothers of SibsA infants (U[19]20, p=0.05, r=4.59).

Regulatory Utterances. No effect of age or group was found in relation to regulatory utterance. Mothers of SibsA infants did display higher levels at 12 months, and slightly lower levels at 18 months, as compared to mothers of TD infants.

Other Functional Utterances. No other statistically significant differences were found in the functional utterances of maternal groups, and they did not significantly change the proportion of such utterances over time.

Table 24. Descriptive statistics for maternal utterance function at 12 and 18 months: Median proportion and average deviation (AD)

Maternal Utterance Function	12 months		18 months	
	TD	SibsA	TD	SibsA
Information-salient	23.1 (8.9)	18.6 (11.2)	7.0 (5.6)	16.9 (4.4)
Affect-salient	19.2 (9.4)	19.8 (12.3)	28.6 (8.5)	25.7 (12.5)
Regulatory	13.5 (14.6)	17.4 (10.6)	19.3 (6.3)	16.7 (3.6)
Interrogation	8 (5.6)	7.6 (5.8)	19.5 (6.3)	12.5 (4)
No response	20.0 (11.1)	20.5 (10.3)	22.1 (9.1)	21.1 (8.5)

Maternal language-expectant responses to infant speech-like vocalisations. Although both groups increased their production of sensitive, language-expectant responses from 12 to 18

months there were no statistically significant effects of group or age on the type of maternal vocal response (see Table 25).

Table 25. Descriptive statistics for maternal response type at 12 and 18 months: Median proportion and average deviation (AD)

Maternal Response Type	**12 months**		**18 months**	
	TD Mdn	SibsA Mdn	TD Mdn	SibsA Mdn
Language Expectant	36.8 (12.3)	35.2 (9.8)	50.6 (10.5)	43.4 (10.7)
Non-expectant	63.2 (12.3)	64.9 (9.8)	49.4 (10.5)	57.1 (10.7)

Contingent and appropriate maternal responses to infant vocalisations. Both maternal groups used a high proportion of sensitive, FO responses at 12 and 18 months (see Table 26). Both maternal groups used a majority of sensitive, appropriate utterances in response to infant vocalisations, as opposed to directive, inappropriate utterances. No group comparisons were statistically significant and no effect of age was found in relation to maternal vocal response for either group.

Table 26. Descriptive statistics for maternal contingent responses at 12 and 18 months: Median proportion and average deviation (AD)

Maternal Contingent Responses	**12 Months**		**18 Months**	
	TD	SibsA	TD	SibsA
FO Appropriate	72.7 (11.5)	68.3 (11.2)	62.5 (12.8)	65.9 (11.7)
FO Inappropriate	0.0 (0)	0.0 (2.9)	0.0 (1.6)	0.0 (1.87)
Redirect Appropriate	5.4 (5.8)	7.7 (4.6)	8.6 (7.3)	8.6 (3.5)
Redirect Inappropriate	0.00 (0)	0.0 (1.76)	0.0 (.4)	0.0 (.83)

Associations between maternal responsive utterances and later infant outcomes. To examine the association between maternal vocal response and later infant socio-communicative outcomes, a Kendall's Tau test for correlation was conducted. Neither the function nor language-expectant

nature of maternal utterances were associated with any later infant outcomes. However, maternal contingent and appropriate utterances were associated with later infant social behaviour, but only for SibsA infants.

For these infants, maternal use of appropriate FO utterances at 12 months was positively correlated with infant initiation of both joint attention (r[10]=.523, p=0.038) and behavioural requests (r[10]=.511, p=0.04) at 18 months. Conversely, maternal use of inappropriate redirective utterances at 12 months was negatively associated with SibsA infants' 18 months initiation of behavioural requests (r[10]=-.609, p=0.026) , as well as both initiation of (r[10]=-.591, p=0.033) and response to (r[10]=-.730, p=0.008) joint attention (see Table 27).

Table 27. Correlations between twelve month maternal FO and Redirective utterances and eighteen month SibsA infant outcomes.

	TIJA	TRJA	TIBR	TRBR
Follow-on Appropriate	.523*	.422	.511*	.405
Redirect Inappropriate	-.591*	-.730**	-.609*	-.462

(*= p<0.05, **= p<0.01 2-tailed significance)

Study Three. Maternal Production of Attention Devices

Methods. Each maternal Attention Device uttered during the full five-minute sessions (not just those produced in response to infant vocalisation) was identified and extracted. These were defined as 'Statements eliciting the child's attention including calling infant's name (for example, 'Look! See this thing here?')'. The social engagement of the infant three seconds before, and within three seconds after, each maternal Attention Device was examined.

Infant social engagement. Infant social engagement states were coded according to three mutually exclusive categories: Engaged, Disengaged and Triadic (see Table 28 for a description). When the infant became distressed, it was not always possible to identify the direction of infant social engagement. As some infants displayed a high proportion of distress, this data is also presented. This data was used to provide a general understanding of infant social engagement patterns, and also to establish what form of infant social engagement behaviour mothers are responding to when they are produced Attention Devices.

Table 28. Codes for infant social engagement prior to maternal Attention Device

Engaged:	Infant is making eye contact with mother.
Disengaged:	Infant is looking away from mother.
Triadic:	Infant is looking at object, or from object to mother.

To then examine the consequence of maternal Attention Devices, infant social engagement following maternal Attention Devices was recorded according to four mutually exclusive categories. See Table 29.

Table 29. Codes for infant social engagement following to maternal Attention Devices

No response:	Infant displays no change in their behaviour
Engaged:	Infant is making eye contact with mother. If making eye contact prior to the Attention Devices, infant additionally smiles or vocalises.
Disengaged:	Infant looks away from mother.
Triadic:	Infant is looking at object, or from object to mother

Results.

Maternal Attention Devices in response to infant levels of social engagement. This section will examine what infant social engagement behaviours mothers are responding to when they use Attention Devices. As two mothers did not use Attention Devices at 9 months and one did not use any at twelve months they were removed from the dataset. Mothers of SibsA infants produced significantly more Attention Devices at 9 months (U[17]=15, p=0.046, r=.49), 12 months (U[19]=21, p=0.053, r=.45) and 18 months (U[19]=13, p=0.014, r=.56).

Descriptive statistics revealed that at 9 and 12 months both maternal groups used Attention Devices most often in response to infant disengagement. At 18 months, mothers of SibsA infants continued this pattern, while mothers of TD infants used Attention Devices most often in response to infant engagement and triadic-engagement. (see Table 30 for Descriptive Statistics – including response to infant Distress.)

Table 30. Descriptive statistics for maternal Attention Device-use in response to infant social engagement at 9, 12 and 18 months: Median proportion and average deviation (AD)

Infant Behaviour	**9 Months**		**12 Months**		**18 Months**	
	TD	SibsA	TD	SibsA	TD	SibsA
Engagement	9.1 (19.8)	18.4 (17.1)	6.25 (30.7)	25 (27.9)	33.3 (19)	21.1 (16.1)
Disengaged	81.8 (24.2)	51.7 (27.9)	47.9 (41.1)	43.2 (32.7)	0 (22.7)	53.6 (18.6)
Triadic	0 (6.8)	22.5 (32.1)	0 (1.6)	0 (5.3)	33.3 (13.1)	16.7 (14.2)
Distress	0 (0)	0 (3.7)	0 (18.2)	0 (10.1)	0 (25.9)	3.57 (6.5)

Within-group Differences. To examine changing patterns in maternal use of Attention Devices, Wilcoxon signed rank tests were conducted. Mothers of SibsA infants displayed a significant decrease in Attention Devices in response to Triadic infant engagement from 9 to 12 months ($Z=-2.023$, $p<0.043$), while mothers of TD infants displayed an increase from 12 to 18 months ($Z=-2.214$, $p<0.027$).

Between-group Differences. To assess the between group differences in the maternal use of Attention Devices, Mann-Whitney *U* tests were conducted. At 18 months, mothers of SibsA infants used significantly more Attention Devices in response to infant disengagement as compared to mothers of TD infants (U[19]21.5, $p=0.05$, $r=0.44$). No other group comparisons were statistically significant.

Infant Response to Maternal Attention Devices. As maternal groups produced different patterns of Attention Devices, the manner in which infants socially responded to these maternal utterances was examined. SibsA infants responded most often to maternal Attention Devices with Engagement at 9, 12 and 18 months, whereas TD infants most often showed no response to maternal Attention Devices at 9 months and responded with Disengagement most often at 12 and 18 months (see Table 31).

Table 31. Descriptive statistics for infant social engagement following maternal Attention Device-use at 9, 12 and 18 months: Median proportion and average deviation (AD)

Infant Behaviour	**9 Months**		**12 Months**		**18 Months**	
	TD	SibsA	TD	SibsA	TD	SibsA
Engagement	30 (15.8)	45.2 (23.9)	20 (23.5)	42.6 (18.5)	25 (16.2)	29.1 (21.2)
Disengaged	18.2 (13.3)	20.1 (12.2)	42.8 (29.6)	27.2 (17.4)	33.3 (22.4)	22.5 (12.3)
Triadic	0 (5.7)	4.1 (7.7)	0 (3.7)	2.9 (6.6)	0 (11.5)	14.6 (9.3)
Distress	0 (0)	0 (3.7)	0 (5.4)	0 (4.5)	0 (7.5)	0 (10.4)

Within-group Changes. A Wilcoxon Signed-rank test was performed. Only one infant social response type changed significantly over time, with TD infants displaying an increasing lack of response from 9 to 18 months (Z=-1.992, p=.046).

Between-group Differences. Only one between group (SibsA vs TD) difference in infant response to Attention Devices was found when Mann-Witney *U* tests were performed. TD infants showed significantly higher levels of disengagement at 18 months as compared to SibsA infants (U[19]20, p=0.04, r=.47).

Patterns of Response. Taking infant antecedent and consequential behaviours together, it was found that for SibsA infants, mothers were most likely to use Attention Devices when infants were disengaged at 9, 12 and 18 months. SibsA infants were most likely to respond to Attention Devices with engagement at each time point. It should be noted that mothers of SibsA infants used Attention Devices in response to a broader range of infant behaviours.

A different pattern emerged for TD infants, as mothers of TD infants were most likely to use Attention Devices when their infants were disengaged at 9 and 12 months, and in response to both engagement and triadic-engagement at 18 months. TD infants were most likely to respond to maternal Attention Devices with no response at 9 months and disengagement at 12 and 18 months.

Study 4. Maternal responses to infant expression of emotion

Methods. Maternal response to their infant's vocal emotional expressions, specifically Distress and Delight, were of interest. As such, infant Delight and Distress vocalisations were identified and the mothers' response as it occurred during or within three seconds of the offset of infant emotional expression was recorded.

Infant Emotional Expression. In order to examine the vocal emotional expression of infants, each instance of infant Distress (crying, fussing or whining) and Delight (laughing or giggling) was identified and coded at 9, 12 and 18 months.

Maternal responses. Maternal responses were recorded as 'Engaged' if she made eye contact, smiled or spoke to her infant, while 'Disengaged' responses were recorded if the mother looked away, stopped speaking or adopted a blank expression.

In order to establish maternal social engagement, looking behaviour was coded in Observer XT using five mutually exclusive codes: Eye Contact, Eyes Closed, Looking Away, Looking at Object and Looking Unknown.

Results. Given that mothers displayed different patterns of responding to infant engagement behaviours, it was of interest to examine how mothers would respond to their infants' overt expressions of emotion. Infant groups displayed no significant differences in the duration of time they spent producing Delight or Distress vocalisations, although SibsA infants did display an increase in Distress, while TD infants displayed a decrease. During the five-minute sessions, some infants did not produce distress of delight vocalisations and they were removed from the dataset (see Appendix Ten).

Maternal engagement following infant emotional expression. In an examination of maternal engagement following infant emotional expression, descriptive statistics revealed that at 9, 12 and 18 months both groups of mothers responded to infant Distress and Delight most often by engaging with their infant. However, mothers of SibsA infants responded to infant Delight with higher levels of disengagement at 9 and 18 months compared to mothers of TD infants. Mann-Whitney *U* tests revealed no statistically significant group comparisons (see Table 32 for Descriptive Statistics).

Table 32. Descriptive statistics for maternal social engagement following infant emotional expression at 9, 12 and 18 months: Median proportion and average deviation (AD)

Age		Distress TD	Distress SibsA	Delight TD	Delight SibsA
9 months	Engaged	83.0 (20.5)	100.0 (20.8)	100.0 (12.7)	73.5 (21.5)
	Disengaged	0.0 (13.5)	0.0 (20.8)	0.0 (10.8)	25.0 (22.2)
	No Response	0.0 (11.7)	0.0 (0)	0.0 (1.8)	0.0 (.6)
12 months	Engaged	91.5 (15.6)	88.0 (14.3)	100.0 (9.5)	100.0 (10.9)
	Disengaged	8.5 (15.6)	12.0 (14.3)	0.0 (5.4)	0.0 (6)
	No Response	0.0 (0)	0.0 (0)	0.0 (4.1)	0.0 (4.7)
18 months	Engaged	100.0 (5.4)	73.5 (21.9)	100.0 (17.9)	78.0 (13.8)
	Disengaged	0.0 (5.4)	26.5 (18.9)	0.0 (12)	22.0 (13.8)
	No Response	0.0 (0)	0.0 (3)	0.0 (5.9)	0.0 (0)

Contingent Vocal Responses to Infant Emotional Expression. In order to examine the sensitive nature of maternal utterances following infant emotional expression, the contingent responses of mothers following infant emotional expression were of interest.

Infant Distress. Firstly, the follow-on and redirective vocalisations of mothers in response to infant Distress were examined. At 9 months, mothers of SibsA infants responded to infant Distress more often with a redirective response, while at 12 and 18 months a similar proportion of both redirective and follow-on (FO) behaviours were utilised. At 9 months, mothers of TD infants responded to infant Distress more often with a FO response, while at 12 and 18 months infant Distress was more often responded to with a redirective response (see Table 28). Mann Whitney *U* tests showed that SibsA mothers used redirective behaviour significantly more frequently at 9 months when compared to mothers of TD infants (U[12]5, p=0.028, r=0.098).

Infant Delight. Finally, maternal contingency following infant Delight was examined. At 9 and 18 months, mothers of SibsA infants responded to infant Delight more often with redirective behaviour, while at 12 months they responded more often with a FO response. Mothers of TD infants responded to infant Delight with a FO response more often at each time point. Mann Whitney *U* tests revealed a significantly lower number of FO responses from mothers of SibsA infants as compared to mothers of TD infants at 18 months (U[14]7.5, p<0.04, r=0.55). (see Table 33)

Table 33. Descriptive statistics for maternal contingent responding following infant emotional expression at 9, 12 and 18 months: Median proportion and average deviation (AD)

Age		**Distress TD**	**Distress SibsA**	**Delight TD**	**Delight SibsA**
9 months	FO	100.0 (16.7)	0.0 (25)	83.5 (22.2)	16.5 (40.5)
	Redirect	0.0 (16.7)	100.0 (25)	21.5 (22.2)	78.5 (40.5)
12 months	FO	22.5 (28.8)	50.0 (24.4)	100.0 (22.2)	71.0 (35.6)
	Redirect	77.5 (28.8)	50.0 (24.4)	0.0 (22.2)	29.0 (35.6)
18 months	FO	33.0 (31.3)	50.0 (23.1)	100.0 (26.3)	36.0 (13.8)
	Redirect	67.0 (31.3)	50.0 (23.1)	0.0 (26.3)	64.0 (13.8)

Discussion

Despite some divergent patterns in infant behaviour, both maternal groups displayed high levels of contingent responding, in general. Taking a more detailed look at maternal responsivity, it was found that mothers of SibsA infants displayed a pattern of responding that was both sensitive and directive, with a combination of attention giving *and* attention getting responses displayed. The following section will discuss such differences and attempt to explain why they may have occurred.

Mothers of SibsA infants responded to their infants' vocalisation more than mothers of TD infants, even when infants were simply making vegetative sounds. In contrast, mothers of TD infants displayed a decrease in response to vegetative sounds. Such findings appear at odds with Butler et al.'s (2011) assertion that mothers of SibsA infants are more focused on their infant's developmentally advanced vocalisations. However, the present study explored a more fine-grained definition of infant vocalisation which may explain these discrepancies. It may be the case that mothers of SibsA infants are anticipating limited social responding from their infants, and as a result they are pre-emptively engaging their infants at all opportunities, even those that are not deliberate social vocalisations on the infant's part. Alternatively, it could be the case that mothers are aware of the subtle differences in linguistic and social engagement displayed by SibsA infants. As such, they may be responding to actual, subtle differences in infant behaviour, as opposed to anticipated differences resulting from previous experience with a child on the spectrum.

A difference in infant behaviour was found in the level of distress exhibited by infants, with SibsA infants displaying an increase from 9 to 12 months, whereas TD infants displayed a decrease in the duration of distress displayed from 12 to 18 months. Both maternal groups responded with a similar pattern of behaviour, generally engaging with the infant in response to distress. It is of interest that mothers of SibsA infants displayed a decrease in disengaged responsive behaviour at

12 months, while their infants displayed an increase in distress at the same time. This may be in keeping with Field's (1981) suggestion that infants struggle with self-regulation and over-arousal while in interaction with their mother, a finding that may be particularly pertinent for infants on the spectrum. It may be the case that a decrease in maternal disengagement could mean that infants have less of an opportunity to self-regulate their distressed state as their mothers encourage them to engage socially. Alternatively, if SibsA infants are struggling to self-regulate leading to distress, it may simply be the case that mothers are required to spend more time actively involved in the interaction in order to aid their infant in regulation.

Continuing to examine infant emotional expression, it is interesting that mothers of SibsA infants responded less to infant delight than did mothers of TD infants. This may be occurring in an effort to aid regulation in the infant. As Field (1981) found, positive social interaction could be over-stimulating for infants. In this instance, if infants are already vocally displaying high levels of positive arousal, it may be beneficial for mothers to disengage with SibsA infants to allow them time to self-regulate and lessen the potential for over-stimulation. This awareness of differing needs in relation to self-regulation may also be apparent in relation to the function of maternal responding following infant emotional expression.

Mothers of SibsA infants displayed a distinct decrease in redirective utterances following infant distress; instead they responded with a less intrusive, follow-on approach. It may be the case that mothers had learned to respond to infant negative over-arousal with an effort to aid infant self-regulation and limit the level of stimulation experienced by the infant. This would suggest that maternal behaviour is actively adapted to the specific needs of SibsA infants.

This theory is further strengthened by the fact that mothers of SibsA infants responded to infant delight with increasingly high levels of redirective behaviour. It may be the case that they are aware

of their infant's arousal levels and are responding in a manner that will limit the possibility of over-arousal. As such, when infants are distressed they are over-threshold in relation to stimulation, and a fruitful maternal response may be to limit responding and allow the infant time to self-regulate. However, when an infant is displaying delight, they have not yet reached threshold in relation to over-stimulation and as such, a redirective response to prevent over-stimulation may be useful. It would be interesting to compare such responsive levels amongst mothers of SibsA infants and first-time mothers of infants who are later given a diagnosis. This may offer some insight into whether mothers are limiting arousal as a result of differences in infant behaviour, or whether it is as a result of the learned experience of already having parented a child on the spectrum who has a unique set of needs in relation to social stimuli. Mothers of SibsA infants displayed low levels of Language-expectant utterances and Information-salient utterances, however both of these patterns were similar to that displayed by mothers of TD infants, and as such no effect of group status is assumed.

The present study also found that, in the main, both groups of mothers responded to their infants' vocalisations in a contextually appropriate manner. However, as mothers of SibsA infants displayed a slightly higher level of inappropriate responses, it may be the case that such perceived inappropriate behaviour could have resulted from 1) subtle differences in infant behaviour, to which maternal response may appear inappropriate; 2) maternal prior experience with ASD, which may lead to subtle differences in maternal response or 3) a combination of these factors. Whatever the cause of these slight differences in maternal behaviour, it would appear that the contextual appropriateness of responses is associated with later SibsA infant development. It is interesting to note that less intrusive and appropriate maternal responses were associated with improved infant

outcomes, whereas more intrusive and inappropriate maternal responses were linked to poorer infant outcomes.

The above findings highlight what may be the subtle but important difference in the needs of the SibsA infant, with a benefit seen through both appropriate directive responding *and* a less intrusive pattern of response that allows for acknowledgement of the infant's behaviour but also allows them the opportunity to regulate themselves. However, a more intrusive pattern of responding was noted for mothers of SibsA infants when considering the context in which attention-directing vocalisations were used. While mothers of SibsA infants were most likely to use Attention Devices in response to infant disengagement, they also spent a large amount of time attempting to direct infant attention away from objects and even from social engagement. In relation to object-use, this maternal redirective behaviour may result from anxiety relating to the limited social engagement and object-interest often associated with an ASD diagnosis.

Conversely, maternal attempts to redirect infants while they are engaged with the interaction may, again, spring from a maternal awareness of the infant's arousal state, with a redirect offering the infant an opportunity to disengage before they become over-stimulated. It is, perhaps, no surprise that both infant groups became less engaged with and more distressed by maternal directives as they aged, with increasing levels of autonomy and physical ability allowing both groups greater opportunity to control their own state of engagement. It is interesting that SibsA infants were more inclined to socially engage with their mothers following maternal directives, which may support the use of contextually appropriate attention devices as a beneficial method to gain infant attention.

Baker et al. (2007) found that a multifaceted study of maternal sensitivity offered insight into the abilities and deficits displayed by mothers interacting with their SibsA infants, suggesting that a

global pattern of sensitivity may not be possible given the challenges faced during interaction. On the surface, the above study could be interpreted in a similar fashion, as mothers display both attention giving and attention getting responsive behaviours. However, it is suggested that this unique pattern may be more appropriate in the context of SibsA infant parenting. Subtle differences in maternal behaviour hint at an intricate pattern of directive and disengaged behaviour that allow infants to experience social engagement, but also allow them the opportunity to maintain a more comfortable level of arousal. It may be the case that mothers of SibsA infants are creating 'adaptive scaffolds' (Adamson et al., 2001) that are provided to not only maintain infant attention and follow infant interests, but also aid the infant in managing their arousal levels. As such, it appears to be the case that mothers of SibsA infants are making subtle and important adaptations of behaviour in response to their infants' needs, to best promote infant engagement.

Limitations

Given the small number of vocalisations displayed by infants at 9 months, it was not possible to examine maternal responses to infant vocalisations at this time. If a longer session of mother-infant interaction were analysed, it is likely that more infant vocalisations and subsequent maternal responses could have been recorded. Similarly, some of the infants displayed no delight vocalisations. Had it been possible to analyse longer segments of video it would have been possible to identify more delight vocalisations and maternal responses to them. However, given the very demanding data production process within the present study, lengthening the analysed sessions would not have been possible. It would also have been of interest to examine chains of maternal and infant behaviour in order to examine how target behaviours may impact on the interaction beyond the immediate responsive behaviour displayed by the interactive partner. Had the study

focused on older infants displaying more advanced vocal behaviours, it may have been possible to examine such behaviour chains within the interaction.

Chapter Five: Maternal Infant Directed Speech

Introduction

One central element of mother-infant interaction is the language to which infants are exposed. This section will present a review of the Infant Directed Speech (IDS) input received by infants. It will offer a timeline of TD infants' perception of and preference for IDS. It will describe changes in IDS as infants age, and it will present the potential roles that IDS may play in TD infant development. This section will also examine the IDS preferences of infants with autism, and it will examine the influence of IDS on their socio-linguistic development.

Describing Infant Directed Speech

IDS differs from Adult Directed Speech (ADS) across almost every linguistic level of analysis (Eigsti, Bennetto & Dadlani, 2007). Features common to IDS include: increased repetition, shorter utterances, longer pauses, a higher pitch, expanded pitch range and characteristic intonational contours (Fernald & Simon, 1984; Katz, Cohn & Moore, 1996; Stern, Spieker, Barnett & MacKain, 1983; Stern, Spieker & MacKain, 1982). Speech is presented in a simplified manner to ensure that it is easy to understand; as such the focus is on the 'here and now' and vocalisations are clearer and phonologically simplified with a high degree of 'baby words' that have meaning within the culture of the infant's family (for example 'bok-bok' for bottle) (Dockrell & Messer, 1999). Speech is specifically directed toward the child (Garnica, 1977) and the focus of the interaction is on shared activities between mother and infant (Messer, 1980). While cultural and linguistic groups differ in the degree of modification that occurs in interaction with an infant, their presence cross-culturally suggests that IDS reflects a universal parenting behaviour (Fernald et al., 1989; Grieser & Kuhl, 1988; Kitamura, Thanavishuth, Burnham & Luksaneeyanawin, 2002). Even amongst mothers using sign-language, IDS is utilised, with signs used at a slower rate and a greater degree of exaggeration

and repetition featured as compared to signs directed toward adults (Masataka, 1996). IDS is not solely a maternal behaviour, as fathers, grandparents and even children as young as 4 have been found to adapt their speech in this characteristic manner (Fernald, 1985). Such findings are presented here to briefly highlight the very particular form of linguistic input received by infants during interaction. A full review of the functional, syntactical and prosodic elements of IDS will be presented in their own separate chapters to follow.

Early Infant Perceptual Abilities and Preferences

While it is of interest to examine the patterns of speech used by caregivers in interaction with their infants, these behaviours would be of limited worth if infants were not attending to them. The following section will present a timeline of the infant's developing ability to perceive the IDS input that they receive, as well as the preference that they show for that input.

A simple way to examine what linguistic input infants can perceive is to examine what they prefer to listen to. From birth, infants display clear listening preferences. Newborns favour their native language over non-native languages (Mehler et al., 1988; Moon, Coper & Fifer, 1993). Equally, newborns initially prefer their mother's ADS over IDS (Cooper et al., 1997; Hepper et al., 1993). This may be due to the fact that their prenatal exposure to their mother's vocalisation would largely have featured ADS. Postnatally, they are exposed to a high level of IDS and, as such, a preference for this form of vocalisation develops. From as early as 3 weeks of age, infants can distinguish between their mother's voice and that of another female (Mills, 1974). By 4.5 months of age, infants spend more time listening to than own name as opposed to other words, even those that sound similar to their own name (Mandel, Jusczyk & Pisoni, 1995). Such studies highlight that from a very early age infants can show a preference for and discriminate between sounds, and even familiar sound patterns within their environment.

A preference for IDS also influences the infant's social interactions, as by 5 months of age, infants appear to form more positive associations with those individuals who address them using IDS, and negative associations with those who have spoken to them using ADS (Schachner & Hannon, 2011). Reciprocal positive associations have also been seen in caregivers, as adults have rated infants as more attractive when they have been shown footage that was filmed while the infant was being presented with IDS (Werker & McLeod, 1989). This clearly highlights the bidirectional nature of the interaction, with a caregiver's use of IDS producing a positive response in TD infants, which in turn, produces a warm response from the caregiver.

By 8 months, infants preferentially listen to other familiar words beyond their own name (Jusczyk & Aslin, 1995). To be able to perceive the sound patterns of these words, infants must be able to extract them from the fluent speech stream that they hear, through a process known as segmentation. It has been suggested that infants' ability to segment the linguistic input that they hear may be aided by their developing knowledge of the statistical relationships between the reoccurring sounds of their native language (Saffran, Aslin & Newport, 1996). By the time infants are 9 months of age, they display a preference for the prosodic patterns of their native language compared to those of non-native languages (Jusczyk, Cutler & Redanz, 1993). At 10 months, infants display an ability to process language-specific aspects of speech within their native language, such as the phonotetic rules associated with sound patterns (Jusczyk, Luce & Charles Luce, 1994) and stress patterns (Juscyzk, Friederici, Wessels Svenkerund & Juscyzk, 1993).

As the infant's preference for and perception of their linguistic environment changes over time, so too does their ability to produce vocalisations reflecting the specific properties of their native language (de Boysson-Bardies, Halle, Sagart & Durand, 1989). Similarly, infants also lose their ability to distinguish between the sound contrasts of non-native languages (Werker & Tees, 1999). Such

studies highlight infants' preference for the linguistic sound patterns of their native language, as opposed to non-native languages (Juscyzk et al., 1993), emphasising the modulating effects that experience may play in infant preference for IDS.

Developmental Changes in the Use of IDS

As infants' perceptual abilities develop, caregivers adapt the IDS output that they produce. Mothers alter the quantity and quality of the acoustic elements of their IDS depending on the age and gender of their infant (Kitamura & Burnham, 2003), their developmental stage (Bernstein Ratner, 1984) and whether their infant is visible or not (Snow, 1972). A number of studies support the suggestion that mothers are adapting their speech output in response to their infant's developing needs. For example, the mean length of utterances (MLU) produced by mothers changes as infants age from 3 to 9 months, with this maternal fine-tuning associated with infants' receptive language abilities at 18 months of age (Murray, Johnson & Peters, 1990). Such studies highlight fact that the interaction is not unidirectional, which means that it is not only the infant who responds to the behaviours of their interactive partner. As infants become more adept at vocalising, mothers naturally increase the level of the complexity of their interaction (for example, Bruner, 1983). This provision of scaffolding allows for the introduction of age-appropriate changes in social responses that help to develop the infant's emerging social and cognitive abilities. Infant vocal behaviour, alongside social structures such as turn taking, elicit specific responses from caregivers that in turn facilitate the infant's learning that the production of certain socio-communicative behaviours is linked to caregiver response (Locke, 1996). The ability of mothers to provide contingent and responsive interactional exchanges serves to facilitate the infant's ability to understand the adult as intentional agents within the interaction (Tomasello, 1995). In a study of maternal contingent responding, Goldstein and Schwade (2009) suggested that mothers tailor the

social feedback provided to infants, with an increasing preference for advanced and complex infant vocalisations shown as infants age.

IDS does not simply provide social feedback to the infant; it also acts as a guide to highlight salient elements in the input that infants receive, with different elements appearing more salient as infants age. Taking a very in-depth approach, an examination of the clarity of maternal vowel-use offers a specific example of the fine-tuning of IDS that is occurring in response to infant development. In speech to preverbal infants, vowels produced by mothers are similar to those produced in ADS (Bernstein Ratner, 1984; Engund & Behne, 2006). However, as infant language abilities develop to the single-word level of language production, mothers articulate their vowels with greater clarity in the content words of their speech (Bernstein Ratner, 1984). IDS directed to infants who have reached the more advanced linguistic level of combining words, features vowels articulated with greater clarity in both content and function words (Bernstein Ratner, 1984). Such modifications of IDS appear to occur when they may be most useful for the developing infant. For example, the preverbal infant is faced with the challenge of sublexical-learning tasks and may benefit more from elongated vowels as opposed to vowel clarification. Infants producing single words are faced with the task of word learning, with content words a particular focus of learning. As such, it is beneficial for mothers to highlight the content words that infants hear. Children who are combining words are faced with the task of syntax-learning, and as such it is beneficial for the content and function words to be highlighted in the IDS input that they received, so that they can learn to combine both.

How IDS Input Affects Infant Development

The above findings highlight the sensitive, adaptive nature of IDS, but they also highlight the beneficial influence that IDS may have on typical infant development. This section will present

research focusing on the role that IDS may potentially play in relation to 1) emotion regulation, 2) affect, 3) attention, 4) social interaction and 5) language learning.

1) **Emotion Regulation.** When speaking to their infants, mothers typically pair specific intonation patterns with specific behavioural contexts. Raised intonation is generally used when calling attention to something, while falling intonation is associated with attempts to soothe or comfort the infant (Kitamura & Burnham, 2003). Further to this, it has been found that infants will display predictable patterns of response when they hear maternal expressions of prohibition and approval, even when expressed using nonsense words (Fernald, 1993). It has been found that despite the native language spoken by mothers, the pattern of intonation associated with prohibition and approval vocalisations leads to predictable infant responses, with infants frowning upon hearing prohibitions and smiling upon hearing expressions of approval. Cross-culturally, infants are soothed by lullabies, which typically share intonation, tempos and rhythms (Standley, 2003). Such findings suggest that IDS may aid in the regulation of emotional states.
2) **Affect.** The above Fernald (1993) study also highlights that IDS appears to aid infants in the identification of affect in their interactive partner. As early as 6 months of age, infants have shown an ability to distinguish between infant directed speech conveying approval and comforting, suggesting that they are making use of the affective information presented in IDS (Spence & Moore, 2003).
3) **Attention.** Evidence for the use of IDS to gain infant attention can be found in the changes in the prosodic content of maternal responses to infant disengagement. In interaction with 3- and 4-month-olds, Japanese mothers have been found to raise the fundamental frequency (the rate of modulation of the vocal folds during speech) of their IDS after their

earlier attempts to gain their infant's attention have failed (Masataka, 1992). This example suggests that when required, mothers can make adaptations to the IDS in order to gain infant attention.

4) **Social Interaction.** Infants smile more upon hearing IDS as compared to ADS, and this makes them more appealing to their caregivers (Werker & McLeod, 1989). In this way, IDS contributes to the establishment of emotional bonds between infant and mother. Further, the proto-conversational nature of the interaction contributes to the infant's developing understanding of the rhythm of turn-taking that is central to interaction (Fernald, 1985).

5) **Language learning.** A large body of research exists suggesting that IDS contributes to infant language learning. The quantity of IDS heard by infants has been positively linked to the size of the infant's vocabulary (Greenwood et al., 2011; Hart & Risley, 1995). To establish whether benefits in infant language processing are associated specifically with exposure to IDS or general language within the environment, one study recorded all language heard by an infant over the course of a day. It was found that only IDS was predictive of the infant's later vocabulary size and word recognition abilities (Fernald, 2011).

It is not just the quantity of IDS heard by infants that is important; the quality also has an impact. For example, infants who hear clear, hyperarticulated /s/ are better able to distinguish between /s/ and /f/, with their ability unrelated to the prosodic content of their caregiver's IDS (Cristia, 2011). Further, in an examination of the full linguistic environment heard by an the infant, it was found that words that were longer, louder and highlighted by pitch excursions were more likely to become part of the infant's vocabulary (Vosoughi, Roy, Frank & Roy, 2011). It should be noted that the above study was just a single case study; however data was recorded over fifteen months, thus offering an extensive study of the infant's linguistic environment.

The above section highlights the beneficial role that IDS may play across a number of areas of infant development. What is assumed is that, for the infant to benefit, they must be attending and responding to the IDS to which they are exposed. One of the abilities that enables TD infants to attend to and learn from their environment is their ability to establish *joint attention*, meaning that they can sustain attention with their caregiver, while also focusing on objects and events in their environment (Bruner, 1974/1975). This allows infants the opportunity to observe their environment as it is discussed through linguistic utterances, thus mapping the environment linguistically as objects are named and events are described (Mundy, 2009; Akhtar & Tomasello, 2001). The infant's focus on objects in the environment combined with the temporally contingent linguistic description provided by the mother offer an opportunity for language learning. Indeed, it has been found that infants who spend longer amounts of time engaged in joint attention with their mothers display larger vocabularies 6 to 12 months later (Mundy & Gomes, 1998). As highlighted in the previous chapter, mothers of TD infants who use their utterances to follow their infant's line of interest and share joint attention rather than redirecting them have been found to have children with more advanced linguistic abilities (Akhtar et al., 1991; Rollins & Snow, 1998; Tamis-LeMonda et al., 2001).

As joint attention abilities are just developing by 18 months, prior to that, mothers have been found to do more of the work in creating and sustaining joint attention during interaction. As such, rather than leave it to the infant to actively initiate and respond to attention, mothers of younger infants may follow the infant's focus of attention and talk about it (Naigles, 2013). Mothers of TD infants who display this type of responsivity tend to have infants who use words at an earlier age (Akhtar, Dunham & Dunham, 1991), are earlier in achieving their first fifty words (Tamis-LeMonda,

Bornstein & Baumwell, 2011) and display more advanced grammatical abilities (Rollins & Snow, 1998).

Difficulties with joint attention and interaction have long been established as central features of autism. If infants on the spectrum are not paying attention to the people in their environment, it is unlikely that they are attending to the language that those people are using (Naigles, 2013). The following section will examine the preferences that infants with autism and children show in relation to IDS, as this may offer insight into the elements of maternal speech that infants on the spectrum are attending to. Further, there will be an examination of the associations between maternal IDS and later developmental outcomes in order to establish some of the elements of IDS that may be particularly salient for ASD/SibsA infant development.

The IDS Preferences of Infants with ASD

Typically developing infants display a clear preference for a number of elements of IDS, and this preference ensures that they attend to and respond to the IDS that they hear. Given the unique patterns of socio-communicative behaviour associated with autism, it is of interest to examine whether infants on the spectrum may also display a preference for IDS, as this may impact on the extent to which they can profit from the IDS input in their environment. Five-year-old children with autism do not show a preference for their own mother's voice over other voices (Klin, 1991), nor do 32-to 52-month-olds with autism show a preference for IDS speech sounds as compared to non-IDS speech sounds (Kuhl et al., 2005). Similarly, individuals with autism have been found to display no specific cortical activation in response to human voices (Zilbovicius et al., 2006), which has been interpreted to indicate that a specific response to IDS may be impossible for individuals with autism.

Beyond this absence of preferential response to IDS, general social responses can also impact on the ability of infants to benefit from the language in their environment. Autism is characterised as an impairment of social engagement, and as such, if infants are not engaged with and attending to people during interaction, they may struggle to benefit from the IDS being produced by their caregivers. For this reason, a large number of early intervention strategies focus on directing children with autism toward the language in their environment, with reported success in relation to language learning (Lovaas, 1981; Stone & Yoder, 2001).

Input Effects of Maternal IDS for Children with ASD

A central impairment in autism appears to be the diminished ability to monitor the attention that other people are paying to their environment, with children with autism displaying joint attention abilities below that of chronologically age-matched children (Charman, 1998; Mundy, 2009; Mundy, Sigman & Kasari, 1994). For this reason, a number of studies have examined mothers' use of IDS to encourage joint attention among infants and children with IDS. For example, one study examined free play sessions over the course of a year, beginning when the children were 30 months of age. It was found that children who showed better language abilities had heard more IDS that followed the infant's focus of attention and was pitched at a level appropriate for the child's comprehension (Adamson et al., 2009). Similarly, Siller and Sigman (2008) found that the more time that mothers of children with autism spent speaking about what their child was pointing to and acting on in their environment, the better the language gains shown by the child.

Further studies have focused on the directive and facilitative nature of the IDS input heard by infants and children on the spectrum, with one study finding that both could contribute to vocabulary gains (McDuffe & Yoder, 2010). Haebig, McDuffie and Ellis Weismer (2013) examined directive IDS in a more nuanced fashion, finding that directives that encouraged child language

production were more predictive of child language gains than directives that encouraged child action. Further studies have found that mothers of children with autism whose IDS followed the child's attention had children who showed better receptive language abilities, response to joint attention (Perryman et al., 2012) and more grammatical complexity (Rollins & Snow, 1998). In sum, IDS that follows the infant's line of attention and encourages language production has been found to facilitate later language production for children on the spectrum.

None of the above studies examined the specific content of the IDS heard by children or infants on the spectrum, and this is an area that remains relatively unexplored. Over the course of seven studies, Naigles et al. (2013) examined two cohorts of mothers and their children who were given an ASD diagnosis. They found that the role of maternal IDS in dyads affected by ASD was similar to that in TD dyads, in that maternal responsive input serves to aid infant language learning. The study emphasised specific elements of maternal language that were associated with improved language abilities for infants with ASD, with more maternal nouns associated with more diverse vocabularies, more yes/no questions associated with more infant auxiliary verbs, and more maternal expansions associated with better infant language scores on standardised tests.

Such studies highlight the important role that IDS appears to play in relation to the infant's changing communicative abilities. While the study offers useful insight into specific elements of the language environment experienced by children on the spectrum, it did not present a full examination of the elements of IDS experienced by the infant. The following chapters will explore in detail the IDS input received by infants more likely to be diagnosed with autism. It will be divided into three sections, focusing on 1) the function, 2) the syntax and 3) the prosody of maternal IDS heard by SibsA infants. Each chapter will offer a review of the literature, followed by an

examination of the properties of IDS that may be unique to SibsA dyads, changes in the features of IDS and associations between these features, and later infant developmental outcomes.

Chapter Six: The Function of Maternal IDS Within Interaction

Overview

This chapter examines how maternal speech may function to influence the infant during interaction. In order to investigate whether mothers are attempting to direct or engage their infants through their speech, maternal IDS that functions to facilitate infant participation and speech that directs infant behaviour was examined. All audible maternal utterances were coded based on their function. Each utterance that could be categorised as facilitative (Compliments, Affirmatives, Imitations, Questions and Descriptions) or directive (Attention Devices, Commands and Negations) was analysed at each time point.

Mothers of SibsA infants produced less facilitative speech at each time point. They produced less praise and decreased their production of imitations and questions as infants aged. A higher number of positive associations between maternal facilitative speech and later infant outcomes were noted for TD infants. Mothers of SibsA infants produced more Directive speech overall, and, unlike mothers of TD infants, they showed an increase as their infants aged. Positive associations between maternal Directives and later infant outcomes were only noted for the SibsA group. It is suggested that in response to increased levels of infant disengagement, mothers of SibsA infants may have fewer opportunities to use facilitative speech, favouring speech that directs the infant's attention. It appears that some elements of this directive form of speech may be uniquely beneficial for SibsA infants, as their attention is directed toward the interaction.

Introduction

The previous chapters have highlighted the importance of mothers' contingent, sensitive responding to their infants. Such responding has been positively associated with infant language acquisition (for example, Tomasello & Farrar, 1986), attachment (Ainsworth, Blehar, Waters & Wall, 1978; DeWolff & van Ijzendoorn, 1997; Meins, 1997), infant self-efficacy (Bigelow, 1999; Jaffe et al., 2001) and development of object play (Bigelow, MacLean & Proctor, 2004). The manner in which the speech produced by mothers functions to engage the infant has also been linked to later infant outcomes, with high levels of sensitive vocal responding during joint attention associated with infant's early vocabulary development (Tomasello & Todd, 1983). Specifically, maternal speech has been found to have a facilitating effect within interaction, particularly so when mothers follow the infant's focus of attention rather than directing it to new objects or events during joint attention episodes (Akhtar, Dunham & Dunham, 1991; Dunham, Dunham & Curwin, 1993; Tomasello & Farrar, 1986). Indeed, when exposed to this responsive style of speech, as compared to playing alone or with less responsive maternal input, infants have been found to display more advanced forms of play (Bigelow et al., 2004). Through the provision of facilitating speech, mothers regulate their responses to their infant's level, while also operating within the infant's zone of proximal development, thus scaffolding play and ensuring that infants are engaged but also challenged. A key factor within this sensitive responding is the speech heard by infants.

IDS has been found to impact upon a developing child's linguistic, social, emotional and cognitive abilities (Garton, 1992; Hampson & Nelson, 1993; Longobardi, 1992; Stern, 1985; Tamis-LeMonda, Bornstein & Baumwell, 2001). As has been established, IDS differs from speech to adults across a range of features. One aspect of IDS that has been a focus of study is the function of the speech produced by mothers. This line of enquiry has examined maternal utterances beyond their

type (for example, imperatives or descriptions) and instead has focused on the function or intention of the utterance (for example, gaining attention or praising). The present section will examine maternal IDS based on the specific function of the utterances produced.

Already within this study, maternal behaviour has been categorised based on sensitivity, which was defined as mother's ability to be emotionally present (Baker et al., 2010), and responsivity, which was defined as temporally contingent and appropriate responses (Dunham & Dunham, 1995; Paavola, 2006). The present section will examine mothers' speech that is defined as Facilitative. This speech style is characterized by behaviours that encourage infant participation within the interaction, typically by acknowledging and expanding on infant vocalisations, following the child's line of attention and producing elaborated discourse (Barnes et al., 1983; Fewell & Deutscher, 2004; Hockenberger et al., 1999; Kloth et al., 1998; Ninio, 1980; Whitehurst et al., 1988). Types of utterances that are defined as facilitative in function within the present study are: Imitations, Descriptions, Questions, Affirmatives and Compliments.

When interacting with their infants, mothers may also produce a more directive form of speech that seeks to maintain control over the interaction, during which speech may not be adapted to the infant's interest or ability (Baumwell et al., 1997; Hart & Risley, 1995). Such interaction may be typified by utterances that redirect infant focus of attention and/or interrupt infant behaviour. These vocalisations are considered less likely to actively encourage infant vocalisation (Masur et al., 2005; Tomasello & Farrar, 1986). A number of studies have sought to define maternal directive behaviour, with a focus on utterances that served to redirect the infant's attention rather than follow it (Kloth et al., 1998) or that directed the infant, seeking limited input and providing limited opportunity for language development (Ninio, 1980). Within the present study the types of

maternal utterances that are defined as directive in function are: Attention Devices, Negations and Commands.

The following section will first present research examining IDS that functions to facilitate infant participation in the interaction. It will then present research examining IDS that functions to direct infant behaviour. This will be followed by a review of research investigating the facilitative and directive speech of mothers in interaction with infants displaying atypical development.

Maternal IDS Facilitates Infant Engagement

Maternal IDS often functions to support the infant in participation within an activity (Bruner, 1981; Mannle, Barton & Tomasello, 1991; Martin & Reutzel, 1999). For example, in an effort to facilitate participation, mothers may produce speech to engage their infant in joint attention or to initiate conversational turns (DeLoache & DeMendoza, 1987; Mannle et al., 1991). If the infant is actively participating in the interaction, they have more opportunity to attend to maternal speech and produce their own vocalisations, thus receiving caregiver feedback and gaining more experience of the turn-taking rhythm of interaction.

It has been found that mothers who produced more facilitative speech by imitating and extending infant vocalisations when interacting with their 30-month-olds, had children who displayed better cognitive abilities at 3 years of age, and better verbal and reading skills at 5 and 8 years (Fewell & Deutscher, 2004). This form of speech has also been associated with better concurrent language skills for 12-month-old infants in free play (Karass et al., 2012). Similarly, interaction with highly verbal infants was found to elicit more conversation-like, facilitative speech from mothers (Paavola et al., 2005). This highlights the bidirectional nature of the interaction, with infant behaviour influencing the form of speech produced by mothers. Further highlighting this

bidirectional effect, it has been found that not only was facilitative speech predictive of later infant language comprehension and production, but infant vocabulary from 13 to 20 months was predictive of maternal facilitative speech (Bornstein et al., 1999).

In a more structured setting, a number of intervention studies have focused on teaching caregivers to speak to their infants in a more facilitative manner, resulting in gains in both infant vocabularies and verbalisations (Hockenberger et al., 1999; Peterson et al., 1999; Whitehurst et al., 1988). Facilitative IDS has been positively associated with a range of infant abilities such as vocabulary, syntax, narrative skill and participation in the interaction (Abraham, 2007). The above studies highlight the important role of maternal facilitative IDS in infant development. Some research has sought to examine specific elements of facilitative speech heard by infants. The next section will present these elements: 1) Questions and 2) Imitation, examining their production during mother-infant interaction and what impact they may have on infant development.

1) Questions. Questions encourage infant engagement through response, and are typically focused on the 'here and now', following the infant's focus of attention (Dockrell & Messer, 1999). There is some debate over the prevalence of questions in maternal IDS. Snow (1977) suggested that a high proportion of questions are common in IDS; however, Paavola et al. (2005) found that aside from Yes/No questions, few other question types were produced. It was suggested that this may have been influenced by the infants' age within the Paavola study. As the infants were prelinguistic, it may be the case that few maternal questions were produced because answers would not be received from the infants. As wh- questions tend to ask for information that is desired but not known by the speaker, and which the speaker assumes the addressee may know (Searle, 1969), mothers may be limiting their production of wh-questions due to their infants' developmental stage. It is not simply the intentional content of questions that may serve to facilitate infant

engagement and participation. Questions typically contain higher pitch and rising contours, both of which are prosodic features favoured by infants (for example, Dryer, 2011; Papousek et al., 1990: Trehub, Bull & Thorpe, 1984). As such, the prosodic content of the questions heard by infants may also facilitate infant engagement. The prosody of maternal IDS will be discussed in Chapter Seven.

It appears that the prevalence of maternal questions during interaction with infants may be associated with beneficial developmental outcomes for the infant. Yoder (1989) suggested that maternal production of questions was positively associated with later infant language-use. In a more structured setting, a booksharing intervention that encouraged maternal questions and expansion of infant vocalisations found gains in infant vocabulary and mean length of utterance (MLU) in comparison to children whose parents were given no training (Whitehurst et al., 1988; Whitehurst et al., 1994). When mothers were taught to increase the number of open-ended and wh-questions produced, their children displayed gains in both narrative skill and vocabulary (Peterson et al., 1999).

2) Imitation. Imitations may be considered as facilitative, as they acknowledge the infant action and, often, expand on it. In this context, imitation contains two essential elements: 1) it must be temporally contingent, in that it is an immediate response to the infant's target behaviour, and 2) it must bear a similarity to the infant's target behaviour. A number of studies have attempted to tease out which of these two elements are central in engaging the infant, with findings consistently suggesting that both elements are important to encourage infant engagement (Escalona, Field, Nadel & Lundy, 2002; Field, Field, Sanders & Nadel, 2001; Heimann, Laberg & Nordøen, 2006).

Maternal vocal imitation of infant vocalisations is highly prevalent during face-to-face interaction (Pelaez et al., 2011). A number of studies have found that parents naturally imitate elements of the vocal output produced by their infants (Field, 1977; Papousek, 1992; Pawlby,

1977). In an analysis of maternal vocal behaviour during free play with their infant, it was found that mothers responded vocally to 86 per cent of their 10-month-old's vocalisations. Of these vocal responses, 21 per cent took the form of imitations (Masur & Olsen, 2008). An examination of the specific infant behaviours that are more likely to elicit maternal imitative responses found that mothers respond more often to consonant-vowel vocalisations as opposed to vowel-like vocalisations (14 per cent as compared to 2 per cent of mothers' responses to infant vocalisation) (Gros-Louis, West, Goldstein & King, 2006). The study suggested that maternal imitation typically follows infant vocalisations that feature higher articulatory complexity. Thus, it may be the case that imitation effects a gradual shaping of infant vocalisations such that they become increasingly complex and adult-like.

Vocalisations that repeat and then expand on infant vocalisations are known as Variation Sets. They have been found to make up 17 – 21 per cent of the speech heard by infants aged between 5 and 30 months (Waterfall, 2006, 2009a). Because such utterances are temporally contingent within the interaction and they share a structural similarity to the infant's previous utterances, it has been suggested that they act to aid infants' comparison of utterance types. The similarities in structure and subject contained within the sets may allow infants to learn new classes of words or phrases that have equivalent meaning within the sentence (Waterfall, 2009b).

A limited amount of research has directly examined the role of maternal imitation in shaping infant behaviour. One study found that maternal imitative responses resulted in more frequent smiles and vocalisations from 3.5-month-olds, as compared to non-imitative behaviour (Field, Guy & Umbel, 1985). More generally, Masur and Olson (2008) found that infants are highly responsive to maternal imitation, with 90 per cent of imitations responded to by infants through a variety of social responses (including returned imitation, smile, gaze shift, general vocalisation or joint

engagement with an object). In an examination of the reinforcing effects of maternal speech on a 12-month-old infant, Bendixen and Pelaez (2010) found that both contingent IDS and maternal imitation had an immediate impact on the infant's production of canonical babbling, with imitation associated with a lesser, but still significant increase in babbling as compared to general IDS. Of course, it should be noted that the study focused on only one mother-infant dyad, and results have yet to be generalised to a broader population.

A longitudinal study of twenty infants at 10, 13, 17 and 21 months revealed a high rate of infant response to maternal imitation from as early as 10 months (Masur & Olson, 2008). Infants' response to imitation (particularly action imitations, rather than vocal) indicated an awareness of being imitated. Maternal imitations have also been associated with infants' concurrent word production and long-term lexicon (Masur & Olson, 2008; Tamis-LeMonda, Bornstein & Baumwell, 2001).

Maternal IDS That Directs Infant Attention

Given the positive infant outcomes associated with maternal facilitative speech that acknowledges infant behaviour and encourages participation, it may be assumed that maternal speech that redirects or inhibits infant engagement may also have some impact on infant outcomes. Some debate exists as to the infant outcomes that may be associated with maternal directive speech. It has been negatively linked to both language acquisition and cognitive skills for infants (for example, Gilmore, Cuskelly, Jobling & Hayes, 2009). Similarly, the less often a mother follows their infant's focus of attention when they speak, the poorer the later communicative skills displayed by the infant (Carpenter, 2012; Harris, Kasari & Sigman, 1996; Tomasello & Farrar, 1986). However, it appears that specific elements of maternal directive speech may provide some beneficial effects. More supportive directiveness (those behaviours that followed the infant's

attentional focus or emphasised achievement) has been associated with infants' vocabulary gains, while intrusive directive behaviour (that which redirected the infant's attention) has been negatively associated with later infant vocabulary outcomes (Masur et al., 2005). Similarly, maternal directives that followed infant attention (for example 'Throw the ball') were associated with later gains in infant vocabulary, while redirective utterances ('Look, there's your giraffe') were negatively associated with infant vocabulary (Akhtar, Dunham & Dunham, 1991; Tomasello & Farrar, 1986).

In an extensive examination of the functional categories of utterances produced by mothers in interaction with their 10-month-old infants, it was found that mothers typically produced a high level of descriptions (Paavola et al., 2005). Within the study, descriptions were defined as a directive behaviour, as they were seen to maintain or initiate the attention of prelinguistic infants through comments relating to immediate infant action (Menyuk et al., 1995; Paavola et al., 2005). However, it could be argued that rather than functioning as a directive behaviour, descriptions may function to follow the infant's line of interest and offer extra information about their environment. As such, it may be possible to view maternal descriptions as a more facilitative form of communication. These interpretations highlight the variety of frameworks that may be used in the categorisation of utterance types into functions.

Maternal Facilitative and Directive IDS to Atypically Developing Infants

Infants developing atypically may display deficits in cognitive, social or linguistic development. Any one of these deficits may impact on the infant's pattern of behaviour in interaction, and they may equally impact on how the infant perceives and responds to the behaviours of their interactive partner. For this reason, mothers in interaction may adapt their IDS, producing more facilitative or directive speech depending on the pattern of behaviours displayed by their infants. This section will

present research examining the maternal production of facilitative and directive speech in interaction with four atypically developing infant samples: 1) Intellectually Disabled Infants, 2) Infants with Down Syndrome, 3) Infants with Autism and 4) SibsA Infants.

1) **Intellectually Disabled Infants.** Although relatively few studies have examined the function of maternal language directed towards infants with intellectual disabilities, some studies have found that mothers adapt their behaviours in response to their child's mental and communicative level in a manner thought to direct attention, whilst also attempting to promote infant communicative abilities (Legerstee & Fisher, 2008; Legerstee, Van Beek & Varghese, 2002). Caregiver imitation has been associated with increased spontaneous infant imitation during free play sessions (Gadzag & Warren, 2000). However, it should be noted that this study focused on only three dyads, thus results may not be generalizable. In an experimental study of maternal imitative behaviour in interaction with infants showing signs of developmental delay, Pelaez et al. (2011) found that contingent vocal imitations served to reinforce early infant vocalisations, with ten of the eleven participating infants displaying reinforcement effects.

2) **Infants with Down Syndrome.** In an examination of the function of parental speech during interactions with children with Down Syndrome (DS), deFalco et al. (2011) focused on behaviours defined as either affective (encouragement, singing, social play) or informative (descriptions, questions, direct statements). Parents were found to produce more affective vocalisations as compared to parents of chronologically age-matched TD infants. While little difference was found in the amount of informative vocalisations produced between groups, it was found that the *type* of informative language produced did differ, with parents of infants with DS producing more directive language. deFalco et al. (2011) interpreted these findings to suggest that parents may be using more directive behaviour to maximise the efficacy of their vocal stimulation in order to scaffold

play and communicative behaviours for their infant. Thus, they highlight the bidirectional nature of the interaction, with diminished attentional abilities displayed by infants with DS leading to a modification of parental behaviour to accommodate infant abilities and preferences. In this sense, such findings belong with the body of work focusing on a parental aptitude to adapt language to better serve the needs of a child with a disability (Legerstee et al., 2002; Legerstee, Markova & Fisher, 2007; Longobardi & Caselli, 2007). However, as the study did not directly address specific infant abilities or the manner in which parental adapted behaviour may be associated with later infant outcomes, no definitive conclusions could be drawn. Contradicting the findings of the above study, Pino (2000) found that in conversation with infants with DS, mothers tended to produce more information-salient speech with a specific teaching function, compared to mothers of TD infants.

3) **Infants with Autism.** As limited social engagement is common in autism, it may be the case that this limited engagement could influence how and which maternal utterances infants can attend to (for example, Charman, 1998, Mundy, Sigman & Kasari, 1994). Equally, it may be expected that infant responsive behaviours may impact upon the speech produced by mothers (Masataka, 2003) as they, for example, attempt to encourage their infants to engage in interaction. Nevertheless, some studies have shown that infants can profit from the naturalistic utterances in their environment, with the overall frequency of adult words heard correlated with concurrent child vocalisations (Warren et al., 2009). Further, it has been found that naturalistic parental expansions of 15- to 24-month-olds' utterances, and descriptions of their own actions while their child is attending have been linked to better vocabularies six months later (McDuffe & Yoder, 2010).

Further studies have examined mothers' production of questions. In interventions, children with ASD have been shown to respond to wh-questions (Yoder, Davies, Bishop & Munson, 1994), while infants who hear a large number of yes/no questions in naturalistic settings display better language abilities eight months later (Swensen, Naigles & Fein, 2007). However, recently, it has been found that wh-questions have more linguistic benefits for TD infants, with mothers of infants with autism producing a lower variety of wh-questions and a higher frequency of less complex wh-questions (Goodwin, Fein & Naigles, 2014). As such, it may be that infants on the spectrum are hearing fewer language examples, which may impact on their ability to learn language. Alternatively, it may be the case that mothers are tailoring their language to best suit the needs of their infants, as more complex language may be beyond their infants' ability to comprehend. Whichever the explanation, the study highlights the potential differences in the maternal output heard by infants on the spectrum.

These differences may be apparent in both the output produced by mothers and in the manner in which the output functions within the interaction. An interesting study by Sanefuji and Ohgami (2011) highlighted the particular importance that some forms of facilitative speech may play for infants with autism, finding that infants with autism gazed for a longer time at mothers when they heard contingent imitation, as opposed to more general contingent behaviours. By comparison, TD infants gazed at their mothers irrespective of the type of responsive behaviour that she used. Meltzoff (2004) suggested that when TD infants observe an interactive partner contingently imitating them, they infer that their partner has the same mental experiences linked to those behaviours. Thus, imitation offers infants an insight into understanding the mental state of their interactive partner, setting the scene for attentional sharing and an appreciation of intentional actions. It has been suggested that for infants with ASD, eye contact can help a child develop an

understanding of the relationship among people, actions and the events within their environment (Tiegerrman & Primavera, 1984). As such, Sanefuji and Ohgami (2011) suggest that contingent imitation, with its ability to promote eye contact in infants with ASD, may be a useful tool within interventions aimed at adapting caregiver behaviour to promote infant interaction.

In an investigation of the vocalisations of mothers of infants with developmental delay, DS and ASD, as well as a typically developing control comparison, it was found that all three atypical groups favoured the use of facilitative, information-salient vocalisations over the use of affect-salient vocalisations (Venuti et al., 2012). Mothers chose to communicate shared meaning about the internal and external world, as opposed to communicating affect (Venuti et al., 2012). Similarly, an equal number of descriptions were produced by all groups, with the suggestion that they function across groups to provide verbal scaffolding for infant exploration as they describe the internal and external world (Longobardi & Caselli, 2007). Mothers of infants with ASD were found to use a higher proportion of name-calling in order to direct the infant's attention. Mothers of TD infants asked a higher number of questions, whereas mothers of developmentally delayed infants tended to use more directing statements. Once again, this study points toward an adapted style of maternal interaction, which sees mothers adopt a form of language output that functions in response to the developmental abilities of their infant. It should be noted that this study offered no information on infant outcomes, so no associations between maternal language style and infant development could be drawn.

It has been suggested that directive speech may demand too much of the attentional abilities of children with ASD, and they may simply not be able to follow the frequently changing focus of attention being presented (Landry & Bryson, 2004). However, when infants are very young and in need of a partner to initiate interactive exchanges, such a directive style of maternal speech may be

beneficial (Pine, 1992; Saxon, 1997; Tamis-LeMonda & Bornstein, 1989). Equally, it has been found that maternal gestures that serve to direct infant attention are linked to long-term benefits for preschool children with autism (Kasari et al., 2012). It has also been reported that maternal persistence in relation to encouraging infants to engage within the interaction has been linked to higher levels of joint attention behaviour for infants with autism (Parladé et al., 2010).

4) **SibsA Infants.** In an analysis of the language that 18-month-old infants more likely to receive an autism diagnosis were exposed to, Jakubowski & Iverson (2011) found that infants heard only half as much speech, but within that speech, mothers used twice as many attention-directing utterances, as compared to mothers of TD infants. They suggested that having an older child already diagnosed with autism, and the expectations that this may bring for a younger sibling, impacted on maternal behaviour, leading to a more directive interactive style, even in the absence of autistic symptomology. As reported in Chapter Three, Wan et al. (2012) also found this pattern of directive behaviour associated with mothers of SibsA infants. However, this study focused only on early infancy (6 to 10 months). It would be interesting to examine if and how this pattern continued as infants aged.

A variety of studies have found directive patterns specific to mothers of SibsA infants as opposed to mothers of TD infants, with such mothers displaying high intensity approach behaviours and availing of more verbal and non-verbal prompts in order to gain the infant's attention (Doussard-Roosevelt et al., 2003; Meirsschaut et al., 2011). Similarly, it has been found that mothers of SibsA infants used more directive language, but also asked more questions of their infant, named their infant and referred to themselves more often as compared to mothers of both TD infants and developmentally delayed infants (deFalco et al., 2011). As such, mothers of SibsA infants appear to display a unique pattern of directive speech during interaction with their infants;

however, few studies have examined how this may impact on later infant development. Quigley and McNally (2013) did find that mothers of SibsA infants were both less responsive and more directive in comparison to mothers of TD infants. No associations were found between maternal utterances and later SibsA infant outcomes, however within the comparison TD group, maternal directive utterances and questions were negatively associated, while responsive speech was positively associated TD infant outcomes. It was suggested that as maternal directive speech did not have negative associations for SibsA infants, it may be suitable for use within interventions to promote infant engagement. However, as no association, positive or negative, was found for SibsA infants, it may also be the case that maternal speech was simply not being attended to by the infants.

The Current Study

The current study aims to examine maternal IDS that functions to facilitate infant participation or direct infant attention. It will investigate these broad constructs and it will take a more detailed approach, presenting the specific utterance-types associated with facilitative and directive speech. It will examine this speech as produced by mothers of SibsA and TD infants when the infants were 9, 12 and 18 months. The following hypotheses will be addressed:

Hypothesis One: *Mothers of TD infants will produce more Facilitative utterances and fewer Directive utterances than mothers of SibsA infants*

Hypothesis Two: *Mothers of TD infants will produce more Facilitative utterances and fewer Directive utterances from 9 to 18 months. No prediction is made for mothers of SibsA infants.*

Hypothesis Three: *Maternal Directive utterances will be negatively associated with developmental outcomes and Facilitative utterances will be positively associated with developmental outcomes for TD infants. The direction of association is not predicted for SibsA infants.*

Methods

The same five-minute videos as previously described were used for the analysis of IDS. Therefore participant information and recording and editing procedures will not be discussed here.

All audible maternal vocalisations were coded by a research assistant using Observer XT 7. The coding unit was defined as a maternal utterance with a single functional category. The coded unit changed when the mother's utterance belonged to a different functional category or when she stopped speaking, with a subsequent silence of two seconds or more. Therefore, an utterance as short as a single word or letter-sound could be coded as a functional category (Bornstein et al., 1992; Penman et al., 1983).

Each maternal utterance was coded according to nineteen mutually exclusive categories detailing the communicative function of an utterance. The codes were adapted from a taxonomy of maternal functional utterances devised by Paavola et al. (2005). The codes were developed to ensure that all possible maternal utterances could be functionally coded using one of the nineteen codes. Every maternal utterance was coded, but mothers did not produce every functional category during their sessions. Each utterance was coded in order to give a full picture of maternal vocal behaviour across the five-minute session; however, only those behaviours in keeping with the focus of previous research will be examined within this study. Once all coding was completed, the frequency of each utterance type as a proportion of the total frequency of utterances types produced was calculated. Analysis relating to any codes not presented in the study can be found in Appendix Eleven. The full list of codes used, definitions and examples can be found in Table 34.

In order to examine maternal vocalisations that functioned to direct infant behaviour, the vocalisations being investigated are: Attention Devices, Commands and Negations. In order to

examine maternal vocalisations that function to facilitate infant engagement, the vocalisations being investigated are: Compliments, Affirmatives and Imitations (as these vocalisations occur in direct response to infant behaviours) and Questions and Descriptions (as these vocalisations are typically uttered in response to the infant's focus interest, and/or to elicit a verbal or gestural response from the infant).

Table 34. The functional categories of maternal vocalisation

Behaviour	Description	Examples
Mand Model	Requests a specific structure and then provides a model	'What's this? Your parrot!'
Question	Including 'Wh' questions, intonation, yes/no questions and tags.	'What will we do?' 'Ball?' 'That's your giraffe, isn't it?'
Description	Statements describing a person's behaviour, actions, feelings, etc., or an object or an event.	'You're hugging him.'
Attention Device	Statements eliciting the child's attention.	'Look!' 'Catherine!'
Commands	Statements directing or inhibiting the child's physical behaviour	'Give that to me.' 'Put the ball in the box.'
Social Play	Interacting with the child in a playful manner	'Peek-a-boo!' 'Oink, oink!'
Conventional Social Expression	Polite, conventional expressions used in social interactions	'Thank you.' 'Bless you.'
Labelling	Utterances containing one word or the word preceded by a demonstrative	'That's a ball.' 'Ball.'
Imitation – faithful	Faithful imitation of child's vocalization	
Imitation – Expansion	Expansion of child's vocalization	
Affirmative	Statements that agree with a previous utterance or action of the child	'Yes.' 'Mmm-hmmm.'
Compliment	Giving explicit positive feedback on the behaviour of the child	'Good boy!' 'Great job!'
Negation	Statements denying the child's previous utterance or action or giving explicit negative feedback on the behaviour of the child	'No, that's not how it works!' 'Ah-ah, that's bold.'
Filler	Words not conveying any referential meaning and appear to be used as automatic responses	'Now...' 'So...'
Non-speech Vocalisation	Vocalisations with no functional content.	Sneeze, cough, eating, gasp
Song / Story / Rhyme	Singing, reading or reciting rhyme to infant.	
Inaudible	Mother's utterance is inaudible.	
Speech to Other	Mother speaks to someone off camera	
No Vocalisation	Mother stops speaking	

A research assistant was trained to a high level of reliability on maternal utterances. When training began, a separate set of five-minute training videos were used. They featured the same dyads, but at different time points, in order to ensure that the research assistant would not be

biased by any over-familiarity or discussion relating to behaviours displayed in the videos. The training videos featured four SibsA dyads (2m, 2f) and four TD dyads (2m, 2f). In order to ensure that a range of maternal behaviours were likely to be captured, a range of infant ages were chosen for the training videos.

Initially, all training of coding was completed on paper to ensure that the research assistant had a clear understanding of the meaning of all codes. A number of training meetings were held to ensure that the research assistant could ask any questions relating to the codes and ensuring that she could be shown a number of examples of each behaviour. When the research assistant and the current author reached consensus on all paper coding, the research assistant was then given extensive training in the use of Observer XT. Once again, a variety of training videos were chosen to evenly represent gender, group and infant age. This second round of training focused on the timing of coding, with consensus achieved if the research assistant and the current author coded the same category of behaviour within 0.5 seconds. To ensure accuracy, videos were watched at full speed and then codes were entered into the Observer Event Log while the video was playing at half-speed. By watching at full speed, the research assistant could be certain that she had accurately heard the full utterance, while re-watching at half-speed allowed the RA to accurately place the code at the most appropriate time point.

Once a high level of interrater reliability had been achieved (.82), the research assistant began coding the 9, 12 and 18 month videos. Consensus was then reached between RA and the current author for the timing and category of each code placed. Once coding was completed, the proportional frequency of each functional utterance in relation to the total number of utterances produced was analysed.

In order to examine the potential links between the functional use of language by mothers, and the later social, cognitive and language abilities of their infants, correlations between infant scores on the Early Social Communication Scales (ESCS) (Mundy et al., 2003) and the Bayley Scales of Infant Development—Third Edition (BSID-III, Bayley, 2006) (discussed in detail in Chapter Two) were examined in relation to maternal directive and facilitative behaviours.

Results

Key Findings

There were few statistically significant differences found in relation to the Directive and Facilitative utterances produced by mothers of SibsA and TD infants. Mothers of SibsA infants produced more Directive utterances, with significantly more Attention Devices produced at each time point. Mothers of TD infants produced more Facilitative utterances at each point, significantly so at 18 months.

Both groups displayed an increase in Facilitative utterances from 9 to 18 months, significantly so for mothers of TD infants. Mothers of SibsA infants increased their production of Directive utterances, while mothers of TD infants displayed a decrease. Neither changes were statistically significant.

Overall, more associations were noted between maternal utterances and later TD infant outcomes than SibsA infant outcomes. The majority of maternal Facilitative utterances were associated with positive outcomes for TD infants, with the exception of Imitations. Few associations were found for SibsA infants in relation to Facilitative utterances, although Imitations were positively correlated with infants' later social abilities. Directive utterances in total were associated with positive outcomes for TD infants. Directive utterance types were associated with negative outcomes for SibsA infants, with the exception of Attention Devices, which were associated with positive outcomes.

Analysis

The primary analysis first examined between-group differences between the Directive and Facilitative utterances produced by mothers of SibsA and TD infants. This was followed by an analysis of the within-group changes in maternal Directive and Facilitative utterances from 9 to 18 months. Finally, there was an examination of the correlation between maternal Directive and Facilitative utterances and later infant outcomes. Non-parametric tests were conducted due to the small sample size and the substantial individual variability indicated by an inspection of the distribution. In addition, medians and average deviations (ADs) are presented rather than means and SDs.

Between-group Differences

To examine between-group (SibsA vs TD) differences in maternal Facilitative utterances (Compliments, Affirmatives, Imitations, Questions, Descriptions) and Directive utterances (Attention Devices, Commands, Negations), Mann-Whitney *U* tests of independent samples were conducted.

Hypothesis. *Mothers of TD infants will produce more Facilitative utterances and fewer Directive utterances than mothers of SibsA infants.*

Facilitative Utterances. No significant difference was found between the total proportion of Facilitative utterances produced by mothers of SibsA and TD infants. Mothers of TD infants did produce more at 9, 12 and 18 months, with a significant difference identified at 18 months ($U[19]=18.5$, $p=0.028$, $r=.49$).

Few Compliments were produced by either maternal group, but mothers of TD infants produced significantly more than mothers of SibsA infants at 12 months ($U[19]=20$, $p=0.038$, $r=.48$). Both

maternal groups asked a large number of Questions, with mothers of TD infants producing significantly more at 18 months (U[19]=21, p=0.050, r=.45). (see Table 35 and 36).

Table 35. Median proportion of Facilitative utterances at 9 and 12 months, average deviation, U score, significance and effect size

Facilitative Utterance Type	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Compliments	0 (.9)	1 (1.3)	29.5	.541	-	2 (1.9)	0 (.8)	20	.038*	.48
Affirmatives	3.1 (3.6)	2.86 (2.4)	35.5	.962	-	5 (2.6)	2.66 (1.9)	34	.683	-
Imitations	4.2 (4.2)	5.72 (6.6)	26	.335	-	2.4 (2.2)	2.85 (2.2)	41	.744	-
Descriptions	6.7 (5.1)	4.15 (3.9)	24	.248	-	9 (3.9)	10 (3.6)	44	.935	-
Questions	15 (4.3)	13.5 (5.6)	31	.630	-	22 (4.3)	18.3 (4)	40	.720	-

(*= p<0.05, **= p<0.01 1-tailed significance)

Table 36. Median proportion of Facilitative utterances at 18 months, average deviation, U score, significance and effect size

Facilitative Utterance Type	18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Compliments	2 (2.9)	2.4 (1.8)	41	.742	-
Affirmatives	4.9 (2.1)	3.6 (1.8)	40	.683	-
Imitations	3 (3.5)	2.85 (3.3)	43	.870	-
Descriptions	19.8 (5.2)	19.1 (4.9)	38.5	.595	-
Questions	23.6 (5.3)	20 (6.1)	21	.05*	.45

(*= p<0.05, **= p<0.01 1-tailed significance)

Directive Utterances. No significant difference was found between the total proportion of Directive utterances produced by mothers of SibsA and TD infants. Mothers of TD infants did

produce less at 9, 12 and 18 months, with a significant difference identified at 18 months (U[19]=11.5, p=0.004, r=.63).

Mothers of TD infants produced significantly fewer Attention Devices at 9 months (U[17]=15, p=0.046, r=.49), at 12 months (U[19]=21, p=0.053, r=.45) and at 18 months (U[19]=13, p=0.014, r=.56). None of the other group comparisons were statistically significant. See Table 37 and 38.

Table 37. Median proportion of Directive utterances at 9 and 12, average deviation, U score, significance and effect size.

Directive Utterance Type	**9 months**					**12 months**				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Attention Devices	1.9 (2.8)	9.1 (3.8)	15	.046*	.49	2.9 (2)	5.4 (3.9)	21	.053*	.45
Negations	0 (4.0)	.99 (1.5)	33	.765	N/A	.89 (1.7)	.38 (1.7)	40	.666	N/A
Commands	9.1 (5.6)	3.9 (2.5)	30	.563	N/A	5.3 (3.1)	4.95 (1.6)	36	.461	N/A

(*= p<0.05, **= p<0.01 1-tailed significance)

Table 38. Median proportion of Directive utterances at 18 months, average deviation, U score, significance and effect size.

Directive Utterance Type	**18 months**				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Attention Devices	2.9 (1.5)	7.5 (3.3)	13	.014*	.56
Negations	1.3 (1.3)	.7 (3.4)	44	.932	N/A
Commands	4.1 (2.3)	7.3 (2.5)	28	.165	N/A

(*= p<0.05, **= p<0.01 1-tailed significance)

Within-group Differences

To examine within-group changes from 9 to 18 months in the Directive and Facilitative utterances of mothers of SibsA and TD infants, Friedman tests were conducted. Post-hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied with a new significance level set at $p<0.017$.

Hypothesis. *Mothers of TD infants will produce more Facilitative utterances and less Directive utterances from 9 to 18 months. No prediction is made for mothers of SibsA infants.*

Facilitative Utterances. For mothers of TD infants, the overall proportion of Facilitative utterances increased significantly from 9 to 18 months ($Z=-2.547$, $p=0.011$). Mothers of TD infants also produced significantly more Descriptions from 9 to 18 months ($Z=-2.429$, $p=0.015$). See Figure 1. No other significant changes were found for either group.

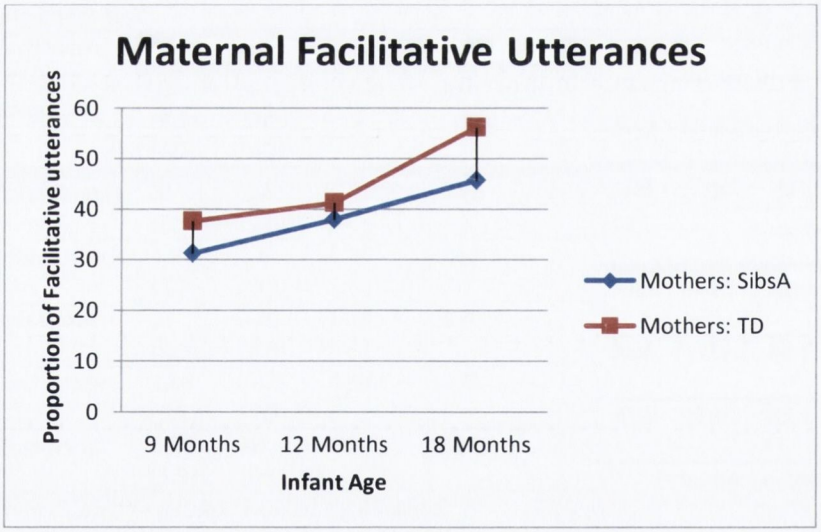

Figure 1. The median proportional frequency of Facilitative utterances produced by SibsA and TD mothers at 9, 12 and 18 months.

Directive Utterances. No statistically significant changes were found in the overall maternal production of Directive utterances for either group (see Figure 2). Mothers of SibsA infants produced more Commands and Negations, while mothers of TD infants produced fewer Commands and Negations over the time period measured, although differences were not significant.

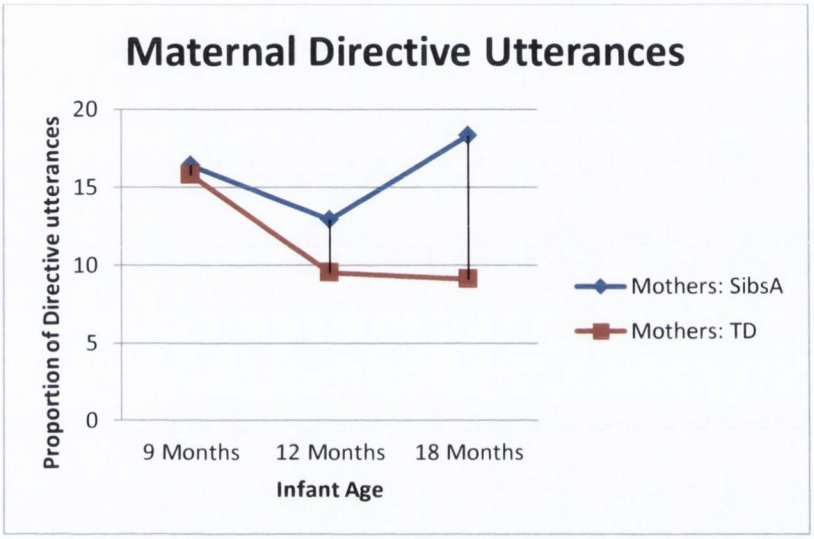

Figure 2. The median proportional frequency of Directive utterances produced by SibsA and TD mothers at 9, 12 and 18 months.

Maternal Utterances and Later Infant Outcomes

To examine the association between maternal Directive and Facilitative utterances and later infant social, cognitive and linguistic outcomes, Kendall's Tau tests were conducted. Infant outcomes were measured using the Bayley Scales of Infant Development (BSID-III, 2006) and the Early Social Communication Scales (Mundy, 2003).

Hypothesis: *Maternal Facilitative utterances will be positively associated with developmental outcomes and Directive utterances will be negatively associated with developmental outcomes for TD infants. The direction of association is not predicted for SibsA infants.*

Facilitative Utterances

TD Infants. The total proportion of maternal facilitative IDS was positively associated with infant cognitive abilities at 18 months (r[9]=.650, p=.011). In relation to the specific categories of Facilitative speech heard by TD infants at 9 months, only one statistically significant positive correlation was found. The remainder of statistically significant correlations identified were negative. See Table 39.

Table 39. Correlations between 9 months maternal Facilitative Utterances and 12 and 18 month TD infant outcomes.

		Compliments	Imitations
12m	**Cognitive**	-.439	-.545*
	RBR	-.654*	.298
18m	**RBR**	.597*	.294
	IJA	.065	-.725**

(*= p<0.05, **= p<0.01 1-tailed significance)

Of the maternal facilitative speech produced at 12 months, a larger number were positively correlated with later TD infant outcomes, while only one was negatively correlated. See Table 40.

Table 40. Correlations between 12 months maternal Facilitative Utterances and 18 month TD infant outcomes.

		Compliments	Imitations	Descriptions	Questions
18 m	**Receptive Language**	-.464	.00	.650**	.526*
	Cognitive	.569*	.000	.650**	.526*
	IJA	.111	-.535*	.056	.167
	RJA	-.115	.628*	-.031	.093

(*= p<0.05, **= p<0.01 1-tailed significance)

SibsA Infants. Far fewer associations were found for SibsA infants. No associations were found between the total proportion of maternal Facilitative utterances and later infant outcomes. At 9 months, only two associations were found between facilitative speech and later infant outcomes. See Table 41.

Table 41. Correlations between 9 months maternal Facilitative Utterances and 12 and 18 month SibsA infant outcomes.

		Imitations	Descriptions
12m	**Cognitive**	.197	-.803**
18m	**RJA**	.714*	-.109

(*= p<0.05, **= p<0.01 2-tailed significance)

Only one maternal facilitative utterance produced at 12 months was correlated with later infant outcomes, with Descriptions positively associated with infant cognitive abilities at 18 months (r[8]=.689, p=.029).

Directive Utterances

TD Infants. For TD infants, the total proportion of maternal Directive IDS was positively associated with infants' IJA (r[9]=.5, p=.03) at 18 months. Mixed results were found in relation to the associations between specific categories of directive speech produced at 9 months and infant language abilities at 12 and 18 months. See Table 42. No correlations were found between maternal directive speech at 12 months and infant outcomes.

Table 42. Correlations between 9 months maternal Directive Utterances and 12 and 18 month TD infant outcomes.

		Negations	Commands
12 m	**Language**	.000	.743**
18 m	**Language**	-.765**	.210

(*= p<0.05, **= p<0.01 1-tailed significance)

SibsA infants. For SibsA infants, the total proportion of maternal Directive IDS was negatively associated with SibsA infants' socio-communicative abilities at 18 months [IBR: (r[8]=-.857, p=.003); RBR (r[8]=-.764, p=.009)]. All significant associations between specific categories of maternal directive speech produced at 9 months and later infant outcomes were negative. See Table 43.

Table 43. Correlations between 9 months maternal Directive Utterances and 12 and 18 month SibsA infant outcomes.

12m		Negations	Commands
	RJA	-.667*	-.182
18m	**IJA**	-.593*	-.255
	IBR	-.473	-.571*

(*= p<0.05, **= p<0.01 2-tailed significance)

Mixed findings were produced in relation to specific categories of maternal directive speech produced at 12 months, and infant cognitive abilities at 18 months. Negations were negatively associated (r[8]=-.716, p=.026), but Attention Devices were positively associated (r[8]=.676, p=.030). Unlike TD infants, no association were found between SibsA language outcomes and maternal directive speech.

Other Significant Findings

The proportion of **Social Play** utterances decreased for both groups over time, but mothers of SibsA infants produced more at each time point, significantly so at 12 months (TD Mdn: 13 [AD: 4.7], SibsA Mdn: 21.1 [AD: 7.13], U[19]=14, p=0.011, r=.58).

Maternal Social Play at 9 months was negatively associated with TD infant response to joint attention at 18 months (r[9]=-.588, p=0.036). Social Play produced at 12 months was negatively associated with TD infants' initiation of joint attention at 18 months (r[9]=-.611, p=0.022). No associations were found between Social Play and later outcomes for SibsA infants. See Figure 3.

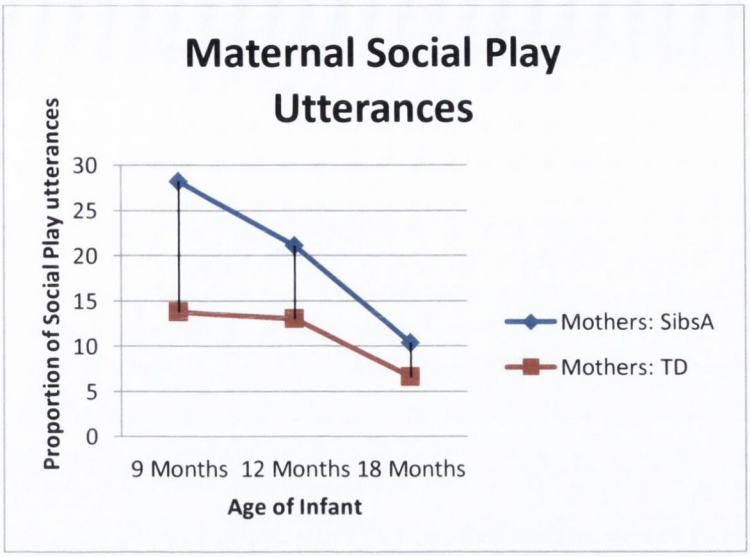

Figure 3. The median proportional frequency of Social Play produced by mothers of SibsA and TD infants at 9, 12 and 18 months

The proportional frequency of **non-speech vocalisations** produced by mother of TD infants at 9 months were negatively correlated with infants' expressive language at 12 months (r[9]=-.707, p=0.010). A large number of positive associations were found between maternal non-speech vocalisations produced at 9 months and SibsA infant outcomes at 12 and 18 months (see Table 44).

Table 44. Correlations between 9 months maternal non-speech vocalisations and 12 and 18 month SibsA infant outcomes.

12m		TIBR	TIJA	Language	Receptive Language
	Non-speech Vocalisation	.571*	-.333	.694*	.667*
18m	**Non-speech Vocalisation**	.643*	.691**	.571*	.643*

(*= p<0.05, **= p<0.01 2-tailed significance)

Mothers of SibsA infants produced fewer Songs, Stories and Rhymes at each point, significantly so at 18 months (U[19] 20, p<0.042, r=.48). See Figure 4.

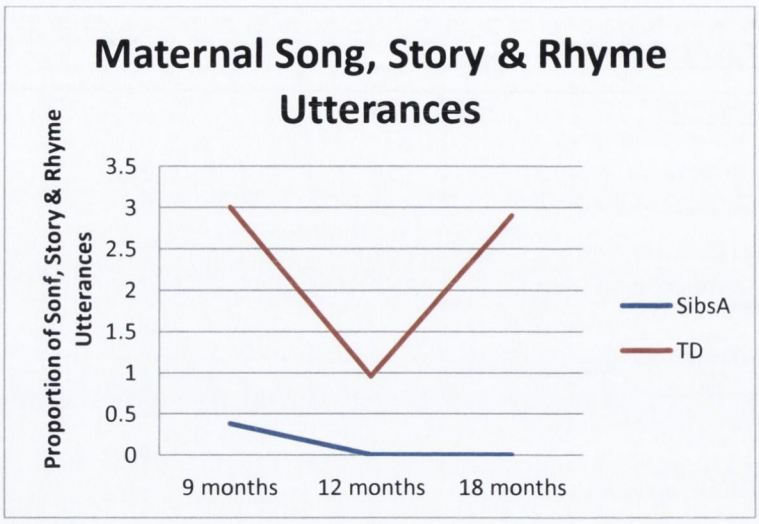

Figure 4. The median proportional frequency of Song, Story and Rhyme utterances produced by mothers of SibsA and TD infants at 9, 12 and 18 months

Discussion

In support of the hypotheses, mothers of SibsA infants showed a trend towards using higher levels of directive vocalisations (although few of these differences were statistically significant). Mothers of TD infants displayed lower levels of Attention Devices as well as a decreasing proportion of Commands and Negations over time. This accords with suggestions that more directive behaviour may be used by mothers during early interactions with their TD infants in order to initiate interactive exchanges (Pine, 1992; Saxon, 1997; Tamis-LeMonda & Bornstein, 1989). As infants gain more autonomy and begin to take a more active, vocal role in the interaction, such directive behaviour is less necessary.

It is interesting that this is not the trajectory of directive behaviour for the mothers of SibsA infants. An increase in directive behaviour at 18 months may suggest that mothers are not receiving or perceiving the increasingly advanced level of social interaction that may be expected from TD infants. As such, mothers may be using their time to redirect the infant from behaviours that the mother does not see as appropriate, and to direct infant attention in order to engage them in social interaction. Jakubowski & Iverson (2011) suggested that higher levels of attention-directing vocalisations uttered by mothers of SibsA infants may be linked to the fact that they already have an infant who has been diagnosed with autism. As such, their expectations/concerns of another diagnosis may lead to a higher production of speech that encourages infant engagement. However, the fact that an increasing number of directive vocalisations are used as infants age, may suggest that this expectation effect is not the sole cause. Were mothers using such vocalisation out of concern rather than in response to infant behaviour, it could be expected that they would produce equally high levels at each time point. However, the increase in directive behaviour appears to

suggest that mothers are responding to a real, albeit subtle, difference in infant socio-communicative behaviours.

It is interesting to note that different patterns of maternal behaviour were associated with positive outcomes for the two infant groups. This may, in part, mirror the findings of Masur et al. (2005), which suggested that directive behaviour could be linked to both positive and negative outcomes, with directive behaviour that redirected infant attention associated with poorer outcomes and directive behaviour that supported infant engagement associated with more positive outcomes. Commands may have been associated with positive outcomes for TD infants as they may facilitate infant interaction by offering an explicit, appropriate direction to allow the infant to take part in the interaction (for example, 'Now you throw the ball!' or 'It's your turn, you go now'). This sort of informative speech may also be linked to directive vocalisations that follow the infant's focus of attention, which have also been linked to more positive outcomes (Akhtar, Dunham & Dunham, 1991; Harris, Kasari & Sigman, 1996; Tomasello & Farrar, 1986). Indeed, this may support the findings of Karass et al. (2002) who found that verbal encouragement was associated with positive infant outcomes.

While Commands offer guided encouragement to engage by behaving in a particular, preferred manner, Attention Devices place less emphasis on infant behaviour, beyond simply engaging. It is interesting that mothers of SibsA infants uttered such a high proportion of these vocalisations, and that they were associated with positive outcomes for their infants. It may be the case that when directive behaviour is focused on the encouragement of infant engagement, it offers the sort of clear, direct form of speech required by infants more likely to receive an autism diagnosis. These findings are in keeping with those focusing on infants with intellectual disability, which suggest that mothers tailor the properties of their speech to suit the developmental needs of the infant

(Legerstee, Markova & Fisher, 2007; Legerstee, Van Beek & Varghese, 2002; Longobardi & Caselli, 2007; Venuti, deFalco, Esposito & Bornstein, 2009). As such, the present study contrasts with Pino's (2000) findings that mothers of infants with intellectual disabilities spend more of their time providing information-salient speech. It may be the case that within an ASD cohort it is more worthwhile for mothers to focus their efforts on encouraging their infants to socially engage, with more information-salient utterances proving overly complex for their infant's socio-communicative abilities and needs.

Beyond directive utterances, mothers of SibsA infants also displayed interesting patterns of facilitative utterance production. They showed a decrease in all facilitative utterances other than Questions and Descriptions at 12 months. The low level of Compliments and Affirmatives uttered may suggest that mothers are taking fewer opportunities to praise their infants. With encouragement linked to positive infant outcomes, should such encouragement take the form of praise, then it may be the case that experiencing lower levels of this behaviour could impact infant language development (Karass et al., 2002). Perhaps a more likely explanation for the lower level of Compliments and Affirmatives expressed by mothers of SibsA infants is that they simply have fewer opportunities to praise their infants as the infants are displaying increasing disengagement from the interaction. This suggestion is strengthened by the fact that mothers of SibsA infants spend more of their time attempting to gain infant attention, which suggests that infant disengagement is impacting on maternal utterances.

In relation to maternal speech that imitates infants, mothers in both groups displayed a much lower level of such vocalisations as compared to that found by Masur and Olsen (2008). While no statistically significant differences were found between maternal groups, mothers of SibsA infants displayed a sharp decrease in imitation production from 9 to 12 months and a lower level at 18

months as compared to mothers of TD infants. Infant groups spent the same amount of time vocalising, however at 18 months TD infants did produce a significantly higher proportion of advanced vocalisations such as words. Therefore, this trajectory of maternal imitation cannot purely be resultant from the fact that SibsA infants were offering less vocal output for mothers to imitate. It is possible that at 9 months the higher level of maternal imitation in the SibsA group may be explained by maternal expectations, with the expectation that their infant may be on the spectrum causing mothers to respond to a higher level of infant vocalisations. In relation to TD infants, their mothers showed a higher level of imitation-production at 18 months. This may mirror findings of Gros-Louis, West, Goldstein, and King (2006) who suggested that mothers intuitively adapt their imitation use in response to increasingly advanced infant vocalisations. As TD infants displayed more advanced vocalisations it may be expected that their mothers may respond with a higher level of imitations.

Maternal imitation production was only associated with positive infant outcomes for the SibsA group, with negative associations found for the TD infants. While maternal imitation in TD infants has been positively associated with linguistic abilities (Masur & Olson, 2008), in the present study, they were positively associated with SibsA infant social behaviour. As it has been found that maternal imitation is responded to by infants on almost every occasion (Masur & Olson, 2008), it may be the case that they function to gain infant attention, which in relation to the SibsA infant could provide an extra benefit of encouraging engagement and benefiting social abilities.

Both maternal groups directed a large number of Questions to their infants, with mothers of TD infants increasing levels sharply from 12 to 18 months. This trajectory may be expected as TD infants become increasingly capable of engaging actively in proto-conversation and responding to maternal Questions. The fact that mothers of SibsA infants were found to decrease the number of

Questions that they uttered may suggest that they were responding to a different pattern of infant behaviours. If infants are less socially engaged, mothers may ask less questions simply because they have limited expectations that they will receive a response. Their time may be better served attempting to direct the infant's attention toward engagement. The significantly lower number of Questions uttered by mothers of SibsA infants at 18 months would appear to support this suggestion. The overall pattern of Questions uttered by mothers of SibsA infants is in keeping with the maternal trajectory of Question production suggested in the literature (deFalco et al., 2011). It would have been worthwhile to examine Questions in greater depth in order to establish if both groups of mothers produced the same proportion Question types. However, given the large number of extra codes that would have been required (Yes/No questions, Wh- questions, Tags, Requests for clarification, Requests for information, Test questions), it was thought that their inclusion may have decreased coding accuracy to a great extent.

While it may be expected that mothers of SibsA infants may also have shown a decrease in the proportion of Descriptions produced as their infants became more disengaged, both groups of mothers increased the amount of Descriptions that they produced by 18 months (however, only mothers of TD infants displayed a statistically significant increase). This finding appears to match that of Venuti et al. (1997), which suggests that both maternal groups may be using descriptions as scaffolding to facilitate infant exploration. This could be beneficial for mothers of SibsA infants as they follow infant interest to offer information-salient vocal output. However, the associated developmental outcomes appear to tell an interesting story, as TD infant outcomes are positively linked to maternal use of descriptions, whereas SibsA infants show more negative associations. This suggests that description-production may be less salient for SibsA infants' interests and that infants need to be more socially engaged to benefit from such information-salient vocalisations.

Beyond those vocalisations clearly associated with directive and facilitative behaviours, other differences were found between types of vocalisations used by mothers of SibsA and TD infants. Social Play was a lesser feature of maternal vocalisation for the TD group. These vocalisations are playful in tone and may be associated with repetitive, familiar games (such as peekaboo) and they may also involve tactile interaction such a tickling. While both groups showed a decrease over time, at each time point mothers of SibsA infants spent more time engaging in social play. Given the stimulative nature of this form of speech, it may be the case that mothers of SibsA infants were using it as an aid in gaining infant attention. As negative associations were only found for TD infants, it may be the case that this familiar and stimulative form of interaction may be overly simplistic and repetitive to benefit TD infants.

When the proportion of maternal vocalisations was examined, the production of songs, stories and rhymes was also found to take a different form for each maternal group, with mothers of TD infants displaying a higher usage at each time point. It has been proposed that routines within mother-infant interaction are an important element of language learning (Bruner, 1983). The predictable and familiar content of songs, stories and rhymes allow the infant to make predictions about their mother's actions and associate her vocalisations with objects and behaviours within the interaction (Bruner, 1983). Within the context of story reading, mothers have been found to use a large number of predictable frames, for example asking questions ('Where's the X?') or directing infant attention ('Look at X.') (Ninio & Bruner, 1978). By providing a predictable frame with one element changed (X), word learning may be enhanced (Paavola et al., 2005). The use of such predictable frames has been linked to infant language development, with 51 per cent of maternal utterances to their 12-month-old taking this form (Cameron-Faulkner et al., 2003). Some have suggested that the active role played by the infant within the interaction is central to the use of

songs, stories and rhymes (for example, Bruner & Sherwood, 1975; Stern, 2000; Trevarthen et al., 2001). This active participation points to the importance of the infant's role in co-constructing the interaction, their intersubjective understanding of the exchange allowing them to initiate and respond to maternal behaviours. As SibsA infants are displaying lower levels of social engagement, this may impact upon the mothers' ability to engage them with songs, stories and rhymes, as such activities require a high degree of sustained, shared attention on the part of the infant.

The large number of SibsA infant outcomes positively associated with non-speech vocalisations produced by mothers may suggest that such vocalisations are serving a different functions between dyads. This category of vocalisation includes coughs, sneezes and gasps and may typically be faster and/or louder than other forms of vocalisation. As such, while it may not be the deliberate intention of the mother, these vocalisations may serve to gain infant attention. Alternatively, it may be the case that SibsA infants are discriminating less between the speech and non-speech vocalisations that they hear. While the vocalisations themselves may not offer useful linguistic or social information for the infant, attending to them may be beneficial as engagement is maintained. Whatever the potential explanation, associations were only found for nine-month maternal vocalisations, suggesting that infants may stop attending to them as they age.

In sum, while maternal groups showed similar patterns of vocalisations, mothers of SibsA infants tended to produce more directive language and less facilitative language. This suggests that mothers may be tailoring their language to the developmental needs of their infant, with mothers of SibsA infants focusing on encouraging their infants to engage socially, while mothers of TD infants focused on responding to their infant's attention, as social engagement had already been achieved. These results tentatively suggest that a clear, directive style that contains information about the environment may be of long-term benefit to SibsA infants.

Limitations

As discussed in the Methodology chapter, some of the RAs had difficulty with the coding process while using Observer XT. For this reason, it was necessary for the current author to act as consensus coder on all coding conducted. This was not ideal, as the current author was not blind to the purpose of the study or to each dyad's ASD status. However, a high level of reliability was met, meaning that despite the fact that the RAs were blind coding, they were seeing and labelling the behaviours as they had been defined. While the process was not ideal, it served as proof that coding was accurate. Further, given that RAs who struggled only had difficulty coding in Observer XT, but were capable of accurate coding on paper, it is thought that the point of difficulty was in the use of the software rather than in the placement of the codes themselves.

In order to make coding as easy as possible for RAs, some codes were collapsed to limit the potential for error, for example, RAs were asked to code 'Questions' within the maternal speech codes. It would have been interesting to have had more detailed information about the type of questions being asked, for example, did questions contain descriptions (That's your ball, isn't it?), require a particular, linguistically advanced response (What will we do with the ball?) or did they require a less advanced response (Will I throw the ball?). Such information would have provided data about the complexity of language being produced by mothers.

Chapter Seven: Maternal Syntax Within Interaction

Overview

Maternal utterances produced during each interaction were transcribed and the syntactical data was extracted. Mothers of SibsA infants were found to display less complex and less diverse syntax, with no increase in complexity displayed over time, unlike the trajectory displayed by mothers of TD infants. It is suggested that this unique pattern in syntax may have occurred as mothers favoured short, attention-directing utterances in an effort to gain their infant's attention. While SibsA infants are not experiencing the complex syntactical input received by TD infants, it may be the case that mothers of SibsA infants are adapting their language in order to simplify the speech heard by infants, thus providing input best suited to their infant's needs.

Introduction

An investigation of the syntax of maternal language offers insight into the structural content that may serve as a foundation for the development of infant language abilities. The present section will examine the syntax that mothers use when in interaction with their infants, how that syntax may change as infants age and how maternal syntax may influence later infant outcomes.

By their second year of life, children can typically construct two-word sentences, through which they are displaying a basic understanding of syntax. Children generally do not produce complex language structures until well into their third year, but when infant ability to *perceive* grammatical structure is examined, an understanding of syntax is apparent long before production occurs. An awareness of syntax develops early in infancy; for example, infants as young as 11 months are capable of detecting when function words have been replaced by 'nonce' words (Shady, 1996). At 16 months infants display a preference for grammatically appropriate words, favouring sentences in which function words are in their proper place, as opposed to those in which words are removed or scrambled (Shady, 1996). At the same age, infants are also sensitive to verbal inflections (Soderstrom, White, Conwell & Morgan, 2007). Due to infants' early awareness of syntax, it is important to investigate the language input to which infants are exposed in order to examine which elements are shaping the development of infant syntax.

While the function and prosody of IDS draw the infant's attention to the language in their environment and provide cues to the structure of language, maternal syntax is the foundation of infant language development. The present section will focus on the syntactical structure of maternal speech produced by mothers of TD infants. This will be followed by an examination of syntactical structures produced by mothers in atypical dyads.

Characteristic features of syntax in IDS. One of the central features of IDS is its simplicity, with sentences taking a shorter, less complex form as compared to ADS. While speech to adults has a mean length of utterance (MLU) of eight or more morphemes, IDS is typically half this length (Kaye, 1980; Nelson, 1973; Phillips,1973; Stern, Spieker, Barnett & MacKain, 1983). However, there are mixed findings concerning maternal MLU, with one study suggesting that the maternal MLU decreases as the infant ages from 4 to 8 months (Sherrod, Friedman, Crawley, Drake & Devieux, 1977), while another study found that maternal MLU increases as infants age from 6 months to toddlerhood (Kaye, 1980). A further study reported an increase in maternal MLU from 6 months; however the study only examined infants at 6 months, and availed of reported results for the later data (Papoušek, Papoušek & Haekel, 1987). A more robust finding may have been produced had the mothers of older infants been examined directly as part of the study, or a longitudinal approach taken. Certainly, it appears that by the time infants have reached 24 months of age and older, maternal MLU has begun to show an increase (Kavanaugh & Jirkovsky, 1982; Phillips, 1973; Snow, 1977).

Despite conflicting findings in relation to maternal MLU, the above studies do agree that mothers' speech to their infants is shorter than speech used when interacting with an adult. This may be the case because mothers are tailoring their language to engage their infant, which leads to short, attention-directing vocalisations that may be more salient for the prelinguistic infant. As a result, infants are exposed to a unique form of vocalisation.

Despite the difference in length, it has been argued that speech directed towards children is not any more simplified than that directed towards an adult (Newport, Gleitman & Gleitman, 1977). In order to shorten vocalisations, mothers make deletions from utterances which, in essence, adds complexity to the task facing the infant, who is required to reconstruct what they have heard in

light of the missing elements. Some research suggests that longer maternal utterances are beneficial to the infant as they offer additional vocabulary and context to support the comprehension of unknown words (Hoff & Naigles, 2002). As such, a number of studies have proposed that it is important for infants to receive a variety of input in relation to MLU, with longer or shorter MLU appearing appropriate within different contexts and in response to differing infant abilities (Barnes et al., 1983; Hoff & Naigles, 2002; Kavanaugh & Jirkovsky, 1982; Snow, 1972). Hoff and Naigles (2002) found that maternal MLU was linked to later infant outcomes, with the suggestion that MLU is positively associated with infant vocabulary and that it accounts for the greatest amount of variance in child vocabulary sizes.

As well as examining the length of maternal utterances, the components of utterances have been investigated. Vocabulary diversity refers to the number of different words used by mothers when interacting with their infant. Different words can be described as those that have a unique word root within the language sample; as such, 'throw' and 'throwing' may be considered as a single word root. A high level of variability has been found amongst mothers in relation to their vocabulary diversity, even amongst mothers of matched socio-economic status (Weizman & Snow, 2001). Studies have linked the diversity of vocabulary to which infants are exposed with later outcomes, for example, a higher level of diversity in utterances was associated with better infant vocabulary growth and usage at 3 years of age (Hart & Risley, 1995) and in a free play setting it is associated with later verbal comprehension and expressive vocabulary (Bornstein et al., 1998; Hoff & Naigles, 2002). In a longitudinal study of families from low income, rural backgrounds, vocabulary diversity to children aged 14 to 36 months was a significant predictor of infant expressive vocabulary, particularly so as infants aged (Pan et al., 2005).

Further studies examining specific elements of IDS have found that the syntactical structure of mothers' speech to their infants also offers important information for infants. Given that mothers use IDS with infants from birth and that the informational content of IDS is not understood at such a young age, it stands to reason that IDS may serve another function alongside the communication of informational content (Soderstrom, 2007). As such, the structural information contained in maternal utterances may be relevant to young infants prior to the functional information. For example, it appears that there are subtle differences in the patterns of syntax-use amongst mothers speaking to their 16- to 22-month-olds, with pronoun-use focused on objects that are present, while this is not the case in ADS (Remick, 1976). These syntactic patterns may have profound effects on the infant's appreciation of the grammatical structure of language, as they provide cues in relation to the construction of language. The high number of subject pronouns may be beneficial for early grammatical development as they serve to highlight verb phrases and simplify maternal input, but as infants age they may need a higher number of noun phrases to gain a full understanding of the syntactical structure of language. The range of grammatical properties found at different infant ages suggests that mothers may be providing the scaffolding for early infant language development (for example, Soderstrom, 2007).

Typically, multiclause utterances are a minor feature of IDS, making up an average of just 10 per cent of maternal utterances (Huttenlocher et al., 2007; Soderstrom, 2008). Despite this, multiclause utterances play an important role in early language acquisition. Infants learn words more easily when they are presented as part of a clause rather than as an individual word (Jucsyzk, Houston & Newsome, 1999). As such, the word may be more easily interpreted when it is embedded, with the information following the target word giving it meaning. Conversely, the role of one-word utterances is controversial, with suggestions that they may aid word segmentation and are linked

to later word acquisition (at least in respect to novel words) (Brent & Siskind, 2001), and also that they limit infant development, with a higher level of maternal one-word utterances associated with lower infant production of syntactically complex utterances (Fernald & Hurtado, 2006). Lew-Williams, Pelucchi and Saffran (2011) presented a more measured interpretation, suggesting that both isolated words and longer maternal utterances act together to scaffold infant word segmentation.

The very nuanced nature of the interaction and the extent to which the behaviour of one individual influences that of their partner is apparent in another element of maternal syntax. Verbs used by mothers to name actions as they are occurring are better learned than those named as they were about to happen (Tomasello & Kruger, 1992). In this way, mothers who are responsively directive (following the infant's current actions rather than redirecting their attentional focus) are more likely to facilitate language development (Akhtar et al., 1991). This finding highlights the great subtlety of the bidirectional relationship, as Tomasello & Todd (1983) had previously found that mothers who use highly directive language have children who learn language more slowly. This emphasises the pivotal role of responsive behaviour within the interaction. It is not simply the behaviours of the mother that are key for infant development; rather, it is how those behaviours are displayed in *response* to infant behaviour.

As has been well established at this stage, mother-infant interaction is bidirectional, as such, the syntax of IDS has been found to change in response to infants' developing communicative abilities. A U-shaped pattern of vocal complexity has been noted within maternal IDS (Philips, 1973). In early infancy, mothers have been found to use more complex vocalisations (for example, Phillips, 1973; Snow, 1977). Indeed, Phillips noted that despite the childish intonation and onomatopoeia, a mother of a young infant 'appeared to be talking to and for herself' (p. 184). However, a shift in

structure occurs, with a more conversation-like tone between mothers and infants becoming established by 7 months (Snow, 1977).

The complexity of IDS is shaped in other ways in response to infants' increasing socio-communicative abilities. Typically, over time mothers show a decrease in contentless utterances, such as vocal play or routines, and an increase in referents to non-present objects (Kavanaugh & Jirkovsky, 1982). They also display a decrease in direct references to the child (Kavanaugh & Jirkovsky, 1982; Snow, 1977). Equally, as infants age, mothers typically display lower levels of exact repetitions of their own utterances (Kavanaugh & Jirkovsky, 1982; Kaye, 1980; Papoušek et al., 1987; Stern et al., 1983). Another feature of IDS is the large number of one-word greetings and phatic utterances such as 'sure' or 'yeah' (Kaye, 1980). One study found that as infants age from 3 to 6 months, such affective utterances are replaced by more information-rich vocalisations (Penman, Cross, Milgrom-Friedman & Meares, 1983). In an examination of the variability of maternal language over time, little difference was found between 8 and 18 months, but at 28 months mothers were displaying a higher level of variability (Phillips, 1973). This was interpreted as an example of the influence that the infant and their response patterns play in shaping maternal output. Such studies underscore the importance of studying IDS at different time points.

Maternal Syntax and Atypical Samples. Given that infants diagnosed with developmental disorders may display limited levels or atypical patterns of social engagement, it may be expected that such unique patterns of behaviour may impact on the initiative and responsive vocalisations of mothers, including their use of syntax.

Down Syndrome. Down Syndrome (DS) is developmental disorder that is commonly studied in relation to infant language development. In studies examining the maternal output addressed to children with DS, it has been found that mothers display a lower level of syntactic complexity as

compared to mothers speaking to age-matched TD infants (Buium et al.,1974; Mahoney, 1988). However, when maternal vocalisations to children with DS are compared to those addressed to developmentally- or linguistically-matched children, more similarities have been found (Rondal, 1988). Specifically, certain data-providing elements of IDS (MLU and vocabulary diversity) were similar to those addressed to TD children. Equally, the use of nouns and verbal deixis (those referring to an object by name) during object-labelling in spontaneous conversation were found to be similar to those used by mothers of TD infants (Cardoso-Martins & Mervis, 1990). However, some differences have been found in the syntax heard by infants with DS. During free-play sessions mothers of children with DS produce almost half as many utterances as mothers of linguistically-matched TD infants (Iverson et al., 2006). The authors interpreted these findings to suggest that mothers were employing a simplification strategy to ensure that the child was not overloaded with verbal information.

The above findings would suggest that mothers are displaying a lower level of some data-providing language features when addressing children with DS as compared to both chronologically age-matched and developmentally-matched children. However, the opposite effect has also been found, with mothers of 24-months-olds with DS producing a similar amount of utterances as those produced by mothers of both age-matched and linguistically-matched infants (Zampini et al., 2011). Indeed, those mothers of infants with lower communicative abilities were found to talk more, with a gradual reduction to match their infant's increasing abilities. Despite the higher proportion of speech, mothers of infants with DS were found to speak with a lower level of complexity, with a higher proportion of simple terms (such as routines or onomatopoeic words). Further to this, they displayed a lower level of function words and auxiliary verbs as compared to mothers of age-matched infants, which further reduced the complexity of their output. Zampini et al. (2011)

suggest that the language input received by infants with DS is generally less complex than it need be, with maternal perception of the infant's limited communicative abilities influencing the language that they provide. This emphasises the important role that maternal expectations can play in influencing the language to which infants are exposed.

Preterm Infants. Infants that have been born preterm are another group that have been studied in relation to later language acquisition, as they are considered at higher risk of physical and psychological developmental difficulties (for example, Cohen & Beckwith, 1979; Picard, Del Dotto & Breslau, 2000; Siegel, 1982). A number of studies have found delays and deficits in preterm infant communicative and linguistic abilities. For example, within a large sample of preterm infants, delays have been found in both lexical and grammatical skills (Kern & Gayraud, 2007).

Some debate exists in relation to the communicative abilities of preterm infants. Infants aged 1 to 3 months have been found to show a delay in initial vocalising as well as a lower level of vocalisations when they do begin (Brown, Bendersky & Chapman, 1986). Other studies have found similar delays (Bzoch & League, 1971; Crnic, Ragozin, Greenberg, Robinson & Basham, 1983; Hedrick, Prather & Tobin, 1975; Smith et al. , 1996). However, in an examination of babbling in preterm and full-term infants, Menyuk, Liebergott and Schultz (1996) found that 8-, 10- and 12-month-olds showed no difference. Equally, no delays have been found in the production of canonical babbling (Eilers et al., 1993).

Given the role that maternal vocalisation plays in providing scaffolding for emergent language, a number of studies have examined the vocal input received by preterm infants, given the debated early deficits. At 8 weeks of age, preterm infants hear a shorter level of maternal MLU as compared to full-term infants (Reissland, Shepherd & Stephenson, 1999). A further study examined both infant and maternal vocal output, finding that the complexity of infant language is similar to that of

full-term infants, but they produce fewer vocalisations overall. Preterm infants were also found to be less responsive and involved in relation to turn-taking episodes. Mothers of preterm and full-term infants have been found to produce a similar quantity of words and utterances, although mothers of preterm infants display a higher level of responsive, active (but not directive) engagement, which the authors suggested was an appropriate response to the less engaged behaviour displayed by preterm infants (Salerni, Suttora & D'Odorico, 2007).

Two potential outcomes have been suggested in relation to the modifications of IDS during interactions with atypically developing infants: exposure to a more simplified form of input may be beneficial to the child during the earliest stages of language acquisition (Girolametto, Weitzman, Wiigs & Pearce, 1999), or, given the mother's awareness of the presence or possibility of language and/or social deficits, they may modify their speech in a manner that may be *over*-simplified and less than optimal for language development (Fischer, 1987). While some studies of children with language delay have suggested that the linguistic input that they receive is similar to that received by TD age-matched infants (Rescorla & Fechnay, 1996; Salerni, Suttora & D'Odorico, 2007), there have been studies which support an 'idiosyncratic feedback cycle' (Girolametto et al., 2002), which suggest that deficits in infant expressive language result in less optimal maternal responsive behaviour (D'Odorico & Jacob, 2006; Tannock & Girolametto, 1992; Vigil, Hodges & Klee, 2005; Whitehurst et al., 1988). Such studies emphasise the important role that infant responding plays within the interaction as even maternal syntax is influenced by the responsive, socio-communicative behaviour of infants.

Maternal Syntax and Autism. In relation to infants more likely to receive an autism diagnosis, maternal expectations may play an important role within the interaction. Mothers do not know if their infant will eventually receive a diagnosis and this expectation, as well as prior familiarity with

the disorder, may impact upon the manner in which they interact with their infant. However, maternal IDS occurs on a second-by-second responsive basis, with behaviours occurring in response to behaviours displayed by the infant. Within this largely intuitive process, syntax is the most unplanned element of maternal speech. Thus the conscious concerns and strategies to aid development that may be associated with parenting a child with ASD may not influence the syntax produced to the same extent that they may affect other elements of speech.

As has already been established, mothers have been found to adapt their vocalisations when interacting with children who have been given a diagnosis in a manner that promotes and attempts to maintain infant engagement (for example, Meyer, Edelberg & Tager-Flusberg, 2011; Wan et al., 2012; the present study). While such patterns have been found in relation to global patterns of maternal behaviour and mothers' functional use of their vocalisations, an examination of the syntactical structure of maternal language in relation to ASD or children more likely to receive an ASD diagnosis has yet to be conducted.

The Current Study

The current study will examine the syntax produced by mothers using three different approaches: 1) between-group comparisons, 2) within-group comparisons and 3) associations between maternal syntax and later infant outcomes.

Between-group: An examination of the differences in complexity, diversity and quantity of syntax produced by mothers of SibsA and TD infants. While mixed findings have been indicated in relation to the syntax used by mothers of infants in other atypical samples, on the basis of previous findings within this study, it is hypothesised that mothers of SibsA infants will display a less complex and less diverse pattern of syntax as compared to mothers of TD infants. Specifically, given that

attention-directing utterances often take the form of single words (for instance, 'Look!' or calling the infant's name) it is proposed that mothers of SibsA infants will produce a higher number of one-word utterances and a lower MLU, and that their vocabulary will be less diverse than that of mothers of TD infants.

Within-group: Changes in syntax quantity, complexity and diversity from 9 to 18 months. As TD infants age, the quantity (as measured by the number of utterances) and quality (as measured by the utterance length and diversity of the vocabulary produced) of maternal language will increase. However, as mothers of SibsA infants receive limited social feedback from their infants, they will have less opportunity to display high quality, complex grammar as they spend more time attempting to engage their infant.

Outcome Associations: Maternal syntax and associated infant outcomes. Findings are also mixed in relation to how the complexity (as measured by the length of utterance) and quality (as measured by the diversity of the vocabulary produced) of maternal syntax may be associated with later infant linguistic abilities (as measured by the Bayley Scales of Infant Development). As such, it is predicted that maternal syntax will influence infant language development, although the direction of influence is not predicted for either dyadic group.

Methods

The five-minute video footage of mothers and infants in free-play interaction was also analysed for syntactical properties. All audible maternal vocalisations were transcribed by two researchers and coded using the CHAT system , the most common format for transcribing, which was developed for the largest child language data repository: Child Language Data Exchange System (CHILDES, MacWhinney 2000). The transcribed data was then analysed using Computerized Language Analysis (CLAN). This program is designed for the analysis of data transcribed in CHILDES. CLAN allows for the performance of a large number of automatic analyses on transcript data, such as frequency word counts, word searches and MLU counts. As is standard within the literature, the main unit of analysis was taken to be an utterance based on pauses and prosodic features. Transcripts were prepared for all dyads that took part at 9, 12 and 18 months. All Transcripts are available on request.

All songs, rhymes, routines, onomatopoeic sounds and instances of book-reading were excluded from analysis, as they did not offer examples of the mothers' unique output. Where proportions were reported these special word forms were excluded. In order to capture the elements of IDS, a broad set of measures were employed.

Measures of diversity examined the lexical diversity, symbolic richness and the range of linguistic features within IDS to which the infants were exposed.

1. Type/Token ratio (TTR). This is a measure of the variation of maternal speech within the five-minute session. It expresses the relationship between the number of words used and the number of occasions on which they were used.

2. Vocabulary diversity measure (VOCD). This allowed for the study of the range of vocabulary to which the infant was exposed.

Measures of the complexity of IDS to which infants were exposed.

1. Mean Length of utterance (MLU) computed in morphemes
2. One-word utterances. The proportional frequency of one-word utterances.

Measures of the quantity of IDS to which infants were exposed.

1. The amount of time spent vocalising to infant.
2. Number of utterances recorded within the five minute session.

To measure hypothesised associations between the syntactic features of the mothers' speech and infant language abilities, the Bayley Scales of Infant Development (BSID-III) (Bayley, 2006) were used.

Reliability

All of the video files were checked against the transcripts in order to ensure accurate coding. Few discrepancies were recorded and they were resolved through discussion. Intercoder reliability was computed for 25 per cent of the transcripts, with equal numbers chosen to represent group and gender. Cohen's kappas ranged from .81 to .93. Variables extracted automatically using CLAN commands were hand checked for accuracy by two coders.

Results

Key Findings

Few differences were found between the syntax of mothers of SibsA and TD infants. However, differences that were found (lower MLU, a higher number of one-word utterances, less vocabulary diversity and less time spent vocalising) highlight that SibsA infants are receiving a less complex form of maternal speech. Mothers of SibsA infants displayed a decrease in the total number of utterances and one-word utterances expressed as infants aged, while only mothers of TD infants displayed an increase in vocabulary diversity. Only one association was found between maternal grammar and later infant outcomes, with the number of maternal utterances negatively associated with SibsA receptive language.

Between-group Differences

To examine between-group (SibsA vs TD) differences in the complexity and diversity of maternal utterances, Mann-Whitney *U* tests of independent samples were utilised.

Hypothesis One

Mothers of TD infants will produce a more complex and diverse pattern of syntax compared to mothers of SibsA infants. Mothers of TD infants will produce a larger quantity of IDS compared to mothers of SibsA infants.

Complexity and Quantity of Utterances

Table 45. Descriptive statistics for the Complexity and Quantity of Maternal Utterances at 9, 12 and 18 months: Median proportion and average deviation (AD).

Maternal Syntax – Complexity	9 Months		12 Months		18 Months	
	TD	SibsA	TD	SibsA	TD	SibsA
MLU	3.22 (.49)	2.8 (.18)	3.53 (.17)	2.76 (.41)	4.30 (.96)	3.28 (.51)
One Word Utterances	38 (11.88)	51 (5.13)	27 (8.55)	40 (9.30)	23 (6.77)	26 (4.80)
Quantity						
Number of Utterances	81 (20.33)	106.5 (20.25)	94 (14.44)	76 (16.20)	82 (7.22)	71 (10.10)
Duration	163 (26.63)	132 (21.00)	142.5 (28.20)	159 (31.90)	121.5 (23.30)	176 (31.90)

MLU. Mann Whitney tests revealed significant differences at each time point, with mothers of TD infants producing significantly higher MLU at 9 months (U[17] 15, p=0.046, r=.49). At 12 months, two outliers were identified and removed from the TD group. Mothers of TD infants were found to produce significantly higher MLU as compared to mothers of SibsA Infants (U[17] 5, p=0.002, r=.71). At 18 months, mothers of TD infants produced a significantly higher MLU (U[19] 20, p=0.043, r=.47). All tests were one-tailed. See Figure 5.

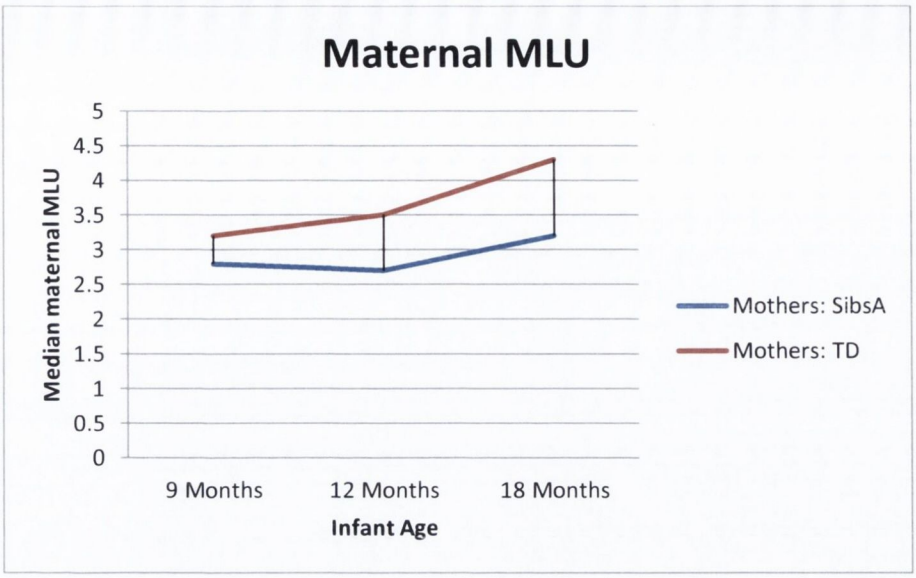

Figure 5. Median maternal MLU produced at 9, 12 and 18 months by mothers of TD and SibsA infants.

One-Word Utterances. Mann Whitney tests revealed significant differences between the maternal use of one-word utterances, with mothers of TD infants displaying significantly less at 9 months (U[17] 10, p=.012, r=.61) and 12 months (U[19] 19, p-0.34, r=.49). No significant differences were found at 18 months (U[19] 31, p=.250). All tests were one-tailed. See Figure 6.

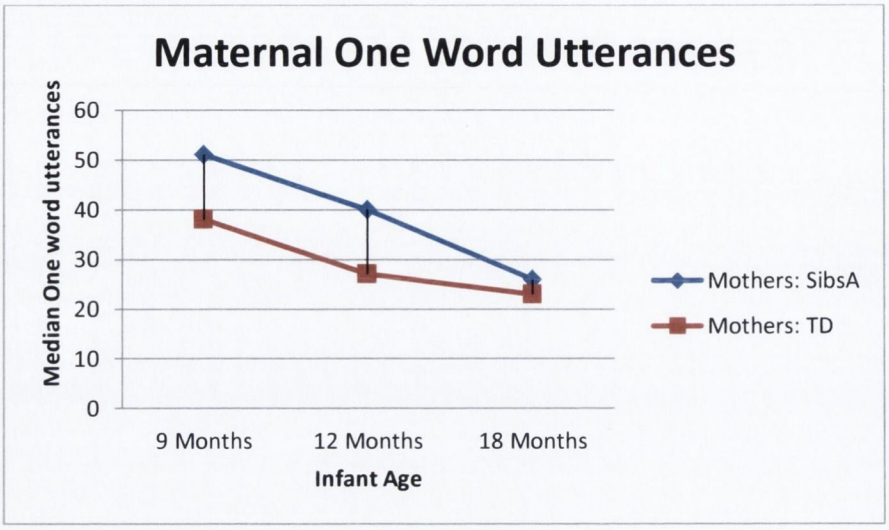

Figure 6. Median proportion of maternal One Word Utterances produced at 9, 12 and 18 months by mothers of TD and SibsA infants.

Number of Utterances. No significant differences were found between the number of utterances produced by mothers of SIBSA or TD infants at 9 months (U[17] 19.5, p=.112), 12 months (U[19] 25.5, p=.111) or 18 months (U[19] 32, p=.288). Only mothers of SibsA infants displayed a steady decrease in the number of utterances produced. Despite this decrease, they did display a higher number of utterances at both 9 and 12 months. See Figure 7.

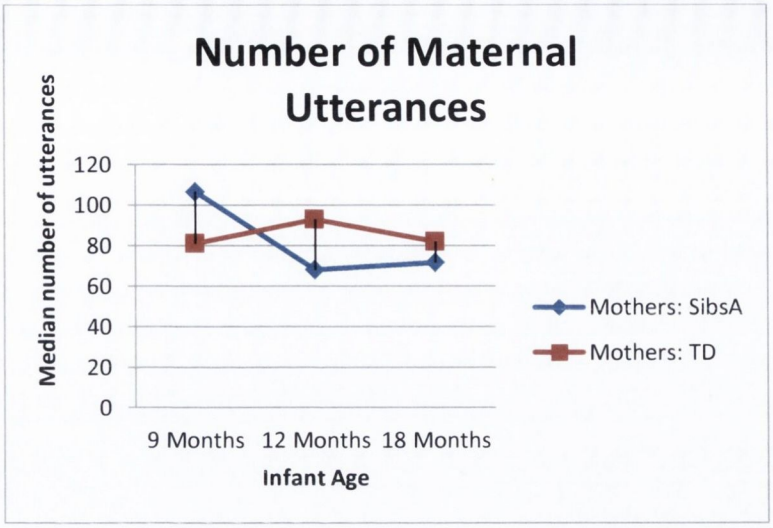

Figure 7. Median number of maternal utterances produced by mothers of TD and SibsA infants at n9, 12 and 18 months

Duration of Maternal Utterances. Independent sample, Mann Whitney tests revealed no significant differences between the amount of time that mothers of SibsA or TD infants spent speaking at 12 months (U[19] 31, p=.278). Significant differences were noted at both 9 months (U[17] 15.5, p=.046, r=.48) and 18 months (U[19] 15, p=.013, r=.56). Tests were one-tailed. Only mothers of SibsA infants displayed a steady decrease in the amount of time spent vocalising. See Figure 8.

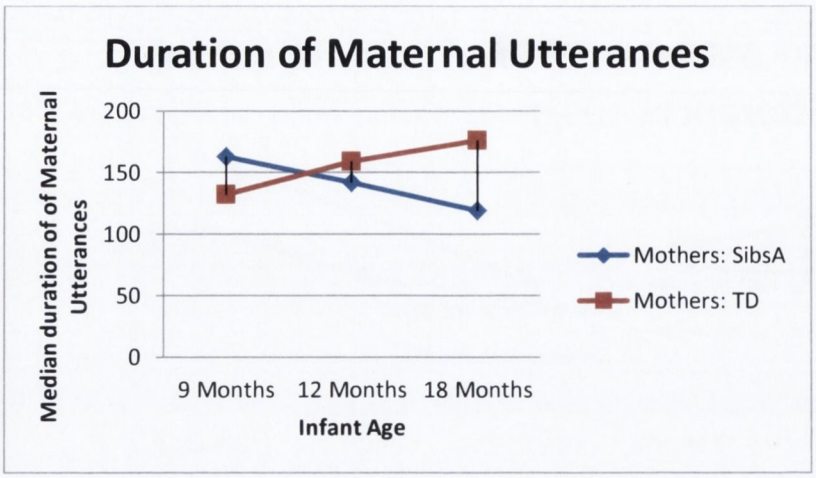

Figure 8. Median duration of maternal vocalisation produced by mothers of TD and SibsA infants at 9, 12 and 18 months

Diversity of Utterances

Table 46. Descriptive statistics for the Diversity of Maternal Utterances at 9, 12 and 18 months: Median proportion and average deviation (AD).

Maternal Syntax - Diversity	9 Months		12 Months		18 Months	
	TD	SibsA	TD	SibsA	TD	SibsA
TTR	.369 (.06)	.382 (.06)	.355 (.05)	.364 (.06)	.371 (.04)	.369 (.04)
VOCD	34.30 (9.30)	32.40 (10.90)	38.50 (5.09)	30.03 (5.06)	57.80 (7.44)	43.55 (8.30)

Type-Token Ratio (TTR). At each time point, maternal groups displayed near-matched levels of TTR. No significant differences were found at 9 months (U[17] 33, p=0.773), 12 months (U[19] 31, p-.253) or 18 months (U[19] 45, p=1).

Vocabulary Diversity (VOCD). No significant differences were found between maternal groups' vocabulary diversity at 9 months; however significant differences were found at both 12 months (U[19] 11, p=.006, r=.64) and 18 months (U[19], 10, p=.004, r=.66), with mothers of TD infants displaying a more diverse vocabulary at each time point. See Figure 9.

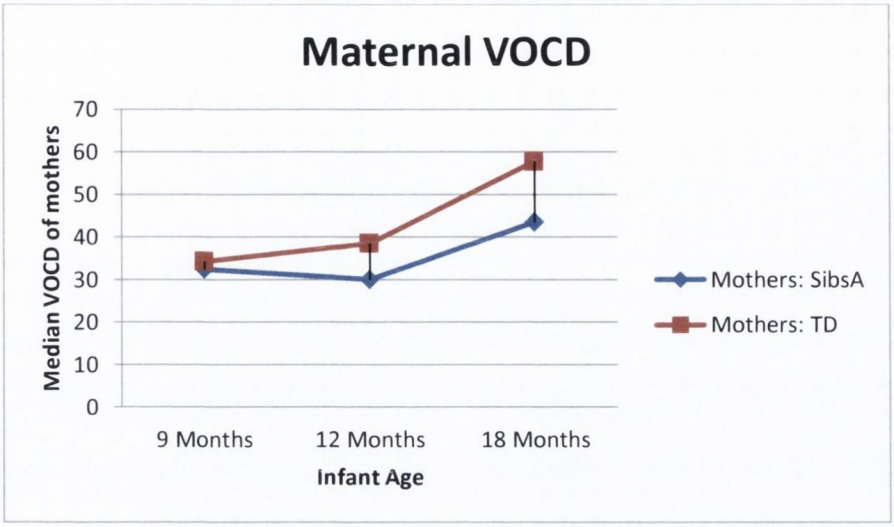

Figure 9. Median maternal VOCD produced by mothers of TD and SibsA infants at 9, 12 and 18 months

Within-group differences

To examine within-group changes from 9 to 18 months in the Complexity, Quantity and Diversity of utterances produced by mothers of SibsA and TD infants, Friedman tests were utilised. Post-hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied with a new significance level set at $p<0.017$.

Hypothesis Two

The complexity, quantity and diversity of maternal syntax will increase from 9 to 18 months for mothers of TD infants. No prediction is made for mothers of SibsA infants.

There was a statistically significant change in the **total number of maternal utterances** produced by mothers of SibsA (χ^2 [2] = 9.250, p = .010). A significant decrease in utterance number

occurred between 9 and 12 month sessions (Z=-2.521, p=0,012) and between 9 and 18 months (Z=-2.380, p=0.017).

A Friedman test revealed a statistical difference in the maternal use of **one-word utterances** for mothers of SibsA infants (χ^2 [2] = 13, p = .002). With a Bonferroni correction applied, a significant decrease in the number of one-word utterances was noted between 9 and 18 months (Z=-2.521, p=0.012) and between 12 and 18 month sessions (Z=-2.701, p= 0.007).

Statistically significant changes were found in the **VOCD** of mothers of TD infants (χ^2 [2] = 14, p= 0.001). With a Bonferroni correction applied, a significant increase in maternal VOCD was identified between 9 and 18 months (Z=-2.666, p=0.008) and 12 and 18 month sessions (Z=-2.666, p=0.008).

Maternal Syntax and Later Infant Outcomes

To examine the association between the complexity and diversity of maternal syntax and later infant social, cognitive and linguistic outcomes, Kendall's Tau tests were utilised. Infant outcomes were measured using the Bayley Scales of Infant Development (BSID-III, 2006) and the Early Social Communication Scales (Mundy, 2003).

Hypothesis Three

Maternal syntax will be associated with infant language development, although the direction of influence is not predicted for either dyadic group.

No associations were found between maternal syntax and later TD infant outcomes and only one association was found for SibsA infants. Receptive language was linked to maternal syntax; specifically, the total number of maternal utterances produced at 9 months was negatively correlated with receptive language at 12 months (r[8]=-.617, p=0.040).

Discussion

Syntactical patterns for both maternal groups were largely similar. However, mothers of SibsA infants did produce a pattern of syntax that differed in relation to some elements of the quantity, diversity and complexity of the language that infants heard as compared to that heard by TD infants. Mothers of SibsA infants spent significantly less time speaking to their infants as compared mothers of TD infants at 9 and 18 months. However, in line with Zampini et al.'s (2011) findings in relation to DS, no significant differences were found in relation to the number of utterances produced by either maternal group. This can be explained by an examination of the complexity of maternal utterances. SibsA infants heard less complex maternal vocalisations, with lower MLU and a higher number of one-word utterances reported.

As such, while they used a similar number of utterances, the utterances themselves were shorter and less complex. This may be the case because mothers are attempting to gain and maintain infant attention, so they utilise a higher number of attention-directing vocalisations. Typically, such vocalisations take the form of short bursts such as name calling or direct bids for attention such as 'Look!'. It appears that for SibsA infants their lack of (or perceived lack of) engagement is impacting upon maternal syntax. One-word utterances have been negatively associated with infant word learning in TD infants (Fernald & Hurtado, 2006; Jucsyzk et al., 1999); however Lew-Williams, Pelucchi & Saffran (2011) suggested that they could provide a beneficial effect within infant language acquisition. It may be the case that within the context of the SibsA dyad the short, more attention-focusing elements of the one-word utterance serve to gain infant engagement. It would be useful to examine this relationship in a larger sample.

Similarly, given that a shorter maternal MLU has been linked to poorer infant language abilities (Hoff Naigles, 2002), it may be the case that this trend towards shorter MLU could suggest that

infants are receiving poorer scaffolding for language development. However, as a number of studies have emphasised the variance within maternal MLU and the importance of adapting MLU to infant ability and interaction context (Barnes et al., 1983; Kavanaugh & Jirkovsky, 1982; Snow, 1972), it may be the case that mothers of SibsA infants are using an utterance length that is best suited to their infants' abilities. This may be another form of the simplification strategy highlighted by Iverson et al. (2006), with mothers attempting to ensure that their infants receive the most appropriate form of linguistic information without being overwhelmed by an excess of data-providing language features.

While patterns of syntax between groups differed in relation to some elements of quantity and complexity, there were some similarities in relation to the diversity of the language to which infants were exposed. Both maternal groups displayed near-matched levels of Type-Token-Ratios at each time point, which suggests that groups were displaying a similar pattern of word-use. However, there was a significant difference in the VOCD displayed by the two groups of mothers, with mothers of SibsA infants displaying significantly lower levels at 12 and 18 months. Given that a high diversity of vocabulary has been linked to positive language outcomes amongst TD infants (Bornstein et al., 1998; Hart & Risley, 1995; Hoff & Naigles, 2002; Pan et al., 2005), it may be suggested that a lower level of VOCD would similarly impact upon outcomes for SibsA infants. However, neither measure of diversity (TTR or VOCD) was associated with later infant language abilities within the SibsA group. Once again, it would be interesting to examine this relationship in a larger sample.

No maternal behaviours were linked to infant outcomes for the TD group, while the number of utterances displayed by mothers at 9 months was negatively linked to SibsA infants' later receptive language. As both groups of mothers displayed a similar number of utterances at 9 months, it may

have been expected that any outcomes related to the number of utterances would affect both groups. Mothers of SibsA infants spent more time talking at 9 months as compared to mothers of TD infants. It may be the case that such a high level of maternal activity was simply over-stimulating for SibsA infants, allowing them limited opportunity to process fully the language to which they were being exposed.

Finally, few changes were noted in maternal syntax over time. However, as predicted, mothers of TD infants did display an increase in the diversity of their vocabulary, suggesting that they were increasing the quality of the language to which infants were exposed in line with their infant's developing expressive and receptive language abilities. This is somewhat in line with the findings of Phillips' (1973), which suggested that maternal linguistic diversity increased in response to infant communicative abilities. However, in the present study this development was seen while infants were younger than those in the Phillips study. It is interesting to note that this increase in linguistic diversity was not found in mothers of SibsA infants. It may be the case that they are not receiving the same pattern of increasing infant response that would be associated with typical socio-communicative development, and as such they do not have the same opportunity to display a range of diverse, responsive vocalisations.

Some of the grammatical behaviours of mothers of SibsA infants did change over time, with both the total number of utterances and the number of one-word utterances decreasing. This may be interpreted in two ways: if syntactical input received by SibsA infants is a reflection of maternal attempts to gain and maintain attention, it may be the case that a decrease in utterances, specifically one-word utterances, could occur in response to an increase in infant engagement. Equally, it may be the case that a decrease in these activities occurs as they are not proving successful in holding infant attention. However, if that were the case, it may be expected that an

increase in a different form of maternal syntax would occur as mothers employ a new strategy to interact with their infants, or it may be that the mothers are withdrawing from the interaction.

Limitations

As with all sections in the study, a larger sample would have offered a more generalizable set of results with higher predictive value. Beyond that, it may have been useful to examine syntax in a more fine-grained manner, with an emphasis on the components of language, such as the use of pronouns (Remick, 1976), nouns and auxillary verbs (Naigles et al., 2013), which have been associated with infant language development in dyads containing in infant with ASD. Unfortunately, given the scale of the study it was not possible to examine maternal syntax beyond the analysis presented.

Within the present study, it is suggested that mothers of SibsA infants use their language to direct infant attention in order to encourage and hold engagement. This appears to occur through both the syntax used by mothers and the message that they convey through their vocalisations. The next section will examine the acoustic pattern of maternal utterances in order to further investigate the range of linguistic input received by SibsA infants.

Chapter Eight: The Prosody of Maternal IDS Within Interaction

Overview

This section examines the prosody of the IDS produced by mothers of SibsA and TD infants during interaction at 12 and 18 months. It also examines the prosody of vocalisations produced by SibsA and TD infants. Audio samples of maternal and infant vocalisations were extracted and analysed on a range of pitch characteristics.

Infant groups displayed similar patterns of prosody at both time points. Although not statistically significant, mothers of SibsA infants displayed an increase in maximum pitch, vocal intensity and pitch range, while mothers of TD infants displayed a stable pattern of vocal intensity and a decrease in maximum pitch and pitch range. Mothers of SibsA infants displayed significantly higher maximum pitch, vocal intensity and broader pitch range at 18 months Concurrent associations were found between the prosodic output of TD infants and their mothers at 12 months and at 18 months. No such concurrent matching of maternal and infant prosody was found for SibsA dyads.

It is suggested that in response to increased levels of infant disengagement, mothers of SibsA infants may be producing prosodic output that functions to gain infant attention through an increasingly exaggerated pattern of prosody that is louder and more varied than that heard by TD infants. It is possible that prosodic matching is not occurring for SibsA dyads because mothers are focused on producing speech that gains infants' attention. Equally, it may be possible that this matching is not occurring because SibsA infants are less focused on the interaction and their mothers' behaviour than are TD infants, despite maternal attempts to encourage engagement.

Introduction

Language deficits are commonly noted in individuals with ASD. For those affected by 'classical autism', approximately 50 per cent will never develop a functional language (Bailey, Phillips & Rutter, 1996; Rapin, 1991). Many children with ASD who do develop verbal communication display an atypical pattern of speech that is generally either 'monotonic' or 'sing-song' (Kanner, 1943; McCann and Peppe, 2003; Paul et al., 2005). Preverbal infants later diagnosed with ASD have been found to display a higher proportion of atypical phonation as compared to typically developing infants (Sheinkopf et al., 2000). Older children have been found to display atypical patterns of stress and volume control as well as deficits in pitch-use and vocal quality (Rapin & Dunn, 2003; Shriberg et al., 2001; Tager-Flusberg, 1981).

Atypicalities identified in speech produced by individuals with autism include: a broader pitch range (Hubbard & Trauner, 2007; Sharda et al., 2010), pitch peaks that are misplaced within sentences and a flatter amplitude (Hubbard & Trauner, 2007). It has also been found that the speech of individuals with ASD displays more 'pitch excursions' than that of non-ASD speech, which makes it similar prosodically to IDS (Sharda et al., 2010). When abnormal speech patterns are present, it has been suggested that they pose one of the most significant obstacles for the individual's social integration and vocational acceptance (Paul et al., 2005; VanBourgondien & Woods, 1992).

The prosody heard by infants in the form of IDS plays an important role in language acquisition, and given the deficits/atypicalities in language production that are common in autism, the study of maternal prosody offers useful insight. This section will describe the prosody heard in IDS. It will examine the function of prosody, specifically relating to infant language acquisition. There will be

an examination of the impact that infant responses have on the prosody of maternal IDS, and there will be a review of the perception of the prosodic elements of speech by infants with ASD.

The Prosody of IDS.

The term 'prosody' is related to a variety of phenomena (such as rhythm, stress and intonation), which serve a grammatical and pragmatic function through variations in pitch, intensity and duration (Crittenden, 1997; Wilson & Wharton, 2006). Just as other elements of IDS differ to ADS, so too do the acoustic properties of IDS differ, with caregivers using a slower tempo, higher pitch, more exaggerated pitch contours and wider pitch range (Bernstein-Ratner, 1984; Bernstein-Ratner, 1986; Fernald et al., 1989; Greiser & Kuhl, 1988; Kemler-Nelson et al., 1989; Kuhl et al., 1997; Moslin, 1979; Song, Demuth & Morgan, 2010). Given the exaggerated, sing-song nature of IDS, it makes sense that it has been referred to as musical speech (Fernald et al., 1989; Trainor, Clark, Huntley & Adams, 1997).

While there are some cross-cultural differences in the degree of exaggeration of prosodic features, the same basic acoustic elements have been found in IDS across cultures and languages (Fernald et al., 1989; Greiser & Kuhl, 1988; Papoušek & Hwang, 1991; Papoušek, Papoušek & Symmes, 1991; Werker, Pegg & McLeod, 1994). There are some differences however. In the US, IDS typically features a high pitch, soft phonation and very pronounced intonation. In Spanish IDS only the strong intonation and accentuation are features (Blount, 1972). Hebrew IDS mainly consists of mono- and bi-syllabic words with the most common stress pattern on the final word (Segal et al., 2006) and even tonal Mandarin IDS features an exaggerated pitch range (Liu, Tsao & Kuhl, 2007). Indeed, the small number of cultures that do not display the exaggerated prosody of IDS, such as the Quiché Maya (Pye, 1986), Kaluli of Papua New Guinea (Schieffelin, 1985) and the rural 'Tracton' African-American subculture (Heath, 1983; Lieven, 1994) highlight just how common such

exaggerated prosodic patterns are in mother-infant interactions. Further, fathers, children and adults with no experience of infants have been found to adopt an exaggerated pattern of prosody when speaking to infants (for example, Dunn & Kendrick, 1982; Fernald et al., 1989; Trehub et al., 1993).

Functions of Prosody.

The prosodic content of language, whether produced as part of IDS or ADS, functions at a number of levels to enable the speaker to construct discourse through expressive language. These levels can be defined as 1) Grammatical, 2) Pragmatic and 3) Affective (Kent & Read, 1992; Mereweather & Alpert, 1990; McCann & Peppe, 2003; Panagos & Prelaock, 1997).

1) Grammatical Prosody. Grammatical prosody includes the suprasegmental cues used to highlight the syntactic information within a sentence (Warren, 1996). Pitch contours signal the ends of utterances and they function to establish whether they are, for example, statements (falling pitch) or questions (rising pitch). Stress within an utterance can be used to signal the type of word that is being produced; for example, noun (**con** vict) or verb (con **vict**). The stress and rhythm of speech help the listener to chunk the flow of speech into words and clauses (for example, 'Lemongrass tea' has a different stress pattern and rhythm to 'Lemon, grass, tea...') (for reviews, see Cruttenden, 1997; Cutler, Dahan & van Donselaar, 1997). As such, the grammatical uses of prosody function to transform the basic syntactical structures of an utterance to convey meaning (Gerken, 1996; Gerken & McGregor, 1998).

2) Pragmatic Prosody. Pragmatic prosody functions to provide social information beyond that conveyed through the syntax of an utterance. This form of prosody functions to convey the intentions of the speaker or the hierarchy of information within an utterance (Van Lancker, Canter

& Terbeck, 1981; Winner, 1988). For example, stress can be used to highlight an element of an utterance as the focus of attention. This emphatic or contrastive stress serves to focus the listener's attention on information that may be new, unfamiliar or unexpected within the sentence (Haviland & Clark, 1974; Bates & McWhinney, 1979). Also, on a pragmatic level, prosody offers clues for turn-taking during interaction (Cruttenden, 1997; Cutler, Dahan & van Donselaar, 1997).

It has been suggested that the language deficits identified in individuals with autism can be found in relation to pragmatics, while formal aspects of speech may more likely be spared (Attwood, 2006; Landa, 2000). Supporting this hypothesis is the finding that syntax is generally spared (Ghaziuddin et al., 2000), while the production and understanding of phenomena that rely on pragmatic enrichment are not; for example humour (Lyons & Fitzgerald, 2004; Werth, Perkins & Boucher, 2001) or non-literal language (Frith & Happé, 1994; Happé, 1993; Martin & McDonald, 2004). In this context, the study of prosody has particular relevance because it functions both grammatically and pragmatically, which may be dissociated amongst listeners and speakers on the spectrum.

3) Affective Prosody. Affective prosody serves a more global function by, for example, offering information about the speaker's attitude (Bolinger, 1989; Cruttenden, 1997; Cutler, Dahan & van Donselaar, 1997; House, 2006). Changes in register may occur to highlight changing social situations, such as speaking to peers or authority figures. Equally, a speaker may use prosody to reflect their feeling state (Bollinger, 1989; Hargrove, 1997). For example, if a person says 'I can't believe the dog stole my dinner again', it is through the prosodic content of their statement that they convey either amusement or rage. As such, the pattern of prosody produced by an individual changes depending upon the context in which it is used. Indeed, when adults listen to a phrase

uttered by another adult, they can better judge the context in which it was spoken when it is uttered using IDS as opposed to ADS (Fernald, 1989).

In speech to infants, typical prosodic patterns have been associated with particular speaker intentions, with large bell-shaped (up-down) pitch contours associated with attention-eliciting; rising contours associated with expressions of approval; lower-pitched, falling contours associated with attempts to sooth the infant, and short, low-pitched falling contours linked to prohibiting utterances (Fernald, 1989; Fernald & Mazzie, 1991; Katz et al., 1996, Papoušek et al., 1991). Mothers attempting to gain their infant's attention typically employ a slow pitch tempo and a large pitch range (Fernald, 1989; Papoušek et al., 1991). Given the musicality of IDS, it is also interesting to note that different types of singing are associated with different interaction contexts, with playing and sleep promotion eliciting different songs (Trainor, 1996; Trainor et al., 1997) and different infant responses (Rock, Trainor & Addison, 1999).

It has long been established that the vocal expression of emotion is similar across languages and cultures (Darwin, 1872/1965; Frick, 1985; Murray & Arnott, 1993; Scherer, 1986). The small differences in the cross-cultural expression of IDS have been mapped onto cultural differences in the acceptability of open expressions of emotion (Fernald et al., 1989). This may suggest that the differences in ID and AD prosodic patterns are strongly influenced by the need of the adult to express emotion. As adults understand words, there may be less reliance on the prosodic elements of speech to convey a message. In the absence of word comprehension, a more exaggerated pattern of prosody may function to convey the emotional message to infants.

In an examination of maternal reproduction of IDS and ADS to express four emotional states (surprise, love, comfort and fear), Trainor, Austin and Desjardins (2000) found few differences between IDS and ADS prosodic emotional content. Indeed, only two differences were found, with

IDS containing a higher pitch than ADS samples, and ID 'love' samples expressed at a slower tempo than AD samples. It should be noted that mothers were asked to imagine the scenarios from which the vocal samples were taken, rather than samples taken from naturally occurring interactions where infant or adult was present. Given mothers' difficulty at expressing the full prosodic range of IDS in the absence of an infant (Fernald & Simon, 1984), it may be the case that the above study was not fully capturing the broad prosodic range that would typically be used in maternal expressions of emotion. Nevertheless, Trainor, Austin and Desjardins (2000) suggest that the similarity of ID and AD prosody noted in their study highlights the role of IDS in expressing emotion, as mothers used the same prosodic patterns to express emotion towards each imagined group. They suggest that because the infant auditory system develops ahead of the visual system, the prosodic vocal expression of emotion by mothers in early infancy is essential for infant emotional development.

Language Acquisition.

While prosody functions grammatically, pragmatically and affectively in both IDS and ADS, one function specific to IDS is the role that prosody plays in infant language acquisition, with the prosodic organisation of IDS regularising and emphasising relevant linguistic structures. There are a number of aspects of IDS that may contribute to infant language acquisition, as the prosodic content provides cues to the acoustic, lexical and grammatical structure of language beyond that available in AD speech. It has been suggested that the short, simplified utterances, longer pauses and slow tempo of IDS may aid infants to parse and process the words and sentences that they hear (Fischer & Tokura, 1996; Kemler Nelson, Hirsh-Pasek, Jusczyk & Cassidy, 1989; Kempe, Schaeffer & Thoresen, 2010; Soderstrom, Blossom, Foygel & Morgan, 2008). Mothers also typically place important or new information at the ends of utterances in IDS (Fernald & Mazzie, 1991),

which aids infant word identification, as compared to occasions were words are placed in sentence medial positions (Seidl & Johnsom, 2006). The exaggerated pitch contours that are typically a feature of IDS have been associated with 6-month-olds' ability to discriminate between vowel sounds (Trainor & Desjardins, 2002). Speech to infants typically contains vowel categories that are more distinct than in ADS (Kuhl et al., 1997), with this distinctiveness positively associated with infant speech perception (Liu, Kuhl & Tsao, 2003).

As well as offering information about the structure of language, the prosody of IDS may also support infant language acquisition as it attracts and maintains infant attention. Infants across a range of ages have been found to show a preference for IDS as compared to ADS. Infants favour the sound of their native language from as early as 3 days of age, an effect that has been attributed to their ability to recognize prosodic content (Mehler et al., 1988; Christophe et al., 2001). Indeed, newborns have been found capable of differentiating between the prosodic content of languages (Nazzi, Bertoncini & Mehler, 1998), word-level rhythm through stress patterns (Sansavini, Bertoncini & Giovanelli, 1997) and pitch contours of words resulting from lexical pitch accents (Nazzi, Floccia & Bertoncini, 1998). As infants reach their first birthday, their ability to discriminate non-native contrasts declines as they become specifically attuned to their native language (Werker & Tees, 1984; Kuhl, 2004, Saffran, Werker & Werner, 2006). Young infants have also been found to prefer prosody that conforms to that of their native language. By 2 months of age, they prefer listening to words in coherent prosodic phrases over words pronounced in a list intonation or words presented in incomplete adjacent prosodic phrases. In fact, listening to prosodic phrases has been positively associated with later word memory (Mandel et al., 1994, 1995). At 4.5 months, typically developing infants can tell if the prosodic phrases that they hear are well formed, favouring phrases with artificial pauses that serve to increase the length of silence at prosodic

boundaries rather than to the same phrases with pauses placed in the middle of prosodic phrases (Jusczyk et al., 1995).

This preference for IDS motivates infants to attend to the language directed to them, which may affect language learning. It has been suggested that a central function of the prosody of IDS may be to ready infants for language learning (Kaplan, Bachorowski, Smoski & Hudenko, 2002; Kaplan, Jung, Ryther & Zarlengo-Strouse, 1996). At 4 months, infants can more readily associate visual stimuli (faces) with passages of IDS, as compared to ADS (Kaplan et al., 1996). On foot of this finding, it is argued that IDS as a stimulus increases infant arousal, thus priming them for learning. Adult directed speech is less stimulating, and as such it may not have the same priming effect and infants are less likely to detect, attend to and process the associated stimuli. This preference for IDS appears to also aid infants in inferring the attentions of speakers producing IDS. Fourteen- to 18-month-olds have been found to reproduce the actions of adults they observed when they were marked by prosodic cues (Sakkalou & Gattis, 2012).

Fewer studies have been successful in examining whether prosody plays a direct role in the learning of linguistic information. However, in examinations of infants' ability to detect words within fluent speech, it has been found that 7.5-month-olds can recognise familiarised words after a one day delay when they are embedded in IDS, but not ADS (Singh, Nestor, Parikh & Yull, 2009). A further study examined how IDS prosody affects word segmentation, even when both IDS and ADS possess identical structures, finding that 7-month-olds can track the statistical regularities and segmented words in an artificial language if presented through IDS, but not through ADS (Thiessen, Hill & Saffran, 2005). The ID and AD stimuli contained the same cues as to the structure of language; the difference presented was only within the prosodic content of the stimuli. It was

proposed that the IDS supported learning by encouraging the infants to attend to the speech, and the statistical regularities contained within.

It has also been suggested that prosody in IDS may affect how infants link the sounds of words and their connected meanings. Upon examining the event-related potentials (ERP) of 6- and 13-month-olds listening to lists of familiar and unfamiliar words in IDS and ADS, it has been found that IDS produces larger ERP amplitudes than ADS, suggesting greater neural activity (Zangl & Mills, 2007). Responses to IDS were dependant on language experience, with 6-month-olds showing increased neural activity only in response to familiar words, while 13-month-olds showed increased activity in response to both familiar and unfamiliar words. It is suggested that this change in activity at 13 months is associated with the beginning of infants' ability to associate words with meanings, with the increased neural activity in response to IDS supporting word learning.

IDS prosody has also been linked to infants' ability to learn object labels. At 21 months infants can better learn object labels if they are presented through IDS rather than ADS, despite being presented with otherwise identical sentences (Ma et al., 2011). By 27 months, infants can learn novel labels through ADS alone, which suggests that they become less reliant on the prosodic cues within ADS. It is suggested that the prosody of IDS acts as a perceptual cue to support word learning, with a gradual decrease in the reliance on IDS occurring as infants become more skilled learners and increase their attention to linguistic cues. The exact mechanism through which the prosody of IDS aids infants in new word learning is not known. Given that the target words were clearly visually identified as they accompanied objects, it is unlikely that infants had difficulty locating the target. Infants may have been tasked with the challenge to segment the new words and recognise them within the speech stream. It is suggested that a greater emphasis on target words, exaggerated pauses and slower speech may facilitate object label learning by highlighting

the novel elements. Alternatively, IDS may specifically facilitate the association between word forms and meanings, just as it facilitates associative learning of visual stimuli (for example, Kaplan et al., 1996, discussed above).

Infant response to maternal prosody. Having established the important functions that IDS prosody plays in relation to infant engagement and language acquisition, it is also necessary to establish the role that infant response to the prosody of IDS plays in shaping the prosody to which they are exposed. A clear indication of the importance of infant response comes from a study of hearing-impaired infants. This study examined the same sample of mothers and infants, investigating the prosodic elements of IDS before and after the infants received a Cochlear Implant (Kondaurova & Bergeson, 2011). It was found that in speaking to both hearing-impaired infants and infants with corrected hearing, mothers use exaggerated prosodic elements, suggesting that exaggerated prosody is a natural behaviour regardless of infant's hearing status. However, maternal prosodic output was influenced by infant response, with changes in pitch and vowel duration linked to hearing status.

Investigating prosody-use in other atypical samples offers insight into the manner in which a partner's socio-communicative responses can influence prosodic patterns. 'Late Talkers' (LT) are identified as toddlers who are slow to develop an expressive vocabulary in the absence of cognitive impairments or neurological disorders (for example, Ellis Weismer et al., 1994; Paul 1991; Paul & Jennings, 1992; Thal et al., 1995). Subsequent language development for LT infants is slowed, with some suggesting that children generally reach a typical range by the age of 3, with the majority caught up by 5 years of age (Paul, 1991, 1996). Other studies have suggested that within LT infants a weakness in the language system persists until adolescence (Ellis Weismer, 2000; Girolametto et

al., 2001; Manhardt, 2002; Paul & Smith, 1993; Rescorla, 1999, 2002; Rescorla et al., 2000; Rescorla & Schwartz, 1990).

While maternal speech to LT infants has been found to be more directive (for example, Lasky & Klopp, 1982), other studies have found few differences in maternal input when compared to mothers of TD infants (for example, Rescorla & Fechnay, 1996). In a broad study of maternal vocalisation to LT infants, D'Odorico and Jacob (2006) found that mothers used flat pitch contours and marked nouns with a pitch peak that was significantly lower than that of mothers of TD infants. These findings were interpreted as evidence that the vocalisation of mothers of LT infants contribute to slowing the development of infant language; however this interpretation does not take into account the active engagement of the infant, who co-creates the interaction and, in turn, influences maternal responses.

While it is interesting to examine maternal prosody in a sample where infant behaviour is atypical, it is equally useful to investigate maternal prosody within a sample of mothers who are behaving in an atypical manner. Given that the mothers in the present study already have one infant who has been give an autism diagnosis, it may be expected that they may be displaying some signs of anxiety that a second infant may be on the spectrum. Such anxiety may impact on the manner in which the mother communicates with her infant. For this reason it makes sense to examine the prosodic behaviour of anxious and depressed mothers when in interaction with their infants, as depression is associated with atypical patterns of IDS.

The IDS of depressed mothers tends to feature a lower level of modulation (pitch range) and a lower mean pitch compared to that of non-depressed mothers (Kaplan et al., 2001). Further to this, it has been found that the acoustic characteristics of the IDS of depressed mothers were found to impact upon infant learning abilities in a face-voice pairing experiment when infants were

interacting with unfamiliar adults (Kaplan et al., 1999) and with their own mothers (Kaplan et al., 2002). In fact, when familiar and unfamiliar infants are exposed to the IDS of depressed mothers they display poorer learning abilities, whereas both groups showed comparatively better learning outcomes following interaction with non-depressed mothers (Kaplan et al., 2002). It was suggested that in providing a lesser quantity and less salient form of IDS as compared to non-depressed mothers, depressed mothers may be offering less environmental stimuli from which their infants may learn.

Prosody Perception in ASD. Given the role of IDS in language acquisition, it is worthwhile to examine how infants on the spectrum may perceive the prosodic elements of the language that they hear, in order to establish whether they may also experience the benefits. Despite differences in pitch production, individuals on the spectrum appear to have no impairments in relation to pitch perception; indeed, they show greater pitch sensitivity and pitch categorisation abilities as compared to typical controls (Bonnel et al., 2003). Further, they show enhanced pitch memory (Heaton, 2003; Heaton, Hermelin & Pring, 1998), superior ability in relation to detecting pitch direction (Heaton, 2005) and detecting contour change (Mottron, Peretz & Ménard, 2000). However, these studies focus on pitch in relation to music rather than specifically examining pitch in vocalisation. Some studies have found that individuals with ASD show deficits in the perception of emotion as conveyed through vocal prosody (Paul, Augustyn, Klin & Volkmar, 2005; Peppé, McCann, Gibbon, O'Hare & Rutherford, 2007); however abilities equal to typically developing infants have also been identified (Boucher, Lewis & Collis, 2000; Brennand, Schepman& Rodway, 2011; Grossman et al., 2010).

In response to apparent deficits in perceiving emotion in prosody, Klin, Jones, Schultz and Volkmar (2005) proposed an *Enactive Mind Theory*, suggesting that many impairments associated

with ASD may occur due to the individual's lacking a predisposition to respond to and seek out social stimuli. As people with ASD develop, this limitation in social engagement impacts on the salience of people and objects, and changes how the individuals interact with their environment. Thus, the subtleties of vocal communication (such as emotional expression) become less salient for the developing child with autism and, as a result, these subtleties become increasingly difficult for them to understand.

Individuals with ASD also show neurological differences relating to their experience of vocal prosody, with atypical Event Related Potentials (ERP) responses to changes in the affective pitch of a word (Korpilahti et al., 2007) and general atypical responses to vocal sounds. In response to both affective and grammatical prosodic cues, people with autism have been found to display more generalised activation in neural regions as compared to people who do not have autism (Eigsti , Schuh, Mencl, Schultz & Paul, 2012). As well as language processing areas that are activated for both groups, people with autism experience activation in brain regions associated with cognitive control, attentional management, visualisation and intention-reading. This has been interpreted to mean that language processing is a less automatic process for those on the spectrum, with a suggestion that possible deficits in theory of mind may be linked to language processing.

Prosody Heard by Infants On The Spectrum. As has been established, the nature of interaction is bidirectional, with the behaviour of one individual influencing that of their partner. Adults working with children with autism decrease speech rate and increase pitch variability, with a greater adaptation seen for those children more severely affected by autism (Bone et al., 2012). Caregivers of infants with autism show a higher level of exaggerated speech, as compared to mothers of both typically developing and language-delayed children (Xu et al., 2012). It is suggested that the exaggerated prosody may function as an attention device devised to elicit a response from

the infant. However, conflicting findings have been produced, with mothers of typically developing infants and infant with autism producing similar patterns of prosody (Sharda et al., 2010).

In an effort to establish how maternal prosodic expression may influence infant social responses, Cohen et al. (2013) examined the responses of infants later diagnosed with autism to the exaggerated prosody of IDS over six months. They found that infants later diagnosed with autism were less responsive and engaged within the interaction, which was associated with a continued exaggeration of maternal prosody, whereas typically developing infants displayed a higher level of responsive behaviour, which was associated with a gradual decrease in exaggerated parental prosody. It is interesting to note that while infants with ASD displayed lower levels of responding, the exaggerated prosody of IDS was linked to responses in general, particularly those that were associated with social orienting. These findings were interpreted to suggest that the prosody of IDS functions as an early, naturally occurring social stimulus that may serve to provide important feedback during interaction. As such, when infants display limited levels of response overall, the exaggerated prosody of IDS may naturally gain infant attention. Cohen et al. (2013) suggest that interventions availing of the exaggerated prosody of IDS may be of benefit in enhancing the social interaction of infants on the spectrum.

The Current Study

The current study will examine the prosody of both mothers and infants at 12 and 18 months during five-minute free-play sessions. It will examine how maternal and infant prosody changes as infants age and whether prosody differs between dyads in which the infant is either typically developing or more likely to receive an autism diagnosis. Finally, the current study will investigate the association between maternal prosodic patterns and later infant outcomes. A number of predictions will be addressed:

Mothers

- In line with previous research (Cohen et al., 2013; Xu et al., 2012) and previous findings within this study, it is predicted that mothers of SibsA infants will produce more vocal prosody associated with attention-directing vocalisation, specifically: higher maximum pitch, lower minimum pitch, a broader pitch range and a higher level of intensity.

- Given that a decrease in social behaviour over time is often associated with ASD, it is expected that mothers of SibsA infants may display an increase in the range of attention-directing vocal prosodic behaviours displayed between 12 and 18 months as compared to mothers of typically developing infants as they attempt to direct their infant to engage.

- In line with previous research, prosodic input that functions to direct infants to engage will be associated with positive infant social abilities at the time that they are produced, but not in the long-term.

Infants

- Given that atypical patterns of vocalisation are associated with autism, infants in the SibsA group will display acoustic patterns that differ from that of typically developing infants.

Methods

The same five-minute videos as previously described were used for the analysis of IDS. Therefore participant information and recording and editing procedures will not be discussed here. As few infant vocalisations were produced and audio footage was of a low quality (for example, audio information distorted by the sound of a washing machine) at 9 months, only the 12 and 18 month data was analysed.

A trained sound designer was recruited to extract maternal and infant audio samples using Soundtrack Pro. Samples were processed to remove overlap of speech between mother and infant. Vegetative vocalisations and environmental noise were removed and gaps between utterances were no greater than 3 milliseconds (msec). Sample length was capped at 20sec to reduce variance between samples and allow for comparison across samples. All maternal vocalisations were 20sec in duration, while infant vocalisations averaged at 15.17sec at 12 months and 18.44sec at 18 months.

Once extracted, samples of maternal and infant vocalisations were analysed for maximum and minimum mean pitch and pitch intensity. Data was analysed using an automated algorithm in Praat software (Boersma & Weenink, 2000), designed for analysing the prosodic elements of vocalisations. Praat allows for the analysis of pitch, duration and intensity of audio samples, through a simple list of options once the audio files have been uploaded. It has a range of detection from 0 to 5,000Hz.

Cognitive and language subscales from the *Bayley Scales of Infant Development—Third Edition* (BSID-III) at 18 months were examined. Non-verbal communication was assessed using the Early Social Communication Scales (ESCS) (Mundy et al., 2003).

Results

Key Findings

No statistically significant between-group differences were noted in the prosody produced by mothers of SibsA and TD infants at 12 months, but at 18 months mothers of SibsA infants produced significantly broader pitch range and higher vocal intensity. No statistically significant within-group changes were noted, but divergent patterns were found, with mothers of SibsA infants increasing the maximum pitch, pitch range and intensity of their vocalisations, while mothers of TD infants decreased their maximum pitch and pitch range, and displayed stable levels of vocal intensity. No between-group differences or within group changes were found in the vocal prosody of the infants.

Between-group Differences

To examine between group (SibsA vs TD) differences in maternal prosodic behaviour, Mann-Whitney *U* tests of independent samples were performed.

Hypothesis One

Mothers of SibsA infants will produce more prosodic behaviours associated with attention-soliciting than mothers of TD infants.

No differences were found between behaviours of either maternal group at 12 months, however, some significant differences were noted at 18 months. Mothers of SibsA infants displayed significantly higher maximum pitch levels (U[17] 7, p=0.005, r=.68), significantly broader pitch range (U[17] 10, p=0.015, r=.59) and significantly higher levels of vocal intensity (U[17] 13, p=0.016, r=.58) (see Table 47).

Table 47. The median prosodic elements of maternal speech at 12 and 18 months, standard deviation, U score, significance and effect size.

Prosodic Behaviours	12 months					18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Min Pitch	82.4 (7.6)	82.5 (18)	29	.558	N/A	88.7 (21)	86.7 (18.2)	35	.657	N/A
Max Pitch	593 (3.6)	597.8 (22.7)	21	.329	N/A	577.6 (43.8)	623.9 (11.9)	7	.004*	.68
Pitch Mean	286.4 (31.2)	300 (16.1)	28	.481	N/A	271.3 (21.5)	298.7 (15.6)	24	.277	N/A
Pitch Range	514.5 (18.3)	507.1 (31.7)	35	1	N/A	476.5 (27.7)	522.9 (15.6)	10	.014*	.59
Intensity	61.8 (2.2)	64.2 (4.7)	35	.657	N/A	60.8 (2.5)	66.3 (2.9)	13	.016*	.58

(* 1-tailed significance)

Within-group differences - Mothers

To examine within-group changes from 12 to 18 months in the prosody produced by mothers of SibsA and TD infants, Friedman tests were performed. Post-hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied with a new significance level set at $p<0.017$.

Hypothesis Two

Mothers of SibsA infants will display an increase in pitch range and intensity between 12 and 18 months as compared to mothers of TD infants.

No statistically significant changes in prosodic behaviour were noted for mothers in either group from 12 to 18 months. However, mothers of SibsA and TD infants did produce different patterns of prosody from 12 to 18 months. Mothers of SibsA infants displayed an increase in Max Pitch, Pitch Range and Intensity from 12 to 18 months, whereas mothers of TD infants displayed a decrease in

Max Pitch and Pitch Range and a relatively stable level of Intensity from 12 to 18 months. Both groups showed a decrease in mean pitch levels (see Figures 10 - 12).

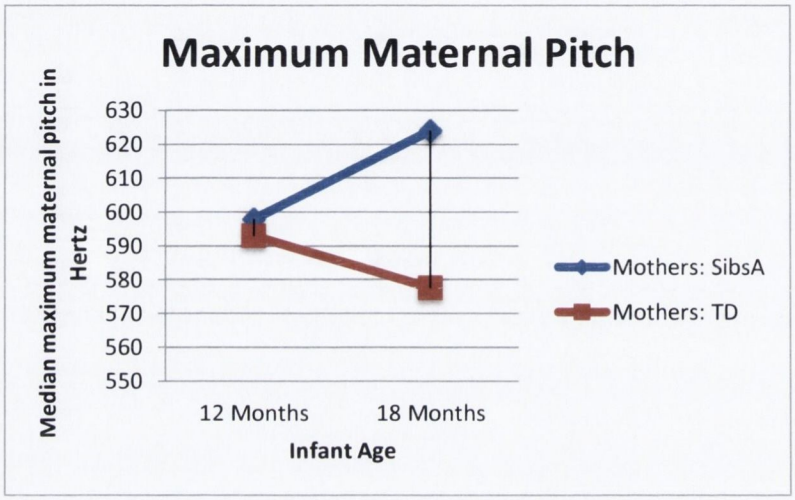

Figure 10. Median maternal maximum pitch in Hertz at 12 and 18 months.

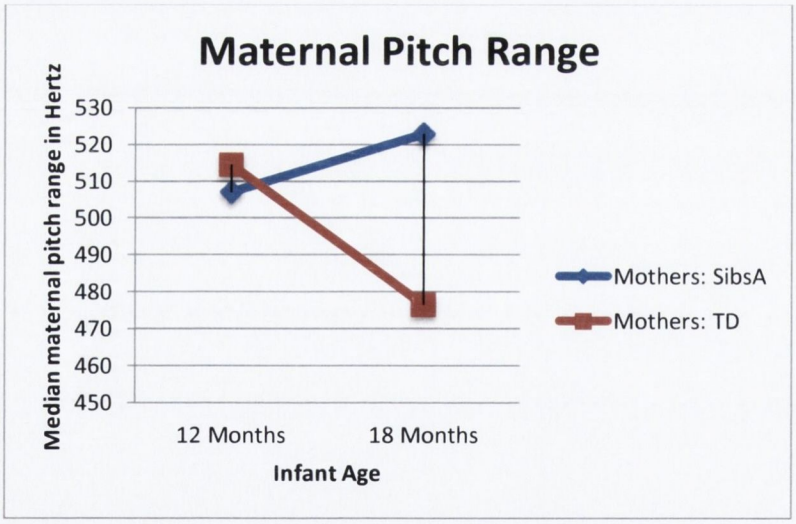

Figure 11. Median maternal pitch range in Hertz at 12 and 18 months.

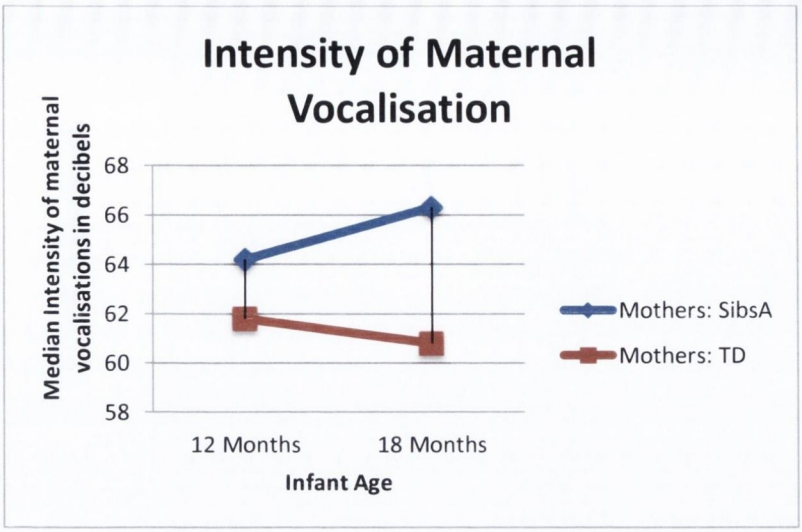

Figure 12. Median intensity of maternal vocalisations in decibels at 12 and 18 months.

Maternal Prosodic Behaviour and Later Infant Outcomes

To examine the association between maternal prosodic behaviour and later infant social, cognitive and linguistic outcomes, Kendall's Tau tests were performed. Infant outcomes were measured using the Bayley Scales of Infant Development (BSID-III, 2006) and the Early Social Communication Scales (Mundy, 2003).

Hypothesis Three

Maternal prosody will be associated with infant linguistic and social abilities.

Kendall's Tau tests revealed very few associations between maternal prosodic behaviour at 12 months and later infant outcomes. Only maternal maximum pitch levels were negatively associated

with initiation of joint attention for TD infants (r[6] = -.867, p=0.015). No associations were found for SibsA infants.

Between-group Differences – Infants

To examine between group (SibsA vs TD) differences in infant prosodic behaviour, Mann-Whitney *U* tests of independent samples were performed.

Hypothesis Four

Infants in the SibsA group will display an acoustic pattern that differs to that of TD infants.

SibsA and TD infants displayed similar patterns of prosody at both time points, with no significant differences in prosody found. SibsA infants were found to produce a broader pitch range and higher pitch intensity, particularly so at 18 months.

Friedman tests revealed no significant changes of acoustic behaviour occurred within groups from 12 to 18 months. See Figure 13.

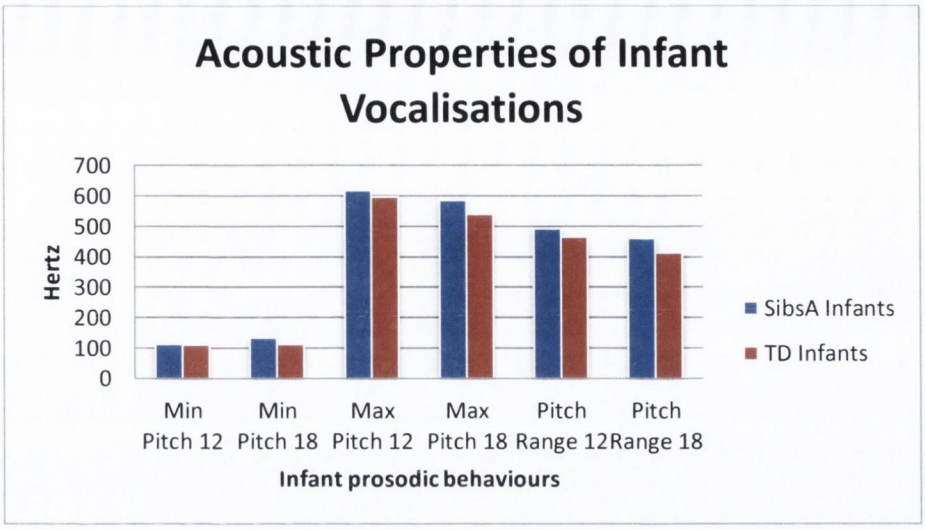

Figure 13. The acoustic properties of SIBSA and TD infant speech in Hertz at 12 and 18 months.

Other Significant Findings

Two-tailed Kendall's Tau tests revealed an association between concurrent maternal and infant prosody for the TD group. TD dyads at 12 months displayed a positive correlation in pitch Intensity ($r[8]=.714$, $p=0.013$). Also within TD dyads, an association was found between the median pitch level of maternal and infant vocalisation at 18 months ($r[8]=.571$, $p=0.048$). No associations were found between concurrent SibsA infant prosody and maternal prosody.

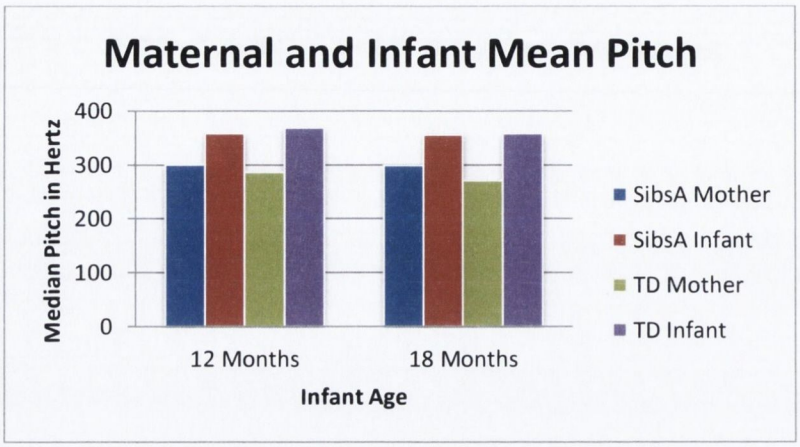

Figure 14. Median maternal and infant pitch in Hertz at 12 and 18 months.

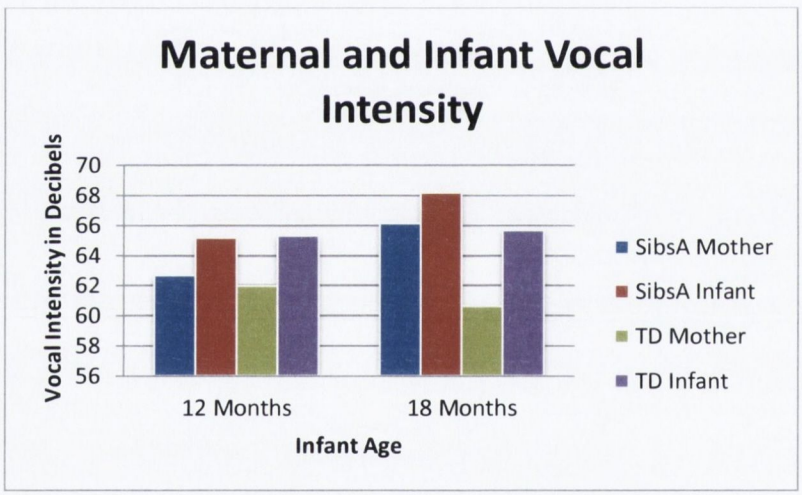

Figure 15. Median intensity of maternal and infant vocalisations in decibels at 12 and 18 months.

Discussion

As predicted, mothers of SibsA infants produced a pattern of prosody that was more exaggerated than that produced by mothers of TD infants, with a higher intensity and broader pitch range. In line with previous research (Cohen et al., 2013), mothers of TD infants decreased the exaggeration of their prosodic output, whereas mothers of SibsA infants increased the exaggeration from 12 to 18 months. In keeping with Cohen et al.'s interpretation of this prosodic exaggeration when interacting with infants on the spectrum, it is suggested that mothers are using their speech to gain and maintain infant attention. It may be the case that because SibsA infants are receiving prosodic input with a broader pitch range and higher intensity, they may be missing out on some of the subtle prosodic elements of maternal speech that serve to highlight the structure of language and thus aids language acquisition. However, a number of studies have highlighted the important role of maternal prosody in gaining the attention of TD infants (Kaplan et al., 1996; Thiessen, Hill & Saffran, 2005; Zangi & Mills, 2007). As such, like mothers of TD infants, mothers of SibsA infants are priming their infants to engage and learn (Kaplan et al., 1996).

In reference to Klin et al.'s (2005) Enactive Mind Theory, if infants with ASD are lacking a predisposition to seek out and engage with social stimuli, producing stimuli that functions to gain their attention and encourage them to focus on the interaction is certainly beneficial. In this way, mothers are creating an environment for their infant in which the people and objects within the interaction become more salient for the infant, thus increasing the likelihood that infants may engage with and profit from their social experiences.

It is interesting that associations were found between concurrent maternal and infant prosodic output for the TD dyads, but not for the SibsA dyads. In an examination of the prosody produced by mothers and their TD infants, Soderstrom (2013) found a matched level of mean pitch, pitch range

and rate of speech. Further evidence of maternal matching of infant prosody has been presented by McRoberts and Best (1997); however they did not find reciprocal infant matching of maternal prosody.

Until now, no studies have examined the potential for reciprocal patterns of prosody within a sample of mothers and their ASD diagnosed or SibsA infants. Within the current study, it may be the case that prosodic matching occurred for only typical dyads because SibsA infants simply are not attending to the details of the social stimuli that they receive, or they are not inclined to share in the social experience of prosodic matching. This would be in keeping with the Enactive Mind Theory. Equally, it may be the case that, as infants are displaying other atypical patterns of social engagement, mothers are choosing to use their vocalisations to gain infant attention; thus they are not matching the pattern of prosody displayed by their infants. Indeed, it is possible that both of these behaviour sets are occurring within the interaction.

The broad pitch range and intensity of the prosody produced by mothers of SibsA infants is interesting when considering research examining depression and the BAP in relation to mothers. Mothers displaying behaviour associated with the BAP have been found to display flatter, less demonstrative speech (Piven et al., 1994). Similarly, mothers who are diagnosed with depression often display limited use of IDS, including the exaggerated pattern of prosody that is typically present (Weinberg & Tronick, 1996). It may be that mothers of SibsA dyads are more similar to a subset of depressed mothers who display a more intrusive style, frequently redirecting their infant's attention and displaying higher levels of hostility (Weinberg & Tronick, 1996).

In relation to infant prosodic output, in contrast to the findings of Sheinkopf et al. (2000) in relation to prelinguistic infants later given a diagnosis, SibsA infants in the present study did not display a pattern of prosody different to that of TD infants. In keeping with the findings of Paul et

al. (2011), limited changes were detected in the vocal output of infants on the spectrum, but these limited changes were also noted for the typically developing group. Indeed, it appears that SibsA prelinguistic infants show a similar pattern of vocalisation overall in comparison to TD infants, with only the complexity of their vocalisations (words and word attempts) differing over time.

Limitations

It would have been preferable to have analysed longer stretches of vocal behaviour for both mothers and infants. To obtain such data for infants would have required much longer filming sessions as they were relatively quiet throughout the process. To analyse maternal vocal prosody beyond the 20 second limit would have been a time consuming process, which was not possible to conduct alongside the very detailed areas of data generation already being conducted within the study. It would also have been useful to ensure complete silence beyond the vocal sounds produced during the filming sessions, as background noise (such as washing machines) made it impossible to use footage at 9 months. While it was not within the focus of the present study, it would be interesting within future research to examine not just mothers' IDS prosody, but also ADS prosody in order to examine how maternal groups are adapting their speech specifically for their infants.

The above study is in keeping with the previous findings presented in this thesis, highlighting the directive nature of maternal behaviour when interacting with SibsA infants. However, each interaction is co-constructed between mother and infant, with the unique temperament, environment, abilities and preferences influencing how the interactive exchange plays out. The next chapter will take an individual approach to the understanding of these interactions, presenting case studies of each of the SibsA dyads, taking into consideration their diagnostic status at 3 years of age.

Chapter Nine: Case Studies of SibsA Dyads

This section will present case studies of the infants who were given an ASD-related diagnosis, and the four infant siblings who were not given an ASD diagnosis by the age of 3. It will present the trajectory of social and linguistic behaviour displayed by mothers and infants at each time point. First, the rationale for conducting such studies will be discussed.

The Heterogeneity of Clinical Autism

Autistic conditions are a spectrum of disorders and/or syndromes, rather than a single clinical condition. As a result of this, the symptoms of the condition can present in a variety of combinations with a range of severity. The condition can present a spectrum of cognitive manifestations from intellectual disabilities and an absence of verbal abilities, to individuals with above average IQs but poor social skills. Symptoms typically shared across ASD diagnoses are deficits in social communication, deficits or atypicalities in language, and repetitive behaviour domains (Geshwind, 2009). The condition commonly presents with symptoms that are independent of the diagnosis, with intellectual disability present in 75 per cent of cases of autism, ADHD in 59-75 per cent of cases, Obsessive Compulsive Disorder in 60 per cent of cases, electroencephalographic abnormalities in 20-50 per cent, seizures in 15-30 per cent and schizophrenia in 5 per cent of cases (Fombonne, 2001). In addition, approximately 15-37 per cent of individuals affected by autism have comorbid conditions such as sensory and/or mobility difficulties, sleep disturbances and gastrointestinal symptoms (Fombonne, 2001).

Infant siblings of children with autism have been found to have a higher rate of certain psychiatric and developmental disorders in comparison to those who have no familial history of autism (Yirmiya & Shaked, 2005; Pickles et al., 2000; Piven, Palmer, Jacobi, Childress & Arndt, 1997;

Smalley, McCracken & Tanguay, 1995; Landa et al., 1992; Landa, Folstein & Isaacs, 1991). Even those siblings who do not receive a diagnosis often display subclinical features of autism such as language delay or social difficulties, with atypicalities detectable as early as 1 year of age (Ozonoff, 2014). As such, even infants who do not receive a diagnosis may display a pattern of behaviour that could atypically shape the interactive experience for both mother and infant. These infants are a group worthy of study in their own right, even if a diagnosis of ASD is not received. This heterogeneity of clinical autism has led to a commonly used expression within the autism community: 'When you've met one person with autism ... you've met one person with autism'.

The present section will examine the very wide variety of behaviours that may be present amongst individuals who have been given a diagnosis. While previous sections have taken a very detailed approach in piecing apart the social and linguistic environment experienced by infants who may be given a diagnosis, this section will focus on the unique pattern of behaviours that may be displayed by infants who have received diagnoses, and how these behaviours may be influencing maternal responses. Through the use of individual case studies, an examination of the distinct patterns of exchange displayed by both mother and infant allows for a detailed study of the bidirectional nature of the interactions. This transactional approach assumes that influence operates between mother and infant, with the unique pattern of behaviours displayed by one member influencing the behaviours of the other in a cyclical exchange of initiation and response.

Six infants were given a diagnosis of ASD or possible ASD by the age of 3 years. All six infants scored below the typically developing average on measures of social, linguistic and cognitive functioning at 12 and 18 months. The following section will detail the trajectory of social, linguistic and cognitive behaviours displayed by infants and mothers. The section will also offer details about

the settings, activities and tone of each interaction. Following the case studies of the infants on the spectrum, the case studies of the four infants who did not receive a diagnosis will be presented.

Diagnosed Infants

Infant 4 and his Mother

Tone of the Interaction. Calm, Playful

Description. This dyad contained one male infant who was 11 months old when joining the study, while the mother was 38 years of age when she first took part. The mother worked at home as a full time mother and the father was present in the home. By 3 years of age, the infant had been given a diagnosis of ASD and ADHD. The mother and infant were not involved in the study when the infant was 9 months of age, so no footage for that time point was available. The 12 to 18 month filming sessions were conducted in the home, and Infant 4 was kept in a high chair throughout. At 12 months, the infant was often disengaged from the interaction, displaying an interest in the objects around him; in particular, the video camera and the family cat. The mother commented on the infant's line of interest, but she also sat quietly, available for interaction but allowing her infant to engage with objects if he wished. At 18 months, the mother was more active in her initiation of interaction, particularly through her use of playful touch (for example playing 'See Saw').

The interaction was conversational in tone, with the mother using proprioceptive counting games to encourage turn-taking. The infant continued to show interest in the objects around him, however he also responded to and later initiated these turn-taking games with his mother. The infant showed low levels of social engagement in the sense that he spent a small amount of time looking at his mother; however throughout the interaction he was clearly listening and responding to his mother's utterances. Both interactions were defined by the relaxed and warm atmosphere created by both mother and infant.

Language. Infant 4 displayed few atypicalities in vocalisation; however he did produce vocalisations with a low minimum pitch and high maximum pitch at 12 months, and a low pitch range at 18 months. He also displayed poor overall language abilities at 18 months.

At 12 months his mother spent a relatively small amount of time talking (see Figure 16). When she did speak her pitch was low. Her responses to her infant's vocalisations were mostly regulatory in function. She uttered a large number of Attention Devices at both 12 and 18 months, and a small number of Questions at 18 months. Also at 18 months, her use of regulatory responses had decreased and she was using a high level of affect- and information-salient vocalisations. She also displayed a low pitch range when she vocalised. She produced a small number of utterances and her MLU was also low. This may have been the case because throughout the interaction she encouraged response from her infant by playing counting games and allowing him the opportunity to take part in counting. As such, an encouragement of engagement and active responding may have taken the place of more complex maternal utterances.

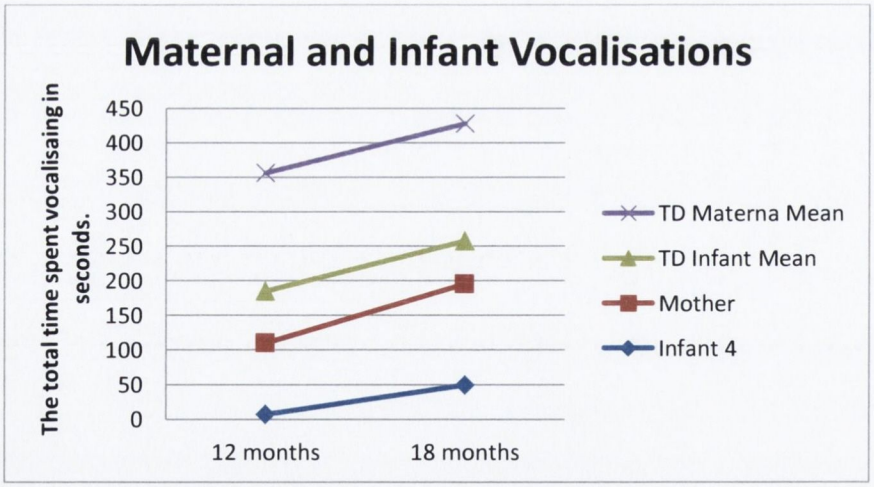

Figure 16. Case Study Infant 4: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. The only social behaviour that may have been an indicator of the infant's ASD status at 12 months was social engagement, with a small amount of time spent engaging with his mother. At 18 months, he did spend a relatively small amount of time actively socially engaged and was less likely to respond to maternal bids for attention; however, he did spend a large amount of time smiling and made a number of initiating bids to physically engage with his mother.

At 12 months, the mother spent a relatively large amount of time disengaged from the interaction, displaying a blank facial expression. However, her lack of immediate engagement with her infant occurred as she followed her infant's line of interest and examined the objects that were holding his attention. So, while she was not always available for eye contact with Infant 4, she was consistently attentive. She displayed a large increase in social engagement when the infant was 18 months. Her facial expression was most often blank. See Figure 17 for the duration of mother and infant social engagement.

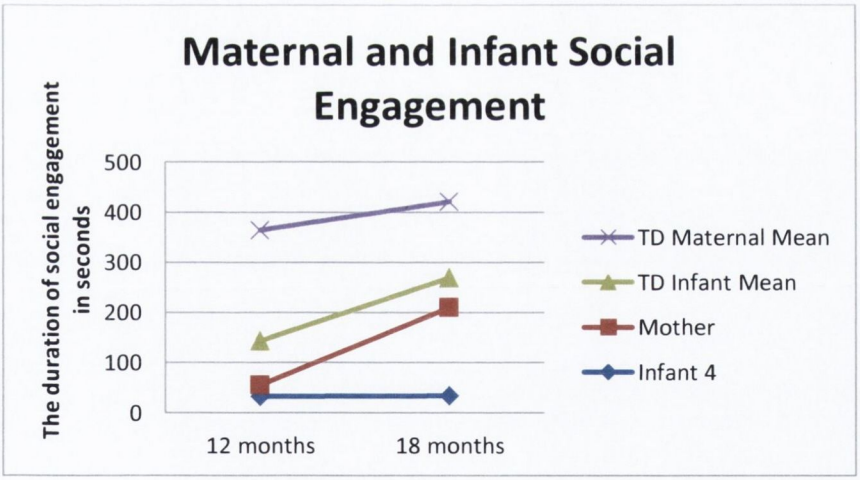

Figure 17. Case Study Infant 4: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. The infant displayed a low level of cognitive abilities at 12 months. By 18 months, while his cognitive abilities were lower than the TD average, the difference was less stark. At both time points, the mother displayed average levels of stimulation of cognitive development towards her infant.

Maternal sensitivity. The mother was very sensitive and non-intrusive in her interaction, particularly so at 18 months. When she did attempt to direct her infant's attention, it was in response to his disengagement at both time points, particularly so during the 12 month session.

Understanding the interaction. Infant 4 displayed deficits in cognitive and linguistic functioning and, by 3 years of age, had received the most severe diagnosis of any of the infants. However, at 18 months he spent much of his time smiling and he was active in initiating games and topics (by, for example, saying the names of his favourite cartoon characters). His mother was the most sensitive of all of the mothers, and together they created an environment that was stimulative in a manner appropriate for the infant's abilities. As such, the mother both allowed the infant space to explore his environment and also followed his line of interest to encourage social interaction. While they may not have co-created a particularly complex stimulative environment for Infant 4, the exchanges were warm and the infant spent much of his time engaging in vocal turn-taking.

Infant 2 and her Mother

Tone of the Interaction. Physical, Imitative

Description. Infant 2 is one of the monozygotic twins. She is female and she was 4 months of age when she began taking part in the study. Her mother was 36 years of age. The mother worked in the home as a full time mother, while her father worked outside the home. By 3 years of age, Infant 2 had been given a diagnosis of possible ASD.

Each filming session was conducted in the infant's home. At 9 and 12 months, Infant 2 was held on her mother's knee during filming, while at 18 months she sat in a high chair. At 9 months, infant 2 was focused on her mother and no toys were used. This offered limited opportunity for the mother to follow the infant's line of attention. When the infant began a clapping game with her mother's hands, the mother continued and encouraged this. At one point the mother called the name of the second twin, Infant 3, in an attempt to gain the attention of Infant 2. At 12 months, the mother used a high level of proprioceptive interaction: clapping hands, singing 'Row, row, row your boat' and playing peekaboo. When the infant shook her head or nodded, the mother responded in imitation. The mother was less talkative, using a high level of touch instead.

At 18 months, the mother continued to use a high level of touch during interaction. Once again, the mother was not talkative. The infant examined the objects around her and the mother followed that line of interest. On one occasion, the infant engaged in finger wagging that may have been stimulative behaviour associated with ASD.

Language. At 9 months Infant 2 displayed low levels of both delight and distress vocalisations. At both 12 and 18 months, she displayed unusual acoustic properties when she vocalised, with a high pitch at both times, but a lower pitch range at 18 months.

When Infant 2 was 9 months old, her mother uttered a large number of Attention Devices, faithful Imitations and Social Play vocalisations. At 12 months she continued to display a large amount of Social Play. At 12 and 18 months, she spoke, on average, less often than mothers of typically developing infants (see Figure 18). The acoustic properties of her speech contained some unusual patterns at both 12 and 18 months, with a lower pitch at 12 months and a higher pitch range at 18 months (a reverse of her daughter's vocal patterns). The mother used a high level of regulatory utterances in response to her infant at 12 months and affect-salient responses at 18 months.

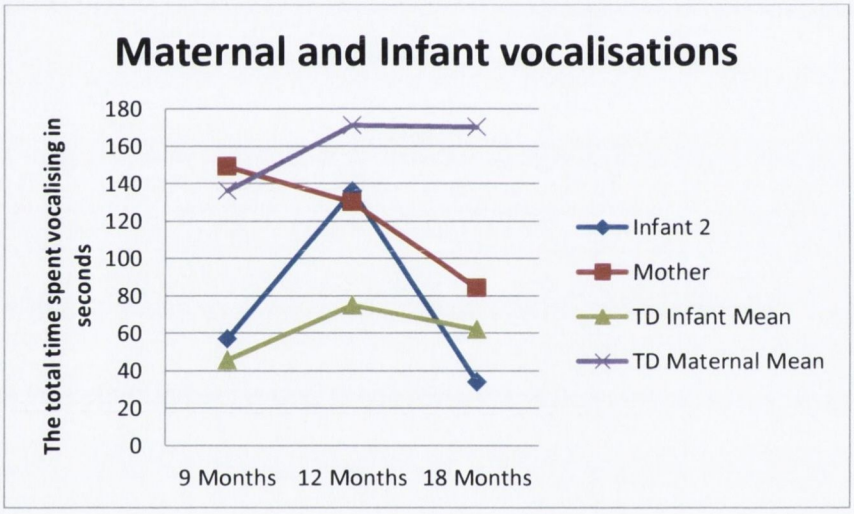

Figure 18. Case Study Infant 2: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. Infant 2 displayed relatively few difficulties in social engagement. At 9 months she was very active, but was very likely to engage when her mother attempted to gain her attention. This was also her response at 12 months. Infant 2 displayed low levels of smiling at 12 months. While she displayed a decrease in social engagement over time, she did display very high levels at 9 and 12 months. By 18 months she spent a large amount of time engaging with objects.

Her mother displayed a high level of engagement at each time point, although, mirroring her infant, there was a decrease from 12 to 18 months (see Figure 19). She also spent a small amount of time smiling at Infant 2.

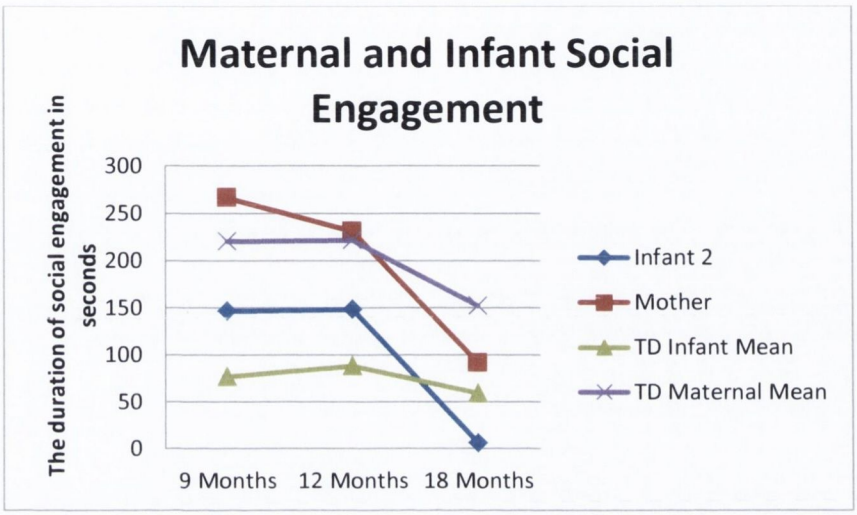

Figure 19. Case Study Infant 2: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. While Infant 2 displayed lower cognitive abilities compared to TD infants at both 12 and 18 months, her scores were not dramatically lower. At 9, 12 and 18 months, her mother displayed a pattern of stimulation of the infant's cognitive development that was almost identical to the TD maternal average.

Maternal sensitivity. In interacting with Infant 2, her mother was sensitive and non-intrusive at each time point. In response to infant distress, she was more likely to disengage at 9 months, but more likely to engage at 18 months, which may suggest that she had developed specific strategies to help the infant regulate her distress. The mother displayed high levels of attention bids when her infant was engaged with an object, which may suggest that she was using the infant's interest in

the objects to engage her. Alternatively, it could be a sign of concerns relating to Infant 2's potential ASD status as an interest in objects is often discussed as an indicator.

Understanding the interaction. Infant 2 displayed few unusual patterns of cognitive and linguistic behaviour; however she did display a decrease in social engagement. Changes in maternal behaviour appeared to be matched to this trajectory, with an increase in attempts to gain infant attention and response to distress. It may be the case that following a decrease in Infant 2's social engagement it was more difficult for the mother to engage her daughter, and as such she showed a decrease in engagement and a low level of smiling. As such, both stimulative and disengaged maternal behaviours may have resulted from the infant's decreasing social engagement.

Infant 3 and her Mother

Tone of the Interaction. Physical, Stimulative

Description. Infant 3 was the second monozygotic twin. As with Infant 2, Infant 3 was 4 months old when she initially took part in the study, while her mother was 36 years. As with Infant 2, she was given a diagnosis of possible ASD by 3 years of age. All filming took place in the infant's home. During filming, infant 3 was held on her mother's knee at 9 and 12 months, while she was placed in a high chair for filming at 18 months.

Infant 3 was very physically active at each time point. At 9 months, she displayed repetitive bouncing and slapping. Her mother responded with imitative bouncing and attempts to engage the infant through movement. At 12 months, once again, the infant engaged in a large amount of repetitive movement. The mother was less physical in her responses, instead commenting on the infant's movements. At 18 months Infant 3 continued to show a high level of interest in movement, and her mother responded with songs and games that encouraged this movement. The infant responded to and initiated these games. It is possible that the high level of repetitive movement displayed by the infant may have been 'stimming' behaviour often associated with autism.

Language. Infant 3 displayed some unusual acoustic properties in her vocalisations at 12 and 18 months, with a higher mean pitch at 12 months and a higher pitch range at 18 months. She displayed a high level of distress at 12 months. This high level of distress may result from the lower level of proprioceptive response displayed by the mother, as she provided fewer regulatory responses through touch than had occurred at 9 months.

The mother spent little time speaking at any time point, and she showed a decrease in the amount of time she spent talking from 9 to 18 months (see Figure 20). Despite this, she did produce

a very high number of utterances when the infant was 9 months, and those utterances were very diverse. She uttered a particularly high number of Social Play vocalisations at 9 months. This trend continued at 12 months, and she also uttered a large amount of Attention Devices, but few Questions. By 18 months the mother was producing speech that contained limited diversity. At 12 and 18 months, Infant 3's vocalisations were most often not responded to by her mother. The acoustic properties of the mother's speech mirrored those of her daughter, with a higher pitch mean at 12 months and a higher pitch range at 18 months.

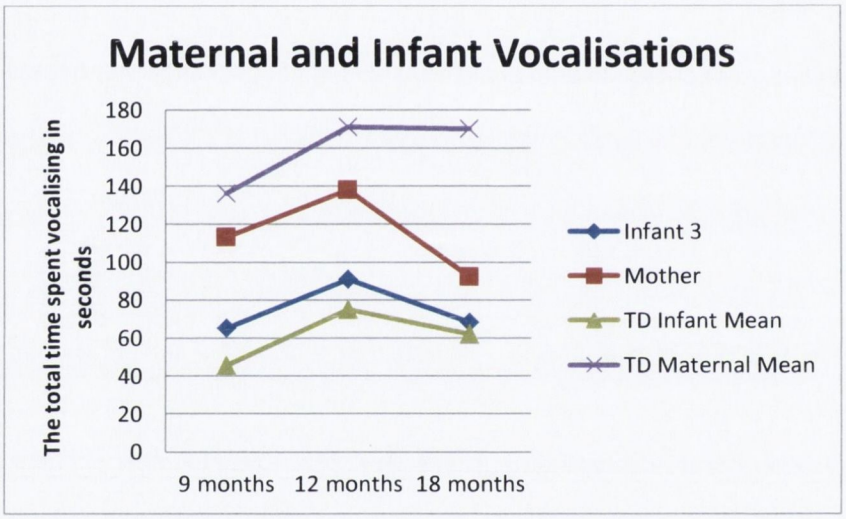

Figure 20. Case Study Infant 3: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. Infant 3 displayed high levels of social engagement at 9 and 12 months, although she did display an overall decrease from 9 to 18 months (see Figure 21). At 18 months she was displaying a very high level of engagement with objects, and little social engagement. At 12 and 18 months, the infant was displaying deficits in both initiative and responsive social engagement. She also spent little time smiling at any time point. At 18 months she was more likely to show no response when her mother attempted to gain her attention vocally. It would have been interesting

to examine whether she might have been more likely to respond to attention bids that incorporated touch.

While Infant 3 spent a small amount of time smiling at 12 months, her mother spent much of the interaction smiling. However, at 18 months the mother was also displaying a very small amount of smiling. The mother displayed an increasingly quiet and blank interactive style at 18 months, with a decrease in social engagement. Despite this decrease, she did spend an unusually large amount of time engaged with her infant at 18 months.

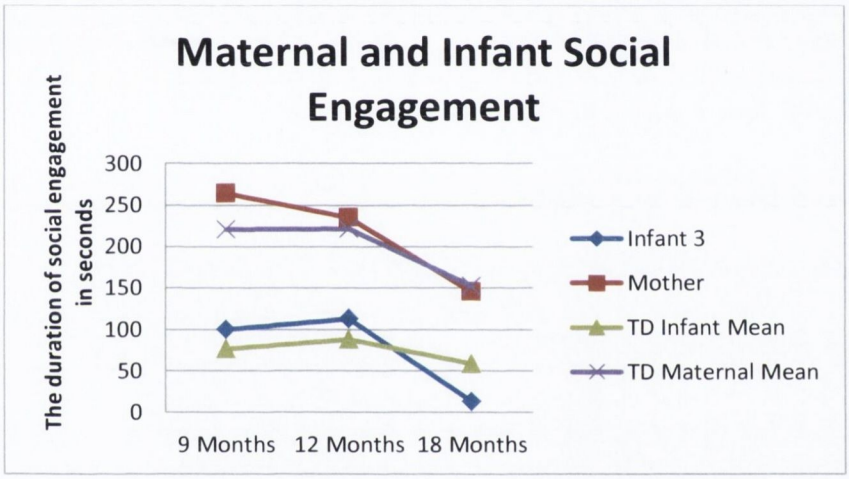

Figure 21. Case Study Infant 3: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. Infant 3 displayed lower cognitive abilities than those displayed by typically developing infants at 12 and 18 months; however the difference in scores was not large. Interestingly, at 9 months the mother displayed a very high level of stimulation of the infant's cognitive development, but this behaviour decreased at 12 and 18 months to a level matching that of mothers of TD infants.

Maternal sensitivity. At each time point, the mother was sensitive; however, she was intrusive within the interaction at 9 months. She was relatively passive within the interactions, disengaging in response to delight at 9 months and in response to distress at 12 months. When she did attempt to gain Infant 3's attention, it was more often in response to the infant's disengagement at 12 and 18 months.

Understanding the interaction. Infant 3 displayed limited linguistic or cognitive atypicalities, but she did display a decrease in social behaviour and an increase in deficits related to social responding. Overall, Infant 3 displayed a high number of atypicalities over time. This broader display of unique behaviours was also mirrored in her mother's responses. She displayed a more varied pattern of behaviour, combining sensitive responding with more intrusive behaviours, mixing disengagement with active attempts to engage her infant. She became less responsive and when she did speak her vocalisations were not complex. While her vocal and facial engagement became more muted, she was consistently engaged and available for exchange with her infant. As with the first twin, this may be a response to decreasing infant social engagement, with stimulative behaviours used in an attempt to gain infant attention but with an overall lack of infant engagement making it difficult for the mother to remain motivated to respond. Interestingly, her adaptation of physical behaviour, from imitative at 9 months to turn-taking proprioceptive games at 18 months, points to the mother's ability to adapt her behaviour to sensitively respond to the infant's interests and shape those behaviours to promote social interaction.

Infant 1 and his Mother

Tone of the Interaction. Physical, Object-focused

Description. Infant 1 is a male infant who had one older male sibling who had been given an ASD diagnosis. His mother was 41 years of age when taking part in the study and she was employed as a paediatric nurse. The father worked outside the home, and was active in the infant's life. The mother mentioned at the very early stages of filming that she sometimes struggled to maintain face-to-face interaction with her infant. This was illustrated in their first filming session when the infant was 6 months of age. While the mother began interacting in the expected face-to-face manner, she then placed her infant in a high chair in front of the television. During the 9, 12 and 18 month filming sessions the mother did engage in face-to-face interaction; however she did briefly turn the infant around so that they were both looking in the same direction at the same toy during the 9 month session.

At each time point, toys and objects were central to the interactions. Whether using cards, a spoon, an activity set or sunglasses, both infant and mother engaged in active play with the objects. The mother utilised repetition at each time point and tended towards very physical play during the 9 and 12 month sessions; for example, banging on the table or covering her son's eyes with his hands to encourage him to play peekaboo. She often used toys to physically interact with her infant, touching his face or tickling him with them. From 9 months of age, the infant displayed physical behaviours that may be associated with ASD, such as tensing, flapping and finger-waving. This behaviour was most apparent at 9 months and only briefly occurred at 18 months.

Language. At 12 months, infant 1 displayed deficits in language abilities relating to both receptive and expressive language. He displayed a very broad pitch range when he vocalised, with a

very high maximum pitch and a very low minimum pitch. At 18 months, he continued to display deficits in both expressive and receptive language, and he displayed the same atypical pattern of acoustic properties when he vocalised.

His mother also displayed some unusual patterns in her language production. When Infant 1 was 9 months, she produced a very high number of utterances and her vocabulary was very diverse. However, by 12 months, she produced a low number of utterances and the vocabulary diversity of her utterances was very low. In a pattern mirroring her infant, she displayed a broad pitch range when she spoke at both 12 and 18 months. At 12 months she uttered a high number of affect-salient vocalisation in response to infant vocalisations, while at 18 months she most often did not respond when her infant vocalised. An examination of the function of her utterances revealed a small amount of Social Play vocalisations at 9 months, but very high levels at both 12 and 18 months. She uttered a large number of Questions and Affirmatives at 9 months, Faithful Imitations at 12 months, and Attention Devices at 18 months. Few descriptions were uttered at 18 months. See Figure 22 for the duration of maternal and infant vocalisations during each session.

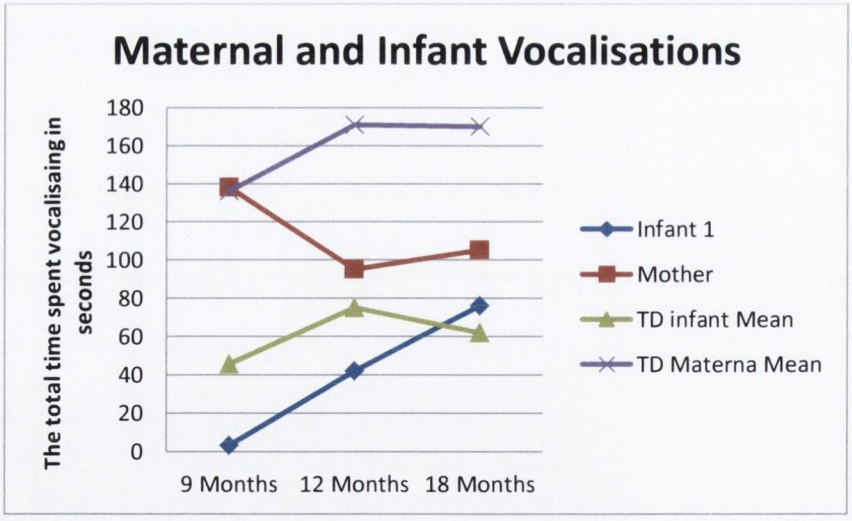

Figure 22. Case Study Infant 1: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social Engagement. At 12 months, Infant 1 was displaying deficits in initiative behaviours when interacting with his mother, while at 18 months he was displaying deficits in both initiative and responsive behaviours. At 12 months, Infant 1 displayed little social engagement, instead focusing on objects in his environment. At 18 months, he showed a low level of object interest and instead spent much of the interaction disengaged. Infant 1 displayed a blank facial expression more often than did TD infants at 18 months, and he displayed low levels of enthusiasm and social interest, but high levels of persistence in relation to object interest. However, at both 12 and 18 months, Infant 1 was very likely to respond to his mother's bids for attention by engaging with her.

Infant 1's mother also displayed some unique patterns of social engagement. At 12 months, she spent a very large amount of her time available for social engagement with her infant. At 18 months, she displayed a high level of disengagement, and she spent a limited amount of time engaging with her infant (see Figure 23). She displayed a higher than TD average level of hostility toward her infant at 12 months, and she spent only a small amount of time talking at both 12 and 18 months. She displayed high levels of Animated Play Face when she interacted with Infant 1 at 12 months, and a high level of blank facial expression at 18 months.

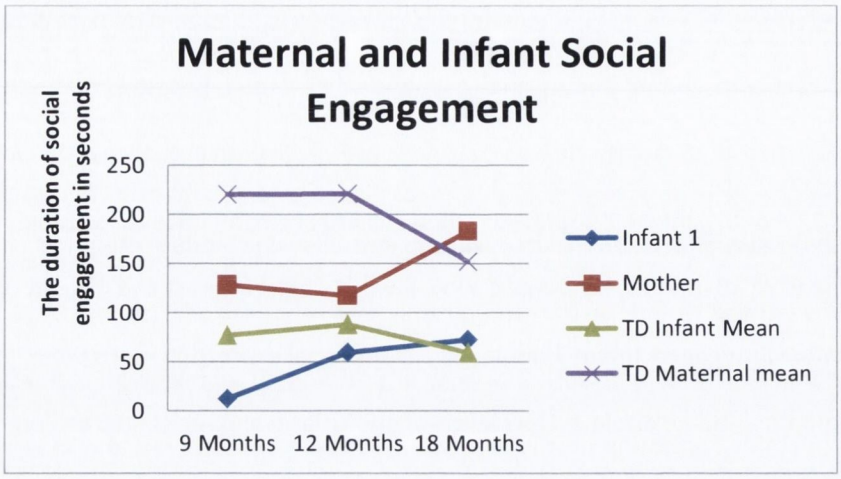

Figure 23. Case Study Infant 1: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. At 12 months the infant displayed below average levels of cognitive abilities, but at 18 months he did not display such a stark difference from the TD average. His mother displayed no unusual patterns in her stimulation of Infant 1's cognitive development at any time point.

Maternal sensitivity. At 9 months, the mother displayed very low levels of sensitivity toward her infant, as measured by the global scale of mother-infant interaction. She was also very likely to attempt to engage her infant when he was already socially engaged. Also at 9 months, she responded to every instance of infant distress by attempting to redirect his attention. When infant 1 was 12 months, she was very likely to respond to her infant's distress, but far less likely to respond to his delight. When she did respond it was only in order to redirect his attention. By 12 months, all attempts to gain Infant 1's attention occurred when he was disengaged from the interaction; this continued when Infant 1 was 18 months. At the same time, the mother displayed a high level of disengagement and unresponsive behaviour during the interaction. She was also very likely to redirect her infant when he displayed delight.

Understanding the interaction. Infant 1 displayed a broad array of deficits and atypicalities in social, cognitive and linguistic behaviour. It seems that in response to these behaviours, his mother established a delicate balance of over- and under-stimulation in order to maintain the interaction and keep her infant engaged. Whether following the infant's line of interest or simply sharing in the co-created culture of the interaction, the mother's focus on toys and objects allowed the infant to engage in his focus of interest while also offering opportunity for shared interaction. This object-focus ranged from the under-stimulating approach of allowing the infant to quietly stack cards, to the more over-stimulating approach of using toys to proprioceptively engage the infant through; for example, tickling.

The mother's choice to respond to the infant's distress but ignore many of his delight vocalisations speaks to her attempts to maintain a calm balance. A distressed child is already over-threshold and as such the mother responds in active attempts to calm him. A delighted child is excited and has the potential to become over-excited very easily. As such, a lack of response to such behaviours may aid in preventing that infant from becoming over-excited and distressed. Further evidence for the mother's attempts to help her infant maintain an emotional balance may be found in her less talkative approach, which allows the infant time to readjust following periods of delight or distress. Equally, the more extreme facial expressions used by the mother may point to her attempts to calm or excite the infant in order to maintain engagement. By 18 months, it appears that while the infant was displaying social and linguistic difficulties, as a dyad they had established a rhythm of exchange that served to follow the infant's focus of interest and attempted to maintain his level of stimulation at a comfortable level. With this established it was possible for a more conversational tone of maternal response to be used.

While Infant 1 did show lower social, linguistic and cognitive abilities than those of TD infants, it does appear that the mother's methods may have had positive effects in that he spent more time engaged in social interaction and was more likely to respond to his mother's bids than TD infants. He also spent a greater amount of his time expressing delight than TD infants. It appears that the mother was taking advantage of the infant's interest in objects (which may be a trait related to his ASD status) in an effort to engage him in the interaction. Equally, it may be the case that she had adopted a less talkative approach as a response to the infant's need for calmer moments within the interaction (which may be related to the hyperstimulation that can affect individuals with autism). In this sense, the infant may be biologically predisposed to engage with certain types of environmental stimuli, with the mother's unique set of interactive behaviours acting as a response to this. As such, while the infant is displaying linguistic and social deficits that are often associated with ASD, mother and infant have co-constructed a pattern of exchange that allows the infant to engage in the interaction on terms that are appropriate for him.

Infant 5 and his mother

Tone of the Interaction. Non-synchronous, Disengaged

Description. Infant 5 and his mother joined the study as part of the typically developing group. There was no known history of autism in their family. Infant 5 was 4 months of age when he joined the study, while his mother was 37 years of age. She worked as a full time mother, while Infant 5's father was a business owner in the food/agriculture sector. At no point did the mother express any concern about her infant's development; however during blind coding, coders noted unusual behaviours such as excessive fussing and a lack of social interest when R was as young as 4 months of age. At 18 months he received a diagnosis of ASD. He was the youngest infant to receive a diagnosis.

Infant 5 was held on his mother's knee during the 9 month session, while he was seated in a high chair at 12 and 18 months. During the 9 month session, infant 5 spent much of his time disengaged from his mother and instead looked out the window or through a nearby door. His mother spoke in a near whisper and much of her utterances were repetitive nonsense words: 'Baba', 'tchoo, tchoo'. At times she spoke in a constant flow of speech, with words and topics often unrelated. At one point she turned the infant around so that he was sitting facing away from her. She was silent in this position. Infant 5 and his mother shared playful moments of proprioceptive touch, although the mother often continued this when the infant had started to fuss.

During the 12 month session, the infant fussed on a number of occasions. The mother did not acknowledge much of her infant's vocalisation, although at one point when Infant 5 grunted in a manner that may be associated with ASD, the mother made an unusual high pitched sound to match him. Much of the time the mother spoke over Infant 5's vocalisations, and much of her

utterances were not related to the context of the interaction; for example, 'Where's Infant 5? Oh he's gone. Goodbye! Goodbye! Where's infant 5? Where's the birds?' while she was tickling him. Infant 5 laughed during the interaction when his mother played touch games such as moving his feet and leaning her face into his.

At 18 months, Infant 5 spent a large amount of his time fussing. On a number of occasions he squealed and grunted, and his mother covered her ears, reprimanding him at one point. She continued to speak over Infant 5's vocalisations, and much of these utterances were repetitive and seemingly without context, for example: 'Bye-bye, shake hands with Mummy. Hello! Hello, hello, goodbye, peekaboo, where's Infant 5's shoes. Hello shoes, hello shoes.' It is possible that by 18 months the mother had begun to suspect that Infant 5 was displaying atypical behaviours, with some concern, perhaps, showing in the utterance: 'Can you see the lorry? Can you see the birds? Can you see anything?'. It is also possible that her frustration with the challenges of communicating with her infant was apparent in her utterance: 'What does Mummy say? No, no, no'. Once again, infant 5 was entertained by his mother's physical play.

Language. At 12 months, the infant displayed unusual acoustic patterns within his vocalisations, with a low pitch range, low minimum and maximum pitches and a low level of intensity. He displayed a high level of distress and he displayed poor expressive and receptive language abilities. At 18 months, Infant 5's vocalisation contained a high minimum and maximum pitch. He also displayed poor receptive language abilities.

At 9 months, Infant 5's mother was very talkative and she produced a high number of utterances, although this levelled off to TD levels at 12 and 18 months. At 12 months, in a pattern matching Infant 5, his mother displayed low levels of acoustic intensity when she spoke. She also displayed a low pitch range and a high minimum pitch. Her vocal responses contained a high level

of interrogatives and regulatory utterances, while she also responded far less often than did mothers of TD infants. She uttered a small number of affect-salient vocalisations at both 12 and 18 months. Also at 18 months, she continued to show a low level of response to Infant 5's vocalisations, and when she did respond she uttered a high number of information-salient vocalisations. She continued to display an unusual acoustic pattern when she vocalised, with a high maximum pitch and pitch range.

An examination of the function of the utterances produced by Infant 5's mother revealed some interesting patterns. She used exceptionally high levels of Social Play at 9 and 12 months, but none at 18 months. She uttered few Descriptions at 9 and 12 months, and high levels of Negations at 12 and 18 months. While she spent a small amount of time speaking at 18 months, a high proportion of her vocalisations were Attention Devices. See Figure 24 for the amount of time mother and infant spent vocalising during interactions.

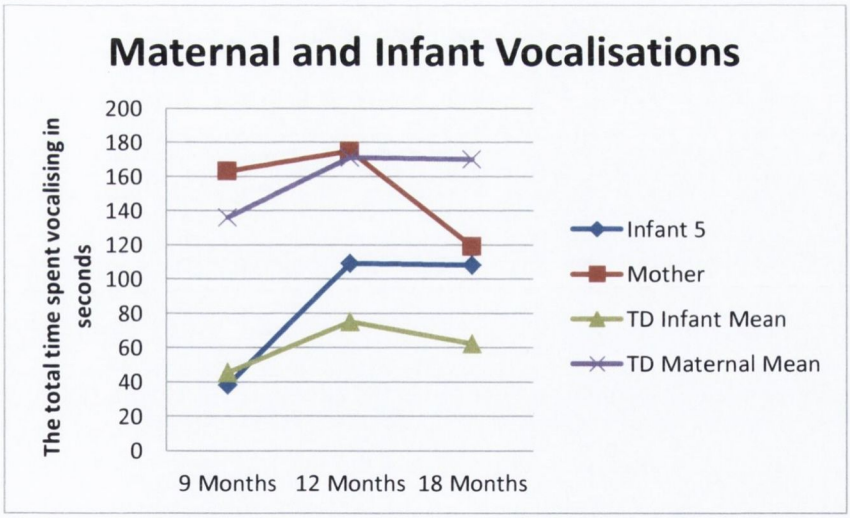

Figure 24. Case Study Infant 5: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social Engagement. At 9 months, Infant 5 displayed few atypicalities in social engagement; however, he was far more likely to disengage or focus on an object if his mother attempted to gain his attention. At 12 months, Infant 5 was displaying clear deficits in both initiative and responsive behaviours, and in comparison to TD infants he spent a large amount of his time frowning. He showed lower levels of positive mood and higher levels of negative mood. Interestingly, at 12 months he also spent a higher than TD average amount of time socially engaged with his mother and he was more likely to respond to his mother's bids for attention by engaging with her than were TD infants. By 18 months, Infant 5 was displaying a more pronounced pattern of atypical social behaviours, and he showed deficits in initiative and responsive engagement, low levels of social engagement, and low levels of both social competence and social interest. He displayed higher levels of negative mood and lower enthusiasm than TD infants. Unusually, coupled with the apparent deficits in social abilities, Infant 5 also spent a higher than average amount of time smiling during the interaction.

Infant 5's mother also displayed some unusual patterns of social engagement (see Figure 25). At 9 months, she was detached from the interaction in the sense that she was less emotionally involved and slow to acknowledge her infant's interests. This continued at 12 months, although she did spend a large amount of time available for engagement as she attempted to make eye contact with her infant. Also at 12 months, she displayed a low level of positive regard for Infant 5 during the interaction. This low level of positive regard continued when the infant was 18 months, and she also displayed a high level of hostility. She did not smile often and she spent a large amount of time engaged with objects.

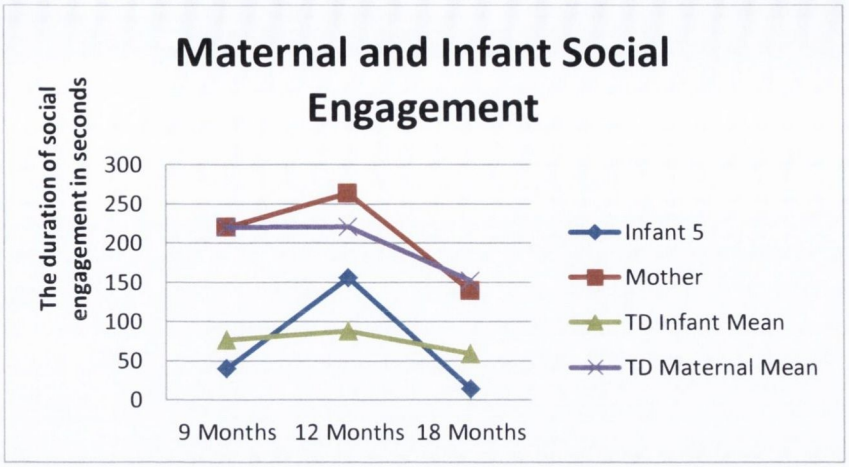

Figure 25. Case Study Infant 5: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. At 18 months, Infant 5 displayed a low level of cognitive abilities. At both 12 and 18 months, R's mother displayed low levels of stimulation of her infant's cognitive abilities.

Maternal sensitivity. Infant 5's mother displayed very high levels of intrusive behaviour at all three time points. At 9 months, Infant 5's mother responded to every instance of infant delight by disengaging with him. She displayed very high levels of engagement at 12 months. Infant 5's mother displayed low levels of sensitivity at both 12 and 18 months. At 18 months, she was far less likely to follow Infant 5's line of interest when he vocalised with delight as compared to mothers of TD infants.

Understanding the interaction. Infant 5 displayed the highest number of atypicalities and deficits of all of the six infants who received a diagnosis. While these differences became particularly apparent at 12 months, at 9 months his mother was responding in a manner that might suggest subtle atypicalities were occurring. Her very talkative approach and her difficulty in establishing synchronous responses may suggest that she was attempting a number of strategies to engage her infant. This pattern increased through 12 and 18 months, with the almost stream-of-

consciousness style of speech adopted by the mother suggesting that she was attempting to find any topic that might gain her infant's attention.

Despite these apparent attempts to focus her infant on engagement, the mother rarely followed her infant's line of attention or responded to his vocalisations. Indeed, the only time that mother and infant really shared a social exchange is when the mother used playful touch; however, she often continued this beyond the point of enjoyment for the infant. It appears to be the case that the infant's broad pattern of atypical behaviours created a difficult responsive environment for the mother, and as such she was required to repeatedly attempt to engage the infant in any manner possible. A lack of experience and/or expectation may also have contributed to the challenges within the interaction, as unlike the other mothers, Infant 5's mother had no prior experience interacting with an infant on the spectrum. It could be the case that the other mothers were better equipped to employ useful tactics to engage their infants due to the fact that they were used to the patterns and rhythms involved in interacting with an infant with ASD. This would highlight the importance of interventions that focus on helping parents to encourage their infants to engage in social interaction.

Infant 6 and his mother

Tone of the Interaction. Calm, Conversational

Description. Infant 6 joined the study when he was 11 months old and his mother was 39 years of age. His mother worked as a full time mother and his father worked outside the home. As they were not part of the study when Infant 6 was 9 months, only two interactions were examined. By 3 years of age, he had been given a diagnosis of Language Delay and possible ASD. The infant was seated in a high chair during the interactions, which were both very warm in tone.

At 12 months the infant was sporadically engaged, as he spent some time examining his surroundings. His mother played many games that were clearly familiar to the infant (peekaboo, tickling games) and sang familiar songs. She sometimes began by asking Infant 6 if he wanted to play a particular game, and continued depending upon his response. When he fussed, she employed a mixture of sympathy and distraction. In the main, the mother stopped each activity when the infant became disengaged, before he began to fuss. At 18 months, the pattern of initiation and response established by Infant 6 and his mother continued. The mother responded to the infant's initiative gestures when he was requesting particular rhymes. The mother repeatedly encouraged Infant 6 to imitate her gestures, which he did. She also encourage vocal turn-taking by asking questions that Infant 6 could respond to, for example, 'Where's Daddy?' and 'Will we do Twinkle Twinkle?'.

Language. Of all of the infants given a diagnosis, Infant 6 displayed the fewest atypicalities in vocalisation. He displayed a higher than TD average level of delight at 12 months and his pitch range was higher at 18 months. At 12 months Infant 6's mother was very talkative (see Figure 26) and she displayed a lower maximum pitch when she vocalised. She used a high level of information-

salient vocalisations and her utterances were limited in their vocabulary diversity. She produced high levels of Social Play at 12 months, and high levels of Commands and Warnings and Negations at 18 months. At 18 months, she was producing a high number of utterances, but the diversity of the vocabulary in those utterances was limited and she asked few Questions.

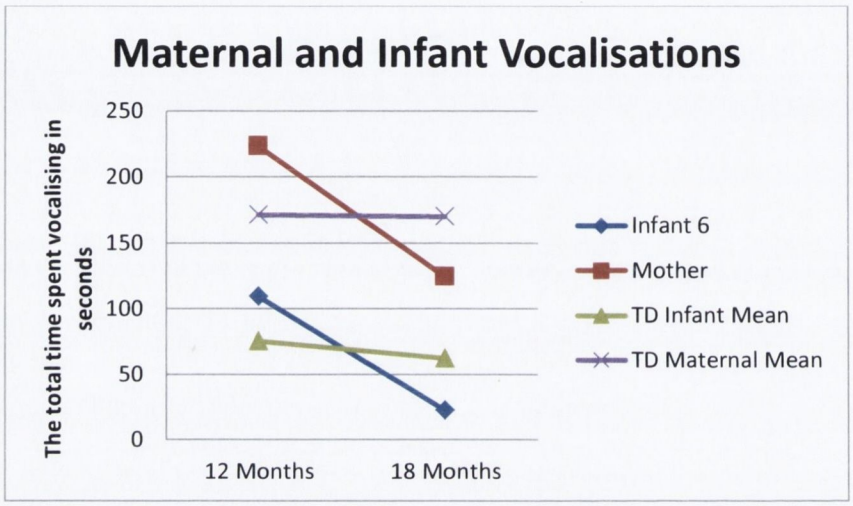

Figure 26. Case Study Infant 6: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social Engagement. Infant 6 also displayed few atypicalities in his social abilities. At 12 months, he spent a higher than TD average amount of time disengaged from the interaction, however at the same time he was more likely to engage and less likely to disengage if his mother attempted to gain his attention. He also spent more of his time smiling when he was 12 months of age. At 18 months, Infant 6 spent an above average amount of his time socially engaged with his mother (see Figure 27). He was more likely to engage with her when she made a bid for attention; but, he was also more likely to respond with distress. He also displayed a high level of negative mood at 18 months.

At 12 months, Infant 6's mother spent a large amount of time smiling at her infant. By 18 months, she was spending a large amount of time socially engaged with her infant; however she

was less in tune and responsive towards her infant. She also displayed lower than average levels of positive regard towards her infant compared to mothers of TD infants.

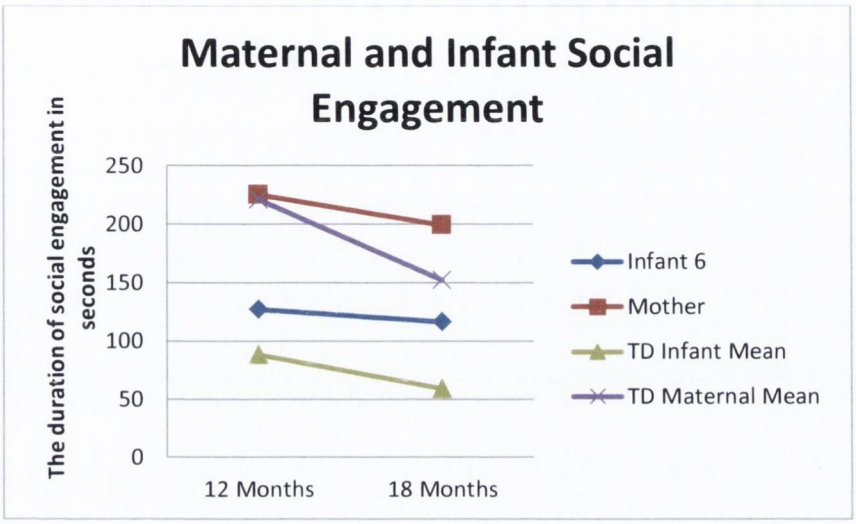

Figure 27. Case Study Infant 6: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. While Infant 6 displayed poorer cognitive abilities than TD infants on average, the difference between their scores was not very large. His mother displayed a pattern of stimulation of cognitive development that was similar to that displayed by mothers of TD infants.

Maternal sensitivity. Infant 6's mother displayed no unusual patterns of sensitive responding at 12 months; however at 18 months she was less sensitive and more intrusive in her responses. Of all of the mothers whose infants were given a diagnosis, she was the only one to respond to infant distress by following the infant's line of interest most often, rather than attempting to redirect his attention.

Understanding the interaction. Infant 6 displayed few atypicalities during the interactions, and his mother displayed a similarly small pattern of atypical behaviours. The infant was less engaged at 12 months; however through the use of repetitive and familiar songs and games the mother

encouraged engagement, and he was very likely to respond to her attempts to gain his attention. This offered a limited vocabulary for the infant, but it did contribute to the high level of smiling from Infant 6. While the mother's behaviour was considered more intrusive at 18 months, there may have been benefits to this as Infant 6 spent a large amount of time socially engaged with his mother and was very likely to engage to her attention bids. While he did fuss at times, he also displayed more vocal and gestural turn-taking than the other six infants who received a diagnosis. In this way, while the mother may have been leading the interaction, it was directed to encourage engagement from the infant. While at times this agenda may have resulted in the mother missing some opportunities to follow her infant's interest, they displayed a warm and playful pattern of initiation and response throughout.

Infant Siblings With No ASD Diagnoses

While it is worthwhile to examine the individual patterns of interaction displayed by mothers and their infants who are on the spectrum, there is also worth in taking this detailed approach to interactions amongst dyads where infant siblings were not given a diagnosis. One male and two female infants were given no diagnoses by the time they were 3 years of age. A third female infant was given no ASD-related diagnosis, but was given a diagnosis of language delay. The following section details the patterns of infant social, linguistic and cognitive behaviour displayed at each time point, and the resultant patterns of maternal response.

Infant 10 and his Mother

Tone of the Interaction. Playful, Synchronous

Description. Infant 10 was 4 months of age when he joined the study, while his mother was 28 years. His mother worked in the home as a full time mother, and his father was employed outside the home. Despite being a part of the SibsA group, Infant 10 had not been given a diagnosis of any kind by 3 years of age. At 9 months, Infant 10 and his mother shared a very light-hearted and playful interaction with both Infant 10 and his mother sitting on the floor. The interaction was less repetitive and less dependent upon familiar rhymes and play than were many of the other dyad's interactions. The mother imitated her son's movements and at times Infant 10 imitated his mother's speech following encouragement. She suggested movements and behaviours, and praised him if he chose to respond by doing them. She praised his spontaneous, deliberate communication (such as clapping).

At 12 months, the playful tone continued; however, Infant 10 was active at times in his attempts to move from his position on the floor. Infant 10's mother imitated his motion, creating a repetitive bouncing game. The interaction was extremely conversational in tone, with the mother asking Infant 10 if he was ready to play games, and asking 'Again?' before she repeated a game. Infant 10's mother also followed his interest, creating opportunities for learning through counting the objects on which he was focused. When Infant 10 displayed any sign of fussing, his mother immediately changed her behaviour.

At 18 months, Infant 10 and his mother increased on the conversational tone of the previous interaction. She used some proprioceptive tickling games, but they were regulated vocally by her infant, with Infant 10 stating where she should tickle. She asked many appropriate questions and

gave Infant 10 the opportunity to respond (for example 'Where's your eyes?' responded to by pointing from Infant 10). Infant 10's mother sometimes imitated his responses to her questions. She regularly checked in with him, assessing whether he wanted to continue playing, for example: 'Ready?', 'Again?'. When Infant 10 showed interest in the writing on his mother's top, she spelled out the writing, using Infant 10's finger to follow the letters.

Language. Infant 10 displayed strong language skills. At 9 months, he displayed low levels of distress, and at 12 months this continued. Also at 12 months he displayed above average language abilities, in particular receptive language. He displayed higher maximum pitch and intensity levels when he vocalised. At 18 months, his strong language abilities continued to be apparent as he displayed above average general language and expressive language abilities. Also at 18 months, he displayed higher levels of both distress and delight.

Infant 10's mother produced an above TD average number of utterances when he was 9 months, and those utterances were highly diverse. At 9 months, she was uttering large numbers of Social Play vocalisations and Imitations that expanded on Infant 10's vocalisations. At 12 months, she continued to produce high levels of Social Play vocalisations alongside high numbers of Attention Devices. At 18 months, she produced high levels of Commands and Warnings. At 18 months, atypicalities in the acoustic pattern of her vocalisations were noted, with a lower minimum pitch and a higher maximum pitch, pitch mean and pitch range. See Figure 28 for the amount of time mothers and infants spent vocalising.

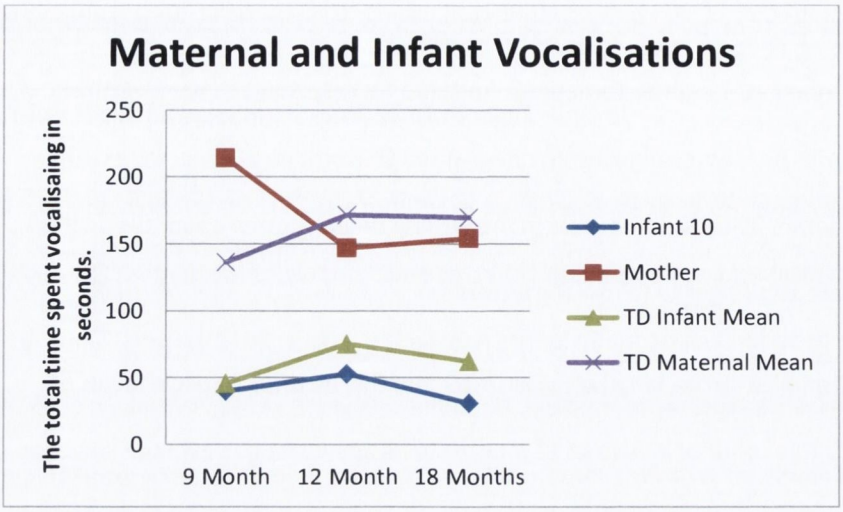

Figure 28. Case Study Infant 10: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. Some more unusual patterns were apparent in Infant 10's social engagement behaviours. At 9 months, he was far more likely to engage with his mother or display distress when she attempted to gain his attention. He was far less likely to show no response. At 12 months Infant 10 spent much of his time smiling and actively engaging with his mother. He was far less likely to disengage or focus on an object. He also displayed high levels of initiative behaviour. However, by 18 months Infant 10 displayed low levels of both initiative and responsive behaviours. He spent less time socially engaged and more time disengaged (see Figure 29). He mostly displayed a blank expression.

At 9 months, Infant 10's mother was very talkative. She spent far less time talking at 12 months, however she did spend much of her time socially engaged and less of her time disengaged, as compared to the TD average. At 18 months, she was displaying lower levels of social engagement and higher levels of disengagement. She also smiled less than the TD average. However, she displayed particularly low levels of detachment and very high levels of positive regard.

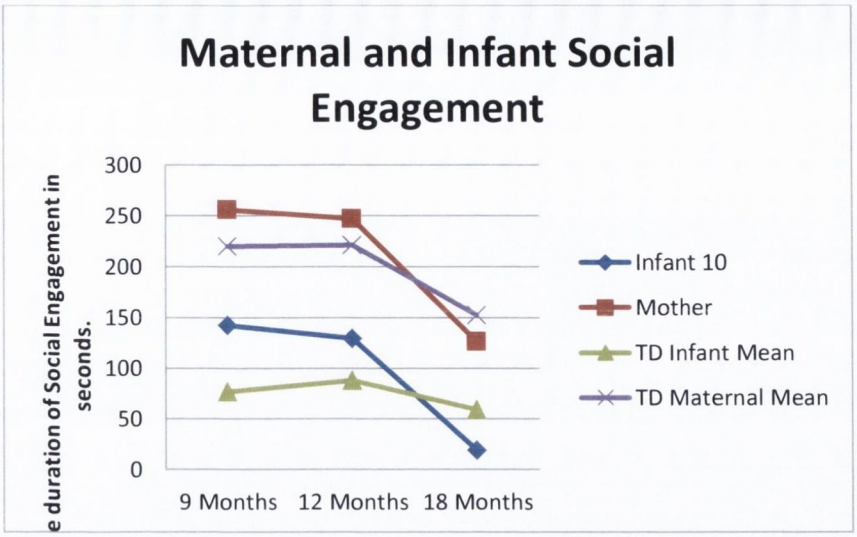

Figure 29. Case Study Infant 10: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. At 12 months, Infant 10 displayed slightly above TD average cognitive abilities. At 9 and 18 months his mother displayed above average levels of stimulation of cognitive development.

Maternal sensitivity. At 9 months, Infant 10's mother responded to her infant's distress by engaging 100 per cent of the time. At 12 months, she was more likely to redirect her infant's attention if he displayed delight. By 18 months, this pattern had changed and she was more likely to follow Infant 10's line of interest when he was delighted. She was also more likely to engage with him when he displayed delight and she was more likely to try to gain Infant 10's attention when he was engaged. She was highly sensitive towards her infant at 18 months.

Understanding the interaction. The interaction of Infant 10 and his mother was playful, varied and typified by an ease in responding and initiating at each time point. Infant 10's strong abilities in both language and cognitive processing may have allowed for an interactive environment where his mother could join him in a very conversational style of engagement. With those strong abilities, it

may have been easier for Infant 10's mother to ask questions with the expectation of responses and to use the environment to teach him, as she was aware that his attention would be held by such an exchange.

However, it could also be the case that this very active, attentive and stimulating style of parenting displayed by Infant 10's mother could be positively contributing to Infant 10's social and linguistic abilities. Indeed, perhaps the most likely interpretation exists somewhere between both suggestions, with higher abilities leading to a more engaged and interested infant, which offers his mother more opportunities to provide a rich and stimulative environment. This enriched environment may then present beneficial effects for Infant 10's developing social and linguistic abilities.

Infant 7 and her Mother

Tone of the Interaction. Relaxed, Repetitive

Description. Infant 7 joined the study when she was 5 months of age, while her mother was 38 years old. Her mother worked full time in the home, while her father was in full time employment outside the home. By 3 years of age Infant 7 had been given a diagnosis of severe Language Delay, but she was not given an ASD diagnosis. At 9 months the infant was very physically active and she vocalised a lot. Her mother rarely acknowledged these vocalisations, with only a briefly imitative response uttered. The mother spent much of her time producing nonsense sounds and blowing raspberries. At times the mother asked the infant about the games they are playing: 'Do it again? Again? Ready?' The mother matched her infant's interest by playing many physical games such as clapping and bouncing. Infant 7 spent much of her time laughing.

The interaction at 12 months was quite similar to that at 9 months. The mother continued to make nonsense sounds. At times her infant's hand was in her mouth as she made the sounds. She asked more questions of her infant, for example, 'What about if I sneeze?' before pretending to sneeze repeatedly. She also tickled her infant while asking questions about where she should tickle ('Will we do [your leg]?'). Infant 7's mother still responded to few of her infant's vocalisations, while her infant spent much of her time laughing.

At 18 months, Infant 7 and her mother were having a more conversational form of interaction. The mother imitated some of her infant's physical and vocal displays. She also followed her infant's line of interest, asking what she was looking at when she was looking out the window. She repeatedly hid a ball up her infant's top, and praised Infant 7 when she found it. Infant 7 enjoyed

the game and initiated repeated hiding of the ball. The infant also imitated her mother's clapping behaviour. The interaction was happy and full of laughter.

Language. Given the Language Delay diagnosis received by Infant 7, it is no surprise that she showed some atypical patterns in the vocalisations that she produced. At 12 months she displayed a higher mean pitch and a lower pitch range, while at 18 months she displayed a higher pitch mean and range. She displayed low levels of distress at 9 and 12 months, but high levels at 18 months. Also at 18 months, she displayed poor expressive and receptive language abilities. At each time point, Infant 7 spent a higher than TD average amount of time expressing delight.

Infant 7's mother also displayed some unusual patterns when she vocalised. She was very talkative at 9 months (see Figure 30). At 9 and 12 months she displayed a high number of utterances, but a low level of diversity within those utterances. She produced high levels of Attention Devices at 9 and 12 months, and high levels of Social Play at each time point. By 18 months, she was producing fewer utterances and the diversity of those utterances continued to be limited. She also produced high levels of Labels during the interaction. In a pattern mirroring her infant, she displayed a high mean pitch at 12 months, and a high pitch mean and range at 18 months. She also displayed a high maximum pitch. At 18 months, she produced a higher than TD average number of affect-salient responses.

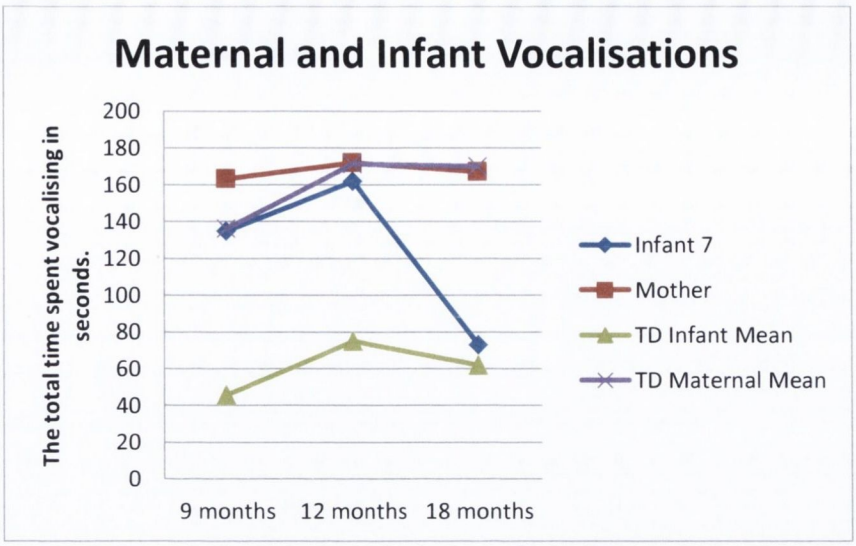

Figure 30. Case Study Infant 7: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. At 9 months, Infant 7 was very likely to engage when her mother attempted to gain her attention. At 12 months, while she spent much of her time smiling, she was also disengaged more than the TD average; she also displayed large deficits in responsive behaviour and some deficits in initiative behaviour. At 18 months, Infant 7 displayed large deficits in both responsive and initiative behaviour; however she spent a below TD average amount of time engaged with an object and displaying a blank facial expression. She was very likely to engage when her mother attempted gain her attention.

Infant 7's mother displayed a decrease in social engagement (see Figure 31), however she did spent much of her time smiling during interaction. At 18 months, she responded contingently, following Infant 7's line of interest. She also displayed a large amount of positive regard towards her infant.

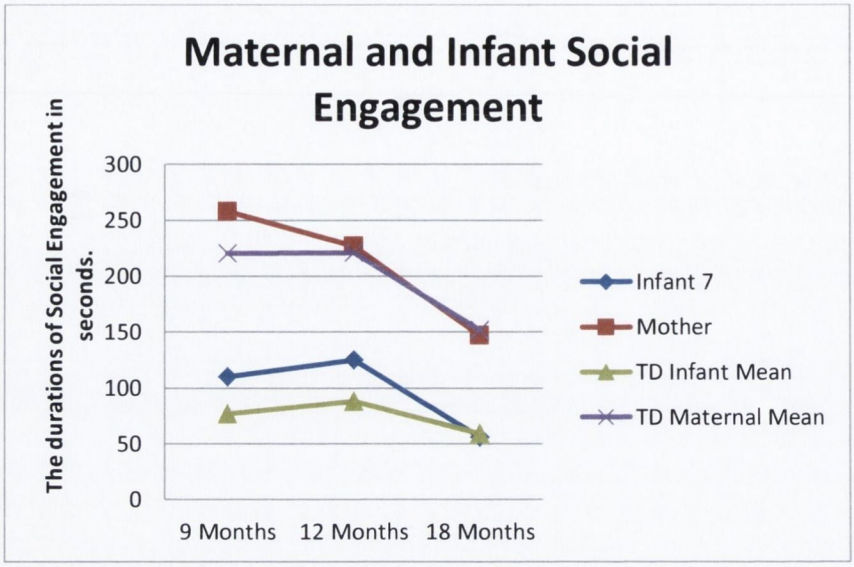

Figure 31. Case Study Infant 7: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. At both 12 and 18 months Re displayed cognitive abilities below that of the TD average. Infant 7's mother displayed a pattern of stimulation of cognitive development similar to that of TD mothers.

Maternal sensitivity. At 9 months, Infant 7's mother was more likely to redirect when her infant showed delight. No atypical behaviours were noted at 12 months, while at 18 months she was less likely to engage when her infant showed distress; however, when she did engage, she more likely to follow her infant's line of interest than redirect. She showed above TD average levels of sensitivity at 18 months.

Understanding the interaction. Infant 7 and her mother also offer a clear example of the bidirectional nature of mother-infant interaction. Infant 7 displayed deficits in both cognitive and linguistic functioning, which meant that the mother had a more limited range of infant behaviours to which she could respond. Her mother displayed little diversity, favouring repetitive attention-

directing noises over more conversational patterns of speech. However, this lack of variety in environmental stimuli may equally impact on the infant's developing language abilities. By 18 months, while the interactive environment was not rich for either infant or mother, they had established a more synchronous pattern, with the mother responding sensitively and the infant guiding some of the interaction. While the interactions were limited in variety and complexity, at each time both mother and infant showed little frustration and appeared to enjoy the exchanges.

Infant 16 and her Mother

Tone of the Interaction. Attention-directing, Infant-led

Description. Infant 16 was 9 months old when she first joined the study, while her mother was 36 years of age. Her mother worked as a full time mother, while her father was employed full time outside the home. By 3 years of age, Infant 16 had been given no diagnoses. Throughout filming, the mother discussed the fact that she felt self-conscious being on camera; however she did not wish to withdraw when asked. She was not available for filming when Ru was 18 months and instead filming took place when Infant 16 had just turned 20 months.

At 9 months, filming occurred at home, with Infant 16 sitting in her high chair. Much of the mother's time was taken with attempts to gain her infant's attention. She banged on the high chair table top, she made clicking sounds, she waved and said 'Hi' and she moved herself so that she was central to Infant 16's line of vision. The infant briefly focused on her mother in response to these bids. When her mother opened and closed her mother, Infant 16 responded in imitation. She also imitated her mother's banging on the table top. The mother also displayed brief imitation of her infant's vocalisations. The infant smiled and laughed in response to tickling and peekaboo games.

At 12 months, Infant 16 was once again sitting in her high chair. Her mother continued to attempt to gain attention, although her attempts we're more conversational in tone, with suggestions that Infant 16 join in the activities (such as tickling and tongue clicking). The mother mirrored her infant's movements, reaching her arms out and moving the table top in imitation of Infant 16's behaviour. She also imitated some of Infant 16's vocalisations. When Infant 16 fussed, her mother responded sympathetically, but did not attempt to redirect her infant's attention. The

mother continued to use loud clapping games, banging and peekaboo to attempt to gain her infant's attention. At one point she moved Ru's face in order to encourage her to make eye contact.

At 20 months, the interaction was much more conversational in tone. The infant was persistent in her wish to watch Mickey Mouse on TV, which she expressed through pointing and vocalising. Her mother responded to each form of communication, often imitating and expanding on the infant's behaviour. When her infant said something that amused her, Infant 16's mother laughed and stroked her infant's face affectionately. Infant 16 instantly repeated the vocalisation. When her infant displayed an interest in something, Infant 16's mother named it clearly, and on occasion Infant 16 repeated what she heard. The mother encouraged her infant on these instances, praising her and clapping. The interaction was driven by the infant's interest and vocalisations, with the mother acknowledging, interpreting and expanding on them. As with the two previous sessions, the mother rarely initiated a new topic or game, preferring to follow her infant's lead. The mother wore a coat throughout the interaction as she commented on the fact that she would have to leave soon after filming was finished. This behaviour was a fitting example of the mother's discomfort within the filming process.

Language. Infant 16 displayed few atypicalities in her vocalisations. At 12 months she displayed more distress and her vocalisations contained a lower minimum pitch. At 20 months she displayed some more atypicalities in the acoustic properties of her vocalisation, with a higher minimum and maximum pitch, as well as pitch range. Also at 20 months, she displayed slightly higher levels of expressive language as compared to the TD 18 month mean.

Infant 16's mother displayed a low level of diversity in her speech at 9 months, even though she was very talkative (see Figure 32). This lack of diversity continued at 12 and 20 months, with a low number of utterances produced at 12 months and a low MLU at 20 months. Infant 16's mother also

displayed a broader range of atypicalities in the acoustic properties of her vocalisations. At 12 months she displayed a high maximum pitch and pitch range, alongside a low pitch mean. At 20 months, she displayed a low minimum pitch and a high maximum pitch and pitch range and was not very talkative. An examination of the function of Ru's mother's utterances revealed that she produced few Descriptions at any point, and few Social Play vocalisations at 9 and 20 months. Also at 20 months, she produced a high level of Conventional Social Expression, Labels and Faithful Imitations.

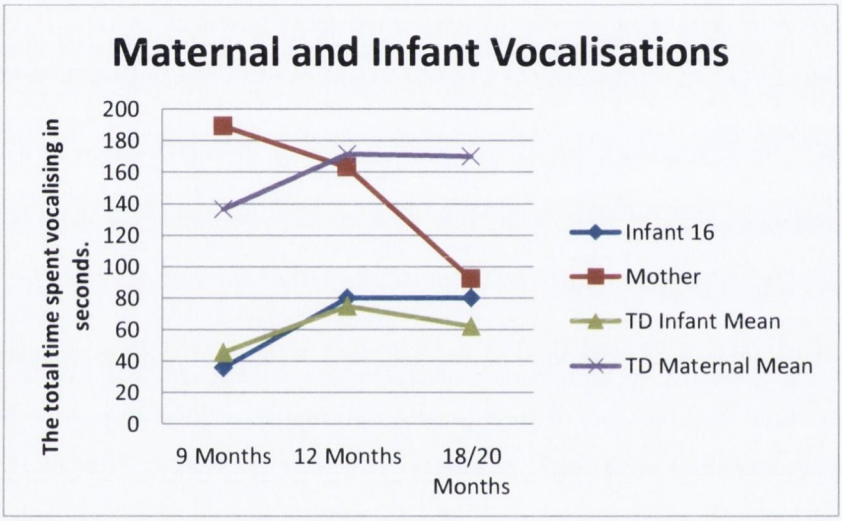

Figure 32. Case Study Infant 16: Maternal utterances and infant vocalisations at 9, 12 and 18/20 months.

Social engagement. At 9 months, Infant 16 did not engage with her mother at any time when her mother attempted to gain her attention; she was far more likely to disengage. At 12 months, she engaged following every attention bid. Also at 12 months, she spent a large amount of time actively engaged in the interaction, and she showed above TD average levels of initiation of joint attention, but below average levels of initiation of behavioural requests and response to behavioural requests. She also spent a large amount of time frowning. At 20 months, Infant 16 was

displaying higher levels of response to behavioural requests and initiation of joint attention, but lower levels of response to joint attention. Also at 20 months, she displayed a high level of interest in objects and little social engagement. She was more likely to respond to her mother's bids for attention with distress and she displayed low levels of affection towards her mother.

At 9 months, Infant 16's mother displayed high levels of detachment and low levels of positive regard toward her infant. At 12 months, she spent much of her time socially engaged with her infant, with this behaviour continuing at 20 months (see Figure 33). Also at 20 months, she displayed an above TD average level of positive regard for her infant.

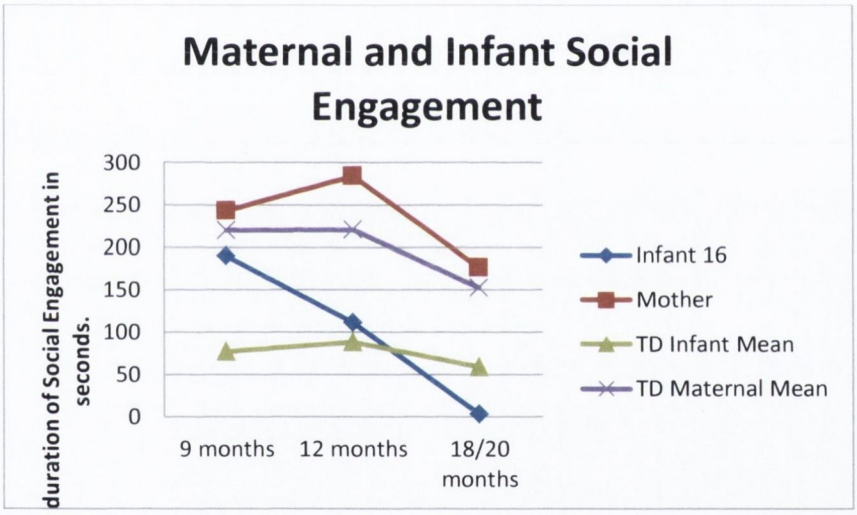

Figure 33. Case Study Infant 16: Maternal and infant social engagement at 9, 12 and 18/20 months.

Cognitive abilities. Neither Infant 16 nor her mother displayed atypicalities relating to cognitive development.

Maternal sensitivity. Infant 16's mother displayed low levels of sensitivity at 9 months. She engaged with her infant 100 per cent of the time that she showed distress, and she

was more likely to redirect her infant than were mothers of TD infants. Each time she tried to gain her infant's attention, it was in response to Infant 16's engagement with an object. At 12 months, she was more likely to attempt to gain her infant's attention when her infant was actively engaged. She continued to respond to each instance of infant distress. At 20 months, Infant 16's mother displayed high levels of sensitivity toward her infant, and she continued to use a high level of bids for attention when her infant was already socially engaged.

Understanding the interaction. At 9 months, Infant 16's mother attempted to guide the interaction, using noise, physical action and brief vocalisations in an attempt to gain her infant's attention. This less sensitive style led to a lower level of engagement on Infant 16's part. At 12 and 20 months, the interaction was very child-led, with Infant 16's mother using her child's vocalisation and line of interest as a starting point for her interactive behaviours. While Infant 16 displayed a very high level of interest in objects at 20 months, her mother's context appropriate responses meant that the infant engaged in turn-taking with her mother. The infant's distress at her mother's attention bids and the low level of affection appeared to be born of her interest in watching television, with her focus of attention limiting affectionate displays toward her mother and increasing frustration when she did not get what she wanted.

Infant 18 and her Mother

Tone of the Interaction. Playful, Relaxed

Description. Infant 18 was 5 months old when she joined the study, and her mother was 34 years of age. Her mother worked as a nurse assistant and her father was employed part-time outside the home. Both parents spoke English fluently. By 3 years of age, Infant 18 had been given no diagnoses. All filming was conducted in the home, with the infant sitting on her mother's knee at 9 months and sitting on a small table at 12 and 18 months.

At 9 months, the infant was very engaged with her mother. The interaction was relaxed, and the infant responded happily to the sound of familiar songs. The songs appeared deliberately structured to gain Infant 18's attention, with quiet and loud parts, funny sounds and the inclusion of the infant's or her sister's name. Mother and infant shared some moments taking turns clicking their tongues, with the mother praising her infant and asking if she wanted to repeat the sound. While the infant was interested in toys, she was easily distracted from them and returned her attention to her mother. The infant grunted in a manner that may be associated with ASD, and the mother responded by imitating the sound. The mother asked 'Again?' after they played tickling games, and she did not repeat the game if her infant seemed disinterested.

At 12 months, Infant 18 was less interested in staying in place for the filming sessions. Her mother showed her toys and counted each of them. The infant was briefly engaged, but then attempted to get down from the table. She said 'Up, up', while gesturing to be picked up. Her mother attempted to distract her by pointing out objects, asking questions ('Where's Infant 18's nose?') and singing songs familiar to the infant. All attempts briefly distracted the infant. When the infant began to fuss her mother imitated her. Infant 18 was interested in the very physical actions

of her mother, such as banging on a toy or the table. A new toy was introduced, and the infant shared attention with her mother when playing with it. Her mother praised her infant when Infant 18 responded as she asked. Despite Infant 18's attempts to leave the table, the interaction was light-hearted and relaxed.

At 18 months, Infant 18 was active from the start, standing on the table and trying to look out the window. Her mother regained her attention by singing a familiar song, which included Infant 18's name. Infant 18 responded by singing along and doing the actions. The infant showed interest in a book, dividing her gaze between her mother and the pages. She commented on the characters she recognised, while her mother repeated what she said and responded, 'Yeah'. The mother also asked questions about the book. As the infant moved on the table and as she examined objects, the mother commented with single words that Infant 18 could understand and repeat (for example, 'Stuck', 'Down', 'Six'). When the infant became focused on the objects out the window, her mother attempted to gain her attention by calling her, saying no and tugging on her dress. The mother then laughed and allowed her infant to continue looking out the window. This typifies the very relaxed approach displayed by Infant 18's mother, who mixed directive, attention getting behaviours with a light-hearted willingness to allow her infant to explore, even when it impacted on the interaction.

Language. At 9 months, Infant 18 was producing fewer than TD average delight and distress vocalisations. At 12 months, she continued to produce low levels of delight vocalisations, but she was producing high levels of distress. Also at 12 months, she displayed a higher mean pitch and pitch range, while at 18 months, she produced a low minimum pitch and a high pitch range and intensity in her vocalisations.

Infant 18's mother displayed few atypicalities in her utterances; she was very talkative at 9 months, but far less talkative at 12 and 18 months (see Figure 34). At each time point, she uttered

few Descriptions, while at 9 and 12 months she produced a high level of Social Play. She produced a low number of utterances overall at 12 months. At 18 months, she displayed a pattern of acoustic properties in her speech that mirrored that of her infant's, with a low minimum pitch and a high pitch range and intensity. She also produced a high maximum pitch. She uttered a high number of Conventional Social Expressions, Labels and Faithful Imitations of Infant 18's utterances.

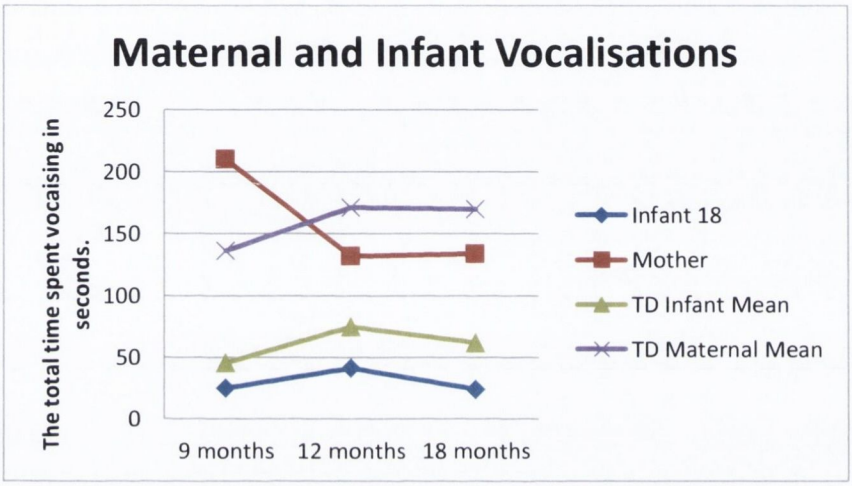

Figure 34. Case Study Infant 18: Maternal utterances and infant vocalisations at 9, 12 and 18 months.

Social engagement. At 9 months, Infant 18 engaged with her mother on every occasion that her mother attempted to gain her attention, and she continued to show a high level of responsive engagement at 12 months. Also at 12 months, she spent little of her time smiling and she was often engaged with objects. She displayed low levels of response to both joint attention and behavioural requests. At 18 months, Infant 18 spent much of her time socially engaged; however she also spent little time smiling, initiating joint attention or displaying affection toward her mother. She displayed limited social interest.

At 9 months, Infant 18's mother displayed a lower than TD average level of positive regard towards her infant. At 12 months she was less animated, less socially engaged (see Figure 35) and

spent much of her time engaging with objects. She spent a small amount of time smiling as compared to mothers of TD infants.

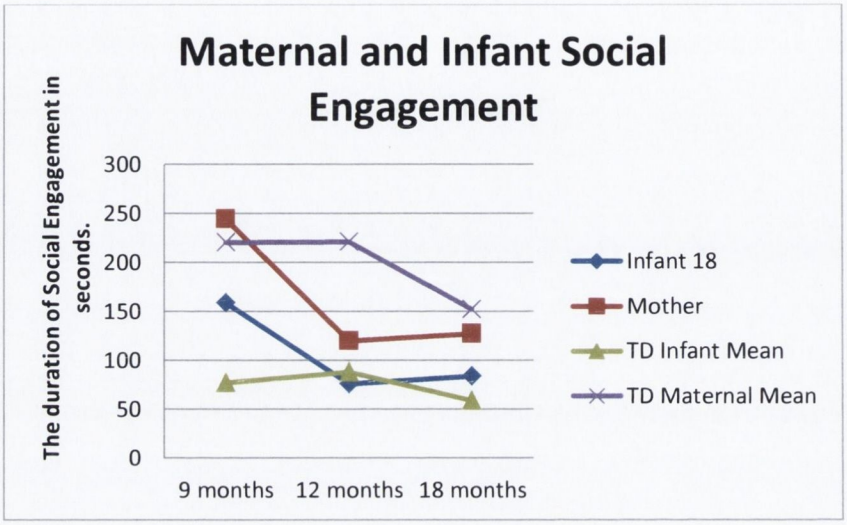

Figure 35. Case Study Infant 18: Maternal and infant social engagement at 9, 12 and 18 months.

Cognitive abilities. At 18 months, Infant 18 was displaying slightly better cognitive abilities than were TD infants. Her mother displayed TD average levels of stimulation of cognitive development.

Maternal sensitivity. At 9 months, Infant 18's mother was less sensitive than TD mothers. She engaged every time her infant showed distress, while she was less likely to engage with her infant when she showed delight. If she did engage following delight, she was most likely to redirect her infant's attention. She most often attempted to gain her infant's attention when she was engaged with an object at 9 months. At 12 months, the majority of her bids for attention occurred when her infant was already engaged. The mother was very likely to engage her infant when she showed distress, and each time she followed her infant's line of attention. At 18 months, Infant 18's mother displayed high levels of sensitivity. She responded more often to her infant's distress by disengaging than did mothers of TD infants. When she did respond, she was more likely to follow

her infant's line of attention. She most often attempted to gain her infant's attention when Infant 18 was disengaged.

Understanding the interaction. The infant became increasingly active and interested in her surroundings as she aged, leaving her mother with the difficult task of attempting to gain her attention. At each point, the mother was relaxed in her engagement. She kept the environment stimulating by presenting objects, playing games and singing songs. She used her vocalisations in particular as a means to gain her infant's attention; for example, singing songs that include the infant's name and varying the pace and volume of speech to grab Infant 18's attention. The mother used other unconventional methods to promote a more conversational tone; for example, she imitated even the atypical vocalisations produced by her infant and she used the infant's interest in making clicking sounds to establish a pattern of turn-taking. Infant 18's mother became increasingly sensitive, mixing an ability to follow her infant's attention and re-engage her when she became very focused on objects. While the mother was less animated than many of the other mothers, this appeared to be in response to her infant's behaviour. Rather than attempt to engage her through exaggerated, animated behaviour, the mother shared in her infant's interests and allowed her the space to explore them.

Mother-Infant Interaction – A Transactional Process

The above case studies clearly illustrate the transactional process that is central to mother-infant interaction. Those infants that were given a diagnosis displayed the broadest range of deficits and atypicalities, and their mothers displayed the broadest range of atypical responses. In fact, there was a clear pattern of atypical behaviour across dyads, with a matched pattern of atypicalities showing between infants and their mothers, whereby the infant with the highest number of atypicalities had the mother with the highest number of atypicalities. This pattern was

apparent throughout all of the dyads down to those displaying the least atypical behaviour. It is interesting to note that maternal behaviours mirrored those of their infant's most often amongst infants who were given an ASD diagnosis, with mothers of less engaged and less talkative infants displaying low levels of engagement and speech themselves.

This may suggest that mothers are experiencing a more limited socio-communicative environment as their infants are or become less engaged and less vocal over time; as such they are provided with fewer infant behaviours to which they can respond. Alternatively, it may be the case that, given that the infants are on the spectrum, they more easily become over-aroused by environmental stimuli, in particular social stimuli. It is possible that mothers are closely watching their infant's behaviour in order to gauge a pattern of stimulation that is most tolerable and beneficial for their infant, and as such they use their infant as a guide to set the most appropriate pitch, amount of speech and time spent engaging.

Across diagnosed and undiagnosed dyads, mothers spent much of their time gaining and maintaining their infant's attention. The manner in which this was conducted varied across dyads, with mothers using a variety of strategies to engage their infants, such as touch, movement, songs, object presentation or name calling. These varied choices attest to the varied approaches that mothers used to best suit the needs of their infants. The mother that used the highest number of attempts to gain her infant's attention and the largest variety of attention device types was R's mother. This is perhaps unsurprising given that R was one of the most disengaged and distressed of the infants. As R was the infant who was not expected to receive a diagnosis as there was no history of ASD in his family, the difficult and disjointed nature of their interaction may have resulted from a lack of experience with ASD and a lack of expectation that R may be given a diagnosis. It may be the case that an understanding of and experience with ASD offers a benefit in that mothers may

be more prepared to adapt to their infant's needs and they may be more attentive to the unique set of socio-communicative behaviours that their infant displays.

Chapter Ten: Conclusion

This study presented a detailed description of the social interactions of mothers and their SibsA infants at 9, 12 and 18 months. It was found that SibsA infants displayed few atypical behaviours, although they did become more disengaged from the interaction and produced few advanced vocalisations as they aged. Mothers of SibsA infants displayed a higher number of atypicalities. It was found that on a global level, they were more intrusive or detached and they displayed increasing hostility. They displayed unique responses to infant behaviour, with more attempts to direct infant attention, even when their infants were already socially engaged. They also were more likely to disengage from the interaction when their infants displayed distress or delight as compared to mothers of TD infants. Maternal utterances within the SibsA group increasingly functioned to direct infant behaviour, while the syntax produced was less complex, with a lower MLU, less vocabulary diversity, less vocalisations and more one-word utterances. They also produced utterances containing a broader pitch range and higher intensity. Both SibsA infants and their mothers displayed a similarly exaggerated pattern of prosody.

Each of the studies presented point to a pattern of maternal interaction that focused on gaining and maintaining the attention of SibsA infants. In keeping with previous research (for example, Baker et al., 2010; Kasari et al., 1988; Lemanek et al., 1993; Saint George, 2011; Wan et al., 2012), mothers showed less sensitive responding and less structuring of the infant's socio-communicative environment. SibsA infants did hear a less complex pattern of maternal speech both prosodically and syntactically, and the function of the speech that they heard was more directive in nature. However, mothers of SibsA mothers were very responsive to their infants during interactions and they were more proactive in regulating infant emotional states. Perhaps most importantly, positive

associations were found between maternal directive behaviour (Attention Devices, maternal intrusiveness and non-speech vocalisations) and later SibsA infant outcomes. Maternal Attention Devices were more likely to encourage infant engagement for SibsA infants, and case studies of SibsA and autistic dyads revealed that directive behaviour often occurred in warm and appropriate settings.

Such findings highlight the risk sensitivity/differential susceptibility that may be a feature of mother-infant interaction in SibsA dyads. While directive and intrusive behaviour may be associated with negative interactions and poorer infant outcomes amongst TD samples and samples of infants displaying a variety of neuro developmental atypicalities (for example, Cielinski, Vaughn, Seifer & Contreras, 1995; Landry & Chapieski, 1989; Lussier, Crimmins & Alberti, 1994; Slomins & McConachie, 2006; Tomasello & Todd, 1983), within SibsA dyads it would appear that SibsA infants uniquely engage with directive behaviours. As such, mothers' display of directive behaviour is responded to by infants, which may increase the amount of directive behaviour displayed by mothers. It would appear that this environmental adaptation on the part of the mother may uniquely foster competence in SibsA infants. Such findings highlight the dynamic nature of infant development and the important role that the social environment can play in shaping infant behaviour and abilities. They also highlight the importance of examining behaviours as they occur in context, with the moment-by-moment dance of mother-infant interaction shaped by both parties.

Practical Applications. The current research is the first to present such a broad-reaching examination of mother-infant interaction in dyads where the infant is more likely to receive an autism diagnosis, and the findings produced offer an opportunity to examine the model of interaction and response that may be at work. It is suggested that mothers are naturally adapting

their behaviour to accommodate the specific interactive needs of their infants, while it also appears that a differential susceptibility to this environmental stimuli is occurring. As such, the 'risk' status of the SibsA infants is positively influenced by maternal behaviour that draws their attention to the interaction. It may appear that they are missing more complex elements of maternal socio-communicative responding, which in typically developing samples have been associated with positive social, cognitive and linguistic outcomes. However, it may be the case that in the absence of maternal directive behaviour, SibsA infants simply would not attend to the interaction, and as such they would gain no benefits from more complex socio-communicative behaviour if their mothers were displaying it. In this sense, maternal directives function positively to direct infant attention to the engagement, allowing SibsA infants to benefit from the maternal behaviour that they then experience. Indeed, it is interesting to note that while mothers increased their production of the elements of speech associated with directing infant behaviour over time, their global interactive pattern was considered increasingly sensitive by RA coders. This suggests that even without measures of infant outcomes, it may be possible for observers to gauge the real-time positive tone of the interaction, despite the high proportion of directive behaviours displayed by mothers.

On foot of the present findings, it is suggested that the commonly-used definition of maternal directive behaviour that focuses on negative outcomes for the infant, be re-examined with greater attention paid to the context in which it occurs. Indeed, it would be worthwhile to examine directive behaviours through a broader set of definitions, such as that used by Lloyd and Masur (2014), which sought to draw a distinction between Responsive Directives, ReDirectives and Intrusive Directives. They suggested that context is important when defining maternal directive behaviour. For example, when infants fail to appropriately engage in object play, a mother may use

a ReDirective utterance to appropriately encourage them to stay on task. In less detailed studies, such behaviour may be defined as intrusive. While measures that seek to quantify concepts such as directiveness, sensitivity and responsivity are necessary as they allow for generalizability, it may be the case that such concepts are not generalizable across all samples and/or across all contexts. As such, a reframing may be necessary to better understand how traditionally described directive, sensitive and responsive behaviour may function differently within SibsA and autistic dyads.

The detailed description of the socio-communicative input experienced by the infant presented in this study may contribute towards research that establishes beneficial interventions that focus on adaptations to maternal behaviour. As such, caregivers may be able to make the most of the infant attention that they gain by providing structured responses that seek to provide more complex input that may encourage language acquisition and cognitive development, whilst still remaining appropriate for the infant's abilities and salient to infant interests. Such an intervention would be beneficial as it is based on behaviour naturally displayed by mothers of SibsA infants, and as such behaviour could be shaped so as to maximise the benefit for the infant in a form that is comfortable for the mother.

The finding that SibsA infants show a strong tendency to respond to their mothers' bids for attention is in keeping with those of Forde et al. (2011), who examined the spontaneous and elicited utterances of older children with ASD. They found that, compared to TD children, children with autism were more likely to produce speech that was prompted by an adult. This highlights the continued relevance of more directive communication from caregivers. By harnessing this early preference, infants may experience a more enriched communicative environment and they may also gain greater experience in engaging in interaction, thus improving their socio-communicative skills. In this context, it may be beneficial for mothers to use that attention in specific ways that

promote interaction and turn taking, for example describing the behaviours of their own behaviours and/or those of their infant, asking Wh-questions to encourage infant response or imitating infant behaviour.

Theoretical Applications. In examining the socio-communicative environment of the infant, the aim of the study was to put the *experience* of SibsA infants at the heart of the research, taking into account the changing pattern of both the input that they receive and the output that they produce. A large number of studies focusing on autism or SibsA infants follow a medical model, with an emphasis on the specific atypicalities or impairments that may be considered central to the condition. The present study favours a social model of autism, with an emphasis on the environment and the infant's active role in co-constructing the interactive experience. By focusing largely on physically based, descriptive codes and definitions of behaviour, the study could describe the experience of the infant without bias and without ascribing value to the behaviours. By presenting a detailed examination of multiple aspects of the interaction, it was hoped that an accurate picture of the infant's environment could be presented. Equally, by examining the individual experiences of infants and mothers through dyadic case studies, the present study sought to acknowledge the unique, individual experiences of the SibsA infants taking part. This approach is in keeping with the Society for Disability Studies (www.disstudies.org) guidelines. To better understand an individual's experience, the most beneficial approach may be to ask the individual directly about it; obviously this can't be achieved with prelinguistic infants. It is hoped that the very detailed approach taken in this study offers a picture of the infants' experience that is as accurate and person-focused as possible.

Advantages and Limitations

The aim of the study was to paint a picture of the socio-communicative environment experienced by SibsA infants, with an acknowledgement that such an environment is co-created by both members of the dyad. This study is the first to examine the SibsA infant's environment in such great detail, and the study design and method were chosen to allow this. Unfortunately, this level of detail made it impossible to include a large sample within the study as it would have been too time-consuming to conduct the required data collection and analysis. Had a larger sample size been possible, the data would have produced results that were more generalizable and of better predictive quality. Because of the sample size the results can only be tentative; however across each area of analysis, a clear pattern of directive behaviour was noted for mothers of SibsA infants, suggesting that a real phenomenon has been detected. As such, the present study provides a clear direction for future research.

Further, the scale of the present study would not allow for the study of interaction beyond five minutes as, again, it would have been too time-consuming. If it had been possible to analyse longer interactions, it would have been interesting to examine chains of initiative and responsive behaviour such that it may have been possible to predict how mothers might respond to particular infant behaviours, and vice versa. Keeping the filming sessions short was beneficial as they more accurately mirrored natural dyadic interactions, as a number of the mothers commented that they struggled to engage in face-to-face interaction for lengthy periods, stating that they would rarely spend any longer than 10 or 15 minutes at a time actively engaged with their infant.

A strength of the study is the real-time, naturalistic dyadic interaction that has been captured, however it would be useful to also gather data in a variety of settings. It has been suggested that research examining IDS should explore a range of different communicative contexts (Broesch &

Bryant, 2014). Given the challenges in face-to-face interaction associated with ASD, it would be interesting to examine whether different interactive contexts elicit different maternal and infant responses. It may be the case that face-to-face exchanges are not the favoured form of interaction amongst SibsA dyads, and they may engage in them less often than TD dyads. While the present study was successful in capturing the natural responsive exchange between mother and infant, it may also be useful to conduct daylong recordings in order to capture the variety of exchanges that may occur within a dyad over the course of a day.

A large number of studies have examined home movie footage of infants subsequently given a diagnosis (for example Adrien et al., 1991, 1992, 1993; Clifford & Dissanayake, 2008). The prospective nature of the present study has the advantage of allowing standardised, structured data collection very early in the child's life, long before detectable signs of atypical behaviour are apparent. However, as not all of the infants within the SibsA group gained an ASD diagnosis, group differences are difficult to achieve.

The longitudinal nature of the study offered the opportunity to examine changes in both infant and maternal behaviour as infants aged and became more autonomous, and as mothers adapted their responses to their infant's increasingly advanced communicative abilities. While such a detailed examination of maternal and infant behaviour over time offered a unique insight into the developing interactions, participation was undoubtedly demanding for mothers. For this reason, it was not possible to conduct testing beyond that presented here. Given the higher likelihood that mothers of SibsA infants would display behaviours consistent with the BAP and/or depression (Bolton, Pickles, Murphy & Rutter, 1998; Bolton et al., 1994; Piven, Palmer, Landa, Santangelo, Jacobi & Childress, 1997) it would have been ideal to have measured both of these constructs. However, when asked, mothers were reluctant to commit to further testing. Indeed, one mother

withdrew from the study on foot of the suggestion. Given the difficulty in recruiting, it was considered most important to continue with the dyads that were comfortable to commit to regular filming. Equally, attachment would have been an interesting area to examine in relation to both mother and infant, but given the demands that were already being placed on dyads to participate regularly, it was not considered possible to include it.

Similarly, touch and gesture are central elements of mother-infant interaction, with touch found to shape infant development across a range of areas (Glover, Onozawa & Hodgkinson, 2002; Koester et al., 1989; Rey & Martinez, 1983; Watt, 1990). Further, infant use of gesture is an important form of communication prior to and following the acquisition of language (Moszkowski et al., 2009). It would have been very worthwhile to have included a measure of maternal and infant touch and gesture to gain a full understanding of every element of the socio-communicative exchange; however the constraints required to accurately record the facial expressions, gaze and vocal behaviour during the interaction meant that natural tactile behaviour was impacted to a point that it could not accurately be captured. Given the more directive maternal style that was apparent for SibsA mothers in each section of this study, it would be interesting to examine different patterns of touch within the interaction. In particular, it would be interesting to investigate different forms of touch used by mothers and the context in which they are used. In this way it would be possible to examine which infant behaviours mothers are responding to when they use different types of touch.

A further area of study that would be worth pursuing in a larger sample is an examination of the effects of infant gender on maternal behaviour. In typically developing dyads, mothers have long been found to interact differently with male and female infants. Male infants are held upright for longer, but they hear less maternal language and their emotional states are responded to less often

than are those of female infants (Moss, 1967). It has been suggested that mothers favour proprioceptive touch over vocalisation when attempting to calm distressed male infants (Golombok & Fivush, 1994). By 6 months of age, female infants are touched, spoken to and breast fed more often than male infants (Goldberg & Lewis, 1969), and at 6, 9 and 14 months, mothers have been found to interact more with female infants than with male infants (Clearfield & Nelson, 2006).

Recent studies examining gender in autistic samples have suggested that autism may take a different form for males and females. Females have been found to have fewer restricted interests, and those that do show such interests generally pick more socially appropriate pastimes (Frazier et al., 2014). Those females who are defined as 'low-functioning' have been found to have poorer social communication abilities and lower cognitive abilities in comparison to males (Frazier et al., 2014). Indeed, it has been suggested that the current definition of autism is based on a male stereotype (Skuse, 2014 in press), with a female model yet to be defined. This suggestion is borne out by first-person descriptions of female autism (for example, Prince-Hughes, 2004; Simone, 2010). Such research is still in its early stages, and it may be beneficial to take a very detailed approach to early infant interaction in order to examine the behaviours and experiences that may be specific to male or female infants on the spectrum.

Recommendations for Future Research

Given the scale of the microanalysis conducted in the present study, it would not be possible to examine a larger sample in the same way. Instead it may be useful to take either a more qualitative or experimental approach. It would be interesting to examine the directive/facilitative behaviours of mothers in detail, while also asking them about their experiences of the interaction, their intentions when engaging with their infant and the strategies that they are consciously employing

to facilitate the engagement. In this way it would be possible to examine whether mothers recognise the directive approach that they are taking.

While the purely observational approach taken in the present study was informative in establishing exactly what is occurring during interaction, a logical next step would be to further examine the interaction through a more experimental approach. For example, it would be useful to examine which maternal behaviours best gain infant attention. This could be achieved through, for example, a task persistence experiment in which one group of mothers interacts as normal, while further groups are instructed to engage their child using specific types of behaviour to gain attention (for example, calling their name, imitation or stating 'Look').

Conclusion

Using a systems-theory approach, the study functioned to describe in detail the interactive experience of SibsA infants and their mothers. Viewing the mother-infant interaction as a complex system allowed for an appreciation of how any atypicalities in behaviour may have shaped the pattern of initiation and response co-constructed by mother and infant. The current study found that SibsA dyads displayed patterns of behaviour that differed from those of typical dyads. In line with the above theoretical framework, it is suggested that subtle differences in the behaviour of infant, mother or both, resulted in a pattern of initiation and response co-created by both infant and mother through trial and error. It is hoped that this study may act as a base for further examination of the within-group pattern of initiation and response that may be specific to SibsA dyads, which could lead to a mapping of predictable patterns of exchange, and may allow mothers a better understanding of the exchange and challenges that may occur within it. Armed with expectations that are based on SibsA dyads rather than typically developing dyads, it may be

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Appendices

Appendix One – Recruitment Poster

Mothers & babies needed for research study on early communication & interaction.

I am looking for mothers of young babies (aged between 3 and 12 months) who also have an older child or children on the autistic spectrum to take part in a psychology study.

As a participant in this study, you would be video taped in your home interacting with your baby for 20 minutes once every 4 weeks until your baby is 12 months old.

If you are interested in taking part or would like more information, please contact:

Dr Jean Quigley

School of Psychology, Trinity College Dublin

quigleyj@tcd.ie, 01 896 2697

Thank you!

This study has been reviewed by, and has received ethics clearance through, the School of Psychology, Trinity College Dublin. The study is funded by the Irish Research Council for the Humanities and Social Sciences IRCHSS.

Appendix Two – Recruitment Letter

Dear Parent,

Firstly I would like to thank you for taking the time to read this recruitment information about my study. I am very excited about this project, which is funded by the Irish Research Council for the Humanities and Social Sciences (IRCHSS), and I hope you will find it of interest also.

Your participation will involve one visit to your home (or one visit to School of Psychology in Trinity College Dublin) every 4 weeks until your baby is 18 months old when you shall be video recorded in face-to-face interaction with your baby for a short period. The tapes will then be analysed and will provide very useful information about this early stage of language and communication development.

Please find enclosed some information about the background to the study, the methodology and approach taken and a consent form for return, should you decide to take part. I hope I have provided you with sufficient information to make a decision and I would of course be delighted to answer any questions or to receive any comments you may have.

If you would like to be part of this study, please sign and return the consent form provided and I will then contact you to arrange a first meeting at your convenience.

Thank you for taking the time to consider this and I look forward to meeting you and your baby.

Very best wishes,

_____

Dr Jean Quigley

Appendix Three – Information Sheet

Information for participation in research study

Dear Parent/Guardian,

I am a lecturer and researcher in the School of Psychology in Trinity College, Dublin and I am studying early mother-infant interaction and language development. I am interested in how mothers and their babies communicate and respond to each other during the normal activities and routines of the day. We know that even very young babies actively participate in, and initiate interaction with, their mother and other family members and using video I would like to try to study this early behaviour in detail. I am hopeful that this work will increase our understanding of how language develops and could also help to identify any early differences or problems for early intervention.

I need to recruit babies aged between 3 and 12 months old. If you agree to participate in this study, you will be asked to commit until your baby is aged around 18 months. This will involve a researcher making one visit per month to your home to video you and your baby interacting, face-to-face for a short period of approximately 20 minutes. A short test, where the parent is asked a series of questions, to measure early communicative behaviours will also be administered when your child is between 8 and 12 months.

All materials will be treated in the strictest of confidence and individuals will not be identified in any written reports. The video material will be kept in a secure location for a period of no less than 5 years, under the terms and conditions of the Data Protection Act.

I hope I have explained the nature of this research to your satisfaction. Please feel free to contact me if you have any questions or if I can clarify matters further. Please sign the attached form if you are willing to participate in this research study. If you do agree to participate, you will be given the name and contact details of a professional attached to the institution or service through which you were recruited whom you may contact if you wish to discuss any issues arising during the course of this study. Please note that you are free to withdraw your participation at any point without prejudice.

Dr. Jean Quigley

School of Psychology
Trinity College Dublin
Tel: 01 896 2697
Email: quigleyj@tcd.ie

Appendix Four – Context-specific Codes

Examples of Appropriate and Directive maternal utterances and antecedent infant behaviours.

Infant Behaviour	Maternal Response	Appropriate	Inappropriate	Follow-On	Redirect
Picks up ball	'Throw your ball'	✓		✓	
Picks up ball	'Look, there's Daddy'		✓		✓
Looks out window	'What do you see?'	✓		✓	
Looks out window	'Are you out there?'	✓		✓	
Infant laughs	'Haha! Good boy'	✓		✓	
Infant laughs	'No, stop that'		✓	✓	

Appendix Five – Letter of Approval from TCD Ethics Board

COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH | TRINITY COLLEGE DUBLIN
Ollscoil Átha Cliath | The University of Dublin

5th April 2012

F.A.O. Catherine Hughes

School of Psychology Research Ethics Committee

Dear Catherine,

I am pleased to inform you that your application entitled "Differential effects of infant risk-status on maternal behaviour" has been approved by the School of Psychology Research Ethics Committee.

It is not routine policy of the Committee to issue duplicate or replacement letters confirming ethical approval. It is therefore the responsibility of the applicant to keep the approval letter safe.

Yours sincerely,

Dr. Tim Trimble
Chair
School of Psychology Research Ethics Committee

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Aras an Phairsaigh
Trinity College
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Appendix Six: Global Rating Scale: 9 and 12 Months

Revision date: April 28, 2006

(PLEASE DO NOT DISTRIBUTE WITHOUT PERMISSION)

QUALITATIVE RATINGS FOR PARENT-CHILD INTERACTION AT 3-15 MONTHS OF AGE

Martha J. Cox, Ph.D. and Keith Crnic, Ph.D.
The University of North Carolina, Chapel Hill
August 2003

Adapted from

Owen, M.T. (1992). *The NICHD Study of Early Child Care Mother-Infant Interaction Scales.* Timberlawn Psychiatric Research Foundation, Dallas, TX.

PARENT CODES

SENSITIVITY/RESPONSIVENESS (Adapted from Ainsworth)

This scale focuses on how the parent observes and responds to the child's social gestures, expressions, and signals as well as responds to cries, frets, or other expressions of negative affect. The key defining characteristic of a sensitive interaction is that it is child-centered. The sensitive parent is tuned to the child manifests awareness of the child's needs, moods, interests, and capabilities, and allows this awareness to guide his/her interaction.

If the child initiates social gestures and expressions (looking at the parent, reaching toward the parent, waving, clapping hands, handing objects, vocalizing), or makes demands, desires, or requests known (stretching arms to be picked up, reaching for toys the parent is holding), the sensitive parent responds appropriately.

If the child loses interest, the sensitive parent takes time to re-engage the child in a manner that demonstrates sensitivity to the child's mood. When the child is bored or frustrated, the parent offers toys or other distractions. When the child is interested and involved with toys, the sensitive parent allows him/her to independently explore them. During play, the sensitive parent provides one toy or game at a time and bases continuation on the child's response. How and what they play is geared to whether or not the child seems to be enjoying the activity. The parent does not persist with an activity or toy that the child is obviously not enjoying.

A sensitive parent provides stimulation that is appropriate to the situation. He/she provides the child with contingent vocal stimulation and acknowledges the child's interest, efforts, affect, and accomplishments.

Sensitive parents can spend some time watching the child, but the difference between them and the detached parent is that the sensitive parent seems to be actively taking an interest in the child's activities, as evidenced by comments and embellishments when the child loses interest. It is at these times--when the child loses interest or is distracted--that the difference between the sensitive parent and the detached, under stimulating parent is most easily seen; the detached parent does not respond, responds in a listless manner, or responds with developmentally inappropriate comments and behavior. The insensitive parent could also be overstimulating/intrusive and might continue in his/her attempts to engage the child even when the child is providing clues that he/she is seeking to end the interaction.

A sensitive interaction is well timed and paced to the child's responses, a function of its child-centered nature. Such an interaction appears to be "in sync". The parent paces games or toy presentation to keep the child engaged and interested, but also allows him/her to disengage in order to calm down and reorganize his/her behavior. Sensitivity involves judging what is a pleasurable level of arousal for the child and helping the child to regulate arousal and affect. When the child loses interest, the sensitive parent switches
to a new tactic or toy and observes the child's reaction, or stops interacting entirely. In this way the sensitive parent can be distinguished from both an intrusive and a detached parent.

Markers of sensitivity include:
(a) acknowledging the child's affect;
(b) contingent vocalizations by the parent;
(c) facilitating the manipulation of an object or child movement;

(d) appropriate attention focusing;
(e) evidence of good timing paced to the child's interest and arousal level;
(f) slowing the pace when the child appears over stimulated or tired (e.g., demonstrates gaze aversion, fussiness);
(g) picking up on the child's interest in toys or games;
(h) shared positive affect;
(i) encouragement of the child's efforts;
(j) providing an appropriate level of stimulation when needed; and
(k) sitting on floor or low seat, at the child's level, to interact.

Thus, the sensitive parent demonstrates the ability to adapt interactions to the child's mood and level of development. The parent neither over-nor underestimates. The parent knows when it is time to increase or reduce the amount of stimulation the child is experiencing. For example, the parent discontinues an activity that is beyond the child's capacity for response or introduces a new activity when the child appears bored. Sensitive parents attend to and follow the child's lead. Ratings on this scale should be based on both quality and quantity of parent behavior.

This scale also focuses on how the parent responds to the child's cries, frets, or other expression of negative affect. It is judged in the following three ways:

1) Proportion of distress signals responded to. The parent consistently responds to all distress signals.

2) Latency of response. The parent responds promptly. Mild fussiness does not require the parent to respond as quickly as does the child's acute distress.

3) Appropriateness of response. Appropriateness of the adult's behavior can generally be inferred by its effectiveness in soothing the child. However, the completeness of the response should also be taken into account. For example, a parent who responds distally (e.g., voice from the other side of the room) should not be judged as sensitive as a parent who approaches and/or picks up the child. Parents who do not acknowledge distress, even if the infant self-soothes quickly, should be judged as less sensitive than those who do acknowledge the distress, however short lived. Parental responses to infant distress generally involve speaking to the child, approaching the child, changing position, offering toys, patting, picking up, holding closely (especially in a ventral/ventral position), and rocking. Any of these or other behaviors can be considered appropriate if they appear to have the effect of soothing the child. If the parent's first response to the distressed infant does not soothe the child, the episode should be judged as insensitive/unresponsive (even if their response was immediate) unless the parent proceeds to offer a "fuller" response (i.e., more proximal soothing behaviors).

Sensitivity/Responsiveness

1 = Not at all characteristic. There are almost no signs of parent sensitivity. Thus, the parent is either predominantly intrusive or detached. The parent rarely responds appropriately to the child's cues, and does not manifest an awareness of the child's needs. Interactions are characteristically ill timed or appropriate. When the child cries or frets, the parent responds not at all, very slowly, negatively or inappropriately. If there is a response, it is only after the child becomes very demanding, and the response is so delayed that it cannot be construed to be contingent upon the child's behavior. A parent who typically appears oblivious or punitive to the child's distress would receive this score.

2 = Minimally characteristic. This rating should be given to parents who display infrequent or weak sensitivity/responsiveness. While the parent is sometimes sensitive, the balance is clearly in the direction of insensitivity. The parent may give some delayed perfunctory responses to cues. The parent responds rarely or slowly to the child's signals (e.g. vocalizations, affect, distress), and appears more unresponsive than responsive. The responses tend to be minimal or perfunctory. For example, if the child shows distress, the parent may talk to or briefly pat a crying child and he/she may not pick up the child. The parent may not typically bring the child to a ventral/ventral position.

3 = Somewhat characteristic. This rating should be given to parents who display some clear instances of sensitive responding. The parent can be characterized as sensitive to the child; however, the parents' behaviors may be mechanical in quality and ill paced. There are fleeting instances of genuine comforting of child (e.g. picking up the child, bringing him/her to a ventral/ventral position), but these instances may be delayed or perfunctory. The interaction can be characterized by a mix of well-timed and faster paced episodes, or by a parent who is trying to be sensitive, but the interaction has signs of insensitivity. This rating can also be given when the parent is making an effort to comfort his/her child, but he/she may appear to not know what he/she should do. The parent is inconsistently sensitive and hard to categorize.

4= Moderately characteristic. This rating should be given to parents who are predominantly sensitive/responsive. The parent demonstrated sensitivity in most interactions but may neglect to give a fuller response or a well-timed or appropriate response. If the child cries or frets, the parent typically responds promptly to the child's distress, demands, and signals, but there is some time in which clear child signals do not receive a response or in which the response is somewhat delayed. Some of the parent's responses are mixed, i.e. some are half-hearted or perfunctory, but the majority are full responses.

5 = Highly characteristic. This rating should be given to parents who are exceptionally sensitive and responsive. Instances of insensitivity are rare and never striking. Interactions are characteristically well timed and appropriate. If the child shows distress, this rating should be given to parents who are exceptionally sensitive and responsive to distress. The parent responds quickly and appropriately to the child's distress. If the child is upset, the parent takes the time to soothe and calm the child. Overall most responses are prompt, appropriate, and effective.

INTRUSIVENESS

An intrusive, insensitive interaction is adult centered rather than child centered. Prototypically, intrusive parents impose their agenda on the child despite signals that a different activity, level, or pace of interaction is needed. High arousal, vigorous physical interaction, or a rapid pace, are not, by themselves, indicative of intrusive overstimulation--if the child responds positively with sustained interest and is not engaging in defensive behaviors. It is when the child averts his/her gaze, turns away, or expresses negative affect and the parent continues or escalates his/her activity that intrusive behavior is most evident. Particularly at 12-15 months of age, a child may respond to intrusive behaviors by displaying active avoidance of the parent. Intrusiveness is also apparent when the parent does not allow the child a "turn" or an opportunity to respond at his/her pace. Some intrusive parents persist in demonstrating toys to the child long after his/her interest has been gained and he/she obviously wants to manipulate the toy him/herself. These parents appear unable to facilitate the child's exploration or regulation of the activity. Another controlling intrusive behavior is displayed by parents who overwhelm the child with a rapid succession of toys or approaches, not allowing him/her time to react to one before another occurs.

Extreme intrusiveness can be seen as overcontrol to a point where the child's autonomy is at stake. It should be kept in mind that a parent can become involved in play with the child without being highly intrusive.

Specific behaviors characterizing intrusive interactions include:
(a) failing to modulate behavior that the child turns from, defends against, or expresses negative affect to;
(b) offering a continuous barrage of stimulation (physical and/or verbal), food, or toys; (c) not allowing the child to influence the pace or focus of play, interaction, or feeding; (d) taking away objects or food while the child still appears interested;
(e) not allowing the child to handle toys he/she reaches for;
(f) insisting that the child do something (play, eat, interact) in which he/she is not interested;
(g) not allowing the child to make choices; and
(h) manipulating the child's body in an intrusive manner (e.g. making the child dance or bounce for the parent)
(i) physically impairing the child's movement

Parent's actions, which are clearly in the child's best interests, such as removing a child from danger, administering medicine, or putting an obviously tired child to bed, are not included in the considerations of intrusiveness. Similarly, bringing the child back to the mat for play when instructions to the mother are to do so, will not be judged intrusive unless the child is handled in an unduly perfunctory or rough manner.

Intrusiveness must be evaluated from the perspective of the child. If fast-paced stimulation is enjoyed by the baby, as shown by smiles and laughter, or seems a part of a game or ritual that is clearly enjoyed, parental behavior that might otherwise be judged intrusive will not be counted as such. An important element in judging the behavior as intrusive or not is the degree to which the parent modulates his/her behavior in response to the child's interest and enjoyment in the stimulation.

Intrusiveness

1 = Not at all characteristic. This rating should be given to parents who display almost no signs of intrusive behavior. The interactions are well-timed and tuned to the baby's signals. The interaction is clearly "child centered".

2 = Minimally characteristic. This rating should be given to parents who display minimal intrusiveness. There is some evidence of intrusiveness, but it is not typical. The parent may initiate interactions with and offer suggestions to the child, which occasionally are not welcomed. The parent may sometimes continue his/her activity in instances when the child engages in defensive behavior, but even when this happens; the parent does not escalate the activity.

3 = Somewhat characteristic. This rating should be given to parents who display frequent, but weak signs of intrusiveness or display a few clear instances of unwelcomed behavior. The parents engage in activities that are characterized by the parent's agenda, and may repeat or escalate these activities, even if the child does not respond negatively to them. The parents are not predominately intrusive, however, intrusive behaviors appear to be more typical than a minimally characteristic (rating of 2) interaction. There may be inconsistent intrusive behavior and the parents may be hard to categorize.

4 = Moderately characteristic. This rating should be given to parents who are regularly intrusive. Parental intrusiveness occurs with moderate frequency. The pace is frequently controlled by the parent and ill timed to the baby's signals. Parents persist with intrusive behaviors even when the child engages in defensive and/or avoidant behavior.

5= Highly characteristic. This rating should be given to parents who are highly intrusive. The parent is consistently and typically intrusive. Most of the observation period is marked by the parent completely controlling the interaction, allowing the child little self-direction in his/her activities. The parent allows the child little autonomy, and essentially negates the child's experience.

DETACHMENT/DISENGAGEMENT

The detached parent appears emotionally uninvolved or disengaged and unaware of the child's needs for appropriate interaction to facilitate involvement with objects or people. This parent does not react contingently to the child's vocalizations or actions, and does not provide the "scaffolding" needed for the child to explore objects. Detached parents "miss" the child's looks to them or reach for a toy, and their timing is out of synchrony with the child's affect and responses (although not the overwhelming barrage of stimulation that intrusive parents present. Simply allowing the child to play by him/herself is not necessarily a sure sign of detachment; this can be appropriate at times, such as when the child is playing happily or contentedly and the parent checks in with the child visually. The detached parent will remain disengaged even when the child makes a bid for interaction with the parent. The detached parent is passive and lacks the emotional involvement and alertness that characterizes a sensitive parent. He/she appears uninterested in the child. There may be a "babysitter-like" quality to the interaction in that the parent appears to be somewhat attentive to the child, but behaves in an impersonal manner that fails to convey an emotional connection between the parent and the child. Other parents may demonstrate a performance-orientation in that the interaction is tailored towards performing for the camera rather than reacting to and facilitating child-centered behavior.
A parent receiving a high rating for detachment is considered to be insensitive. A low rating for detachment can signal either sensitivity or intrusiveness.

Detachment can be marked by:
(a) putting the child so he/she faces away from the parent without attempts to visually "check in"
(b) presenting toys without first engaging the child or showing him/her how to manipulate them;
(c) rarely making eye contact or rarely talking to the child
(d) not responding to the child's vocalizations, smiles, or reaches for toys
(e) an unawareness of the child's capabilities and appropriate activities
(f) positioning the child so that he/she cannot reach or manipulate a toy
(g) ignoring the interesting things the child does
(h) letting the child play unsupervised without checking in
(i) continually calling the child "baby" instead of using his/her name
(j) directing comments or stares towards the camera
(k) behaving in a mechanical or performance-oriented manner
(l) behaving in an emotionally uninvolved manner or appearing to be a baby-sitter rather than a parent when interacting with the child

While an intrusive parent might persist in presenting a toy to the child even if the child turns away, the detached parent does not respond to the child's bids to play with the toy (e.g., the child reaches for the toy, hands the toy to the parent or looks to the parent for a reaction to actions with the toy, and the parent neglects to respond to the child and to facilitate play). Detached parents tend to pay greater attention to the toys than to their child's response to the toys, or they tend to pay greater attention to other objects or people outside of the play interaction, or they appear distracted, for whatever reason, from attending to the child's interest. When interactions do occur, they may have an artificial or performance-oriented quality.

This scale contains both qualitative and quantitative components. A parent who interacts consistently with the child but does so in a perfunctory or indifferent manner with little or no emotional involvement would be rated high on detachment.

Detachment

1 = Not at all characteristic. This rating should be given to parents who display almost no signs of detachment or under involvement. When interacting with the child, the parent is clearly emotionally involved. These parents can be sensitive or intrusive.

2 = Minimally characteristic. This rating should be given to parents who display minimal signs of detachment. While they are clearly emotionally involved with the child during most of the interaction, there may be brief periods of detachment.

3 = Somewhat characteristic. This rating should be given to parents who remain involved and interested in the child while at the same time demonstrating the tendency to act in an uninterested, detached or perfunctory manner. Parents alternate between periods of engagement and disengagement. The periods of disengagement may be marked by unemotional or impersonal behavior. There may be a low-level of impersonal/unemotional behavior running throughout the interaction.

4 = Moderately characteristic. This rating should be given to parents who are predominantly detached. While there may be periods of engagement, the interaction is characterized chiefly by disengagement. The parent may be passive and fail to initiate interactions with the child. When interactions do occur, they may be marked by an impersonal, perfunctory style. Parent may show a lack of emotional engagement throughout the interaction

5 = Highly characteristic. This rating should be given to parents who are extremely detached. The child lies or sits without parent attention almost all of the time, even when the parent is within a suitable distance for interacting. In the minimal instances of involvement, the parent's behaviors are simple, mechanical, stereotyped, bland, repetitive, and perfunctory. The parent is clearly not emotionally involved with the child, and appears to be "just going through the motions".

POSITIVE REGARD FOR THE CHILD/POSITIVE AFFECT

This scale rates the parent's positive feelings toward the child, expressed during interaction with him/her.

Positive feelings are shown by
(a) speaking in a warm tone of voice
(b) hugging or other expressions of physical affection
(c) an expressive face
(d) smiling
(e) laughing with the child
(f) enthusiasm about the child
(g) praising the child
(h) general enjoyment of the child

Positive regard is evident when the parent listens, watches attentively, looks into the child's face when talking to him/her, has affectionate physical contact, and is playful. Ratings on this scale are based on both quality and quantity of positive regard. Keep in mind the uniformity of positive affect, and also be aware of the "brightness" in vocal quality. Positive regard that lacks "genuineness" should not receive a rating of 5.

1 = Not at all characteristic. This rating should be given to parents who display little positive regard. This rating can also be used for positive expressions (laughing, smiling) that appear to be inappropriate to the situation or an inaccurate reflection of the parent's feelings. The parent may be expressionless or flat, or negative.

2 = Minimally characteristic. This rating should be given to parents who display infrequent or weak signals of positive regard. The intensity and frequency of behavioral indicators of positive regard are both low.

3 = Somewhat characteristic. This rating should be given to parents who inconsistently express positive affect towards their child. Parents can receive a rating of 3 when they are hard to categorize (a mix between positive and negative or flat affect).

4 = Moderately characteristic. This rating should be given to parents who predominantly display positive regard. Parents must show some enthusiasm for the infant, but "true delight" is not evident as in a rating of 5. Parental enthusiasm for the infant must be evident in more than just the parent's voice. More frequent and intense positive affect is shown than in a rating of 3, but the parent is not as consistently positive as those scored as a 5.

5 = Very characteristic. This rating should be given to parents who are exceptionally positive, in terms of facial and vocal expressiveness and behavior. Affect is positive and spontaneous. The parent shows a range of expressions and behaviors that are all clearly positive. He/she clearly "delights" in the child.

NEGATIVE REGARD FOR THE CHILD/NEGATIVE AFFECT

This scale rates the parent's negative regard for the child. Both frequency and intensity of negative affect toward the child are considered.
Some markers of negative regard include:
(a) disapproval
(b) tense body
(c) negative voice when correcting
(d) abruptness
(e) tense facial muscles and strained expression
(f) harshness
(g) threatening the child or punishing without explanation
(h) roughness in wiping the child's face, changing his/her diapers, or burping
(i) calling the child unflattering names
(j) teasing in a non-playful manner

Coders should be sensitive to non-verbal as well as verbal indicators. Ratings on this scale are composed of both qualitative and quantitative evaluations. The amount and intensity of negative affect exhibited is evaluated in relation to the duration of the observation period.

1 = Not at all characteristic. This rating should be given to parents who do not display negative regard for the child either in words or in expressions. No evidence of anger, distrust, frustration, impatience, disgust, general dislike, or other indicators of negative regard is observed in the parent's face or voice. The parent may be expressionless or flat or positive.

2 = Minimally characteristic. This rating should be given to parents who display minimal negative regard. There are one or two instances of negative affect with moderate or low intensity of negative expression.

3 = Somewhat characteristic. This rating should be given to parents who display a few weak instances of negative affect or regard (about 3 or 4) or one particularly intense expression of negative regard. The parent's may show a mix of negative affect and positive or flat affect. The difference from a rating of 2 is frequency and intensity in expression.

4 = Moderately characteristic. This rating should be given to parents who predominantly display negative regard. Persistent evidence of low-intensity negative regard or some evidence of more intense negative regard is observed. Parents are more negative than positive throughout the interaction. Parents who engage in mean spirited teasing should receive at least a rating of 4.

5 = Highly characteristic. Feelings of negative regard are expressed strongly, or persistent moderate levels of negative regard are expressed. The overriding affect influencing the parent-child interaction is negative.

ANIMATION

This scale measures how animated the parent is. Animation may reflect energy, excitement, or interest (e.g., watching the child with eyes bright). Animation is often seen in big facial expressions such as opening mouth wide, eyes open wide, and an enthusiastic tone of voice. Lack of animation, (i.e., flat affect) may reflect boredom, depression, fatigue, or distraction. Parents who show consistently high levels of physical and verbal animation should be given a "5." Parents who lack animation, but are not blank or impassive and flat in face and voice, or parents who are inconsistently animated should be scored in the middle range. Parents whose face and voice are flat, impassive, expressionless, and lack energy should be given a score of "1." This scale assesses the parent's overall demeanor, not just animation with the target child.

1 = Not at all characteristic. This rating should be given to parents who are highly impassive, flat and low energy in the face and voice. There is a consistent absence of any animation or energy.

2 = Minimally characteristic. This rating should be given to parents who are predominately flat. Some periods of animation alternate with more clear periods of flatness.

3 = Somewhat characteristic. This rating should be given to parents who are inconsistent in their use of animation, but who overall display a balanced mix of animation and flatness of affect. These parents may present a disconnect between face and voice such that one is consistently animated while the other is consistently flat or passive.

4 = Moderately characteristic. This rating should be given to parents who are predominately animated. The parent is usually animated, but there is some time when facial expression is blank and impassive or the voice lacks energy.

5 = Highly characteristic. This rating should be given to parents who exhibit high and consistent levels of animation in the face and voice.

STIMULATION OF DEVELOPMENT

This scale measures the degree to which the parent tries to foster the child's development. A stimulating parent may take advantage of even simple activities (like feeding and diapering) to stimulate development, and will consistently engage in a variety of activities that can facilitate learning. The parent will make deliberate attempts to encourage the child's development, achievement and learning.

Behaviors characterizing stimulation include:

(a) attempting to focus the child on an object or task

(b) focusing the child's attention on perceptual qualities (sounds, colors, movement, etc.) of objects

(c) verbally responding to or expanding the child's verbalizations or vocalizations

(d) encouraging the child to actively participate in activities

(e) assisting in motor movement or coordination

However, parents who simply focus or encourage a child should not be given the highest scores. Higher scores should be reserved for parents who engage in some of the following:

(a) describe or label toys or objects or demonstrate how they work

(b) stimulate the child's verbalizations or vocalizations and expand on them

(c) read or recite to the chil;

(d) encourage or reinforce the child's attempts at mastery, or challenge the child to try something new

(e) present activities in an organized sequence of steps

(f) teach the child or give him/her an opportunity to experiment with materials that illustrate or teach concepts

(g) ask questions that require problem solving

(h) label and interpret the child's experiences (e.g., "You think that's funny")

(i) assist the child in motor coordination or mastery of a developmental milestone, and so on

Activities involving strictly physical stimulation such as rough and tumble play, bouncing, and tickling are not considered as stimulating development per se, but it is possible for a caregiver to provide stimulation in these contexts if the caregiver expands on these experiences with verbal labels. For example, active play with a child that expands on the child's abilities or assists in the coordination of the child's movements would be considered stimulation of development because it encourages and elaborates on the child's current ability and mastery. This scale does not measure those activities that are only social (smiling) or caretaking (soothing), but stimulation can occur in these contexts as well.

The focus of this scale is on the amount and quality of activities that may ultimately enhance perceptual, cognitive, linguistic, and physical development. The parent's attempts may be less than perfect from a developmental psychologist's point of view, but they reflect the parent's belief that he/she is teaching the child. Simply placing objects in front of the child or handing him/her toys is not to be considered stimulating. Stimulation must involve effortful interaction with the child in the contexts described above.

All qualitative judgments must be considered in relation to the quantity of stimulation provided by the parent: How many of the available opportunities for stimulation were taken advantage of? A parent who simply repeats a word or phrase that a child says (e.g., "shoe") would be lower level stimulation than putting the word in a sentence or elaborating on it (e.g., "The shoe is red"). A rating of 1 should be given to those parents who provide almost no stimulation of development. If a parent spends a very brief portion of the time in high-quality interactions with the child and provides that child with no stimulation for the remainder of the time, he/she would receive a rating of 2. A parent might also receive a 2 if stimulation is continuous but minimally advantageous. A rating of 3 is generally given when the parent doesn't strive to offer cognitive or physical stimulation for some small portion of the time or when he/she neglects some aspects of stimulation (e.g., manipulative skills), but otherwise engages in stimulating activities. A rating of 4 should be given to parents who clearly have a stimulation agenda, but may fail to take full advantage of opportunities or whose efforts are not "rich" in stimulation. A rating of 5 should be given to those parents who work at providing exceptionally advantageous stimulation. Higher scores for stimulation of development indicate that the parent's stimulation attempts are at the appropriate developmental level for the child and are in tune with the child's interests and activities so that the child may potentially benefit from the parent's behavior.

Note that at 3 months, stimulation of development may take the form of physical and sensory-motor stimulation, whereas at 6 and 12 months, stimulation of development may tend to focus on cognitive stimulation.

1 = Not at all characteristic. This rating should be given to parents who provide little or no stimulation. The parent makes almost no attempts to teach the child anything or provide any stimulation. He/she may provide routine care but does not use it as an opportunity for learning. The parent may ignore the child's activities or interact perfunctorily, providing no stimulation. The parent never does more than offer toys in a perfunctory, mechanical manner, without demonstration or labeling or bouncing the child around. The parent is typically silent. Any efforts made are developmentally inappropriate.

2 = Minimally characteristic. This rating should be given to parents who provide infrequent or weak stimulation. The parent's conscious and purposeful attempts to engage the child in development-fostering experiences are limited. He/she may label or demonstrate materials or demonstrate physical activities, but does so perfunctorily and with minimal elaboration.

3 = Somewhat characteristic. The parent makes some effort to stimulate development, but it may not be her/his main agenda or the parent's agenda is inconsistent. Efforts to engage the child are limited in number and are often unsuccessful. The parent does not consistently take advantage of opportunities to provide stimulation. The parent provides few opportunities for rich, varied stimulation and most attempts are repetitive.

4 = Moderately characteristic. This rating should be given to parents who have a clear agenda of expanding their child's physical and/or cognitive mastery. Parents who receive this rating provide adequate stimulation but could reasonably be expected to provide more and higher-quality stimulation. The parent may find some new ways to engage the child with toys or activity, for example, but these ways are limited in number. Parents who provide a rich linguistic or physical environment, but do not demonstrate the potential of toys or movements, would receive this rating as well as parents who demonstrate toys or movements in a stimulating but non-vocal manner.

5 = Highly characteristic. This rating should be given to the parent who is consistently stimulating and takes advantage of many activities as opportunities for stimulation. The parent provides frequent stimulation through "lessons," explanations, activities, physical games, or toys. Teaching and fostering development is a primary intent of the parent's frequent interactions with the child, and as such the stimulation episodes should be more frequent and prolonged. The parent thoughtfully varies and elaborates on these activities, providing numerous opportunities, which are exceptionally advantageous to the child. He/she provides rich stimulation in terms of language and movement as well as embellishment of the potential of the physical world.

CHILD SCALES

POSITIVE MOOD

This scale assesses the extent to which the child is satisfied, content, and pleased with the situation overall. Measures of child positive affect include smiles, laughter, and positive tone of voice, as well as enthusiasm expressed with arms, legs, and body tone. Lack of positive affect may be manifested by a neutral or negative mood. Note that positive and negative mood are two independent codes and scores should be assigned based on the behaviors evident in the interaction. For example, a 3 on positive mood does not necessarily mean that the child receives a score of 3 on negative mood.

Ratings on this scale should be based on the quality and quantity of behavior. Attempt to balance both the intensity of the child's positive affect and the relative amount of time positive behavior is shown. A rating of 1 should be given to those children who exhibit almost no positive affect. A child would receive a 3 for an entire observation period of weak positive affect (e.g., contentment) with 1 or 2 strong instances of positive mood. A rating of 5 should be given to those children who regularly display high-intensity positive affect, who "sparkle".

1 = Not at all characteristic. This rating should be given to children who display almost no signs of positive mood. The child may be fussy, or largely neutral or flat throughout the interaction. Children who show fleeting interest in the interaction (e.g. brief periods of observing toys, etc.) and no clear signs of positive affect may receive a 1.

2 = Minimally characteristic. This rating should be given to children who predominately display infrequent or weak positive affect (e.g. ambiguous vocalizations, small smiles, smirks). The child may show several fleeting instances of positive affect that may be paired with few, low intensity expressions of negative affect, or the child may be characteristically pleasant, content, or satisfied throughout the observation period. At 12 months, the child may exhibit only 1 display of stronger positive affect (e.g., full smile). Contentment may be characterized by the child's sustained interest in the interaction (e.g. observing the toys, parent, etc. throughout most of the interaction) without showing any clear signs of positive affect.

3 = Somewhat characteristic. This rating should be given to children who are characteristically content, but show at least 1 or more instances of clear positive affect (e.g. full smiles, laughter). The child may also show some instances of negative mood or neutral expression.

4 = Moderately characteristic. This rating should be given to children who predominately display positive affect. The child exhibits several instances of strong positive affect (expresses enthusiasm, playfulness, smiling, and laughter) and are frequently pleasant.

5 = Highly characteristic. This rating should be given to children who are exceptionally positive in terms of physical and vocal expressiveness. This child displays

multiple instances of strong positive affect and is characteristically "happy" during the observation period. The child should truly "radiate" or "sparkle". For this rating, a child can have no prolonged episodes of flatness or strong distress.

NEGATIVE MOOD

This scale assesses the extent to which the child cries, fusses, frowns, tenses the body while crying, throws "temper tantrums," or otherwise expresses his/her discontentment. Note that positive and negative mood are two independent codes and scores should be assigned based on the behaviors evident in the interaction. For example, a 3 on positive mood does not necessarily mean that the child receives a score of 3 on negative mood.

Ratings on this scale should be based on both qualitative (intensity) and quantitative (frequency) assessments.

****If there is a false start (interaction is restarted after taping has begun) and the child displays signs of negative mood, <u>DO NOT</u> code the behavior if it is apparent that the child was negative because he/she was hungry, tired or needed to be changed. If this is not the case and the child continues to be negative when taping commences, then you should take into account the behaviors elicited during the false start****

1 = Not at all characteristic. This rating should be given to children who display no negative affect. There are no signs of strong (intense crying, body stiffening) or weak (fussing) negative affect from the child during the observation period.

2 = Minimally characteristic. This rating should be given to children who display infrequent or weak signs of negative affect. The child may display fleeting instances of mild negative affect, though the instances are more intense than in a rating of 1.

3 = Somewhat characteristic. This rating should be given to children who display one or two strong instances of negative affect or instances of negative affect are inconsistent. The child may display a mix of negative and positive and/or flat affect throughout the interaction. Child may inconsistently respond to parental attempts to soothe and longer or stronger attempts to soothe may be required.

4 = Moderately characteristic. This rating should be given to children who display stronger negative affect. The child displays two or more instances of strong negative affect or are moderately discontented ("fussy") throughout most of the observation period. Fairly consistent parental soothing is needed to calm, though the child does show some periods of calmness.

5 = Highly characteristic. This rating should be given to children who are crying and angry for most of the observation. Expressions of negative affect are much stronger and more explicit, which could include, but is not limited to more screaming, hostile verbalizations, or intense body language. The child is resistant to parental attempts to soothe and is rarely or never content or positively affective.

ACTIVITY (for use at 6 and 12 months only)

The extent to which the child is motorically active during the observation. This includes: the speed of motor activity (moving fast, squirming), the frequency of motor activity (spending a lot of time in high-energy activities), the amplitude or intensity of motor activity (shaking, bouncing or kicking vigorously), the duration of motor activity (persisting in energetic activity longer than other children). Vocalizations indicative of activity (i.e., high intensity, not including crying) are usually accompanied by some physical movement. However, there may be occasions during which a vocalization is an activity in its own right. Although, in order for it to be coded as activity, it must be child-initiated, focused, sustained, and purposeful (i.e., for the purpose of entertainment). Child-initiation is key to determining a score for activity.

High activity is typically marked by a variety of behaviors and characteristically involves whole body movement (e.g., the child may display some arm movements followed by wiggling of the body and/or high intensity leg movements—full body does not necessarily imply that the child's entire body has to move all at once, rather a succession of movement can occur and still be considered "full body" movement). Moderate to high intensity motor activity while crying or fussing (kicking, flailing arms, wiggling, etc.) can be coded as activity. If this is the only display of activity, however, then the score should be no higher than a 2. If the activity during distress is of moderate to low intensity, then the score should be a 1. If the parent is the cause of the high intensity movements (e.g., arms moving while bouncing) and that is the only instance of high intensity movement, be cautious when assigning a high activity score to the child. Remember this is a *child* code and we are interested in what the child is doing voluntarily. Parents who manipulate the child's body (e.g. shake them, move hands on toys) should not be coded as child activity. Involuntary actions (e.g. hiccups), and unsteadiness (e.g. baby is too small to support him/herself when sitting up) should also not be coded as activity.

With 6-month olds, low intensity activity may be marked by reaching, grabbing, and/or sucking on objects. Hitting and/or banging of the toys may be quite common, however, in order for hitting and banging to be considered high-level activity, the action must be high intensity and sustained.

For 12-month olds, the intensity of the activity, including speed, as well as the quantiity of the activity should be weighed carefully. Crawling or walking should not automatically be considered high intensity activities.

Examples of intensity:
Low (not an exhaustive list): passive sucking, simple holding of objects, reaching, grasping, minor hand and/or feet movements. At 12 months, low intensity activity may include simple hand movements with the toys. Behaviors may be marked by a sense of lethargy.
High (not an exhaustive list): rolling over, standing on own (no help from parent), lifting body up, crawling, sustained hitting/banging of objects, flailing of arms, aggressive kicking of legs, arching back, twisting body, etc. At 12 months, high intensity activities may include walking or crawling fast, walking or crawling while throwing, or high energy throwing. Full body activity (e.g., bouncing) should still be considered high intensity.
Be aware that these ratings are context-sensitive within each episode; different activities pull for a different level of motor activity. Structured activities may look different. Also be aware that the position of the child may also pull for different levels of activity (e.g. baby on his back or sitting in mom's lap).

Activity

1 = Not at all characteristic— A child with a score of 1 is predominately lethargic. Child typically stays still or in one place not moving arms, legs, hands or feet; sits or lies quietly. All activity, if any, is of low intensity, even if it persists for much of the interaction.

2 = Minimally characteristic—This child is below average in activity for a child of this age. More intense, self-initiated activity would be expected. However, the child is not fully lethargic as would be characteristic of a child scoring 1.

3 = Somewhat characteristic—The child may show a predominant amount of self-initiated activity. Alternatively, the child may be difficult to characterize due to a mix in activity. The child may display frequent moderate intensity activity or brief instances of high intensity activity.

4 = Moderately characteristic—The child is above average in activity. The child predominantly shows intense, sustained activity. However, the child either does not keep up the vigor of the activity or displays some periods of inactivity or low intensity activity. Activity for the most part tends to be self-initiated and is characterized by high intensity movement.

5 = Highly characteristic—This child is frequently/typically initiating movement. The child is constantly moving some body part; something is moving at all times. There is evidence of consistent high intensity activity. The activity may be varied or can be a single, sustained intense activity. The majority of activity is typically self-initiated. There may be some brief periods of moderate levels of activity, but these periods are far outweighed by hi levels of sustained activity. For example, a child can achieve a rating of "5" if he/she displays moderate levels of manipulation of an object but then escalates his/her activity level (i.e. he/she starts crawling, standing up, moving entire body, etc.).

**NOTE: Revised after consultation with Keith Crnic (12/16/03).

SUSTAINED ATTENTION (for use at 6 and 12 months only)

This scale assesses the child's sustained attention to/involvement with the physical world (i.e., objects and people). The involved child initiates contact with objects or responds with strong attention to objects or persons engaging them. In either case, the attention must be sustained. There are a variety of ways that attention can be displayed. For example, when objects are within reach, a child may seek toys out, look at them, touch them, explore them; and may comment on them. Alternatively, a child may watch intently or reach as a parent demonstrates an object or plays a game. The child seems interested in objects/people and what can be done with them. The length of possible sustained attention will increase with age. The uninvolved child may appear apathetic, bored, distracted, or distressed (e.g., frequently looking away or squirming/flailing).

Coding sustained attention in infants requires attending to gazes, facial expressions and behaviors construed as attempts to initiate contact with object or the parent. Sustained attention in infants may be demonstrated by visual tracking of objects held or moved by parents. Intensity of the sustained periods of attention should also be taken into consideration when assigning scores. Infants who focus with great intensity on an object (e.g. appears that their focus cannot be broken or is hard to break) should receive higher scores. Infants may display interest in objects by placing them in their mouths. However, the infant needs to display exploration of the object (not simple mouthing) in order for the behavior to be coded as high sustained attention. Higher forms of exploration or "complete" exploration of objects involve multiple object directed behaviors (i.e. looking, licking, twisting in hands, etc.). Higher forms of focus are marked by eye gaze matching activity (i.e. looking at the object while banging it). Be aware that these ratings are both context-sensitive and age-dependent. Monitor the parents' activities, but do not use them to determine a score. Even if the parent is intrusive in presenting toys to the child or presents the toys at a rapid rate, infants with higher levels of sustained attention will try to attend to objects and remain involved and interested. Also, keep in mind that enjoyment and interest are separate, but related constructs to higher levels of sustained attention. Enjoyment and interest in combination with sustained attention can be used for discriminating judgments regarding score assignments.

***NOTE:** Do not code sustained attention to things off camera. Only code the infant's attention to the objects, people, and/or activities in the interaction.

Sustained Attention

1 = Not characteristic—The child displays limited sustained attention. Attention is not sustained and the child typically moves rapidly from activity to activity. The child's focus is limited and displays very few attempts to initiate contact with objects.

2 = Minimally characteristic—The child exhibits some periods of attention to objects or activities, however, the instances are very brief and the intensity of the attention is weak. Periods of distraction exceed those of interest. While child may initiate contact with an object more so than a rating of "1", attention for the most part lacks initiation. A child may watch when an object is demonstrated, but mostly fails to reach or initiate contact.

3 = Somewhat characteristic---The child maintains involvement for relatively longer periods of time. However, the child demonstrates a loss of attention or exhibits less complete exploration when involved with an object or activity. Child may alternate between periods of attention and lack of focus.

4 = Moderately characteristic—For the most part child initiates or responds to objects/activity and the child sustains contact/involvement with the objects or activity. While the child may display brief instances of lack of attention, the child is clearly more involved than not. The child's attention is typically less focused or intense than a rating of 5.

5 = Highly characteristic—The child is clearly involved, interested, and focused for a substantial majority of the time. When the child is playing with objects, he/she is interested in playing with objects and the activity is sustained due to the child's intense attention. The child exhibits a thorough, sustained examination/exploration of the object or activity. There may be moments when the child glances away from the object, but they do not disrupt the flow of the interaction.

**NOTE: Revised after consultation with Keith Crnic (12/16/03).

DYADIC CODES

DYADIC MUTUALITY

This scale assesses the synchrony of the interaction and the degree of shared experience between parent and child. Essentially we are interested in the behaviors that reflect intimacy and coordination in the dyad. Dyadic mutuality may be reflected by reciprocal play, reciprocal communication and shared enjoyment. At the low end, lack of mutuality will be reflected by an interaction that is stifled, conflictual, or non-reciprocal. There may also be a veneer of intimacy evinced by a perfunctory or mechanical quality to the interaction. There may be a stifling of emotion or behaviors, which negate or reject partner behavior. Dyads who are low on this scale rarely exchange glances or shared experience during the interaction. They may negate or reject the experience or behaviors of the partner, or they may be largely disengaged from one another (e.g., playing independently, ignoring the partner's behavior or bids for attention). Dyads high on this scale almost always have a moment of shared emotion that is pleasurable. They are often engaged in the same activity and share experiences with the toys or activities (e.g., infant shows parent toy, parent comments and/or expands on the child's activity). They often show interest in and accept the bids for interaction from the partner. At the high end, there is also a clear synchronous back and forth between the partners, such that both partners are open to the behaviors and emotions of each other. The partners are in tune to each other's signals and respond appropriately.

1 = Not at all characteristic. This rating should be given to dyads whose interaction is largely devoid of any shared experience. The interactions may be characterized by one of the following three descriptions: 1) the dyad appears disengaged (e.g., play independently; sit passively, not participating; rare eye contact); 2) there is underlying conflict or ambivalence within the dyad (e.g., either partner may reject or ignore the other partner by pushing away; looking away; failing to look at the other partner when attention is sought; disapproval of the other's behavior); or 3) parent and child have very little coordinated play or emotion and appear disconnected from each other. When the interaction is "off," attempts to recover synchrony are rare and when they do occur, they are often unsuccessful.

2 = Minimally characteristic. This rating should be given to dyads that exhibit low levels of synchrony, but are not as severe in their rejection or level of ignoring the partner as evinced in a score of 1. The parent or child makes some attempts at recovery of synchrony. There is some clear evidence, although brief, of shared experience (e.g., positive affect; eye contact; acceptance of

toys/activities). There are often signs of disengagement, rejecting, or ignoring behavior by the parent or child. Or, the dyad may just be "off" in terms of timing, without exhibiting rejecting or ignoring behavior.

3 = Somewhat characteristic. This rating should be given to dyads that show a mixture of synchronous and non-synchronous behaviors. Parent and child are clearly synchronous/engaged for a period of time, but there are some instances during which synchrony is lost and not recovered. Attempts at synchrony are sometimes unsuccessful or delayed. There may be moments of tension, disengagement, or passivity by either partner making synchrony difficult. Dyads may appear to be struggling to get or keep in sync.

4 = Moderately characteristic. This rating should be given to dyads that show some break in their level of synchrony, but still are largely engaged and accepting of each other. There is an underlying warmth and appreciation between the two partners that is expressed, even without clear overt signs. Brief periods of independent play, disengagement, passivity, or rejection may be noted, but they rarely break the flow of the interaction, and the interaction is otherwise relaxed. The dyad may have one or two interchanges during which the interaction is out of sync, but there is an attempt to reconcile the synchrony of the interaction, although there may be some delay to the recovery of the interaction.

5 = Highly characteristic. This rating should be given to dyads that exhibit a clear, synchronous interaction with clear evidence of shared positive affect. Both parent and child exhibit clear interest and acceptance in one another and the shared activities. There are clear instances of mirroring and a give and take between partners. The interaction is largely enjoyable for both partners. Moments of non-synchrony are rare and when they do occur, they are very brief and the recovery is swift. There are almost no negating or rejecting behaviors by either partner, so that the interaction flows freely and maintains synchrony

Appendix Seven: Global Scale 9 and 12 Months Score Sheet

Infant's name:	**Age group:**
Maternal Sensitivity/Responsiveness:	
Maternal Intrusiveness:	
Maternal Detachment/Disengagement:	
Maternal Positive Regard/Affect:	
Maternal Negative Regard/Affect:	
Maternal Animation:	
Maternal Stimulation of Development:	
Child Positive Mood:	
Child Negative Mood:	
Child Activity:	
Child Sustained Attention:	
Dyadic Mutuality:	

9 and 12 month Score Sheet

Appendix Eight: Global Scale: 18 Months

Mother-Child Structured Interaction

Qualitative Rating Scales

Adapted From NICHD Study of Early Child Care Research Network

Modified by A. Quittner for the CDaCI study

Adapted from Quittner version by J. Baker for the Messinger Sib Study*

I. Mother Rating Scales

1. Sensitivity/Responsivity
2. Respect for child's autonomy
3. Stimulation of cognitive development
4. Detachment
5. Positive regard
6. Hostility

II. Child Rating Scales

1. Enthusiasm
2. Negativity
3. Persistence
4. Affection toward mother
5. Social interest
6. Social competence

III. Dyadic Scale

1. Affective mutuality/felt security

*Stimulation of Auditory/Linguistic development omitted. Detachment and child social codes added (adapted by J. Baker from system developed by J. Belsky, K. Crnic, et al. and used by Fenning, Baker, Baker, & Blacher, 2007 for details).

Sensitivity/Responsivity

The key defining characteristic of sensitivity is that it is child-centered. The sensitive mother is tuned in to her child and manifests awareness of her child's needs, moods, interests, and capabilities. She allows this awareness to guide her behavior with her child.

In the toddler years, developmental issues center on the child's needs for autonomy and control, independence, mastery, and self-regulation. The sensitive mother is responsive to these needs and the child's own agenda. The need for dependency on mother is present as well, and struggles between conflicting needs may be present. The sensitive mother is flexible in supporting and responding to the opposing desires that can be present simultaneously. A sensitive mother of toddlers structures her child's physical and social environment so that the child has legitimate, interesting options for play, so the child's preferences can be honored within reason, and so that the child can remain effectively engaged in playful or goal-directed activity. The sensitive mother also offers frequent praise and encouragement, withholds criticism, and provides the right mix of support and independence so that her child can experience success and pride, and develop effective self-regulation skills.

If her child initiates social gestures verbally or nonverbally (e.g., looks at mother, asks to be held, shows mother objects, speaks to mother, touches mother affectionately); makes demands, desires or requests known; asks questions or asks for assistance, the sensitive mother responds appropriately.

If the child appears disengaged, the sensitive mother takes time to reengage her child in a manner

that demonstrates awareness of and sensitivity to the child's mood and preferences for play style and content. For example, if her child is uninterested the mother may show new combinations of the toys, new activities, or other engaging opportunities; help the child decide what to get involved with; or help the child make the transition to a new activity. When her child is interested and involved with toys, the sensitive mother allows him/her to independently explore them. When the child is independently engaged, the sensitive mother will still check in with her child visually and shows that she is actively taking an interest in the child's activities.

Insensitive mothers ignore their child, respond in a listless manner, or respond with developmentally inappropriate comments and behavior. Alternatively, the insensitive mother could be overstimulating and intrusive; for example, by continuing to engage her child even when the child is providing clues that s/he is seeking to end the interaction or desires to work autonomously.

Observers must also consider the genuineness of the mother's responses to her child. Sensitivity which does not appear genuine is denoted as "apparent sensitivity." Apparent sensitivity is marked by a "disconnect" between WHAT the mother is saying and the MANNER in which she says it. This "apparent sensitivity" is belied by the mother's affect – which may be flat, unnaturally sweet, pretentious, or hyperexaggerated. Here, the observer can sense that the mother's behavior is inauthentic.

Markers of maternal sensitivity include (a) acknowledging the child's affect; (b) responsiveness to the child's talk and/or activity; (c) facilitating, but not over controlling the child's play; (d) appropriate timing of activities to reflect the child's interest; (e) changing the pace when the child appears understimulated, overexcited, or tired; (f) picking up on the child's interests; (g) shared positive affect; (h) providing an appropriate level of stimulation and appropriate range and variety of activities; (i) timely discipline that matches the nature of the misdeed and the child's ability to understand and benefit from it; and (j) general flexibility in handling compliance and autonomy issues.

1. Very Low. Mother displays no ability to sense or respond to child's emotional states or cues. This mother can be detached and aloof or overtly hostile to or rejecting of the child's emotional needs and bids for support. Alternatively, the mother may be so preoccupied with self that she appears incapable of taking the child's perspective or even perceiving what the child is feeling and thinking.

Stated differently, there is no affective attunement by the mother and the interaction is completely adult-centered. This rating is rare and is often difficult for the observer to see.

2. Low. Mother displays one of the behavioral styles described in #1, but the interaction contains instances where some sensitivity to the child's behavior or affect is present. Mother may make brief or weak attempts to respond to the child's actions or to facilitate play. The overall tone of this interaction is a failure of emotional attunement with the child, but the failure is less severe and less pervasive than #1.

3. Moderately Low. This mother's ability to read the child's emotional cues is weaker than that of the "average" mother. While she sometimes acknowledges the child's affect or appropriately responds to his overtures, there are a number of instances in which she fails to do so. Thus, the interaction is marked by several occasions in which the mother is either inappropriately adult-centered or emotionally detached. In addition, her attempts to respond to her child's emotions may seem inauthentic or "staged."

4. Moderate. The "moderate" rating is used for mothers who display inconsistent sensitivity. Inconsistent mothers exhibit equal portions of appropriate and sensitive behavior and behavior reflecting an indifference to or a lack of awareness of the child's actions or emotions. These mothers may occasionally make positive statements in a bored tone, smile in a less than genuine manner, or otherwise display half-hearted interest.

5. Moderately High. This rating is used for mothers whose interactions with her child, though on the positive side of the continuum, show a few instances of detachment, preoccupation, or adult-centeredness. This mother is "good enough" in tuning in to her child's cues, but does not exhibit the "special" quality associated with a higher rating.

6. High. This code is similar to a #7; however, the interaction lacks the consistently "exceptional" quality which is associated with a #7, generally because the observer notices instances in which the mother is inattentive or has minor lapses in responding to the child's actions or speech or acknowledging his emotions. This rating is appropriate for highly attuned mothers with some lapses in attention or affective involvement.

7. Very High. This rating is appropriate for interactions that have an "exceptional" quality which psychologists deem optimal. The mother is emotionally present throughout the interaction and is consistently and genuinely attuned to the child's emotional cues. This is demonstrated most forcefully by a sense of synchrony in the dyad between child behavior and maternal response. The mother maintains interested eye contact, and the interaction is marked by warm smiles and a feeling of emotional intimacy and respect. This being said, do not wait for a "perfect" mother before giving this rating – if you cannot pinpoint something which the mother "missed" during the interaction, a #7 should be assigned.

Mother's Respect for Child's Autonomy:

This scale reflects the degree to which the mother acted in a way that recognized and respected the validity of the child's individuality, motives, and perspectives in the session.

A mother scoring low on this scale would be very intrusive in her interventions with the child, exerting her expectations on the child in a way that makes the child a satellite or servant of the mother rather than a mutually negotiated relationship, or implicitly defining her interactions in terms of a win-lose power struggle in which compliance by the child makes mother the winner and the child submissive. Mothers may intrude either harshly or with affection; in either case, her actions do not acknowledge the child's intentions as real or valid and communicate that it is better and safer to depend on her for direction than to attempt individuality.

In contrast, a mother scoring high on this scale acknowledges the child's perspectives and desires as a valid part of the child's individual identity. A mother scoring very high does this explicitly by negotiating rules with the child, verbalizing her acknowledgement of the child's intentions, does not deny the child's right to those desires, and models her own identity and the validity of her own desires in the way she expects the child to respect her individuality, too. Note: Mother can get a low score just by denying the child's individuality strongly (e.g., interrupting the child, doing things before the child can on his/her own, etc.) even though it is not interrupting the child's behavior.

1. Very low. Mother completely denies the child's individuality in the techniques she uses. Mother is very intrusive, physical and forceful in controlling the child.

2. Low. Mother strongly denies the child's individuality, but there are a few opportunities for the child to experience autonomy, whether by variation in mother's approach or simply by occasional absence of maternal controls over the child. Mostly, however, this mother's style denies the child's autonomy and mother is intrusive.

3. Moderately low. Mother does not completely deny the child's individuality, but she effectively communicates that the child's intentions do not have validity compared to her own

intentions for the child. She also intrudes strongly on the child's behavior, giving him/her little chance to do anything on his/her own.

4. Moderate. Mother shows moderate respect for child's autonomy. She is moderately intrusive. Although mother does not deny the child's separate identity, she does very little to support the validity of the child's individuality. She might communicate doubts to the child about the appropriateness of having his/her own intentions, or intrude abruptly on the child several times.

5. Moderately high. Mother does allow the child some autonomy of intentions, but she does not actively support and reinforce this perspective in the child. She may reflect the child's intentions and ideas by engaging the child, but she also exerts her will at times over the child in a way that shifts the child's perspective.

6. High. Mother respects child's autonomy. She is not intrusive over the child; instead, she acknowledges the child's intentions, communicates trust in the child's individuality, and allows a mutually negotiated interaction.

7. Very high. Mother very clearly interacts with the child in a way that acknowledges the validity of the child's perspective, encourages the child to acknowledge his/her intentions, and to negotiate the course of interactions in the session. This mother also models her individuality to the child in these negotiated interactions and may insist on the importance of her interventions being followed, but she does so while acknowledging the reality and validity of the child's differing perspective and never in an intrusive manner.

Stimulation of Cognitive Development:

This scale measures the degree to which the mother tries to foster her child's cognitive and mental development. A stimulating mother may take advantage of any activity to stimulate development. She will consistently instruct the child and/or engage in a variety of explicit activities with the intent to facilitate learning, development and achievement.

The focus of this scale is on the mother's effortful teaching that may ultimately enhance perceptual, cognitive, and linguistic development.

Behaviors characterizing stimulation include: (a) talking about and demonstrating aspects of the toys or physical world (such as explaining what can be done with a stencil), (b) focusing the child's attention on the unique attributes and perceptual qualities of objects (i.e. their colors, how they move, what they can be used for); (c) suggesting more sophisticated play activities (e.g., "why don't you try..."); (d) verbally responding to and expanding on what the child says; and (e) encouraging the child to actively engage in play with the toys. Mothers simply focus or encourage should not be given the highest scores. Highly stimulating mothers (a) help their children acquire or master new skills, (b) illustrate or teach concepts or principles, (c) ask questions that encourage problem solving, (d) encourage or reinforce sophisticated pretend play sequences, and so on.

If the topic or mode of stimulation is poorly matched to the child's developmental level or interest, then the mother's behavior is not seen as stimulating development, because it is unlikely to affect the child's cognitive development. For example, efforts to teach a 3-year-old to print his name, when he cannot yet hold a pencil and does not want to try, are not cognitively stimulating.

1. Very Low. Mother provides no cognitive stimulation. The mother makes no attempt to stimulate or teach the child anything. She either is totally uninvolved or fails to provide any information about the toys or situation.

2. Low. Mother occasionally provides weak stimulation.

3. Moderately Low. Mother provides some stimulation with some of the toys, but most of the interaction is not characterized by cognitive stimulation.

4. Moderate. Mother provides cognitive stimulation during much of the session, but overall she does not stimulate a higher level of mastery or sophistication in the child (i.e. features of stimulation required of the higher scorers).

5. Moderately High. Mother provides stimulation throughout the session, some of which stimulate a higher level of mastery or sophistication, but there are some periods in which it is infrequent and does not exhibit features of the higher scores.

6. High. Mother provides cognitive stimulation that clearly seeks to stimulate a higher level of mastery, understanding, or sophistication and does so during most of the session.

7. Very High. Mother provides cognitive stimulation that clearly seeks to stimulate a higher level of mastery, understanding, or sophistication and does so consistently throughout the session.

Detached Manner

The detached parent appears unaware of the child's needs for appropriate interaction to facilitate involvement with objects or people, or the parent is unable to provide such interaction. Parent is disengaged from the child.

Behaviors typical of detached parents include not facing or making eye contact with the child, and/or not talking to the child. This parent does not react contingently to the child's vocalizations or actions, and does not provide the scaffolding needed for the child to explore objects or complete tasks. Detached, under stimulating parents "miss" the child's looks towards them or reaches towards a toy, and their timing is out of synchrony with the child's affect and responses (although not the overwhelming barrage of stimulation that intrusive parents present). The detached, under stimulating parent is passive and his/her non-involvement lacks the alertness of that of the sensitive parent.

Detachment and under stimulation can be marked by putting the child so he/she faces away from the parent; presenting toys without first engaging the child, or without showing, or explaining to him/her how to manipulate or use the toys; rarely talking to the child; not responding to the child's comments, smiles, or reaches for toys; an unawareness of the child's capabilities and developmentally appropriate activities; positioning the child so that he/she cannot reach, manipulate, or use a toy. Behaviors such as cleaning, soothing, talking to, or feeding the child are carried out in a mechanical, detached, distant manner without social interaction. Parents ignore the interesting things the child does, and let the child play unsupervised. Simply going through the motions when interacting with the child. Also, think about bids for interaction on the part of the child toward the parent; the detached parent will remain detached even in the face of these.

A parent is not necessarily detached if he or she is not interacting with or actively involved with the child. A sensitive parent will give the child space to explore and to be independent. A parent should not be rated for detachment if he or she continues to monitor the child while not interacting, waiting for optimal times to make comments, structure, or actively interact.

Detached Ratings

1. Very Low. No signs of detachment. Parent is invested during interactions and is attentive and interested when not actively interacting with child.

2. Low. There are one or two instances in which parent appears to be slightly disinterested and/or detached, but is generally clearly involved.

3. Moderately Low. Parent has a few instances of clear detachment when child is playing independently or shows some mechanical interactions with child, but is generally responsive when the child bids and is interested and involved during most of the period.

4. Moderate. Equally detached and involved -- The parent demonstrates the ability to remain involved and interested in the child as well as demonstrating the tendency to act in an uninterested or detached manner. Difficult to characterize.

5. Moderately High. Parent is relatively more detached than involved. Parent may show periods of involvement but these are outweighed by periods of detachment. Some opportunities for involvement and/or child bids are missed or responded to in a perfunctory manner.

6. High. Mother is detached most of the time. She generally does not initiate interactions with the child and interactions are mechanical or distant in nature. Mother misses several opportunities for involvement and/or child bids.

7. Very High. Parent shows extreme detachment and disinterest. Virtually all interactions are bland and distant and parent attempts to avoid interactions with the child. Parent misses and/or dismisses clear bids from the child.

Positive Regard for the Child:

This scale rates the mother's positive feelings toward her child expressed during interaction with him/her. Positive regard can be demonstrated when mother displays warmth, acceptance and respect for her child.

It is evident when the mother listens, watches attentively, looks into her child's face when talking to him/her. Mothers who give praise without a warm tone as well as those who fail to praise when the opportunity presents itself, would not receive the highest score. Markers of positive regard include: (a) speaking in a warm tone of voice; (b) hugging or other expressions of physical affection; (c) smiling; (d) laughing with the child; (e) enthusiasm about the child; (f) praising the child; and (g) clear enjoyment of the child. Ratings on this scale are based on both QUALITY and QUANTITY of positive regard.

1. Very Low. Mother gives no indication of positive feelings toward the child. There is no affirmative evidence of warmth, enthusiasm or affection on the mother's part. While such a mother may exhibit some hostility, this is not a requisite for a rating of #1. This rating indicates the absence of warmth for and enjoyment of the child; it does not connote actual hostility.

2. Low. Mother exhibits minimal evidence of positive feelings or regard for her child. This mother may occasionally praise the child, speak in a warm tone, smile at the child or otherwise minimally display warmth or affection, but these displays are infrequent.

3. Moderately Low. Less than an "average" degree of affection and respect for the child is shown. Mother misses obvious opportunities to praise the child, and signs of affection (attentive listening, smiling) are weak or half-hearted. The overall feeling is that the mother lacks the enjoyment of and respect for the child that would characterize an "average" mother. However, there are several occasions on which the mother appropriately expresses warmth toward and acceptance of her child.

4. Moderate. A score of "moderate" is appropriate in cases in which the mother shows inconsistent warmth and affection to her child – that is, she alternates between accepting and warm versus "neutral" attitudes during the observation period. As in the Sensitivity scale, a mother whose affect or bodily cues are inconsistent with her verbal expressions of praise or affection is assigned

this score. Note that excessiveness of praise or other expressions of positive regard is often an indicator of inauthenticity.

5. Moderately High. This rating is given to the mother whose displays of affection/praise/warmth fall on the positive side of the continuum; however, there are some lapses in her behavior and affect toward the child. Though generally displaying respect/enjoyment, there are several occasions in which she displays less than optimal regard for the child. She may occasionally speak in a detached tone of voice, fail to listen to the child, fail in making appropriate eye contact, fail to respond to the child's expressed preferences or otherwise communicate that the child does not enjoy her full respect and acceptance.

6. High. This mother clearly enjoys her child and accepts and respects the child for who he/she is; this is evident in her affect and behavior. The #6 score is given when such a mother has a minor yet clearly perceptible lapse in behavior – that is, the observer can point to a specific instance in which positive regard was absent. This mother may have a moment of self-absorption or "mechanical" responsiveness to her child, or fail to praise the child when it seems appropriate to do so. In addition, the #6 score is used for the very capable mother who has done nothing "wrong," yet who does not display the degree of "clear enjoyment" and acceptance of her child that is necessary for a rating of #7.

7. Very High. This rating is used when the mother consistently displays the markers of warmth/acceptance/respect noted above. This mother attentively listens and responds, makes appropriate eye contact, appears to enjoy being in the presence of her child. Even on occasions in which the child is inattentive or uncooperative, the mother is accepting and respectful of her child; that is, her regard for the child is unconditional.

Mother Hostility

This scale reflects the mother's expression of anger, discounting or rejecting of the child. A mother scoring high on this scale would clearly and overtly reject the child, blame him or her for mistakes, and otherwise make explicit the message that she does not support the child emotionally. A mother scoring low on this scale may be supportive or cold, but she does not blame or reject the child. A rejecting mother may also show some Sensitivity (and the inconsistency of her behavior would be revealed by these two scores). Given the low frequency and the clinical relevance of rejecting one's child during a videotaped session, any events which are clearly hostile should be weighted strongly in this score.

1. Very low. Mother shows no signs of rejection. She may or may not be supportive, but she does not try to put down the child or avoid the child in rejecting ways. Passive or emotionally uninvolved mothers would be included in this scale point if the mother did not reject the child or communicate hostility toward the child.

2. Low. The mother conveys a little hostility once or twice. The messages are not overt but muted forms of hostility (e.g. pulling away, pulling something away from the child with a jerk, brief displays of exasperation, looking at the child coldly for a brief time, teasing with a negative content but with accompanying humor or warmth, parroting or mimicking the child). Or, the mother shows a diffuse level of discontent, discomfort, or boredom, but it is not directed at the child.

3. Moderately low. Signs of hostility again are very fleeting, but they occurred on several occasions during the session, and at least one sign could be identified as clear and overt or an accumulating sense of unexpressed anger and avoidance toward the child was seen in the mother's behavior.

4. Moderate. Several instances of hostile or rejecting behaviors are seen. Two or more of these events are reliably clear to observers, but expressions are brief and do not set the tone of mother's interactions immediately following the episodes.

5. Moderately high. Mother is overtly rejecting or hostile several times. Behaviors include overt and clearly communicated rejections of child and expressions of hostility or anger which appear intermittently

through substantial periods of the session. This mother's behavior is more rejecting than not, either by the frequency of hostile behavior or by the potency by which rejection is communicated several times in the

session.

6. High. This mother has frequent expressions of rejection and hostility directed toward the child. There is little or no effort to show warmth during substantial portions of the session, especially after mother becomes irritated with the child (i.e., mother may initially be warm and then rejects the child strongly). Mother is frankly and directly rejecting and hostile (e.g., telling the child she will leave him/her behind if he/she does not do the task, using negative performance feedback but little positive feedback, blaming the child for incompetence on the tasks, and overtly refusing to recognize the child's success, e.g., "You couldn't have done it without me showing you!"). Any warmth seems superficial related to the mother's distancing from the child; rejection is used as a control technique against the child.

7. Very high. This mother shows characteristics of the previous scale point, but expressions of anger toward the child also are accompanied by strong, barely controlled emotions, suggesting the possibility of physical abuse and neglect of the child in some situations.

Child's Enthusiasm:

The child acts with vigor, confidence, and eagerness to do the tasks. Child takes an active interest in his/her activities, invests effort in them (although not necessarily very persistent), and appreciates successes. Enthusiasm involves both a sense of agency and coordination between affect and behavior. Child should appear well integrated in the sense of directing his/her energy into activities without conflicting motivations or repression of feelings and with confidence that everything is okay. Enthusiasm must be scored for goal-oriented behavior on the tasks (insofar as mother defines these as goals of the situation). Other goals or expressions of excitement may be in service of distracting the mother, winning approval, etc., and would not represent enthusiasm here.

1. Very low. Child shows no enthusiasm. Child seems hesitant to engage problems or does so "mechanically" and with no evidence of being interested in or excited by his/her performance (although this child may nonetheless be distraught over failures). Child shows extreme lack of confidence in his/her behavior and is affectively restrained.

2. Low. Child is generally not enthusiastic. Child does take some active interest in his/her activities and becomes engaged for brief periods, but is mostly restrained.

3. Moderately low. Child shows some clear moments of enthusiasm and active engagement in her/his activities but primarily she/he does not engage the situation in this way.

4. Moderate. Child shows a mixture of enthusiasm and restraint or superficiality of effort. This may occur because the child is very slow in "warming up" to the potential of the situation or because his/her enthusiasm waxes and wanes and is not reliably invested in the activities.

5. Moderately high. The child is basically interested in the activities and is enthused for much of the session about these or related activities. There is a sense of harmony between affect and behavior in the child's enthusiasm, but child also has periods in which this is not the case.

6. High. Child demonstrates enthusiasm and coordinated affect and behavior for most of the session with only brief and minor periods in which this is not so. The child is quite eager and confident in approaching the activities and enjoys her/his accomplishments.

7. Very high. Child shows high enthusiasm in activities throughout the session. Child approaches goals eagerly, and with some persistence when she/he encounters difficulties, and the intercoordination of affect with behavior gives the child a notable sense of energy in all activities. Child seems to have great confidence that the situation will turn out well and that she/he can trust in her/himself and the support of her/his mother without fear that something "bad" will happen. Child clearly "jumps" on tasks with eagerness and wants to get involved.

Child Negativity:

Child negativity is the degree to which the child shows anger, dislike, or hostility toward the mother. At the high end, the child is repeatedly and overtly angry at her, e.g., forcefully rejecting her ideas, showing angry and resistant expression, pouting, or being unreasonably demanding or critical of her. For the lowest rating, there are neither overt nor covert signs of such anger. Expressions are essentially positive toward mother whether or not the child is compliant or much involved with her. Low ratings may include brief instances of frustration or rejections of mother's help.

1. Very Low. Child shows no signs of negativism. She/he shows through consistently positive interactions toward the mother that s/he has a truly positive relationship toward her and feels no abiding anger toward her.

2. Low. Child shows no clear indications of negativism, but the tone of some interactions is less positive than one would desire in an ideal relationship toward the mother.

3. Moderately Low. Child is negativistic only briefly in any overt fashion, but these suggest some noticeable anger and resistance in the child's interactions with mother.

4. Moderate. Child shows clear negativism toward the mother on several occasions or one significant occasion, but these are rather isolated episodes separated by periods in which the child behaves quite positively toward the mother.

5. Moderately High. Child is frequently negativistic or a few instances of strong or intense negativism, but these are not predominant in the interactions.

6. High. Child's anger is a predominant aspect of their interactions, but it is shown in more sporadic and generally subtler ways than in #7.

7. Very High. Child is repeatedly and overtly angry or resistant toward the mother. The degree of anger here seems so strong that the child cannot disguise it in subtler ways for long, but it repeatedly appears in her/his interactions with her.

Child Persistence:

This is a measure of the extent to which the child actually was involved with the toys in the session. At the low extreme, the child shows no involvement with any of the toys, refuses to become involved and either flees or spends his/her time in off-task activities, or is involved only to the extent that mother enforces his/her attention to her directions and responds to her questions about the task. At the high end, the child is actively engaged with the toys and plays persistently either directly on his/her own or through mother's mediating suggestions (regardless of how good the child or mother's skills really are). The child may be either sober or playful; persistence does not necessarily include enthusiasm. The child may be responsive or not to the mother's directions as long as s/he shows motivation toward engagement with the toys. Although the child's degree of attention to the toys may depend greatly on the mother's efforts to keep the child interested, the observer should consider this rating to reflect the child's involvement with the toys regardless of the degree to which mother was instrumental in creating the persistence.

1. Very low. Child displays no involvement with the toys. S/he seems to want no part in this play activity.

2. Low. Child is engaged with the toys but always superficially and never with effort or concentration.

3. Moderately low. Child plays with some persistence or concentration but s/he has no long periods of concentrated play.

4. Moderate. Child sustains some long periods of involvement with the toys, but clearly loses interest for some periods of time.

5. Moderately high. Child devotes relatively large periods of attention to the toys and plays with regularity. S/he gives sustained attention for periods of time with clear involvement. His/her persistence occasionally wanes.

6. High. Child persists in play activities across most of the session. S/he loses interest or concentration only briefly within an overall pattern of involvement with the toys.

7. Very high. Child is persistent virtually throughout the session.

Note: A child who plays much of the time because of constant efforts by the mother to return the child to play should not get a 6 or 7 score, even though the child was engaged with all the toys. An initial lack of attraction to one of the toys should not in itself preclude the rating of 6 or 7.

Child's Affection Towards Mother:

This scale reflects whether there was a substantial period of positive regard and sharing of happy feelings of the child toward the mother. Although the child also might become angry or avoid the mother elsewhere in the session, a high rating still could be given if some portions of the session met the criteria of this scale. The criteria of this scale are evidences that the child approached and attempted to share positive affects with the mother. (Note: The intensity of expression is not particularly relevant to this rating, but rather the frequency with which the child shares positive affect with mother--looking at mother, making eye contact and smiling, and other "approach" behavior affectively.)

1. Very low. Child clearly does not attempt to share experiences with mother. Signs such as failure to make eye contact with mother when expressing happiness, directing expressions of success to the experimenter but not to the mother, and similar clues can be used as evidence that the child attempts little sharing of feelings with mother.

2. Low. Child has very minor incidents which seemed expressive of positive regard toward mother and from which one might infer some positive feelings are expressed toward her. Yet, child largely shows no positive regard toward her.

3. Moderately low. Child shows some positive regard but it is brief or mixed in quality. Possibly, child seems ambivalent in such expressions.

4. Moderate. Child shares some of his/her happy expressions with mother but, again, these are only minor elements of interaction and are not sustained by the child for more than a moment at a time. Thus, the behaviors are expressed repeatedly and/or clearly, but do not reflect a period of the child closely sharing his or her affect with the mother.

5. Moderately high. The child has one or more periods in which he or she sustains in expressing positive regard and sharing happy expressions with the mother. The child seems to maintain the positive regard toward the mother sufficiently to allow a "bout" of sharing positive expressions with the mother. During such a bout, the child also does not seem to shy away from

having an emotional bond with the mother (although this may happen at another time in the session).

6. High. The existence of a "bout" of sustained positive expression and sharing these feelings with the mother is quite clear in terms of: a) the duration of such interaction for at least a couple of minutes, and b) the lack of ambivalence in the child's expression of feelings toward the mother. Clearly this child was expressive, warm, and engaging of the mother for at least one substantial period of the session.

7. Very high. The child demonstrates a very positive, engaging and sharing relationship toward the mother for a substantial period of the session. This pattern is of long duration although it may not occur again if the mother and child begin having problems. Nonetheless, the child's relationship with the mother seems very warm and positive for a major portion of the session.

Social Interest

The degree to which the child initiates social interactions with the parent and responds to their social initiations. Frequency, intensity, and variety of initiations and responses are considered. Behaviors must be construed to have social interactive intent. A child who spends most of the time demanding to be held, although this is technically initiating, will not receive a high sociability score. The following behaviors are considered initiating behaviors: looking at parent (when preceded by a parent behavior eliciting looking), looking and/or commenting, looking at parent and pointing, offering parent an object (spontaneously, without prompting), approaching parent, and inviting parent to participate in play or activity.

Social Interest Ratings

1. Very low. No social initiations by child and no responsiveness to other's overtures.

Oblivious to social environment; engaged in own activity, including non-activity, for most of the observation.

2. Low. Social initiations by child are extremely rare or ambiguous. Child is largely uninterested in other people. Child is generally engaged in own activity. May be one or two brief, low intensity responses (e.g., a look) occasionally, but these occur exclusively in response to persistence on part of the parent.

3. Moderately low. Social initiations by child are somewhat rare or ambiguous. Child is relatively uninterested in other people. Child is usually engaged in own activity. May be some responses of moderate intensity (sustained looking, short comments), but these usually occur in response to some persistence on part of the parent.

4. Moderate. Child may initiate (e.g., looks, comments), but less frequently than a 4 or 5. Child typically responds to other people; initiations lack intensity and responses to others are lacking in spontaneity.

5. Moderately high. Child initiates (e.g., looks, comments) frequently, with more

persistence or intensity, and/or demonstrates more spontaneity than a rating of 3, responses to others' bids are also often timely and contingent.

6. High. Child initiates a great deal, using a variety of signals. Child appears to desire social interaction for the majority of the period. Multiple instances of child directing social situations, signaling to other people, and responding to their initiations. Child clearly initiates and responds to social bids (if developmentally appropriate on the parent's part), such as smiling, waving, commenting, looking, pointing, and approaching.

7. Very high. Child shows almost constant interest in social interaction, and very little interest in not interacting . Child is constantly directing social situations, signaling to other people, and responding to their initiations. This level of social interest may appear unusual in that the child may appear to be uncomfortable not interacting. This code is very rare. Remember that the child must be directing the parent with a social goal.

Social Competence

The degree to which the child demonstrates competence in his or her social interactions with the parent. This code does not measure the frequency of social initiations or interactions, nor the child's interest in interacting, but rather the competency demonstrated when choosing to interact with the parent. For example, a child can be very interested in interacting with his or her mother, but do so in a negative, demanding, or otherwise difficult manner (and would therefore receive a low score for this code). Conversely, a child can have a low general interest in interactions, but can demonstrate competence during the few interactions that occur. Competence includes behaviors such as those indicating that the child has successfully read the parent's social cues (e.g., non-verbal or verbal), politeness, cooperation, empathy, helpfulness, turn-taking, sharing, appropriate inhibition of behavior, appropriate attention to parent, listening, prosocial non-verbal behavior / posture, and other prosocial behaviors. A child should be marked down on social competence for the demonstration of poor social skills, such as aggression, hostility, haughtiness, demandingness, intrusiveness, socially-detrimental impulsivity, and other disruptive behavior.

Social Competence Ratings

1. Very low. Child exhibits no socially competent behaviors during interaction with the parent. Several socially inappropriate behaviors occur.

2. Low. Of the interactions in which the child participates, some involve a few low-level competent behaviors with the parent (e.g., may cooperate briefly or show some appropriate non-verbal behavior) but child generally exhibits inappropriate behavior.

3. Moderately low. Child is generally less competent than competent in interactions. Child demonstrates several competent behaviors varying in level of competence, but child still lacks prosocial behavior more than demonstrates it and is generally more inappropriate than competent during interactions.

4. Moderate. Child demonstrates approximately equal levels of competent and socially-inappropriate behavior. Child may have many prolonged instances of competent behavior, but also demonstrates similar periods characterized by inappropriate behavior.

5. Moderately high. Child's exhibits more competent behavior than not, in interactions with parent. Child demonstrates some inappropriate behavior, but interactions are generally characterized by the prosocial behaviors noted above.

6. High. Child is consistently competent in interactions. Very few instances (one or two) of less than competent behavior can be noted, but child is generally characterized as very competent.

7. Very high. Child exhibits competence consistently in every interaction with parent. Socially inappropriate behavior is completely absent and there are no clear missed opportunities for prosociality.

Affective mutuality/felt security:

This scale assesses the availability and mutuality of emotion between the child and parent and how secure the child feels with the parent. There is an emphasis on the child having a sense that the parent has his/her own best interests in mind. When assessing mutuality of affect, it is necessary to evaluate both **verbal** and **non-verbal** communication of one another's affective states. Open and free communication will be marked by emotion exchanged and a sense of personal involvement and engagement. The child appears free to express positive or negative emotions or feelings and a close emotional bond between the two is evident. At the low end, closed communication or lack of mutuality will be reflected in an interaction that is stifled or non-reciprocal.

The rater must be alert to the exchange of emotion and the subtle cues by which emotion and emotional connection are conveyed – facial expressions, gestures or movements, body positioning, eye contact, vocal inflections. Essentially, we are interested in behaviors which reflect on intimacy in the dyad. That is, we are assessing the dyad's attunement and responsiveness to one another's feelings (affect), thoughts, moods and preferences. Markers of a high score include (a) a sense of synchrony in the parties' interactions and communications, (b) mirroring of one another's actions, expressions or vocal patterns, (c) naturalness and a demeanor of relaxation in the interaction, (d) physical closeness (when the child is old enough to move away), (e) frequent eye contact, (f) open sharing or expression of emotions (verbally or

physically). Dyads high on this scale almost always have a moment of shared emotion that is pleasurable.

At the low end, we see a pattern in which the parent stifles the child's emotions through "dampening behaviors" which avoid or negate the expression of emotion. Dampening behaviors include ignoring the child or changing the subject when the child expresses his feelings; frowning or other negative facial expressions when the child expresses emotion and verbally rejecting/refuting the child's expressions about his experience ("Don't be such a baby."). Alternatively, we may see a complete disengagement with one another in terms of emotional exchange, warmth or personal involvement. There may also be conflict or tension between the mother and the child, which the parties do not make an effort to repair, discuss or alleviate. In dyads with low scores, there may be a veneer of intimacy or mutuality masking an impoverished experience; the emotional experience of the parent may be quite different from that of the child.

The rater will need to distinguish between affect that is muted or deemphasized because of the mothers' focus on task (but which still regards the child's feelings) and that which has as its purpose to stifle emotional expression. In the former, dyads which are otherwise open and expressive may be genuinely and highly engaged in a cognitive task (e.g., a puzzle). In the latter, the mother's focus on task may be predominant, and in disregard of the child's emotional cues; these mothers communicate well on a cognitive level, but are relatively poor at emotional communication.

It should be noted that this is a dyadic scale in which the child's age and developmental level play a role. Very young children generally have a limited ability to attend to the mother's emotional state and to respond in a reciprocal manner. They have generally not yet developed the attentional and interactive skills which underlie a mutual, intimate and open emotional relationship. Thus, dyads with younger children will, on average, have lower mutuality scores than those with older children. This being said, dyads with younger children in which there is a great deal of eye contact and a high level of shared emotion are not precluded from receiving the higher scores.

7. Very High. There is a sense that experiences (whether positive or negative) are shared, that the parent shows a response to the child's emotion and vice versa. There is a sense of synchrony and mutuality in the way that the parties interact. Smiling back and forth usually takes place; eye contact occurs when the child or parent seeks it. With older, more verbal children, there may be personal exchanges such that the child uses "I" statements to talk about

feelings. With these more verbal children, there may be reflections on the experience with the toys (e.g. "this is hard" or "this is silly"), that are responded to in a fashion that supports the mutuality observed in the dyad. Generally, there are several sustained bouts of reciprocally communicated, positive emotion shared by the partners.

6. High. Similar to number 7, though a somewhat less active and overt exchange of emotion is noted. There may be a minor lapse in the mother's attunement to her child's affective state. There is an underlying sense of warmth, appreciation and personal involvement between the two that is expressed less dramatically or with fewer overt signs than a score of 7.

5. Moderately High. The parties communicate in a relaxed manner, but the mutuality and openness of their emotional communication does not have the intimate and exceptional quality seen in the higher scores. The parties have a good relationship, but the quantity and/or quality of the "markers" of high mutuality are lower than in the higher scores. The parent and child may have an interchange in which the mother fails to acknowledge the child's emotional experience (e.g. frustrated child, mother ignores), but there is an attempt to repair the affective breach. Generally, there is at least one bout of reciprocal sharing of positive emotion.

4. Moderate. These dyads show a mixture of warmth and personal involvement, on the one hand, and either restrictive, tense, or disengaged behaviors, on the other hand. There is somewhat less intimacy than one would expect in an interaction between a parent and a child. The parent may sometimes ignore or fail to validate the child's expression of frustration or anger (dampening of affect); there may be an effort to "accentuate the positive" in disregard of the child's need for validation of his experience. Despite these periods of misattunement or less than optimal engagement, however, there is a sense the dyad also likes each other, but that they are struggling a bit to figure it out.

3. Moderately Low. There are no bouts of positive emotion shared between the two. Although the parties maintain an emotional connection, the expression of emotion, more often than not, is either avoided or is somewhat negative or hostile in quality. The parent may often ignore or discourage the child's expression of his feelings or experience of the session. Alternatively, the child may often fail to respond to the mother's efforts to interact. The child's behavior may (as in the lower scores) take on an anxious or detached quality, suggesting a fear or recognition that s/he cannot count on the parent for assistance. The child rarely initiates bids for security or parent affect. There are also moments of warmth, but these are infrequent and occur under minimal stress.

2. Low. These dyads share the characteristics of number 1, but with some expressiveness and warmth at limited times. The parent may be threatened by the child's emotion and may frequently disengage with or reject the child if the child makes bids for assistance, support or emotional connection.

1. Very Low. These dyads are most often entirely disengaged around emotion. There is very little attention to each other in terms of warmth or personal involvement; it is as if they have no familial relationship at all. Dampening statements may even be absent, since these dyads have no emotional connection. Alternatively, there may be underlying conflict or hostility, causing the parties to ignore one another's affective bids or actively avoid a mutually enjoyable experience of the session. Rarely, these dyads display emotion in a non-reciprocal or inauthentic manner. In the non-reciprocal dyad, the child's expression of fear or need might be met with laughter; the child's joy might be met with indifference (or vice-versa). In the emotionally inauthentic dyad, a veneer of intimacy or a staged-like quality masks an impoverished experience for the parent and child.

Appendix Nine: Global Scale 18 Months Score Sheet

Infant's name:	**Age group:**
Maternal Sensitivity/Responsivity:	
Maternal Respect for Autonomy:	
Maternal Stimulation of Cognitive Development:	
Maternal Detachment:	
Maternal Positive Regard:	
Maternal Hostility	
Child Enthusiasm:	
Child Negativity:	
Child Persistence:	
Child Affection toward Mother	
Child Social Interest	
Child Social Competence	
Dyadic Affective Mutuality/Felt Security	

Appendix Ten – The number of infants who did not express Distress or Delight during interaction

	9 Months		**12 Months**		**18 Months**	
	Delight	Distress	Delight	Distress	Delight	Distress
SibsA	3	3	1	1	0	2
TD	3	3	2	2	4	2

Appendix Eleven - Median proportion of maternal speech functions at nine, twelve and eighteen months, average deviation, U score, significance and effect size.

Function of Maternal Speech	9 months					12 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Mand Model	1.7 (1.33)	0 (0)	13.5	.015*	.59	0 (1.32)	0 (.19)	35	.32	-
Conventional Social Expression	0 (.63)	0 (0)	20	.039*	.50	0.7 (.53)	0 (.31)	28	.12	-
Labelling	4.3 (3.24)	0 (1.15)	20.5	.115	-	4.1 (3.15)	2.75 (2.14)	44	.94	-
Filler	13 (3.68)	9.5 (4.26)	25	.290	-	11.4 (4.07)	8.8 (4.16)	33	.33	-
Non-speech Vocalisation	9.2 (4.52)	9.25 (5.06)	31	.630	-	11.8 (5.74)	7.45 (3.68)	34.5	.39	-
Song/Story/Rhyme	2.9 (3.34)	0 (2.52)	17.5	.060	-	3 (3.66)	.38 (1.92)	25	.097	-
Inaudible	0 (0)	0 (.19)	27	.122	-	0 (.52)	0 (.35)	42	.767	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Function of Maternal Speech	18 months				
	TD Mdn (AD)	SibsA Mdn (AD)	U	Sig.	ES
Mand Model	2.4 (1.49)	.70 (1.44)	35.5	.420	-
Conventional Social Expression	0 (.49)	0 (2.6)	39.5	.604	-
Labelling	0.90 (0.68)	1.1 (2.5)	36	.450	-
Filler	15.1 (5.1)	15.3 (4.07)	43	.870	-
Non-speech Vocalisation	2.8 (3.38)	4.05 (3.95)	37.5	.540	-
Song/Story/Rhyme	.95 (1.47)	0 (.16)	13	.005*	.65
Inaudible	0 (.25)	0 (.18)	43	.819	-

(*= p<0.05, **= p<0.01 2-tailed significance)

Not included in the table is the code 'No Vocalisation', as this data is relatively meaningless when presented as a proportion of maternal utterances. Rather, the duration of maternal speech was presented in the 'Syntax' section of Chapter Seven. Also not presented is the data relating to the 'Speech to Other' category, as this was rarely coded, and by definition it was not a part of the speech that mothers directed towards their infants. It was included as a category to allow the RA to distinguish between speech directed to the infant and speech directed to the PI. In this way, there was no concern that maternal speech directed toward the PI could be mistakenly coded as speech directed to the infant.