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Exploring Motivation for Social Interaction in Children with Autism

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ABSTRACT

Exploring Motivation for Social Interaction in Children with Autism

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Autism was originally described as involving an apparent lack of *motivation for social interaction*[1]. Social motivation has not figured prominently in subsequent theorizing regarding this disorder. Instead, theory of mind deficits have taken center stage as a theory of autism. This is surprising because evidence of social motivation deficits appear early, and might prove to be both specific to, and universal in, autism. The current study aimed to determine whether children with autism exhibit deficient social motivation in a controlled setting, and aimed to examine the relationship between social motivation and theory of mind competence.

Fifteen 3-5-year-old children with autism (ASD) and 17 age-matched typically developing (TD) children participated. Measures of social motivation included: looks to experimenter during free play, forced choice between social and nonsocial interaction a) with a toy and b) to obtain a desired food item, and score on the Dimensions of Mastery Questionnaire. Measures of theory of mind competence included measures of imitation, joint attention, and understanding of desire, intentionality and false belief. All tasks required minimal language skills. The Peabody Picture Vocabulary Test – Fourth Edition (PPVT-IV) (Dunn & Dunn, 2007) and the Vineland Social-Emotional Early Childhood Scales (Sparrow, Balla, & Cicchetti,1998) were also administered.

The ASD children looked at, and obtained food from an experimenter less frequently than did TD children. Parents reported that ASD children were less motivated to interact with others. ASD children were also impaired on the joint attention and understanding of desire tasks, but not on imitation, or understanding of intentionality or false belief. Few relations between performance on the social motivation and theory of mind tasks were detected. However, a significant correlation did emerge between social motivation and receptive language in the ASD group. In conclusion, the ASD group exhibited deficient social motivation. Evidence for

impairments in theory of mind was less consistent, and was not tightly linked to impairments in social motivation. The current results highlight the promise of social motivation deficits in explaining symptoms of autism.

[1] Kanner, 1943

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Dedication

This dissertation is dedicated to the memory of my grandmother, Barbara Page Fiske, for her love, support, and belief in me throughout my life and education.

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CHAPTER 1: Background

Introduction

The incidence of autism has increased over the last two decades, with some estimates currently as high as 1 in every 138 individuals (Fombonne, 2005). Autism was first described in 1943 as a disorder in which, among other traits, children were born lacking *motivation for social interaction* (Kanner, 1943). The definition of autism has since evolved and it is now defined as a complex disorder encompassing impairments in social interaction and communication, as well as an unusual pattern of restricted and stereotyped behaviors and interests (APA, 1994). A variety of theories, such as weak central coherence (Happe, 2005; Happe & Frith, 2006), executive function deficits (Ozonoff et al., 2005), and a theory of mind deficit (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002), have been proposed in an attempt to explain the impairments in autism. Evidence for each characteristic impairment is reviewed before a detailed evaluation and comparison of theories is provided.

Social Impairment in Autism

The social impairment in autism is characterized by deficits in a number of areas including social speech, eye gaze and joint attention, imitation, affective development, play behaviors, and peer relations (Bruinsma et al., 2004; Carter et al., 2005; Charman et al., 1997; Kylliainen & Hietanen, 2004; Leekam et al., 2000). Individuals with autism display a general lack of interest in listening to speech. This is particularly striking in light of the fact that

typically developing infants exhibit a preference for the human voice at birth (Carter et al., 2005). Furthermore, although quality and degree of eye gaze in this population varies with the level of functioning of individuals, the consensus in the literature is that impairment/atypical eye contact is common (Carter et al., 2005). Leekam et al. (2000) studied gaze following in preschool aged (2-5 years) children with autism. In order to do so, three phases of investigation were implemented: a baseline phase in which the experimenter turned her head to the side to look at a box during four different trials, a training phase in which the experimenter turned her head to the side to look at one of the boxes and it lit up each time, and a test phase in which the experimenter turned her head toward a box, but it would only light up if the child followed the experimenter's gaze and also looked at the box. The results indicated that, when compared to developmentally delayed peers, preschoolers with autism have difficulty following another's direction of gaze, as observed in their decreased looking at the object of the experimenter's gaze during the test phase (Leekam et al., 2000).

Individuals with autism are also more likely to avoid eye contact with others (Bruinsma et al., 2004), and less likely to coordinate eye gaze with other gestural and verbal means of communication (Carter et al., 2005). These deficits likely contribute to broader impairments in joint attention, or the "awareness of another person's orientation to an object or event in the world (Leekam & Ramsden, 2006, p. 185). Interestingly, however, although both initiating and responding to joint attentional bids are impaired, initiating joint attention appears to be more affected than responding to the joint attentional bids made by others (MacDonald et al., 2006).

Another impaired aspect of social interaction in autism involves the ability to imitate. There are many reports of impaired voluntary imitation in children with autism (Charman et al.,

1997; Hobson & Meyer, 2006). This deficit is not, however, clear cut. Some studies have found that children with autism appear to be able to engage in simple imitation with objects, while others report impairments on imitation tasks (Carpenter, Pennington, & Rogers, 2002). More specifically, Rogers et al. (2003) found that young children with autism were impaired on oral-facial imitation (e.g., stick out tongue and wiggle, make a kissy sound) and object imitation (e.g., pull duplos apart and bang together), but not on manual imitation (e.g., patting chest with one hand, open-close a hand).

Another aspect of social development which is impaired in autism is the recognition and understanding of emotions (Downs & Smith, 2004; Heerey, Keltner, & Capps, 2003). Lower functioning individuals appear to exhibit pervasive deficits in emotions, while higher functioning individuals demonstrate more specific deficits (Heerey, Keltner, & Capps, 2003). Heerey, Keltner, and Capps (2003) looked at the difference between recognition and understanding of self-conscious (e.g., embarrassment, shame) and non self-conscious (e.g., anger, fear, happiness, sadness, surprise) emotions in high functioning children with autism and Asperger's Syndrome. The children were shown pictures depicting various emotions and were asked to label the picture independently or by choosing an emotion word from a list provided to them. The results indicated that the children with autism performed equally well on the identification of the non self-conscious emotions, but performed more poorly on the self-conscious emotions (Heerey, Keltner, & Capps, 2003).

The above impairments in autism, lack of interest in social speech, poor eye contact, deficient imitation, and impaired understanding of emotions, combine to create difficulties with appropriate play and peer relations. Although typically developing children develop play skills

in the first two years of life, children with autism struggle in this area (Carter et al., 2005; Charman et al., 1997). Play in children with autism is characterized by a "lack of social engagement as well as repetitive and stereotyped object manipulations" (Carter et al., 2005, p. 321). Symbolic play, in particular, appears quite challenging for this population (Brown & Whiten, 2000). This difficulty engaging in play, especially with others, has a significant impact on these children's ability to establish age appropriate peer relationships (APA, 1994; Brown & Whiten, 2000). In fact, individuals with autism often exhibit decreased initiation of social contact with others and prefer to engage in activities of their own choosing in isolation (Carter et al., 2005).

Communication Impairment in Autism

Although we know that a qualitative impairment in communication is one of the three primary diagnostic criteria of autism (APA, 1994), an early delay or deficit in communication is not necessarily indicative of autism. Many other disorders of childhood also include such a delay (Tager-Flusberg, Paul, & Lord, 2006). Moreover, approximately 25% of children with autism have an apparently typical progression of language development until the single-word stage of language development. After that point, however, these children lose the few words that were previously acquired, a pattern that is specific to autism (Tager-Flusberg, Paul, & Lord, 2006). Evidence indicates that although individuals with autism exhibit impairments in language, language is generally delayed, rather than deficient, moving more slowly, but following a typical pattern of development (Tager-Flusberg, Paul, & Lord, 2006).

There are, however, aspects of communicative development in autism which might

indicate points of deviancy from the norm. Some examples include 1) echolalia, or the tendency to repeat, with similar intonation, words or phrases that have been heard previously, 2) confusion of personal pronouns, such as I/you, 3) unusual prosody, and 4) disproportionate difficulty with the pragmatics of language (Tager-Flusber, Paul, & Lord, 2006), including impairment in both comprehension and production of nonverbal communication (Stone et al., 1997). For example, individuals with autism are impaired in their ability to use gestures, with declarative gestures more impaired than imperative gestures (Charman et al., 2003). Although each of these deviances affects the communication of individuals with autism, approximately 80% of individuals in this population are able to communicate with others using at least single words (Tager-Flusberg, Paul, & Lord, 2006).

That said, the function of language in individuals with autism appears to differ from that of typically developing individuals. Typically developing individuals communicate for a variety of functions (e.g., commenting, engaging, gaining attention, requesting, etc.), whereas individuals with autism communicate primarily for the purpose of requesting (Stone et al., 1997). Furthermore, the ways in which verbal individuals with autism use words tend to differ somewhat from those of the typically developing population in that they are less likely to use mental state terms (e.g., know, think, etc.), more likely to use neologisms (e.g., 'falling water' to mean 'rain'), and more likely to exhibit pedantic speech (e.g., overly formal) (Tager-Flusberg, Paul, & Lord, 2006).

Restricted, Repetitive, and Stereotyped Behaviors and Interests

The third area involved in the diagnosis of autism, restricted, repetitive, and stereotyped

patterns of behaviors and interests (APA, 1994), has received relatively less attention compared to the social and communication impairments. Behaviors such as repetitive motor mannerisms (e.g., hand flapping, finger flicking), persistent interest in parts of objects (e.g., spinning wheels), restricted interests/preoccupations, and inflexible adherence to nonfunctional routines are characteristic of individuals with autism (Richler et al., 2007). Although these behaviors may be observed in typically developing individuals and individuals with other disorders, they are generally more common and severe in individuals with autism (Richler et al., 2007). There has been some debate, however, as to the presence of such behaviors in very young children with autism (Chawarska & Volkmar, 2005; Richler et al., 2007; Woods & Wetherby, 2003). Woods & Wetherby (2003) suggested that children with autism under 36 months may not exhibit restricted and repetitive behaviors, while Chawarska and Volkmar (2005) indicate the importance of considering the *type* of such behaviors produced by very young children with autism. Chawarska and Volkmar (2005) reported that behaviors such as excessive mouthing of objects may be observed in infants with autism.

Theories of Autism

A plethora of theories have been put forth to explain the symptoms of autism. Three theories, however, have dominated the field in recent years, focusing on: 1) weak central coherence (Happe, 2005; Happe & Frith, 2006), 2) executive function deficits (Ozonoff et al., 2005), and 3) a theory of mind deficit (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002). Each of these theories presents with unique strengths as will be seen in the ensuing discussion of each theory.

None, however, provide a complete account of the core triad of symptoms observed in this population. A return to the original definition of autism offers a promising alternative account, one based on a social motivation deficit.

CHAPTER 2: Theories

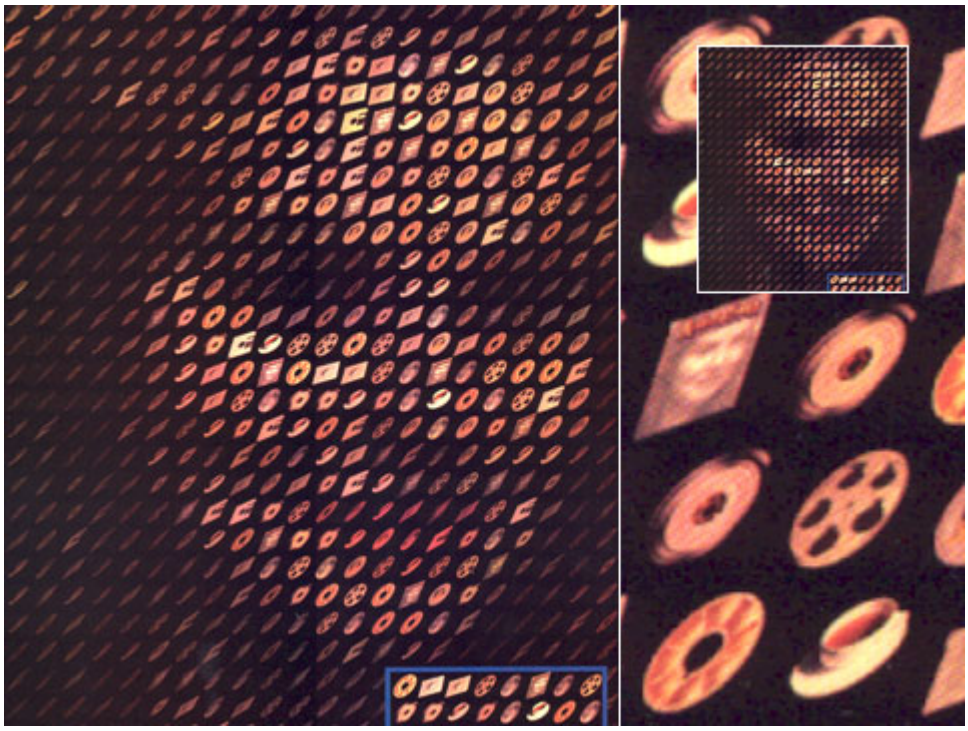
Weak Central Coherence

The weak central coherence account seeks to address both strengths and weaknesses of individuals with autism by highlighting their *different,* rather than their *deficient,* processing style (Happe, 2005; Happe & Frith, 2006). Central coherence refers to the tendency observed in typically developing individuals to process information globally, focusing on the coherent whole rather than on the details or individual components of experience (Happe, 2005). Individuals with autism, however, appear to exhibit the opposite processing style. As a result, children with autism may lose the global experience or miss the higher level meaning of the information being processed (Happe, 2005). When reading a story, for example, children with autism may get caught up in the details, such as names of places, and not attend to the larger narrative thread. Comprehension failure necessarily follows.

The weak central coherence account of autism is consistent with both observed weaknesses (e.g., generalization), as well as strengths/talents in this population (e.g. memorization) (Happe & Frith, 2006). For example, although typically developing individuals tend to recall meaningful sentences better than unconnected strings of words, the meaning behind sentences does not affect individuals with autism as strongly (Happe, 2005). Furthermore, when individuals with autism are presented with homographs embedded within sentences, they often fail to use the information presented in the sentence to determine the pronunciation of the homograph (Happe, 2005) (e.g., Look at the beautiful <u>bow</u> in her hair. vs. You must <u>bow</u> to the king.).

Weak central coherence is also evident in the perceptual capabilities of individuals with autism. This includes particular skill at discriminating visually confusing patterns and visually searching for targets (Happe, 2005; Happe & Frith, 2006). These tasks require attention to details, and can be hindered by attention to the 'big picture.' For example, in order to rapidly find a specific item in a visually complex scene, it is useful to be able to attend primarily to details and not get distracted by what the scene is portraying on a broader scale (see picture below).

ILLUSTRATION 1: Visually Confusing Pattern



Although, the above examples are consistent with the weak central coherence account of autism, contradictory evidence is also plentiful. First, individuals with autism *are* able to seamlessly integrate some information into global percepts. For example, in a review of the

literature, Happe & Frith (2006) found evidence that individuals with autism are able to put elements of their daily routine together, able to put visual elements together to create a coherent drawing, and able to process musical stimuli in a global manner. These authors suggest that a local processing bias does not necessarily translate into a deficiency in global processing.

A second area of evidence contradicting the weak central coherence account of autism concerns the performance of these individuals when they are instructed to attend to global information. Global processing can be facilitated by simple instruction (Happe & Frith, 2006). For example, in a task examining pronunciation of homographs in a sentence, children with autism performed poorly in non-cued situations, but were able to correctly pronounce homographs and comprehend their meanings when specifically cued to the presence of the homographs (Happe & Frith, 2006). This suggests a difference in style rather than ability. Moreover, some evidence has suggested that weak central coherence is only characteristic of a subset of the autism population and, therefore, is not a universal trait of this disorder (Happe & Frith, 2006). Neither is weak central coherence specific to autism. Individuals with other disorders, such as schizophrenia, depression, Williams syndrome, and right hemisphere damage, also demonstrate this local processing bias (Happe & Frith, 2006; Worth, 2003). Finally, and most importantly for the current discussion, although weak central coherence could affect social skills (e.g., a failure to track global information in a social setting, such as turn taking or goals of games or communication, could affect an individual's ability to interact socially), proponents of this view do not attempt to pursue this line of argument (Happe & Frith, 2006). Therefore, weak central coherence, as currently formulated, fails to articulate the basis for the social impairments in autism. Therefore, although this account provides information for the processing style in

some individuals with autism, it does not clearly delineate how this style could *cause* the triad of symptoms observed in autism.

Executive Dysfunction

An alternative account suggests that individuals with autism suffer primarily from deficits in executive functioning (Happe et al., 2006; Lopez et al., 2005; Ozonoff et al., 2005). Executive function (EF) refers to, "goal-directed, future-oriented behaviors thought to be mediated by the frontal lobes…, including planning, inhibition of prepotent responses, flexibility, organized search, self-monitoring, and use of working memory" (Ozonoff et al.., 2005, p. 606). Executive function deficits have been found not only in individuals with autism but also in family members of individuals with this disorder (Ozonoff et al., 2005). Not all aspects of executive functioning, however, are deficient in autism.

Happe et al. (2006) assessed the executive function skills of 32 boys with high functioning autism and Asperger's Syndrome. They used 11 tasks to examine skills in the following three areas: response selection (e.g., Go-No Go task), flexibility (e.g., verbal and design fluency), and planning/working memory (e.g., cognitive estimates). The Go-No Go task required the children to watch a series of airplanes and bombs on a screen and to push a button is response to the airplanes, but to withhold response to the bombs. The verbal fluency tasks required the children to name as many words beginning with a specific letter (e.g., B words) or falling within a specific category (e.g., animals). The design fluency tasks involved asking the children to draw as many designs as possible within specified time periods. The cognitive estimates task required the children to provide estimates for quantities for which they were

unlikely to know an exact number (e.g., How old is the oldest person in Britain?). Happe et al. (2006) found that boys with high functioning autism and Asperger's Syndrome demonstrated a specific profile of executive function skills, indicative of poor response selection/monitoring and inhibitory control. Additionally, Happe and colleagues (2006) found that the younger children in the autism group tended to have more difficulties than did the older children, particularly with verbal fluency, planning, flexibility, and working memory.

Unlike the weak central coherence account, executive functioning has been explicitly linked to social skills. Appropriate social interaction requires the ability to process and hold in mind myriad information about a social context (e.g., current topics of conversation, nonverbal information, contextual information, pragmatic information) and then to use it to plan one's response. Orchestration of these complicated processes requires facile executive functioning (Ozonoff et al., 2005). Evidence has also indicated a link between executive functioning and the repetitive and restricted behaviors characteristic of individuals with autism (Lopez et al., 2005). Lopez et al. (2005) measured the repetitive and restricted behaviors of relatively high functioning (i.e., IQs above 70) adults with autism using the following four measures: the Autism Diagnostic Observation Schedule, Autism Diagnostic Interview-Revised, Gilliam Autism Rating Scale, and the Aberrant Behavior Checklist. Executive functioning skills were assessed using 1) the Delis-Kaplan Executive Function Scales, which includes tests such as the Stroop Test, the Tower of Hanoi, and a card sorting task, and 2) the Wisconsin Card Sorting Test, which requires examinees to figure out the periodically changed rules for sorting cards based on yes/no responses from the examiner. Results indicated that restricted and repetitive behaviors were related to specific aspects of executive functioning skills such as working memory, cognitive

flexibility, and response inhibition. Other areas of executive function, namely fluency and planning, were not found to be significantly correlated with restricted and repetitive behaviors, though planning, not fluency, was found to be significantly impaired in the autism group compared to the typically developing group (Lopez et al., 2005). The authors present their results as "preliminary evidence of an association between abnormal functioning in the prefrontal cortex [the presumed cite of executive functioning] and restricted, repetitive symptoms" in autism (Lopez et al., 2005, p. 457). Further evidence has been found for a connection between executive functioning and language skills. Happe et al (2006) found that communication, as measured by the Vineland Adaptive Behavior Scales was related to flexibility, planning, and working memory in children with high functioning autism and Asperger's Syndrome.

Despite these connections between executive functioning, on the one hand, and social skills, communication, and restricted, repetitive behaviors, on the other, the evidence of a specific connection between executive dysfunction and the communicative deficits in autism is inconsistent. Research indicates that language deficits in autism appear more closely related to global mental ability (as measured by intelligence tests) than to executive functioning per se (Ozonoff et al., 2005). It is possible, therefore, that some aspects of the language/communication deficits observed in autism may be related to executive functioning difficulties, and/or that these deficits could be observed in sub-groups of autism, but that executive dysfunction may not be the best predictor of communicative deficits in autism.

Another significant limitation of the executive function account is that, similar to the weak central coherence account, it is not specific to autism. Other disordered populations, such as individuals with reading and writing disorders, fetal alcohol syndrome and, most notably,

individuals with Attention-Deficit/Hyperactivity Disorder (ADHD), also show deficits in executive functioning, though there appear to be some distinctions in the aspects of executive functioning affected in each population (Happe et al., 2006; Schonfeld et al., 2006). For example, Happe et al. (2006) found that children with ADHD were more impaired on response inhibition than were children with autism and Asperger's Syndrome, but both groups performed poorly on response selection tasks. In addition, evidence suggests that the deficient executive functioning observed in individuals with autism is more common in low functioning individuals and may lessen over time (Happe et al., 2006), suggesting that it might be best characterized as a delay rather than as a core cognitive deficit, and that it is not a universal deficit in this population.

Theory of Mind

Perhaps the most prominent explanation of autism is the theory of mind account. This theory attempts to explain social and communicative impairments in autism by attributing them to underlying deficits in the ability to understand others' minds. Specifically, individuals with autism are thought to have a deficit in the ability to attribute mental states (e.g., beliefs, desires, intentions) to themselves and others, and therefore have difficulty understanding, explaining, and predicting their own and others' behavior (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002). The strictest test of a mature theory of mind is a false belief task. Understanding that another person has a false belief requires comprehending that others may experience the world differently and may therefore form unique representations thereof.

A traditional false belief task consists of a scene played out by two characters (e.g., Sally and Anne). In the first scene, Sally and Anne are in a room with a basket and a box. Sally puts a ball into the basket and then leaves the room. While she is gone, Anne moves the ball into the box. When Sally reenters the room, the child observing the scene is asked: "Where does Sally think the ball is?" By the age of approximately four years, typically developing children are able to answer this question correctly (i.e., Sally thinks the ball is in the basket), indicating that they understand that Sally holds a false belief (Joseph & Tager-Flusberg, 2004; Carpenter et al., 2002). For children with autism, however, success is frequently not evident until children have a verbal mental age of approximately nine years (Joseph & Tager-Flusberg, 2004). The age at which children with autism reach this verbal ability varies considerably. For some, this level is never reached.

Although the theory of mind account has traditionally focused on determining when, or if, children with autism are able to acquire the ability to pass false belief tasks, theory of mind is a considerably more complicated concept that is characterized by a protracted developmental progression. A variety of precursors to a fully mature theory of mind have been identified, including both behavioral precursors, such as imitation (Williams et al., 2006) and joint attention (Charman et al., 2000; Dawson et al., 2002), and conceptual precursors, such as understanding of intentionality (Meltzoff, 1995) and desire (Ziv & Frye, 2003). Each of these will be discussed in turn.

Imitation

Imitation has been described as "a core cognitive process required for the development of

social cognitive ability" (Williams et al., 2006, p. 610). Imitation has been specifically implicated in the development of the ability to form representations of oneself and others (Charman et al., 2000). Meltzoff & Moore (1995) suggest that imitation is an early indicator of an infant's recognition that others are similar to oneself and that "the infant uses the other to learn about the self, just as surely as using the self's experiences helps to interpret the behavior of others" (p. 76). This early use of imitation to learn about oneself and others provides information crucial for developing a theory of mind. At birth, infants have been shown to be able to imitate simple body movements, suggesting that this foundational ability is innate (Meltzoff, 1995; also see Rogers, 2006). However, see Hayes & Watson (1981) for other interpretations of neonatal imitation. In any case, it is not until around nine to twelve months that infants are able imitate actions on objects, indicating an initial understanding of the relation between people and things. This latter skill is important because a crucial component of theory of mind entails understanding the relationship between the mind and the world (Meltzoff, 1995).

Intentionality

In order to understand the relationship between people and objects, children must come to understand that the mind generates intentions that guide goal-directed actions on the world. By 18 months of age, infants appear to understand that people have intentions, but objects do not. In Meltzoff (1995), toddlers observed either an adult or a machine attempt to perform an action (e.g., pull a dumbbell shaped object apart), but fail to do so. The children were significantly more likely to imitate the intended goal (e.g., pulling the dumbbell apart) of the human than that of the machine. Infants and toddlers are also more likely to imitate actions that are a goal in and of

themselves rather than actions that are a means to a goal, in which case they are more likely to imitate the goal, not the action (Carpenter, 2006). For example, if typically developing 12 month olds observe an adult make a toy animal hop to the center of a table, they will imitate this manner of manipulating the toy. If, however, they observe the adult hop a toy animal into a house in the center of a table, they will simply put the toy into the house (Carpenter, 2006). Therefore, by 18 months, toddlers are beginning to understand that people (but not machines) have intangible mental states that direct their behavior.

Joint Attention

An understanding of the relationship between the mind and the world is further observed in infants' joint attention abilities, which also develop during the first 18 months of life (Kaplan & Hafner, 2006). Joint attention is thought to have at least two distinct components: initiating joint attention (IJA) and responding to joint attention (RJA) (Mundy et al., 2007). RJA requires that a child be able to detect, maintain, and follow another's gaze and/or gestures, as well as understand goal directed behavior. IJA, on the other hand, requires that a child use eye contact/gestures to direct others' attention to a target of particular interest (Mundy et al., 2007). For example, typically developing infants and toddlers frequently alternate their gaze between a familiar adult and what that adult is looking and/or pointing at (RJA) (i.e., detection of eye gaze and understanding of others' goals). These infants will also alternate their own gaze between a familiar adult and an object of interest, often accompanied by pointing to the item (IJA), in order to show the adult the item of interest (i.e., goal directed behavior). The coordination of the

production and comprehension of nonverbal communication allows infants and toddlers to engage in joint attention.

Desire

Another component of theory of mind involves understanding that intentional behavior is driven by desire. For example, a man might go to the store (an action) to buy ice cream (his goal) because he has a craving for something sweet (a desire). Ziv and Frye (2003) suggest that desire is a key component in theory of mind because it helps explain why specific goals are chosen over others. Phillips et al. (2002) found that by the age of 12 months, infants have at least a simple understanding of desire. In their study, infants observed someone as she exclaimed positively over a particular stuffed cat (e.g., "Ooo, look at that kitty!"). A screen was then placed between the child and the experimenter with the cats. After the screen was removed, the child observed the same person either holding that same cat, or a different one. Infants appeared surprised to see the person holding the cat she had *not* previously exclaimed over. This suggests that, by 12 months, infants have at least a rudimentary understanding that vocal and facial expression can be used as an indicator of desire and that desire can be used to predict intentional actions.

Further development in the understanding of other's desires is demonstrated in a study by Repacholi and Gopnik (1997). When 14- and 18-month olds were offered the choice of either a cracker or a piece of broccoli, most chose the cracker. The experimenter then demonstrated a preference for the broccoli. Next, the toddlers were asked to give the experimenter something to eat. At 14 months of age, toddlers primarily gave the experimenter the food they themselves

preferred (i.e., the cracker). By 18 months of age, however, the toddlers gave the experimenter her preferred food (i.e., the broccoli), thus indicating that they are able to evaluate the desires of others.

Theory of Mind in Autism

Behavioral precursors to theory of mind (i.e., imitation and joint attention) have been extensively explored in children with autism and both appear deficient in very young children in this population (Charman et al., 1997). Toddlers with autism have been shown to struggle with imitation of simple actions on objects (Hobson & Meyer, 2006), even when compared to age-matched developmentally delayed peers. Other evidence, however, has demonstrated that encouraging children with autism to imitate can bring their imitation skills up to the level of their typically developing peers (Beadle-Brown & Whiten, 2004), and that they are more likely to imitate actions on toys with strong sensory effects (Hobson & Meyer, 2006). Toddlers with autism have also been shown to demonstrate poorer joint attention skills, as observed in fewer gaze shifts from an ambiguous toy to an adult, than typically developing infants at the same age (Charman et al., 1997). Additional evidence indicates that young children with autism are less likely than typically developing children to share things with others or to bring things to show a parent (Eaves & Ho, 2004).

Conceptual precursors to theory of mind are not unambiguously impaired in autism. Carpenter et al. (2001) compared children with autism to children with developmental delays in their understanding of others' intentions and found no difference, and Alderidge et al. (2000) found that young children with autism did not differ from typically developing controls on their

understanding of intentionality. Understanding of desire, however, does sometimes appear to be impaired in autism. Research indicates that, when asked to explain the behavior of others, children with autism are more likely to do so in terms of desires than in terms of beliefs (Rieffe, Terwogt, & Stockmann, 2000). When asked to attribute desire based on eye gaze (e.g., what does ____ want?), however, children with autism perform more poorly (Peterson et al., 2005).

The evidence suggests that the theory of mind difficulties exhibited by children with autism are not limited to relatively late emerging understanding of false belief, but rather begin early in development. Given that one precursor, understanding of intentionality, appears intact in children with autism, as well as evidence of islands of intact imitation, joint attention, and understanding of desire, it is important to determine whether the impairments observed in the other precursors are due to a lack of understanding and/or ability or are due to a lack of motivation to attend to others, which leads to these deficits.

Summary

Despite the evidence of theory of mind deficits in autism, there are reasons to be cautious in fully embracing this as a wholly sufficient account of the disorder. First, theory of mind deficits appear to be related more closely to verbal age and general cognitive abilities (Buitelaar, et al., 1999b; Hughes & Ensor, 2005; Prior et al., 1998; Whitehouse & Hird, 2004; Ziatas, et al. 1998) than to diagnosis of autism per se (Mundy, 2003). Second, and relatedly, theory of mind deficits are not specific to autism (Buitelaar et al., 1999a; Prior et al., 1998; Serra et al., 2002; Whitehouse & Hird, 2004; Ziatas et al., 1998). For example, children with specific language impairment (SLI) have been shown to exhibit clear delays in theory of mind skills (Holmes, 2002) and have specifically been shown to have as much difficulty as children with autism in

providing correct mental state answers in false belief tasks (Gillott et al., 2004). Third, when children with autism are successfully taught theory of mind skills, and are able to pass false belief tasks, this "does not necessarily lead to advancement in real-life social competence" (Volkmar et al., 2004, p. 142). These individuals do not suddenly demonstrate typical social abilities (Chin & Bernard-Opitz, 2000; Gevers et al., 2006; Muris et al., 1999), as the theory of mind account might predict. Instead, these individuals continue to exhibit marked limitations in social interaction, suggesting that theory of mind deficits may not fully account for the social and related communication impairments found in this population (Downs & Tristram, 2004).

CHAPTER 3: Social Motivation

New Directions

Although all three theories of autism (i.e., weak central coherence, executive dysfunction, and theory of mind deficits) have received a great deal of attention during the last two decades, each is limited in its ability to fully explain the disorder (Volkmar et al., 2004). The limitations of these three theories indicate the need for consideration of alternative accounts.

One possibility is that individuals with autism are lacking motivation for social interaction, as was suggested in the very first description of this disorder (Kanner, 1943). This is a promising alternative as social motivation emerges very early in development and could therefore affect the development of language, social skills, and theory of mind. Additionally, a deficit in this area might well be specific to autism, and could be a universal characteristic in this population. In the next section, we further expand on this possibility by exploring social motivation in relation to autism.

Social Motivation

Unfortunately, social motivation appears to be a much used, but infrequently defined, term in the literature. Motivation in general has been defined as "…the 'energization' of behavior" (Elliot et al., 2006, p. 378) and "implies an emotion or desire operating on the will and causing it to act" (Merriam-Webster's Collegiate Dictionary, 1996, p.759). Intrinsic motivation is "the desire to engage in an activity because we enjoy it or find it interesting" (Aronson, Wilson, & Akert, 1999, p. 167). These definitions provide us with a way to think about general

motivation, but not social motivation specifically. The term *social interest*, however, which sometimes appears to be used interchangeably with *social motivation*, is defined as "the interest that primes people to want to be with others, to look at others, and to relate to others on a personal level" (Grelotti et al., 2002, p. 215). Using Elliot et al.'s (2006), Merriam-Webster's (1996), and Aronson et al.'s (1999) definitions of motivation, and Grelotti et al.'s (2002) definition of social interest, we can provide the following working definition for *social motivation*: the energy and desire that directs people's interests toward others and causes them to want to interact socially with them.

Social Motivation in Autism

Throughout the literature on autism there are numerous references to a social motivation deficit. For example, Grelotti et al. (2002) refer to autism as "a population with little to no social interest" (p. 214) and suggest that children with autism spectrum disorders do not value social stimuli the way that typically developing children do (see also Berger, 2006; Charman, 2006). Huber and Zivalich (2004) further suggest that the symptoms of autism, as described in the DSM-IV "are almost diametrically opposed to…social interest" (p. 350).

Anecdotal clinical observations support these characterizations. When children with autism respond to others, or communicate, they typically do so in order to obtain a desired item (Chin & Bernard-Opitz, 2000), rather than to engage in a social interaction per se (i.e., without social motivation). For example, a child who desires juice may approach a parent, request the juice, and then walk away without any further interaction. Or, a child who has become frustrated and upset with a therapist in a session may sit in the therapist's lap (even if other laps are

available) after the activity is completed, without attending to the therapist. The child's purpose in this case appears to be to sit down rather than to derive comfort through physical or social contact with the therapist. In such a situation, a typically developing child would likely seek out someone other than the adult who had just upset them.

Although social motivation in autism has rarely been the direct focus of empirical investigation, a close look at the literature provides a wealth of evidence convergent with the idea that social motivation is a core deficit in autism. Furthermore, the literature begins to provide a framework for explaining how such an impairment might unfold in development and impact a broader range of competencies. Even in infancy, children with autism respond atypically to social stimuli. From birth, typically developing infants exhibit a preference for human faces over other stimuli (Grelotti et al., 2002). Children with autism, however, display abnormalities in face processing and orient more readily to inanimate objects than to faces (Klin et al., 2005). Furthermore, children with autism do not respond typically in the still face paradigm. In this procedure an adult faces a child and briefly interacts with him. The adult then presents an emotionless face, followed by another brief period of interaction. Typically developing infants will attempt to engage the adult when she is displaying the still face and, when no response is forthcoming, these infants will smile less and look away from the adult. Children with autism do not exhibit this typical pattern of response (Klin et al., 2005, p. 690), but rather tend to ignore the adult demonstrating the still face the majority of the time (Heimann, Laberg, & Nordoen, 2006).

Berger (2006) proposes that the "core problem [in autism] is the very early failure to orient to social stimuli" (p. 358), which could result in the relevance of social stimuli being

broadly diminished (Klin et al., 2005). Volkmar et al. (2005) also suggested that early deficits in social motivation in autism may lead to a lack of orientation and engagement in the early environment, perhaps caused by neurological dysfunction that inhibits individuals with autism from experiencing the positive internal reactions to others' touch, smiles, and voice (Berger, 2006). They therefore fail to learn that others are a source of positive reinforcement and fail to develop typical motivation for social interaction. This could cause a series of developmental events in which the child fails to acquire the necessary developmental social experiences which would enable them to develop appropriately in the social-cognitive domain. For example, dysfunctional social orienting in infancy would likely affect joint attention, which is known to be impaired in autism (Eaves & Ho, 2004; Gomez & Baird, 2004; MacDonald et al., 2006) and is thought to be fundamental for communicative development (Charman et al., 2000).

Importantly for the social motivation account, MacDonald et al. (2006) point out that the joint attention deficits observed in young children with autism do not reflect a cognitive deficit in theory of mind (as described in the previous section) because these children successfully respond to the attentional bids of others. These children are particularly impaired in their *initiation* of episodes of joint attention, suggesting a lack of motivation to share with others rather than a failure to understand the need for joint attention. In fact, Mundy et al. (2007) describe a social motivation perspective on initiating joint attention, suggesting that "motivation differences may reflect a stable temperament-like feature of IJA development…[such that] some infants may display more interest in social events and engage" more (p. 950). Mundy et al. (2007) further indicate that increased social motivation and attention is likely to lead to increased social

opportunities, and social information processing, therefore stimulating social-cognitive development.

If joint attention deficits in autism are indeed caused by a social motivation deficit, broader consequences of this core social motivation deficit are likely to be evident in the domains of language and theory of mind. A child who is not socially motivated is unlikely to attend to others' enough to learn how to use language appropriately (e.g., pragmatics) and accurately (e.g., pronouns), and is unlikely to learn the rules of appropriate social interaction. When communicating, typically developing individuals frequently use powerful cues, such as eye gaze and gesture, to indicate the referent of their communication (e.g., "Hey, look at that bird!" as they point into the sky at the bird). If people are motivated to attend to others, they will attend to both the object and the other person involved in an interaction (joint attention), allowing them to understand the communicative intent of the other person; this facilitates language learning (e.g., identification of the bird) and theory of mind development (e.g., understanding that the other person is thinking about the bird). More broadly, a lack of social motivation, including motivation to communicate and respond to others (e.g., attend to the language and interaction of others), both of which have been equated with missed opportunities for learning language (Koegel & Koegel, 1995; Koegel et al., 2003), may be associated with, or cause, difficulties in joint attention.

These cascading influences of early deficits in social motivation might be confounded by persisting deficits in motivation more broadly speaking. Dichter-Blancher et al. (1997) note that typically developing children exhibit mastery motivation, "the inherent drive which leads young children to explore the environment and master tasks that are at least somewhat challenging to

them" (p. 545). Mastery motivation involves the ability to persist in a task and to take pleasure and pride in one's accomplishments (Dichter-Blancher et al., 1997). In order to tackle the challenging task of social interaction, children must be motivated to master it. Unfortunately, mastery motivation is not typically observed in children with autism. In fact, Koegel and Koegel (1995) and Koegel et al. (1998) suggest that lack of motivation should be targeted as a major issue in autism, perhaps even as a core deficit. Their empirical work in support of this position demonstrates that increasing motivation, via increasing children's success in a variety of tasks including social approach tasks as well as nonsocial tasks, results in improvements in acquisition and generalization to a wide range of areas, including social interaction (Koegel & Mentis, 1985).

Importantly, however, empirical evidence suggests that deficits in motivation broadly speaking do not provide a complete explanation of the symptoms in autism. Moore and Calvert (2000) examined differences in attention, motivation, and word learning in older children with autism when taught vocabulary words via human instruction or computer instruction. Children were more attentive to the computer instruction and remembered more words taught by this method than by human instruction. In addition, when asked whether they wanted to continue instruction with a human or with a computer, children were more motivated to continue with the computer (Moore & Calvert, 2000). This research suggests that individuals with autism are not lacking motivation per se, but rather may be lacking *social* motivation specifically.

It has been hypothesized that this lack of social motivation occurs very early on in infants with autism (Berger, 2006; Grelotti et al., 2002) and that this deficit affects not only the development of social skills (Berger, 2006), including theory of mind skills, but also affects the

development of language (Koegel & Koegel, 1995; Koegel et al., 2003). Therefore, the need to explore social motivation in autism is clear.

Summary

In sum, evidence from toddlers, preschoolers, and elementary age children with autism suggests that children with this disorder do not exhibit the social motivation one would expect (Charman, 2002; Grelotti et al., 2002; Huber & Zivalich, 2004; Klin et al., 2005; MacDonald et al., 2006). Instead, these children appear to interact with others primarily to receive desired items or activities. They are much less likely to interact for purely social purposes. This lack of social motivation is hypothesized to emerge in infancy (Berger, 2006; Grelotti et al., 2006), affecting the development of language (Koegel & Koegel, 1995l Koegel et al., 2003) and social skills (Berger, 2006), including theory of mind skills. This lack of social motivation could lead to devastating deficits in social interaction, communication, and language.

An account based on social motivation is promising as an advance over the weak central coherence, executive dysfunction, and theory of mind accounts for the following reasons. First, lack of social motivation appears to be more specific to autism than the factors at the core of these alternative accounts. Although individuals with a variety of disorders such as Specific Language Impairment (SLI), Attention Deficit Hyperactivity Disorder (ADHD), reading and writing disorders, schizophrenia, Williams syndrome, Fragile X, deafness, and Fetal Alcohol Syndrome display delays in theory of mind, executive dysfunction, and/or central coherence (Buitelaar et al., 1999; Gillott et al., 2004; Happe et al., 2006; Happe & Frith, 2006; Holmes, 2002; Keysor & Mazzoco, 2002); Miller, 2004; Schonfeld et al., 2006; Serra et al., 2002;

Whitehouse & Hird, 2004; Worth, 2003; Ziatas et al., 1998), these individuals do not appear to have a lack of motivation for social interaction. Second, neither executive function deficits, nor weak central coherence, are universally characteristic of individuals with autism (Happe et al., 2006), while social motivation appears to be. Third, social motivation is not likely to be as closely associated with verbal age and cognitive ability as are theory of mind skills. The desire to interact socially with others develops prior to even the most primitive linguistic skills, and prior to many early appearing cognitive skills, and therefore is likely to be independent of these factors. Finally, a social motivation account may provide a more parsimonious explanation of the impairments observed in autism. A deficit in social motivation can not only explain the social interaction difficulties exhibited by individuals with autism, but may also be able to explain the language *and* theory of mind *and* broader social-communicative difficulties observed in this population. Furthermore, it is possible that the repetitive and restricted behaviors in this population may stem, in part, from a lack of motivation to attend to what is and is not socially appropriate. If this is the case, the social motivation account could provide an explanation for this symptom as well.

CHAPTER 4: The Current Study

The Current Study

The increasing prevalence of autism has motivated a more intensive search for explanations of the impairments involved in this disorder, along with increased attempts to design effective treatment approaches. Although impairment in social interaction is a diagnostic criterion for autism, we do not yet know whether this impairment is more closely related to deficient theory of mind, or executive dysfunction, or weak central coherence, or a lack of social motivation. Because the theory of mind account specifically addresses the social skills of children with autism, it will serve as the counterpoint to the social motivation account in the context of the current investigation.

Although numerous studies have been conducted exploring theory of mind in individuals with autism (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002), social motivation in autism has received significantly less attention. This might, in part, be due to the difficulty of measuring social motivation. In an attempt to measure motivation more generally, Morgan, Maslin-Cole et al. (1992) developed a questionnaire assessing mastery behaviors, including social behaviors (Glenn et al., 2001), the Dimensions of Mastery Questionnaire (DMQ). The DMQ measures social mastery motivation with items such "Enjoys talking with adults, and tries to keep them interested" and "Tries hard to make friends with other kids" and "Likes to "talk" with other children." Lim and Young (2006) suggest more specifically that "social approach and motivation can be studied by measuring the latency time to approach another individual and the

amount of time spent in social contact" (p. 507). Heimann, Labert, and Nordoen (2006) suggest that rates of touching, looking, and requesting from another person can be used to measure social interest. Finally, Hughes (1997) has used forced choice tests, in which two options are provided, to measure intrinsic motivation for exploration in animals.

These methodological approaches were implemented in order to consider four core questions. First, we considered whether children with autism, as compared to typically developing children, reveal low motivation for social interaction in a controlled setting. In order to do this, we measured whether children with autism look at, request from, and choose to interact with others less than do typically developing children. We additionally examined whether parents of children with autism report that their children exhibit less interest in social interaction than do parents of typically developing children. We predicted that all measures would indicate less social motivation in children with autism than in their typically developing peers.

Second, we asked whether children with autism would demonstrate deficits, relative to their typically developing peers, on a number of measures of specific components of theory of mind. We assessed imitation and joint attention, as well as conceptual understanding of others' intentions, desires, and false beliefs, specifically choosing tasks requiring minimal to no verbal language ability in order to observe evidence of deficits, or lack thereof, where other tasks failed to do so. We chose to assess both behavioral and conceptual precursors to theory of mind in order to provide more complete picture of the deficits in this area than is typically presented. We did not, however, assess all aspects of theory of mind (e.g., emotional understanding). Based on previous research indicating deficient theory of mind in children with autism, we predicted that

children with autism would exhibit deficiencies in most of the precursors to theory of mind. More specifically, we predicted that children with autism would 1) imitate less, 2) engage in joint attention less often, and 3) show less understanding of desire, and 4) false belief than their typically developing counterparts. Based on previous research, however, we predicted that understanding of intentionality would not be impaired in the children with autism. Furthermore, we predicted that joint attention and understanding of desire, both involving social attention to others and attention to their faces, would be more impaired than imitation and understanding of intentionality in the children with autism. We also remained open to the possibility that we might *not* find deficits on any theory of mind measure. The precursors do not require the same level of sophistication in understanding, and the language demands on the false belief task were minimal, making it possible that it would be a useful measure for a population with limited verbal skills.

Third, we asked whether lower social motivation in autism could predict the severity of autism, as measured by social and language deficits (the primary impairments associated with autism), better than could deficiencies in theory of mind. We predicted that children with autism who revealed low social motivation, would also be more severely affected in terms of their social and language skills, as indicated by lower scores on the Vineland SEEC IR (Sparrow, Balla, & Cicchetti,1998) and the PPVT-IV (Dunn & Dunn, 2007).

Fourth, we asked whether there is a relationship between social motivation and theory of mind in both children with and without autism. The fact that joint attention is related to language, cognitive, and social competence (Mundy et al., 2007) and imitation can be used to learn about both self and others (Meltzoff & Moore, 1995), suggests that at least the behavioral

precursors of theory of mind depend on social interaction. Furthermore, an understanding of intentionality, desire, and false belief appear to require attention to others, which requires motivation to attend to the interactions of others even if one is not directly involved in the interactions. If this is the case, then a deficit in social motivation could have a significant impact on theory of mind and its precursors. Mismatches could be particularly informative by indicating a differentiation between these two areas. In the event that such mismatches arise, we predicted that low social motivation, as measured by eye gaze during free play, parent questionnaires of social motivation, and forced choice tasks, would be a better predictor of social skills (as measured by the Vineland Social-Emotional Early Childhood Scales (Sparrow, Balla, & Cicchetti,1998)) and language (as measured by the Peabody Picture Vocabulary Test-Fourth Edition (Dunn & Dunn, 2007)) deficits in autism than would low theory of mind understanding.

Method

Participants

Fifteen children with autism, aged three to five years old participated. These children were diagnosed on the autism spectrum (i.e., autism or pervasive developmental disorder - not otherwise specified) by an independent clinician using the criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). A second group of 17 typically developing children, matched to the autistic group on gender and chronological age (within two months), also participated. All of the children were from monolingual homes and had no cognitive, developmental, motor, visual, or hearing impairments, other than autism. The

participants were recruited through local clinics, special and regular education classes, and an established database of families interested in research participation.

Procedure

Each child participated in one videotaped session. Children participated in tasks that proceeded in the following fixed order: 1) free play, 2) gumball task, 3) the Peabody Picture Vocabulary Test- Fourth Edition (PPVT-IV) (Dunn & Dunn, 2007), 4) false belief task, 5) imitation task, 6) intentionality task, 7) desire task, 8) forced choice task, and 9) joint attention tasks. In addition, parents of each child were interviewed using the Vineland Social-Emotional Early Childhood Scales (Vineland SEEC Scales) (Sparrow, Balla, & Cicchetti,1998) in order to assess the severity of each child's social impairments. Each parent also filled out a questionnaire assessing their child's motivation, particularly their social motivation (e.g., Dimensions of Mastery Questionnaire), and a general questionnaire regarding their child's development and treatment (if appropriate).

SOCIAL MOTIVATION TASKS:

1. *Free Play:* At the beginning of the session, experimenter 2 engaged in a period of free play with each child. A consistent set of toys was available to the children: a colorful ball-like toy that expanded and contracted, a 3-piece peg puzzle, a 4-piece interlocking puzzle, a shape sorter, and a toy car. The experimenter observed the child and made neutral comments while the child played, limiting her verbalizations to things such as "Oh?" and "OK." She did not initiate social interaction with the child. If the child asked her questions, however, she responded with

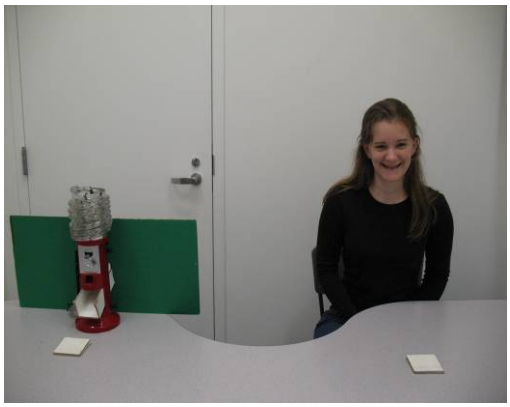
comments such as “I just want to see you play” or “I don’t know.” During this time, we measured how often the child looked at the experimenter, by tallying the number of times the child made eye contact with the experimenter (as described by Heimann, Laberg, & Nordoen, 2006). (See Figure 1)

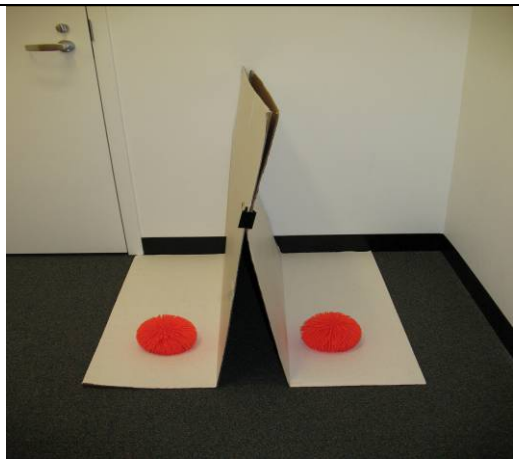
2. *Gumball Machine Task:* The child was seated at a table facing experimenter 1 and a gumball machine-like device, which was capable of dispensing small food items. It was decorated with a string of colored lights which lit up and played a tune when food was dispensed. Two buttons were on the table. Experimenter 2 demonstrated to the child the effect of pushing each button. One button caused the toy to dispense a desired food item (previously determined by providing options to the child and allowing the child to choose his favorite food option). Pushing the other button caused experimenter 1 to extend her hands (closed, palms together, one facing up and one facing down) toward the child, then open her hands (like a crocodile) to display the same desired food item. Experimenter 1 smiled and said “Here you go” as she allowed experimenter 2 to take the food from between her hands. The order in which these were demonstrated was counterbalanced. Next, the children were allowed to push the buttons to obtain the desired food item for a total of 5 minutes. The machine was operated by experimenter 1 during the demonstration and by experimenter 2 for the rest of the activity. When the child pushed the button for the machine, experimenter 2, hidden below the table behind a screen, pushed buttons causing the machine to light up and play a tune, and simultaneously put food down a ramp in the machine, causing the food to come out near the child. If the children attempted to push both buttons at the same time, experimenter 1 verbally discouraged them from doing so and encouraged them to push only one at a time. If the children did not push buttons, or asked if they

could push, they were verbally encouraged to push buttons in a general manner so as not to bias responses. (See Illustration 2)

3. *Forced Choice Task*: The children were presented with a scenario in which they had the option of entering one of two partitioned areas (e.g., experimenter 2 said: "Where do you want to go?" while facing the child toward the two options). One of these areas contained an interesting toy. The other area contained the same toy as well as experimenter 1. The children needed to make a choice as to which area they wished to enter. This was then repeated with a 2nd interesting toy with experimenter 1 sitting at the opposite location. The order in which the toys were presented and the side on which experimenter 1 was seated was counterbalanced. (See Illustration 2)

ILLUSTRATION 2: Materials in Social Motivation Tasks

Free Play Toys	**Gumball Task**
	
Forced Choice Task	**Forced Choice Task**



FALSE BELIEF TASK:

The false belief task followed a modified version of the procedure developed by Onishi & Baillargeon (2005) to test infants. We chose this task because it makes minimal demands on language. This is preferable for two reasons: 1) language is a known difficulty for children with autism (APA, 1994), and 2) language is known to confound results of false belief tasks and we wanted the purest measure of conceptual knowledge of belief, independent of language, which has been shown to correlate highly with more traditional false belief measures (Hughes & Ensor, 2005; Whitehouse & Hird, 2004). In the current task, the child was seated at a table across from experimenter 1 and facing a green box, a yellow box and a small toy watermelon in between (see Illustration 3). The child was given 10 seconds to observe this scene. Next, each child observed belief induction trials, followed by test trials as follows:

1. Belief Induction Trial 1: *True Belief Green*: the toy was put into the green box (by EX2) in full view of both EX1 and the child. The child observed as the adult looked at the two boxes. EX2 moved the yellow box half way to the green box, then moved back to its

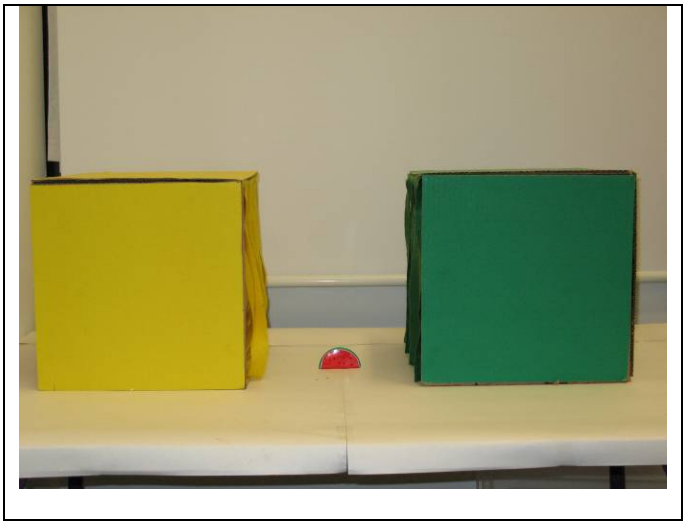
original position. EX2 asked the child, "**Where will Gwen look for the watermelon?**" EX2 said, "**OK**" regardless of what the child said.

2. Test 1: *Green Box Test*: EX1 reached into the GREEN box and left her hand there until the trial was over (for 10 seconds). If the child understood false belief, he should realize that experimenter 1 correctly believed that the watermelon was in the green box. This response is consistent with true belief so should not be surprising to the child observing.
3. Belief Induction Trial 2: *False Belief Green*: the screen was placed fully up so that the EX1 was unable to see the boxes. The child observed as EX2 moved the toy from the green box to the yellow box. EX2 asked the child, "**Where will Gwen look for the watermelon?**" EX2 said, "**OK**" regardless of what the child said.
4. Test 2: *Green Box Test*: Same as Test 1. If the child understood false belief, he should realize that experimenter 1 believed that the watermelon was in the green box because that was where she last saw it, despite it being moved outside of her field of vision. This response is consistent with the experimenter's belief so should not be surprising to the child observing.
5. Belief Induction Trial 3: *False Belief Green*: the screen was placed fully up so that the EX1 was unable to see the boxes. The child observed as EX2 moved the toy from the green box to the yellow box. EX2 asked the child, "**Where will Gwen look for the watermelon?**" EX2 said, "**OK**" regardless of what the child said.
6. Test 3: *Yellow Box Test*: the screen came down and EX1 reached into the YELLOW box and left her hand there (for 10 seconds) until the trial ended. If the child understood false belief, he should realize that experimenter 1 *should* believe that the watermelon was in

the green box. Her response of reaching into the yellow box was not consistent with what her belief should have been and, therefore, should be surprising to the child observing.

7. Belief Induction Trial 4: *True Belief Green*: the toy was put into the green box (by EX2) in full view of both EX1 and the child. The child observed as the adult looked at the two boxes. EX2 moved the yellow box half way to the green box, then move back to its original position. EX2 asked the child, "**Where will Gwen look for the watermelon?**" EX2 said, "**OK**" regardless of what the child said.
8. Test 4: *Yellow Box Test*: Same as Test 3. If the child understood belief, he should realize that experimenter 1 should *know* that the watermelon was in the green box and, therefore, her response (reaching into the yellow box) was not consistent with true belief and should have been surprising to the child observing.

ILLUSTRATION 3: False Belief Task Set-Up



Both verbal and non-verbal responses were recorded and coded whenever possible. Pointing and/or naming the box where the *experimenter* last saw the object indicated understanding of

belief. Longer looking times at scenarios that were inconsistent with Experimenter 1's beliefs (e.g., EX1 reaching into the yellow box in the *False Belief Green* scenario) were taken as indications of surprise and understanding of belief. Specifically, surprise on true belief violations were taken as a basic understanding of the task and were used as a comparison point for the evaluation of looking times on the false belief trials.

OTHER THEORY OF MIND TASKS:

Given that some of the participants in this study were very young and that some of the participants with autism were not expected to be able to display a fully mature theory of mind due to developmental delays, tasks assessing emerging components of theory of mind were also administered. A variety of skills including imitation and joint attention, as well as conceptual understanding of intentionality and desire were assessed separately.

Behavioral Fundamentals of Theory of Mind

Imitation: The participants observed the experimenter perform two completed, intentional actions on two different objects and were then provided with the opportunity to imitate for 20 seconds. Children were provided with no specific instructions during this period. The actions chosen were unlikely to emerge in the spontaneous activity of children. One action involved the experimenter placing her forehead on a box. The second action consisted of the experimenter placing a plastic sponge into an egg slicer and putting the top of the egg slicer down onto the sponge. (See Illustration 4) Successful responses consisted of exact imitation of the experimenter's actions.

Joint Attention: Two types of tasks were administered as in Charman et al. (2000). First, the child sat between two experimenters. A remote control car (disguised by a white washcloth and an upside down funnel) made sounds and moved for a total of one minute, including two stops and starts (see Illustration 4). The number of times the child looked at each experimenter was recorded. Two goal detection tasks were also used to assess joint attention. First, the blocking task was used, in which an experimenter allowed a child to become visually and manually engaged with a toy and then covered what the child was playing with for 5 seconds, preventing the child from engaging in further activity with it. This was repeated once. In a teasing task, the experimenter took a desired toy, then, when the child reached for it, she removed it from reach for 5 seconds. The child then got the toy. Again, this was repeated once. During the 5 seconds of blocking or teasing, responses were coded for whether or not the child looked at the experimenter's eyes and how many times the child looked. Additionally, we recorded whether and how the child responded verbally to the blocking or teasing event.

ILLUSTRATION 4: Imitation and Joint Attention Materials

Imitation

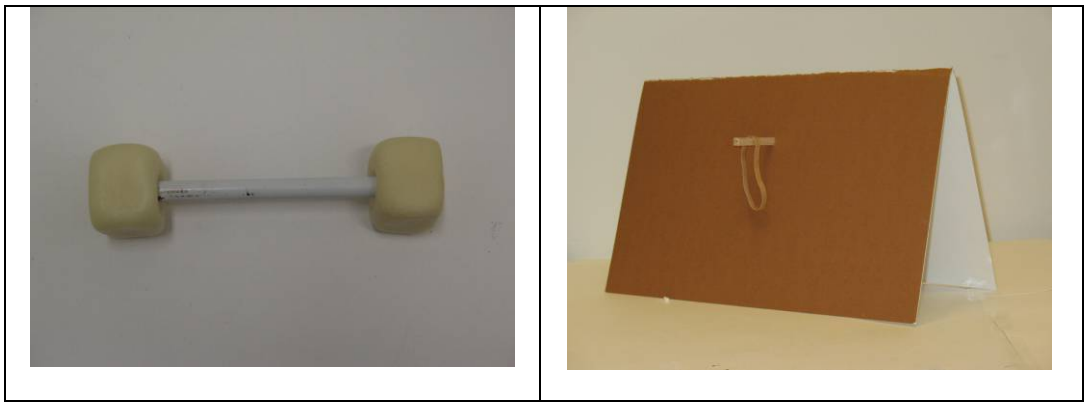
Joint Attention

Conceptual Fundamentals of Theory of Mind

Intentionality: The procedure used in Meltzoff (1995) was implemented with minor modifications (i.e., the same children were exposed to the baseline procedure *and* to the experimental procedure). The children were initially provided with two objects for 10 seconds each to determine whether or not they would spontaneously perform the target actions. The children then observed the experimenter attempt, but fail, to perform simple, novel acts upon 2 novel objects. These consisted of 1) pulling apart a dumbbell-type apparatus, and 2) putting a string on a rod (see Figure 4). For each, the experimenter demonstrated the attempt 3 times in 10 seconds after which the children were handed the toy and provided with 20 seconds of response time. Videos were coded for whether or not the children imitated the experimenter's goal (i.e., the completed action). Only fully completed actions were coded as successful responses. In a few cases, the children performed the target act during the baseline period. In such cases, after completion of this activity, they were asked what the experimenter was trying to do with the

object. If the child responded by stating the experimenter's intention, this was coded as a successful response.

ILLUSTRATION 5: Intentionality Materials



Desire: The child was seated at a table across from an adult. Two stuffed cats (A and B) were placed on the table. As in Phillips, Wellman, and Spelke (2002), the adult looked at cat A and used her face and voice to express interest and joy in that particular cat. Next, the experimenter turned her gaze to the child and a second experimenter asked the child which cat the first experimenter wanted. A screen then hid the first experimenter and cats. When the screen was removed, the first experimenter was shown holding cat A, which she had expressed interest in (consistent). Next, the procedure was repeated, but this time the adult expressed interest in cat A and was shown holding cat B after the screen was removed (inconsistent). The procedure was repeated with a set of stuffed dogs. The order in which the cats and dogs were presented was counterbalanced between subjects. Changes in looking time between the consistent and inconsistent test events were recorded. In addition, behavioral and/or verbal indications of surprise were also recorded (e.g., widening of the eyes, giggling/laughing, verbal responses such

as “That’s silly!”). Longer looking times at the inconsistent events were considered indicative of surprise, suggesting that the child understood which animal the experimenter desired. Any correct verbal responses were also recorded and, if a child did not demonstrate differences in looking times, but did provide a correct verbal answer, this was considered an indication of understanding of others’ desires.

STANDARDIZED MEASURES

Peabody Picture Vocabulary Test-Fourth Edition (PPVT-IV) (Dunn & Dunn, 2007): The PPVT-IV is a standardized measure of single word receptive vocabulary. The child is presented with 4 pictures per page and asked to identify a single item on each page, either by pointing or indicating the number of the picture (each picture is represented by a number placed below it).

Vineland Social-Emotional Early Childhood (Vineland SEEC) (Sparrow, Balla, & Cicchetti, 1998): The Vineland Social-Emotional Early Childhood Scales is a standardized measure of social-emotional skills in young children, aged birth through five years. It is a parent interview encompassing three areas: Interpersonal Relationships, Play and Leisure Skills, and Coping Skills.

Dimensions of Mastery Questionnaire (DMQ) (Morgan et al., 1997): The DMQ is a measure of mastery motivation, designed by Morgan, Maslin-Cole et al. (1992). It measures general mastery motivation as well as other areas such as social persistence with adult, social persistence with children, and object persistence. It is a two page questionnaire, using a Likert scale,

designed to be completed by a child's primary caregiver.

CHAPTER 5: Results

Results

Reliability

Forty-one percent of the participants were double-coded for reliability. Inter-rater reliability was calculated for each of the tasks. Items with discrepancies were recoded a third time, thus providing a tie-breaking final code. Final inter-rater reliability was as follows: free play looks 84.6%, gumball task 92.3%, false belief task 100%, imitation task, 100%, intentionality 100%, desire task 100%, forced choice task 100%, and joint attention tasks 100%.

Social Motivation

A composite social motivation score was devised by coding each individual component of social motivation (free play looks, social proportion of pushes on gumball task, forced choice, DMQ adult, and DMQ children) and adding them together to create a score ranging from 0-10 as follows:

1. *Free Play Looks*: the subjects were ranked in ascending order according to how many times they looked at the experimenter. They were then divided into 3 sections, with the lowest 3rd receiving a score of 0, the middle 3rd receiving a score of 1, and the highest 3rd receiving a score of 2.
2. *Gumball Social Proportion*: Similar to free play looks, the subjects were ranked in ascending order according to their proportion of social pushes and then divided into

thirds. The lowest 3rd received a score of 0, the middle 3rd received a score of 1, and the highest 3rd received a score of 2.

3. *Forced Choice*: In this task, the children could choose the toy both times (no social choices), the toy 1 time and the experimenter with the toy 1 time (1 social choice), or the experimenter with the toy both times (2 social choices). Scores were therefore assigned as follows:

    0 = no social choices or no response

    1 = 1 social choice

    2 = 2 social choices

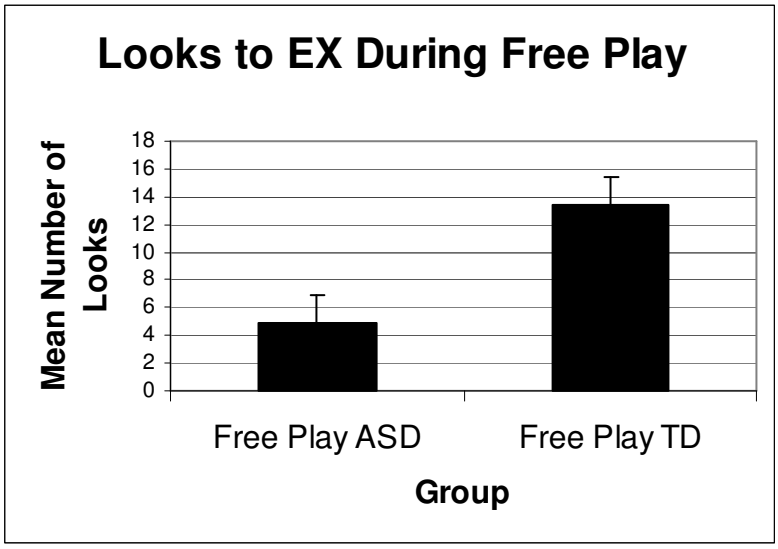
4. *DMQ Adult*: Similar to free play looks, the subjects were ranked in ascending order, according to scores on the DMQ with adults, and then divided into thirds. The lowest 3rd received a score of 0, the middle 3rd received a score of 1, and the highest 3rd received a score of 2.
5. *DMQ Children*: Again the subjects were ranked in ascending order, according to their scores on the DMQ with children, and then divided into thirds. The lowest 3rd received a score of 0, the middle 3rd received a score of 1, and the highest 3rd received a score of 2.

The typically developing children ($M = 5.82$) had significantly higher total social motivation scores than did the children with autism ($M = 1.73$) ($t(30) = 8.99$, $d = .857$, $p < .01$) (see Table 1).

Social Motivation: Free Play

All children, both with and without autism successfully engaged in free play. Children with autism, however, looked at the experimenter less frequently than did typically developing children (M_{ASD} = 4.93, *sd* = 4.87 vs. M_{TD} = 13.41, *sd* = 9.96, *t*(29) = 2.91, *p* < .01, *d* = .56) (see Figure 1 and Table 2).

FIGURE 1: Looks at Experimenter During Free Play



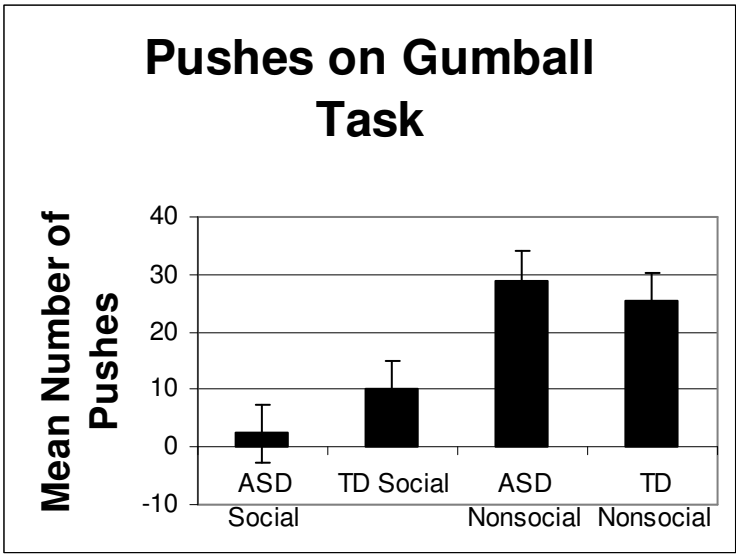
Social Motivation: Gumball Machine

All typically developing children, and 14 out of 15 children with autism, were able to participate in the gumball machine task. One child with autism was unable to understand the task even after the demonstration. This child was, therefore, excluded from this analysis. Additionally, one typically developing child was excluded from this analysis due to mechanical difficulties resulting in a lack of video.

Both groups revealed a significant preference for the nonsocial over the social alternative (ASD *t*(25) = -4.93, *p* < .01, *d* = -1.97; TD *t*(31) = -3.53, *p* < .01, *d* = -1.27). The TD group produced more social pushes (M_{ASD} =2.31, *sd* = 3.01, M_{TD} =9.47, *sd* = 9.44, *t*(28) = 2.63, *p* < .05,

d = .99), but the raw number of nonsocial pushes did not differ significantly across groups (M_{ASD} = 28.86, sd = 16.34, M_{TD} = 25.43, sd = 15.92, t(28) = -.58, p = .57, d = -.22), but the difference in the proportion of social pushes was not captured when using a t-test. A Mann Whitney U test revealed a stronger preference for the social alternative in the TD group than in the ASD group (M_{ASD} = 2.36, sd = 2.89, M_{TD} = 10.06, sd = 9.42, U = 44.00, Z = -2.29, p < .05). It should be noted that one child with autism pushed three times for social interaction and did not push at all for the machine; this was not only an unusual pattern of preference for a child with autism, but was also an unusually low number of pushes overall (M = 33.43, sd = 18.53) and an unusually low number of pushes for children with autism (M = 15.19, sd = 17.93) (see Figure 2 and Table 3). Further analysis excluding this participant did not reveal any changes in the results.

FIGURE 2: Pushes on Gumball Task



Social Motivation: Forced Choice

All children in both groups were able to participate in the forced choice task (N_{ASD} = 15, N_{TD} = 17). The first five participants, all children with autism, participated in only one trial of the forced choice task. The procedure was then modified slightly such as all other children participated in two trials in order to assess side-preference as an alternative to social preference as a basis for choice. For the children who participated in one trial, there was a 50% chance that they would choose to interact with the toy *and* the experimenter. For the children who participated in two trials, there was a 25% chance that they would choose to interact with the toy *and* the experimenter both times. For the purposes of calculating an overall social motivation score, the forced choice task was coded as described above. For the purposes of individual analysis of this task, children received a score of 1 if they chose to interact with the experimenter with a toy both times (or one time if they only participated in one trial) and a score of 0 if they chose to interact with the experimenter with the toy once (or no times with one trial), as this would not reflect a clear social motivation. No significant difference was found between the two groups in their choices to interact with an experimenter with a toy vs. a toy alone (p = .16 Fisher's Exact Test) (see Table 4).

Table 1: Social vs. Nonsocial Preference in Forced Choice Task

	TD	ASD
EXPERIMENTER + TOY (BOTH TIMES)	1	4
TOY ALONE (BOTH TIMES)	7	5
NO PREFERENCE (ONCE EACH SIDE)	9	6

Total	17	15

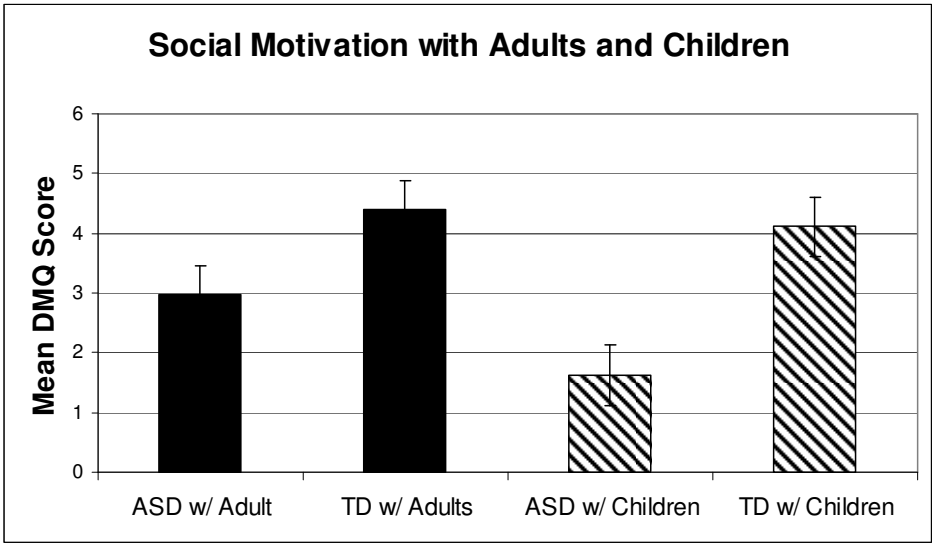
*The 1st 5 children participated in only one trial. The side preference they chose was counted as a choice for both times.
* For the purposes of statistical analysis, the choices for toy alone both times and no preference were combined.

Social Motivation: DMQ

All parents filled out and returned the DMQ. Typically developing children were reportedly more motivated than ASD children to interact socially with both adults (M_{ASD} = 2.79, sd_{ASD} = .75 vs. M_{TD} = 4.39, sd_{TD} = .48, $t(30) = 7.24$, $p < .001$, $d = 2.64$) and children (M_{ASD} = 1.63, sd_{ASD} = .64 vs. M_{TD} = 4.11, sd_{TD} = .59, $t(30) = 11.39$, $p < .001$, $d = 4.16$). Interestingly, typically developing children were also reportedly more motivated than ASD children to engage with toys and other objects (M_{ASD} = 2.67, sd_{ASD} = .81 vs. M_{TD} = 3.62, sd_{TD} = .50, $t(30) = 3.9$, $p < .01$, $d = 1.42$). In order to determine whether social motivation was particularly impaired (as opposed to motivation more broadly speaking) in the ASD group, we next directly compared social motivation to object motivation. Although object/nonsocial motivation was significantly higher than social motivation to interact *with children* (object motivation M = 2.67 sd = .81, social motivation with children M = 1.62, sd =.64, $t(13) = -4.19$, $p < .01$, $d = -2.32$), it did not differ from social motivation to interact *with adults* (M = 2.79, sd = .75, $t(13) = .529$, $p = .606$, d = .29). In contrast, typically developing children exhibited significantly higher social motivation with children than object motivation, but there was not a significant difference in their social motivation with adults and their object motivation (object motivation M = 3.58, sd = .506, social motivation with children M = 3.97, sd = .659, social motivation with adults M = 4.05, sd = 1.17,

$t(15) = 1.58$, $p = .14$ for object/social motivation with adults, $d = .82$; $t(15) = 2.57$, $p < .05$, $d = 1.33$ for object/social motivation with children).

FIGURE 3: DMQ Scores

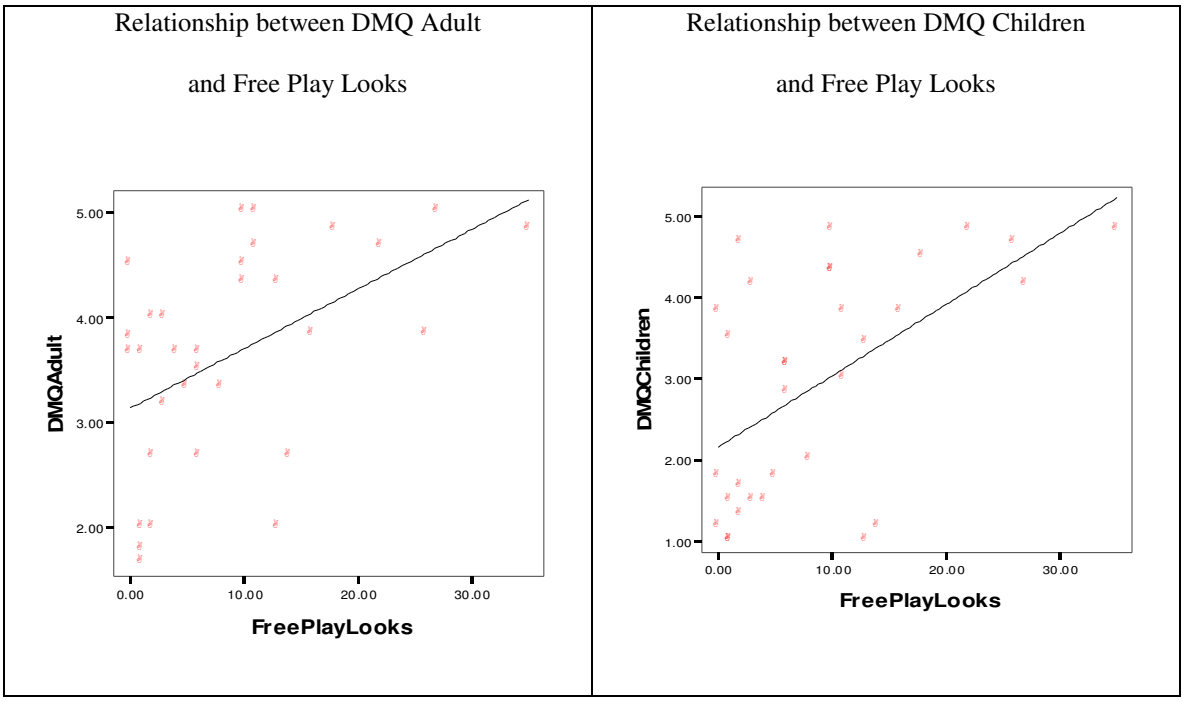


Parents also completed an informal questionnaire asking questions regarding development, language, social skills and preferences, and treatment (if applicable). 64.7% of the TD children reportedly preferred to play with other children than alone, and 64.7% preferred to play with adults rather than alone. 6.25% of the ASD group preferred to play with other children rather than alone, but 81.25% preferred to play with adults rather than alone.

Relationship between Measures of Social Motivation

Number of looks to the experimenter during free play was significantly correlated with the DMQ measure of social motivation with adults ($r = .49$, $p < .01$) and the DMQ measure of social motivation with children ($r = .56$, $p < .01$). No significant correlations were found between any other measures of social motivation.

FIGURE 4: Correlations Between DMQ Adults and Children and Free Play Looks



Theory of Mind

A total theory of mind score was calculated based on a composite of performance on all related tasks. Each component of theory of mind tested (i.e., imitation, joint attention, understanding of intentions, desire, and false belief) was coded as follows:

1. *False Belief*: There were two false belief questions, with a 50% chance of answering correctly on each question. Therefore, there was a baseline 25% chance that a child would answer *both* questions correctly. Scores were assigned as follows:

   0 = none correct or no response

   1 = 1 correct

   2 = 2 correct

2. *Imitation*: There were two imitation probes. Scores were assigned as follows:

   0 = none correct or no response

   1 = 1 correct

   2 = 2 correct

3. *Joint Attention*: Children received a score of 0 if they did not look at the experimenter during these tasks. A score of 1 was assigned to any number of looks below the median and a score of 2 was assigned to any number of looks above the median.

4. *Understanding Intentions*: There were two intentionality probes. Scores were assigned as follows:

   0 = none correct or no response

   1 = 1 correct

   2 = 2 correct

5. *Understanding Desire*: There were four desire questions, with a 50% chance of responding correctly on each question. Therefore, there was a baseline 12.5% chance that a child would answer 3 out of 4 questions correctly. Scores were assigned as follows:

    0 = 0 or 1 question answered correctly

    1 = 2 questions answered correctly

    2 = 3 or 4 questions answered correctly

These scores were then added together such that each child could obtain a total theory of mind score ranging from 0-10. Further analysis was conducted in order to determine whether there were differences between the two groups on either conceptual (i.e., understanding of intentions and desires) or behavioral (i.e., imitation and joint attention) precursors to theory of mind.

Typically developing children received higher total theory of mind (ToM) scores (M = 6.88, sd = 1.49) than did the children with autism (M = 3.8, sd = 2.1, $t(30) = 4.81$, $p < .001$, d = 1.76). Typically developing children also received higher scores specifically on conceptual precursors to theory of mind (M_{TD} = 3.29, sd_{TD} = 1.21, and M_{ASD} = 1.73, sd_{ASD} = 1.28, $t(29)$ = 3.53, $p < .01$, d = 1.31) and on behavioral precursors to theory of mind (M_{TD} = 3.0, sd_{TD} = .94, and M_{ASD} = 2.13, sd_{ASD} = 1.06, $t(30) = 2.46$, $p < .05$, d = .90) (see Table 5) when analyzed separately.

TABLE 2: Means & Standard Deviations for Theory of Mind Tasks

	GROUP	MEAN	SD
CONCEPTUAL	TD	3.2941	1.21268
CONCEPTUAL	ASD	1.7333	1.27988

BEHAVIORAL	TD	3.0000	.93541
BEHAVIORAL	ASD	2.1333	1.06010
TOTAL ToM	TD	6.8824	1.49509
TOTAL ToM	ASD	3.8000	2.11119

Total ToM = total theory of mind (false belief + intentionality + desire + joint attention + imitation)

False Belief Task

All children participated in the false belief task. Two out of 17 (11.77%) typically developing children, and no children with autism, exhibited an understanding of false belief, as measured by verbal response or pointing in this study. No difference was found between the two groups in the proportion of children who were able to pass the false belief task as measured by verbal response or pointing (p = .49 Fisher Exact Test). Additional analysis was conducted to examine the number of times the children corrected the examiner when she reached into a box. There was no difference between the two groups on their mean number of corrections (M_{ASD} = .46, sd = .78, M_{TD} = .75, sd = 1, $t(27) = .85$, p = .402, d = .32).

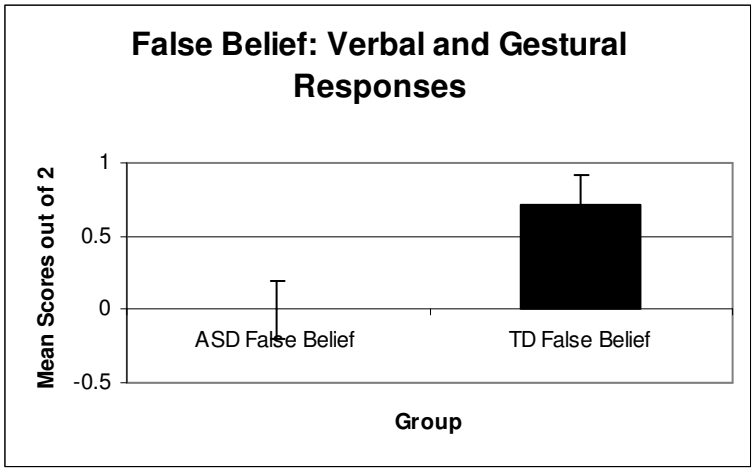
Analysis of looking time during each of the 4 trials also revealed no significant differences between the two groups. When looking times at expected (i.e., experimenter reached into the box she should have *thought/known* the toy was in) versus unexpected (experimenter reached into a box she should *not* have known the toy was in) events were analyzed, a significant difference was found only in the typically developing group between trials 1 (expected) and 4 (unexpected), both true belief trials, (Trial 1 M = 6.59, sd = 4.43, Trial 4 M = 3.57, sd = 2.64, $t(30) = 2.41$, $p < .05$, d = .88), indicating that the TD children understood the concept of belief, but the ASD children did not.

Further analysis compared performance on true belief and false belief understanding in each group. Trial 1 was a true belief trial with an expected action on the part of the examiner, while trial 2 was a false belief trial with an expected action from the examiner only if the children understood false belief. Therefore, if the children understood false belief, no difference in looking times would be expected between these two trials. Trial 3 was a false belief trial equivalent to trial 2, and trial 4 was a true belief trial with an unexpected action from the examiner. If the children understood both true and false belief, a difference in looking times would be expected between trials 3 and 4, with longer looking times at trial 4 (unexpected event). No differences were found between trials 1 and 2 or between trials 3 and 4 in either group. (See Table 6 and Figure 5)

TABLE 3: Looking Time During the False Belief Task

GROUP/TRIAL	MEAN	SD
ASD Trial 1	5.534	3.23
ASD Trial 2	5.4187	3.15
ASD Trial 3	3.7814	3.23
ASD Trial 4	5.7807	4.86
TD Trial 1	6.5975	4.29
TD Trial 2	5.4319	2.45
TD Trial 3	4.2338	4.30
TD Trial 4	3.5669	2.63

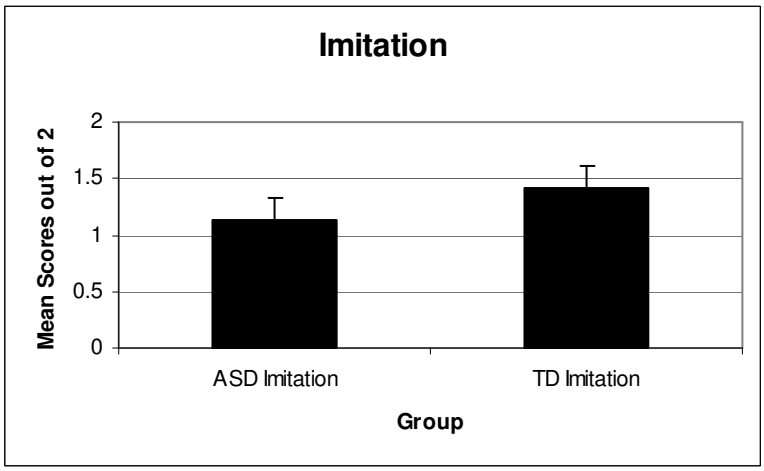
FIGURE 5: Verbal and Gestural Responses on False Belief Task



Imitation

All children in both groups participated in the imitation task. No differences were found across groups in their ability to imitate (p = .16 Fisher Exact Test) (see Figure 6).

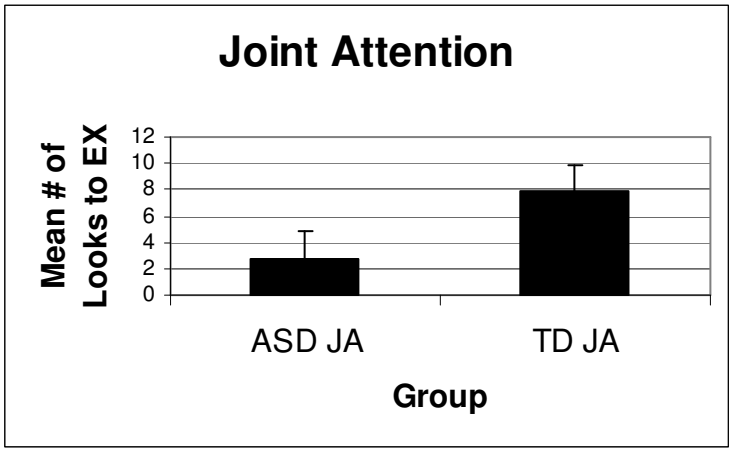
FIGURE 6: Imitation



Joint Attention

All children in both groups participated in the joint attention tasks. Typically developing children (M_{TD} = 7.94, *sd* = 5.1) looked significant more often at the experimenter than did the children with autism (M_{ASD} = 2.8, *sd* = 2.37; $t(30) = 3.59$, $p < .01$, $d = 1.31$) (see Figure 7).

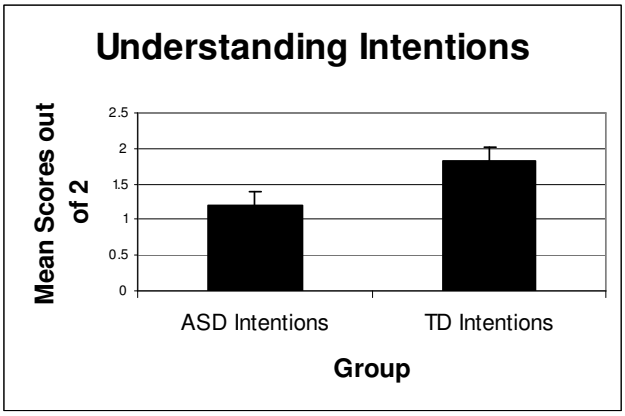
FIGURE 7: Joint Attention Looks



Intentionality

All children participated in the intentionality task. Eighty percent (12 out of 15) of the children with autism and 100% of the typically developing children demonstrated an understanding of intentionality. No significant differences were found between the two groups on this measure (p = .09 Fisher Exact Test) (see Figure 8), though there was a trend toward greater understanding in the TD group.

FIGURE 8: Intentionality



Desire

All children in both groups were able to participate in the desire task. Typically developing children were better at understanding others' desires than were children with autism, as evidenced by their verbal and/or gestural (i.e., pointing) responses (χ^2 (1, N = 31) = 15.78, p < .05).

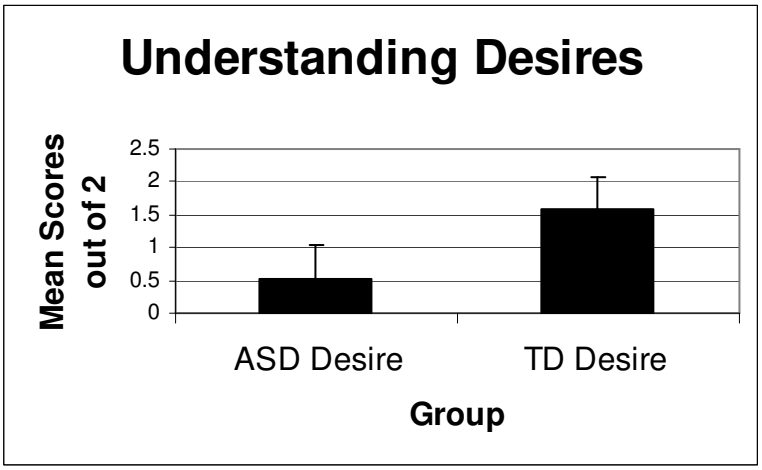
The amount of time that the children spent looking at inconsistent versus consistent events was also analyzed. If the children understood desire, it would be expected that they would look longer at the inconsistent events than at the consistent events. Neither group demonstrated this pattern of looking (See Table 7 and Figure 9).

One possibility is that this difficulty in understanding desire arose from a difficulty in attending to the task. If the children were not looking at the experimenter's direction of face/eye gaze, they would not be able to determine which item she desired. To examine this possibility, we also coded looking time to the experimenter during her expressions of desire. Unfortunately, due to poor camera positions during this phase, only partial data were available. The ASD group spent significantly less time looking at the experimenter's face than did TD children (M_{ASD}=2.69, sd_{ASD}=1.59 vs. M_{TD}=4.24, sd_{TD}=. 97, t(24) = 2.98, p < .01, d = 1.22).

TABLE 4: Mean Looks at Consistent and Inconsistent Events with Cat and Dog Trials

	GROUP	MEAN	SD
Cats Consistent	TD	9.72	.91
	ASD	8.07	1.19
Cats Inconsistent	TD	8.49	.957
	ASD	7.57	1.056
Dogs Consistent	TD	11.88	1.10
	ASD	7.86	.953
Dogs Inconsistent	TD	9.07	.858
	ASD	7.71	1.05

FIGURE 9: Understanding Desire



Severity of Autism

Two measures of severity of autism were used in this study: the Vineland SEEC IR Scale (Sparrow, Balla, & Cicchetti, 1998) and the PPVT-IV (Dunn & Dunn, 2007) (both assessments have a mean of 100 and a standard deviation of 15). The typically developing group had a mean

score of 114 (high average) on the PPVT-IV and 122 (above average) on the VSEEC IR. The autism group had a mean score of 90 (average) on the PPVT-IV and 61 (below average) on the VSEEC IR. The two groups differed significantly from each other on both measures (PPVT $t(26) = 4.77$, $p < .01$, $d = 1.87$; VSEECIR $t(30) = 11.79$, $p < .01$, $d = 4.31$).

Social Motivation and Severity of Autism

In order to explore the relationship between severity of autism and social motivation, we looked at correlations between social motivation, as measured by the gumball machine task, the DMQ (Morgan et al., 1997), free play looks, and the forced choice task, and the Vineland SEEC Interpersonal Relationships (IR) Scale (Sparrow, Balla, & Cicchetti,1998), and the PPVT-IV (Dunn & Dunn, 2007). Total social motivation was significantly related to scores on the Vineland SEEC IR ($r = .556$, $p < .05$) and had a borderline relationship with the PPVT-IV ($r = .509$, $p = .063$). The PPVT-IV and social motivation with children on the DMQ were also significantly related ($r = .555$, $p < .05$). No other significant correlations were found, though borderline relationships appeared between the DMQ social motivation with adults and the Vineland SEEC IR ($r = .479$, $p = .071$) and between the VSEECIR and Free Play Looks ($r = .470$, $p = .077$) (see Table 9).

TABLE 5: Correlations between Social Motivation and Severity of Autism

	Total	**Social**	**Free**	**Forced**	**DMQ**	**DMQ**	**PPVT**	**VSEECIR**

	Social Motivation	Proportion	Play	Choice	Adult	Child		
Total Social Motivation		.640*	.524*	.039	.580*	.272	.509^	.556*
Social Proportion			-.093	.417	.400	-.090	-.116	.485
Free Play				.087	-.041	.023	.409	.470
Forced Choice					-.274	.339	.227	-.009
DMQ Adult						.265	.107	.479^
DMQ Child							.555*	.324
PPVT								.328
VSEECIR								

* = significant at .05 level
^ = trend (.07 or below)

Theory of Mind and Severity of Autism

A significant correlation was found between total theory of mind and the PPVT-IV (r = .650, $p < .05$). A significant correlation was also found between Vineland SEEC IR and the number of times the children looked at the adult during joint attention activities (i.e., blocking, teasing, car) ($r = .667$, $p < .01$). No other significant correlations were found in this area.

TABLE 6: Correlations between Theory of Mind and Severity of Autism

	PPVT	VSEECIR	Total ToM	Imitation	Intentionality	Desire	Joint Attn.
PPVT		.328 (p = .252)	.650 (p = .012)	.282 (p = .328)	.219 (p = .451)	.498 (p = .070)	-.014 (p = .962)
VSEECIR			.315 (p = .253)	-.224 (p = .423)	.242 (p = .384)	-.054 (p = .849)	.650 (p = .009)
Total ToM				.458 (p = .086)	.441 (p = .100)	.712 (p = .003)	.335 (p = .223)
Imitation					-.302 (p = .275)	.237 (p = .396)	-.185 (p = .51)
Intentionality						.196 (p = .484)	-.044 (p = .877)
Desire							.206 (p = .462)
Joint Attn.							

Social Motivation and Theory of Mind

Social Motivation and Theory of Mind: ASD

Total theory of mind in participants with autism was correlated with free play looks (r = .747, $p < .01$), but not with other aspects of social motivation. Free play looks were also correlated with understanding of desire (r = .516, $p < .05$) and joint attention (r = .625, $p < .05$). Proportion of social pushes was highly negatively correlated with imitation (r = -.959, $p < .01$), but not with other aspects of theory of mind. Social motivation in autism, as measured on the DMQ, was not significantly correlated with any aspects of theory of mind. (See Table 11)

TABLE 7: Correlations between Theory of Mind and Social Motivation: ASD

	Total ToM	Imitation	Intentionality	Desire	Joint Attention
Social Pushes	.130 (p = .657)	.191 (p = .512)	.004 (p = .988)	-.125 (p = .670)	-.023 (p = .938)
Social Proportion	-.392 (p = .263)	-.959 (p = .000)	.133 (p = .715)	-.180 (p = .619)	.303 (p = .394)
DMQ Adult	.263 (p = .345)	.080 (p = .777)	.211 (p = .451)	.155 (p = .580)	.155 (p = .582)
DMQ Child	.142 (p = .629)	.000 (p = .999)	.104 (p = .723)	-.190 (p = .515)	.047 (p = .872)
Free Play Looks	.747 (p = .001)	.092 (= = .744)	.439 (p = .102)	.516 (p = .049)	.625 (p = .013)
Forced Choice	-.171 (p = .542)	-.395 (p = .145)	-.055 (p = .847)	-.064 (p = .820)	.181 (p = .518)

Social Motivation and Theory of Mind: TD

A trend was found in the TD participants between total theory of mind and proportion of social pushes ($r = .574$, $p = .065$). Proportion of social pushes was not correlated with any individual measures of theory of mind. Another trend was found between social motivation with children, as measured by the DMQ, and imitation in typically developing children ($r = .476$, $p = .073$). Joint attention was correlated with both free play looks ($r = .589$, $p < .05$) and negatively correlated with forced choice ($r = -.543$, $p < .05$).

TABLE 8: Correlations between Theory of Mind and Social Motivation: TD

	Total ToM	Imitation	Desire	Joint Attention	False Belief
Social Pushes	.624 (p = .010)	.228 (p = .395)	.104 (p = .700)	.020 (p = .94)	.190 (p = .480)
Social Proportion	.574 (p = .065)		-.026 (p = .939)	-.188 (p = .580)	.435 (p = .181)
DMQ Adult	.051 (p = .855)	-.404 (p = .136)	-.018 (p = .950)	.444 (p = .097)	-.157 (p = .577)
DMQ Child	.141 (p = .616)	.476 (p = .073)	-.169 (p = .547)	-.035 (p = .902)	-.097 (p = .731)
Free Play Looks	-.135 (p = .607)	.052 (p = .843)	-.322 (p = .207)	.589 (p = .013)	.238 (p = .357)
Forced Choice	-.218 (p = .400)	-.091 (p = .728)	.065 (p = .803)	-.543 (p = .024)	.350 (p = .169)

Predicting Group Membership

Discriminant analysis indicated that, when combined, the social motivation and theory of mind measures were able to correctly predict group membership 100% of the time. Social motivation measures were also able to correctly predict group membership 100% of the time. Theory of mind variables were able to predict group membership 84.4% of the time, correctly predicting TD membership 88.2% of the time and ASD membership 80% of the time (see Table 13).

Social motivation, as measured by the DMQ Adult and Child, was also able to predict 100% of the cases. Other individual measures of social motivation were less successful. Proportion of social pushes was able to correctly predict 64.7% of the TD children and 80% of the ASD children (see Table 14). Individual theory of mind measures were also less successful. False belief was able to correctly predict only 29.4% of the TD children, although it predicted 100% of the ASD children. Conceptual precursors of theory of mind combimed (i.e., understanding of desire and intentionality) were able to predict 76.5% of TD participants and 80% of ASD participants. Behavioral precursors of theory of mind combined (i.e., imitation and joint attention), were able to correctly predict 76.5% of TD children and 86.7% of ASD children. Imitation/Intentionality combined were able to correctly predict 82.4% of the TD participants and 60% of the ASD participants. Desire/joint attention combined were able to correctly predict 88.2% of the TD children and 80% of the ASD children (see Table 15).

TABLE 9: Predicted Group Membership

		GROUP	**Predicted Group Membership**		**TOTAL**
			TD	**ASD**	
All Variables	%	TD	100	0	100
		ASD	0	100	100
Social Motivation Variables	%	TD	100	0	100
		ASD	0	100	100
ToM Variables	%	TD	88.2	11.8	100
		ASD	20	80	100

TABLE 10: Social Motivation Predictors of Group Membership

		GROUP	Predicted Group Membership		TOTAL
			TD	ASD	
Social Proportion	%	TD	64.7	35.3	100
		ASD	20	80	100
DMQ Adult + Child	%	TD	100	0	100
		ASD	0	100	100

TABLE 11: Theory of Mind Predictors of Group Membership

		GROUP	Predicted Group Membership		TOTAL
			TD	ASD	
False Belief	%	TD	29.4	70.6	100
		ASD	0	100	100
Desire + Intentionality (Conceptual Precursors to ToM)	%	TD	76.5	23.5	100
		ASD	20	80	100
Imitation + Joint Attention (Behavioral Precursors to ToM)	%	TD	76.5	23.5	100
		ASD	13.3	86.7	100
Imitation + Intentionality	%	TD	82.4	17.6	100
		ASD	40	60	100

Desire + Joint Attention	%	TD	88.2	11.8	100
		ASD	20	80	100

CHAPTER 6: Discussion and Conclusions

Discussion

Despite the fact that autism has become a hot topic of research in recent years, the underlying deficits responsible for this disorder are not yet well understood. Various theories have been proposed, such as weak central coherence (Happe, 2005; Happe & Frith, 2006), executive dysfunction (Ozonoff et al., 2005), and theory of mind dysfunction (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002). None of these theories, however, provides a complete account of autism. The theory of mind account perhaps comes closest by specifically addressing the social deficits, which are arguably the most distinctive in characterizing autism. At the same time, however, this theory is plagued by serious limitations. In the current work, we turned to an early conception of autism in search of a more satisfactory explanation. Deficient social motivation, which was highlighted in the very first definition of autism (Kanner, 1943), seemed a viable alternative because it could explain the social and language deficits, and appeared to be both universal within, and specific to, autism. In order to explore the merits of an explanation based on a deficiency in social motivation, relative to the previously dominant theory of mind explanation, we asked four questions: 1) Do children with autism reveal lower social motivation, in a controlled setting, than do typically developing children? 2) Do children with autism perform more poorly on theory of mind tasks than do typically developing children? 3) Can

social motivation predict severity of social and language deficits in children with autism? 4) Is there a relationship between social motivation and theory of mind?

Social Motivation

Although many references have been made to a lack of social motivation in children with autism, no clear definition is available. We therefore developed a working definition of social motivation by combining established definitions of motivation and social interest. *Social motivation is the energy and desire that directs people's interests toward others and causes them to want to interact socially with them.* We also developed four measures of social motivation for the current study, drawing upon elements of established procedures for assessing motivation more broadly and social interest more specifically. Overall, we found that children with autism exhibit deficient social motivation in relation to their typically developing peers.

First, we examined looks to the experimenter during free play. Consistent with our predictions, children with autism looked at the experimenter less often than did typically developing children. This finding is consistent with well documented abnormalities in patterns of eye contact in children with autism (Charman et al., 1997; Neumann et al., 2006; Pelphrey, Morris, and McCarthy, 2005). In the past, however, research on eye contact/gaze has focused on topics such as visual fixation patterns (Klin et al., 2002), gaze following (Kylliainen & Kietanen, 2004), and using eye gaze to infer mental states (Baren-Cohen et al., 1995). Furthermore, decreased eye contact in children with autism has often been associated with deficient joint attention. The current investigation extends this work by emphasizing how patterns of eye gaze

can indicate social motivation. Specifically, the more socially motivated children are, the more likely they should be to look at others.

Our second social motivation task, the gumball task, required participants to choose to obtain a desired food item from either a machine or a person. Consistent with our predictions, the children with autism chose to obtain food from a person significantly less often than did the typically developing children. Previous literature has suggested that motivation may be a core deficit in autism (Koegel and Koegel, 1995; Koegel et al., 1998). Our study, however, examined *social* motivation specifically, experimentally pitting it against nonsocial object motivation. It is the first to demonstrate that social motivation, rather than motivation in general, is lacking. Recall that the two groups pushed an equivalent number of times for the machine, despite the difference in their frequency of pushes for social interaction.

The strength of these conclusions, however, must be tempered by the possibility that extraneous factors influenced preferences above and beyond social motivation. After all, although the ASD group demonstrated a *stronger* preference for the machine over the experimenter than did the TD group, the TD group also showed a significant preference for the machine. This might be accounted for by preferences for novelty rather than social versus nonsocial interaction. For example, although most children have been exposed to machines that provide food, food is most often provided to children by other people, potentially making the machine more novel than the person. The possibility of novelty preferences guiding choices was considered when designing this task. In fact, we attempted to match the machine and the experimenter on both novelty and complexity. The majority of the children were unfamiliar with the experimenter, making her novel, and the machine was unlike typical vending machines,

making it novel as well. We created multi-modal, dynamic responses from both the machine and the experimenter that lasted approximately the same length of time. Despite our best efforts, however, it is possible that one was more novel or complex than the other, contributing to the children's preferences.

Our third measure of social motivation, a forced choice task, involved children choosing between a toy and the experimenter with the same toy, on the assumption that the more socially motivated children were, the more likely they would be to choose to interact with the experimenter and the toy together. Contrary to our predictions, neither group revealed a clear preference. In fact, if anything, the ASD children chose the experimenter with the toy more often than did the TD children. There are, however, reasons to be cautious about interpreting this finding. Most notably, the TD children did not perform as anticipated, thereby potentially undermining the validity of the task. Only 6.25% (chance = 25%) of the typically developing children chose the experimenter with the toy both times, possibly reflecting stronger stranger anxiety. In contrast, approximately 33% of the ASD group revealed this pattern of response. It appeared as though the ASD group focused exclusively on the toy regardless of whether or not someone else was there. When these children chose the side with the experimenter with the toy, they did not play interactively with the toy and the experimenter. Instead, they played with the toy alone. Admittedly, this pattern of behavior could be interpreted post-hoc as a lack of social motivation. Future research, armed with this preliminary data, will be necessary to determine the viability of a forced-choice approach to address social motivation. One possibility is that a toy that requires interaction between two people (e.g. a simple board game), rather than a toy that is

easily played with alone, might increase the chances that the children would make a clearer choice between social and nonsocial interaction.

Finally, we drew on sub-scales of the Dimensions of Mastery Questionnaire (DMQ) (Morgan et al., 1997) to provide a formal, standardized, parent-report measure of social motivation. As predicted, parents reported that typically developing children were more motivated to interact with both adults and children than were children with autism. The TD group also exhibited more nonsocial motivation than did the ASD group. Moreover, the DMQ indicated that typically developing children exhibited more social motivation with other children, but not with adults, than nonsocial motivation. In contrast, the children with autism demonstrated more nonsocial motivation than social motivation *with other children*, but equivalent nonsocial motivation as social motivation with adults. The two groups therefore demonstrated opposite patterns with reference to motivation with other children, while both exhibited similar patterns with reference to motivation with adults. This result in the children with autism may be related to the increased effort on the part of parents of children with autism to interact with their children. Perhaps these parents provide desired items and/or activities to their children, therefore increasing their children's motivation to interact with them. Other children, on the other hand, likely have no need or desire to work to obtain interaction with a child with autism. It is also possible that parents want to think that their children with autism are motivated to interact with them and that this desire influences their perceptions of their children's social motivation with adults. Another possible explanation for this result is that children with autism find adults easier to understand and, therefore, more motivating to interact with. This finding needs to be explored further in order to determine why children with autism

might be more socially motivated with adults than with other children.

We found relatively weak relationships among our measures of social motivation. Looks to the experimenter during free play were related to social motivation on the DMQ, but no other significant relationships were found. The measurement of social motivation is challenging and has not been previously attempted with children with autism. The lack of strong relationships between measures suggests that these tasks may not have been sufficiently sensitive and would benefit from modification. Future studies could modify these tasks as well as attempt to design novel tasks to determine the most effective and sensitive way of measuring social motivation in young children with autism. For example, in order to eliminate the influence of novelty on the gumball task, children could be allowed to interact with both the machine and the experimenter prior to beginning the task. Furthermore, the DMQ measured both social motivation with adults and children. The gumball task could be performed as described here as well as with the two choices being an adult and a child (i.e., requesting food from an adult or from a child). This might increase the relationship between the gumball task and the DMQ. Despite the difficulty of measuring social motivation, and the weak relationships between our measures, the current findings concur with recent research in the field of autism. Social tasks have been found to be more challenging than nonsocial tasks, and children with autism appear to prefer objects over people (Dawson et al., 2002; Loth & Gomez, 2006). The current study expanded on previous work by creating tasks which were equivalent in their difficulty level, but varied on the social-nonsocial dimension. This enabled us to determine whether social motivation versus difficulty level affects the interaction choices of children with autism.

The results of the current study support our prediction that children with autism have deficient social motivation relative to their typically developing peers. More broadly, they lend credence to the possibility that early, deficient social motivation could lead to the symptoms involved in autism. Despite converging evidence for a social motivation deficit, however, the question remains as to how this deficit may relate to other deficits in autism, such as those observed in relation to theory of mind.

Theory of Mind

Current work on theory of mind in autism focuses primarily on false belief understanding. A mature understanding of false belief, however, is thought to be gained through a developmental process involving imitation, joint attention, and understanding others' intentions and desires (Charman et al., 2000; Dawson et al., 2002; Williams et al., 2006; Ziv & Frye, 2003). We therefore expanded on previous research in the field by exploring false belief understanding, as well as its developmental precursors.

As predicted, children with autism performed significantly worse on the theory of mind tasks, overall, than did the typically developing participants. This finding is consistent with a plethora of recent research suggesting that children with autism struggle to understand and predict their own and other's thoughts, intentions, and beliefs (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002). However, performance on theory of mind related tasks was not uniform for children with autism. Children with autism performed worse than typically developing children on two tasks, understanding of desire and joint attention, while succeeding, like their typical counterparts, on

imitation and understanding of intentionality. Both groups performed poorly on the false belief task.

False Belief

Contrary to our predictions, no difference was found between the two groups on their ability to understand false belief, when measured with verbal responses, pointing, or eye gaze. In fact, there was little evidence that the children were responding appropriately to true beliefs. Based on looking time alone, only the TD group revealed some basic understanding of the task. The typically developing children's lack of understanding of false belief was surprising because we explicitly chose a task developed to measure this concept in typically developing *infants* to ensure that no extraneous linguistic or cognitive task demands would interfere with demonstrating conceptual understanding in this area (Onishi & Baillargeon, 2005). Although we did modify this task to allow for verbal responses (when children were capable of providing them), no verbal response was required. It appears, however, that this task is insensitive to false belief understanding in preschool age children. One possibility is that eye gaze measures might not be valid measures for preschool aged children, who process information quickly (relative to infants) and who can communicate through speech rather than nonverbal means.

Behavioral Precursors to Theory of Mind

Inconsistent with our predictions, we found no difference between the two groups on their ability to imitate. This finding is, however, consistent with some previous research. Although young children with autism typically struggle with very simple imitation with objects

(Hobson & Meyer, 2006) and infants with autism exhibit less imitation overall than their typically developing counterparts (Charman et al., 1997), when encouraged to imitate, children with autism are not deficient in their imitation skills (Beadle-Brown & Whiten, 2004). Furthermore, they are more likely to imitate actions on toys with strong sensory effects (Hobson & Meyer, 2006), suggesting performance rather than conceptual limitations. Many of the children with autism who participated in this study had been receiving developmental therapy drawing on the principles of applied behavior analysis. These children had likely received training in how to imitate actions on objects when modeled by an adult. It is possible that this experience inflated their imitative skills on our task.

Performance on our second measure of behavioral precursors to theory of mind, joint attention, was consistent with our predictions. During the joint attention tasks, children with autism looked at the experimenter significantly less often than did their typically developing peers, but did attend well to the available toys. These findings are consistent with Charman et al. (1997) who found that 20 month old infants with autism produced fewer gaze shifts between ambiguous toys and adults to share interest, but did demonstrate an interest in nonsocial aspects of the situation. Our results also support Dawson et al.'s (2004) findings that children with autism are less likely than both typically developing and developmentally delayed children to initiate joint attention with others by using eye gaze shifts between an adult and an item of interest. As mentioned previously, poor joint attention could be a result of deficient social motivation.

Conceptual Precursors to Theory of Mind

Consistent with our predictions, the children with autism did not differ from their typically developing counterparts in their ability to understand others' intentions. This finding adds to previous research indicating that children with autism are able to copy goal-directed actions of others after observing them (Hobson & Meyer, 2006). It remains possible, however, that children with autism are able to understand intentions in a structured setting in which distractions have largely been removed, yet continue to struggle with understanding intentionality in their considerably more complex and demanding everyday lives. Examination of understanding intentionality in natural settings would be an important direction for future work.

We further explored conceptual precursors to theory of mind by assessing understanding of desire in children with autism. The task in the current study required the children to identify desire based on eye gaze, and examined an understanding of desire using both a verbal and/or pointing response measure as well as an eye gaze measure. Consistent with our predictions, young children with autism had more difficulty understanding the desires of others than did their typically developing counterparts, which is consistent with some of the previous research. Although verbal children with autism appear to be able to use terms reflecting an understanding of desire (Rieffe, Terwogt, & Stockmann, 2000), when asked to identify others' desires based on direction of eye gaze, children with autism perform poorly (Peterson et al., 2005). The ability to understand desire might be related to the deficits we found in social motivation, as attention to others is necessary in determining their desires. Supporting this possibility were results indicating that the children with autism attended significantly less to the experimenter during her expressions of desire than did the typically developing children. Our findings in this area

warrant further investigation, particularly to determine the relationship between social motivation and understanding desire. One possible expansion on the current work would be to measure understanding of desire in a naturalistic setting. Another possibility would be to target either understanding of desire or social motivation in treatment and measure the other to determine whether an increase in one could cause an increase in the other.

Severity of Autism

Social Motivation and Severity of Autism

In order to further evaluate the social motivation account of autism, we explored the relationship between social motivation and severity of autism (as indexed by performance on standardized measures of receptive language and social skills). We found that, for children with autism, total social motivation was related to social skills (as measured by the Vineland SEEC IR (Sparrow, Balla, & Cicchetti,1998)). A trend was also found for a relationship between total social motivation and receptive language (as measured by the PPVT-IV (Dunn & Dunn, 2007)). Receptive language is also related to social motivation with children, but not social motivation with adults (on the DMQ). Furthermore, the results revealed a trend toward a relationship between the Vineland SEEC IR (Sparrow, Balla, & Cicchetti,1998) and both looks to the experimenter during free play and social motivation with adults (DMQ). These findings reinforce the need to look closely at the reasons underlying the differences between social motivation with adults versus children.

Theory of Mind and Severity of Autism

Thus far, we have examined social motivation, theory of mind, and the relationship between social motivation and severity of autism. We know that individuals with autism have difficulties with theory of mind tasks (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002) and we also know that theory of mind, as measured by performance on false belief tasks, is related to language competence in children with autism, but is not directly related to social competence or repetitive interests and behavior (Joseph & Tager-Flusberg, 2004). Therefore, in order to both build and expand on current knowledge, as well as to determine whether theory of mind or social motivation better predicts severity of autism, we explored the relationship between theory of mind and both language and social skills.

Consistent with our predictions, we found that total theory of mind was related to receptive language ability, as measured by the PPVT-IV (Dunn & Dunn, 2007). This result parallels previous research in this area (Buitelaar, et al., 1999b; Prior et al., 1998; Whitehouse & Hird, 2004; Ziatas, et al. 1998). When we examined the various components of theory of mind individually (e.g., imitation, joint attention, intentionality, desire), we found a relationship between joint attention and social skills (Vineland SEEC IR). Interestingly, no other significant relationships were found.

Given the prominence of the theory of mind account, it is somewhat surprising that theory of mind skills were not unambiguously related to severity of autism. This result is, however, consistent with our suggestion that, although theory of mind deficits are unarguably present in many individuals with autism, theory of mind is not a core deficit in this population. As theory of mind skills do not become fully apparent until approximately four years of age

(Loth & Gomez, 2006), and the precursors do not emerge until between 12 and 18 months (Kaplan and Hafner, 2006; Meltzof, 1995; Phillips et al., 2002; Repacholi & Gopnik, 1997; Rogers, 2006) it would seem unlikely that this could account for social deficits that can be observed from birth in individuals with autism.

Summary

Contrary to our predictions, and the predictions made by the theory of mind account, we did not find consistent relationships between social skills (Vineland SEEC IR), and social motivation, or theory of mind, though social skills were related to overall social motivation. Our finding that theory of mind skills are not unambiguously related to severity of autism further supports previous work indicating that, though children with autism may be able to learn how to pass tests of emotions and belief understanding, this does not translate into a similar development in their social skills in real life situations (Bauminger & Kasari, 1999; Hadwin et al., 1997; Joseph & Tager-Flusberg, 2004; Loth & Gomez, 2006).

These null results must, however, be interpreted with caution. We had a relatively small number of children participating in each group, limiting the strength of our conclusions. Furthermore, all of the children with autism participating in this study received developmental therapy, much of which focused on social interactions and communication. It is possible that, although these children exhibited lower social motivation, joint attention and understanding of desire and false belief, than their typically developing peers, the negative consequences of this for receptive language and social interactions were mitigated by treatment. It would, therefore,

be beneficial to replicate this study with newly diagnosed children who have not yet received therapy.

Social Motivation and Theory of Mind

Our interest in the relationship between social motivation and theory of mind stemmed from a desire to explore whether the former might cause a deficit in the latter. The current study, however, reveals no consistent relationship between social motivation and theory of mind.

A trend was revealed toward a relationship between proportion of social pushes (gumball task) and total theory of mind in the typically developing children, though this relationship did not play out in the autism group. Proportion of social pushes was, however, highly *negatively* related to imitation in the autism group. Although this result initially appears contrary to commonly held beliefs about the relationship between imitation and social skills, the gumball task used here did not measure social skills per se. Rather, the gumball task measured social motivation. Beadle-Brown and Whiten (2004) found that imitation was a good predictor of social skills in children with autism. Charman (2002) indicated that "imitation is a form of social learning that involves observing others, listening to others, and learning from others" (p. 96) and involves the acquisition of novel responses on the basis of social experience and reinforcement. An important area for future research will be to explore the relationship between social motivation and imitation versus social interaction and imitation. In order to do so, imitation could be taught to children with autism, with pre- and post-tests of social motivation or social interaction to determine whether increasing imitation increased social motivation and/or social

interaction. On the flip side, intervention targeting social motivation could include pre- and post-tests of imitation to determine whether increasing social motivation could impact imitation.

A relationship was also found between looks to the experimenter (free play) and total theory of mind in the ASD group. Furthermore, looks to the experimenter was related to both joint attention and understanding of desire in the autism group. The relationship between joint attention and free play looks is straightforward in that both tasks involved looks to the experimenter, though free play did not present any specific demands, whereas the joint attention activities did. Furthermore, joint attention, free play looks, and understanding of desire all required attention to the experimenter's face and/or eyes, rather than attention to the experimenter's hands, as was necessary in the other theory of mind tasks. It is possible, therefore, that social motivation was required to attend to the experimenter's face and/or eyes, providing another possible explanation for the relationships between some of the social motivation and theory of mind tasks.

Overall, our findings regarding the relationship between social motivation and theory of mind were inconsistent. It appears that some aspects of theory of mind, such as imitation, joint attention, and understanding desire, may be related to social motivation. It is possible that both the understanding of desire and the joint attention tasks were also measuring social motivation, therefore explaining the relationships with the social motivation measures. The lack of positive relationships between theory of mind precursors not involving social motivation as clearly (e.g., understanding intentions, false belief), suggest that social motivation and theory of mind may represent two distinct sets of skills. Due to the preliminary nature of these results, this is an area that warrants further study in order to elucidate this relationship more clearly. For example, the

false belief task used in this study did not appear to be an ideal measure for this age and population. It is possible that a better measure of false belief would have been more closely related to social motivation. Furthermore, this is the first study to look specifically at social motivation in children with autism. Perhaps, as attempts at designing tasks to tap this concept are modified, a stronger relationship will be found between social motivation and theory of mind.

Theoretical Implications

The current study examined two different theories of autism, one well established (i.e., theory of mind) and one new (i.e., social motivation). Our findings regarding theory of mind skills in ASD were inconsistent. Based on the ToM account, children with autism should have performed poorly on measures of theory of mind *and* its precursors (Buitelaar, et al., 1999; Buitelaar, van der Wees, et al., 1999; Hughes & Ensor, 2005; Joseph & Tager-Flusberg, 2004; Serra et al., 2002). Our findings indicate that these children with autism are impaired in joint attention and understanding of desire, but have spared abilities on imitation and understanding of others' intentions. It is possible that joint attention and interpretation of desire both require more social motivation than do the ability to imitate and understand intentions. In fact, in our study, and others, both the imitation task and the intentionality task primarily require the child to attend to objects or actions, but did not require the child to attend to the experimenter's face or emotions. The joint attention and understanding of desire tasks, however, both require eye gaze and attention to another's face and/or emotions. Our findings are consistent with previous research which has demonstrated children with autism are able to explain others' behavior in

terms of desire (Rieffe, Terwogt, & Stockmann, 2000), but struggle to determine desire when provided with eye gaze toward objects of desire (Peterson et al., 2005).

We suggested earlier that the lack of initiation of eye gaze in the free play task indicated a lack of social motivation. Assuming this to be true, the pattern of results from the precursors of theory of mind make more sense. Young children with autism were more motivated to engage in tasks requiring less social interaction (i.e., imitation and understanding intentions) and less motivated to engage in tasks requiring more social interaction (i.e., joint attention and understanding others' desires). This line of reasoning is further supported by the fact that, when the joint attention and understanding of desire tasks were combined, these scores better predicted diagnosis than when the other two precursors of ToM, imitation and understanding of intentionality, were combined.

The increased motivation to engage in less socially demanding tasks may also explain the difference in social motivation with adults and children that was exhibited by the children with autism. Engaging with other children is likely to be more demanding than engaging with adults, who are more inclined to play a dominant role in interactions with children. Adults may lead and support interactions more than other children do, making these interactions less socially demanding than interactions with other children.

Additional support for the social motivation account of autism comes from its ability to predict diagnosis accurately for both groups. Although the theory of mind measures were able to predict diagnosis the majority of the time, as discussed above, two of the precursors to theory of mind, joint attention and understanding of desire, may be directly related to social motivation.

Indeed, it is possible that these measure social motivation more effectively than they measure theory of mind.

Clinical Implications

The research conducted in this study provides preliminary evidence of a social motivation deficit in young children with autism. Further evidence was also provided for deficits in some aspects of theory of mind in this population (i.e., understanding of desire and joint attention). These findings suggest areas to target during intervention with young children with autism. Targeting social motivation, especially social motivation with other children, may impact receptive language and social skills in children with autism. Due to the intrinsic nature of social motivation, however, targeting this area in treatment could be challenging. Previous research suggests that individuals with autism may be deficient in assigning social reward values due to a lack of ability to learn the associations between positive experiences and their relationship to other people (Dawson et al., 2002). This deficiency affects their ability to attend socially to others and affects their social motivation. Based on this explanation of the cause of social motivation difficulties in this population, treatment targeting this area could focus on emphasizing the associations between positive experiences (e.g., tickling, food) and other people.

Koegel (1995) and Koegel et al. (1998) suggest that lack of motivation may be a core deficit in autism and that increasing motivation results in improvements in the acquisition and generalization of skills in a wide variety of areas, including social skills (Koegel & Mentis, 1985). The current research provides a more specific aspect of motivation to target during intervention in the hopes that increasing social motivation will result in increased social orienting

and general attention to others, which would increase their ability to acquire social and language skills.

Future Research

There are many areas related to the current findings that would benefit from further research. First, further studies examining social motivation in children with autism are warranted. It is important to replicate these results with children with autism across a wider age range as well as with a variety of measures of social motivation. Although individuals with autism often have significant impairment in a variety of areas, their development is not stagnant. It is possible that there are developmental patterns to be found regarding social motivation in autism. For example, if infants or toddlers with autism exhibited less deficient social motivation, which grew more severe over time, this would be important to document in order to target treatment appropriately to avoid loss of social motivation over time. As part of this developmental investigation, neurobiological bases should be explored. Evidence has indicated that neurobiological dysfunction may affect social motivation (Berger, 2006). Therefore, future research could explore the relationship between social motivation and neurological underpinnings.

Second, the relationship between nonsocial and social motivation in both children with autism and typically developing children needs to be explored further to clarify which types of motivation are affected in children with autism. Motivation with different types of objects (e.g., toys, computers, playground equipment) could be compared to social motivation. Children with autism have been found to imitate more with objects affording high sensory stimuli than with

other objects (Hobson & Meyer, 2006). It is possible that certain types of objects attract this population more strongly and affect their motivation to interact with objects rather than people. Therefore, it is critical to repeat the gumball task with machines varying in types, and levels, of sensory stimulation, novelty, and complexity.

Third, future research could explore social motivation for adults versus children. The current study found that children with autism appeared to be more socially motivated with adults than with other children. Our results also indicated that social motivation was related to receptive language level. Perhaps children with autism are better able to understand adults and this increased understanding facilitates their interaction with adults. If this were the case, children with autism might have increasing social motivation with individuals of increasing age. Our finding of increased social motivation with adults over children needs to be confirmed with measures other than parent report. For example, in the gumball task, a child, or children of varying ages, could be substituted in for the adult in order to assess motivation with a child versus a machine. Or, the child with autism could choose to request food from an adult versus a child to see whether social motivation differed between the two. If the difference between social motivation with adults and children is confirmed, the reasons for this discrepancy in social motivation warrants further exploration.

Fourth, further exploration of the relationship of social motivation to a wider range of severity measures is warranted. We looked at the relationship between social motivation and social skills and language in children with autism, and the current study found that overall social motivation is related to social skills. Social motivation with children was related to receptive language level. No other clear relationships were found between social motivation and language

or social skills. Other measures of language and social skills (e.g., the Autism Diagnostic Observation Schedule, measures of expressive language, etc.), however, might reveal more relationships with social motivation.

Fifth, an exploration of the relationship between social motivation and restricted, repetitive, and stereotyped interests and behaviors would be informative for this account of autism. This area of autism is less well researched than the social and communication impairments. We know that specific stereotypical behaviors and/or repetitive patterns of behavior, such as excessive mouthing, aversion to social touch, hand and finger mannerisms, inappropriate use of objects, and repetitive interests and play, can be observed as early as the first two years of life in infants and toddlers with autism (Chawarska & Volkmar, 2005). The reason for such behavior, however, is not clearly understood, though sensory dysregulation and/or sensory seeking have been suggested as explanations (Tsatsanis, 2005). It is possible that in typically developing individuals, this behavior is socially moderated, allowing it to decrease appropriately with age. If individuals with autism are not socially motivated, and therefore do not attend to social cues, they may not adapt their behavior to typical social norms and may exhibit unusual behaviors and interests. The social motivation deficit explanation for the restricted and repetitive interests and behaviors in autism, however, was not specifically addressed in this study. An account of autism will have to provide an explanation for all three of the diagnostic criterion of autism.

Sixth, an exploration of specific cognitive deficits in autism, such as sensory perception, attention, and memory (Tsatsanis, 2005), outside of the core triad of symptoms, would be informative. The current study did not address these cognitive areas. It is possible that a social

motivation deficit is related to these skills, which would strengthen this account of autism. It is also possible that social motivation could relate to some, but not all, of these cognitive areas. Attention and sensory perception, specifically to social stimuli (e.g., to tones of voice or subtle facial expressions), for example, might be related to social motivation. As the prevalence of autism increases, accurate diagnosis, and sub-typing within the diagnosis, is becoming more important. It is possible that a social motivation deficit could be descriptive of a subpopulation of autism, rather than underlying the entire disorder.

Seventh, the ability of children with autism to understand others' desires needs to be explored further. The current results indicated that this population has difficulty understanding others' desires. It is possible that this deficit is related to lack of attention to others. We found that children with autism attended less to the experimenter during her expressions of desire, were deficient in their joint attention compared to their typically developing peers, and were less socially motivated. If children are not socially motivated and do not attention to others, or with others, they are less likely to notice the reactions of others, which would likely decrease their awareness of others' likes and dislikes. Previous research, however, has indicated that, in some cases, children with autism appear to be able to understand desire. Further exploration of understanding desire in autism could be informative in understanding this apparent discrepancy.

Finally, the relationship between social motivation and theory of mind could be further explored. The current study indicates that there is a relatively weak link between these two areas, indicating that they may be separate and distinct from one another. Before firm conclusions can be drawn, however, further research is needed to elucidate this relationship. A more effective measure of false belief understanding, for example, could be compared with

social motivation to determine whether the current result of a lack of relationship continues to hold true. It is difficult, however, to measure false belief without relying heavily on both comprehension and production of language. It is possible, therefore, that a new, nonverbal, measure of false will need to be designed before it can be effectively compared with social motivation.

Conclusion

In 1943, autism was first described as a disorder in which individuals lacked motivation for social interaction (Kanner, 1943). In response to weaknesses in other theories, there has been a recent return of interest in other factors, such as social motivation. Deficient motivation, and social motivation in particular, has been posited to account for at least some of the deficits involved in autism (Berger, 2006; Dawson et al., 2002; Heimann, Laberg, & Nordoen, 2006). Motivational problems are thought to emerge at a very young age, affecting opportunities for social information processing, social problem solving, and social cognition (Mundy et al., 2007). The current study is the first to specifically examine social motivation and to provide empirical evidence that, in a controlled setting, young children with autism exhibit deficient social motivation relative to their typically developing peers. We also conducted an extensive exploration of theory of mind and its developmental precursors, finding that not all aspects of theory of mind are equally challenging for young children with autism. Furthermore, we explored the relationships between deficient social motivation and theory of mind, and severity of autism in an attempt to provide additional information for both diagnosis and treatment. The relationships between severity and both theory of mind and social motivation, however, were

inconsistent and remain to be elucidated. Although further research is needed to confirm the current results, our findings provide information that could be incorporated into treatment, and potentially, diagnosis. This study provides preliminary evidence of a previously noted, but unstudied, aspect of autism, deficient social motivation, and provides a framework within which further research on this topic may proceed.

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Appendices

APPENDIX 1: MOTOR SKILLS

Autism Group: Motor Skills

Subject #	Age	1st rolled over	Sat without support	Crawled	Stood without support	Took first steps	Walked without assistance	Dressed self	Used a crayon	Rode a tricycle	Ate with a spoon
3		4 mo.	7 mo.	11 mo.	12 mo.	12 mo.	13 mo.	3-4 yrs.		2.5 yrs.	3 yrs.
4		3 mo.	6-7 mo.	10 mo.	12 mo.	12 mo.	12.5 mo.	Not yet	18 mo.	Not yet	2 yrs.
5		3 mo.	4 mo.	5 mo.	AA	17 mo.	18 mo.	Not yet		Not yet	12 mo.
6		AA	AA	AA	AA	AA	AA	Not yet	AA	Not yet	AA
7		4 mo.	6 mo.	9 mo.	12 mo.	15 mo.	15 mo.	4 yrs.	2 yrs.	3.5 yrs.	2 yrs.
8		3 mo.	6 mo.	9 mo.	12 mo.	14 mo.	15 mo.	2 yrs.	3 yrs.	Not yet	2 yrs.
9		3 mo.	6 mo.	8 mo.	11 mo.	12 mo.	13 mo.	5 yrs.	2 yrs.	2.5 yrs.	3 yrs.
10		4 mo.	6 mo.	7 mo.	9 mo.	12 mo.	14 mo.	4 yrs.	2 yrs.	3 yrs.	2.5 yrs.
11		3 mo.	6 mo.	8-9 mo.	15-16 mo.	15-16 mo.	17 mo.	Not yet	2 yrs.	3 yrs.	15-18 mo.
12		2 mo.	5 mo.	5 mo.	9 mo.	10 mo.	11 mo.	4 yrs.	2.5 yrs.	2.5 yrs.	2 yrs.
13		4 mo.	7 mo.	6 mo.	10 mo.	12 mo.	14 mo.	Not yet	2.5 yrs.	Not yet	2 yrs.
14		6 mo.	9 mo.	11 mo.	15 mo.	14 mo.	18 mo.	Not yet	3 yrs.	3 yrs.	2 yrs.
15		5 mo.	6 mo.	8 mo.	15 mo.	15 mo.	15 mo.	5 yrs.	2.5 yrs.	5 yrs.	18 mo.
17			6 mo.	8 mo.	11 mo.	17 mo.	18 mo.	2.5 yrs.	2 yrs.	3 yrs.	18 mo.
19		5 mo.	6-7 mo.	10 mo.	12-13 mo.	16 mo.	16 mo.	Almost 4 yrs.	3 yrs.	3 yrs.	2.5 yrs.

*** AA – Reported as age-appropriate**

Typically Developing Group: Motor Skills

Subject #	Age	1st rolled over	Sat without support	Crawled	Stood without support	Took first steps	Walked without assistance	Dressed self	Used a crayon	Rode a tricycle	Ate with a spoon
16		5.75 mo.	6 mo.	7.5 mo.	10 mo.	11 mo.	12 mo.	2.75 yrs.	2.5 yrs.	3 yrs.	15 mo.
18		3 mo.	6 mo.	9 mo.	10 mo.	11 mo.	13 mo.	23 mo.	18 mo.	2.5 yrs.	19 mo.
20		AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
21		4 mo.	7 mo.	8 mo.	9 mo.	9.5 mo.	10 mo.	3 yrs.	2 yrs.	2.5 yrs.	2 yrs.
22			6 mo.		7-8 mo.	7-8 mo.	8 mo.			< 12 mo.	
23		4 mo.	5 mo.	8 mo.	12 mo.	13 mo.	13 mo.	3 yrs.	18 mo.	3 yrs.	12 mo.
24		4 mo.	6 mp.	8-9 mo.	10 mo.	12-13 mo.	14 mo.	3 yrs. 9 mo.	2.5 yrs.	3 yrs. 10 mo.	20 mo.
25		8 mo.	9 mo.	10 mo.	11-12 mo.	11 mo.	2 yrs.	4.5 yrs.	2.5 yrs.	2.5 yrs.	4 mo.
26		3 mo.	5 mo.	6 mo.	10 mo.	12 mo.	15 mo.	30 mo.	24 mo.	30 mo.	15 mo.
27		3.5 mo.	4 mo.	5 mo.	8 mo.	9.5 mo.	10 mo.	2 yrs.	2 yrs.	2 yrs.	1 yr.
28		3-4 mo.	4-5 mo.	6 mo.	14 mo.	14 mo.	14 mo.	2.5-3 yrs.	6 mo.	2.5 yrs.	6 mo.
29		3 mo.	6 mo.	9 mo.	12 mo.	12 mo.	13 mo.	2 yrs.	18 mo.	2 yrs.	2 yrs.
30		1 mo.	6 mo.	7 mo.	8.5 mo.	10 mo.	10.5 mo.	2.5 yrs.	2 yrs.	2.5 yrs.	
31		4 mo.	6 mo.	7 mo.	7 mo.	9 mo.	9 mo.		15 mo.	2 yrs.	10 mo.
32		3 mo.	6 mo.	7 mo.	7 mo.	10 mo.	10 mo.	3 yrs.	2 yrs.	2yrs.	12 mo.
33		2 mo.	6 mo.	11 mo.	10 mo.	11 mo.	14 mo.	3 yrs.		2 yrs.	14 mo.
34		4-5 mo.	6-7 mo.	4 mo.	11 mo.	12 mo.	13 mo.	3.5 yrs.	2 yrs.	2 yrs.	2.5 yrs.

*** AA – Reported as age-appropriate**

APPENDIX 2: SPECIFIC LANGUAGE SKILLS

Autism Group: Language

Subject #	Age	PPVT-IV	Responded to name	Pointed to pictures	Followed 1-step directions	Followed 2-step directions	Followed complex directions	Babbled	Spoke 1st words (not mama/dada)	2-wd. Phrases	Complete sentences	Spoke clearly for strangers	Relates happenings
3			2 yrs.	2 yrs.	18 mo.	2 yrs.	4 yrs.	18-24 mo.	2 yrs.	2 yrs.	3 yrs.	3.5 yrs.	
4			AA	12 mo.	9 mo.	18 mo.	3 yrs.	2-3 mo.	1 yrs.	2.5-3 yrs.	3.5 yrs.	2 yrs.	Not yet
5			12 mo.	12-18 mo.			Not yet	5 mo.	10 mo.		5 yrs.		Not yet
6			D	D	D	D	D	D	D	D	D	D	Not yet
7			<12 mo.	12 mo.	13 mo.	2 yrs.	4 yrs.		12 mo.	18 mo.	2 yrs.	3 yrs.	4 yrs.
8			15 mo.	12-15 mo.	18 mo.	3 yrs.	Not yet	12 mo.	3 yrs.	3 yrs.	3.5 yrs.		
9			3 yrs.	3 yrs.	3 yrs.	4 yrs.	Sometimes now		3 yrs.	4 yrs.	5 yrs.	4 yrs.	5 yrs.
10			12 mo.	18 mo.	2 yrs.	3 yrs.	4 yrs.	3.5 yrs.	12 mo.	2 yrs.	3 yrs.	2 yrs.	4 yrs.
11			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12			3 yrs.	2 yrs.	4 yrs.	Not yet	Not yet		2 yrs.	4 yrs.	Not yet	Not yet	4 yrs.
13			3 yrs.	3 yrs.	3 yrs.	3 yrs.	Not yet	4 mo.	18 mo.	2 yrs. 8 mo.	2 yrs. 8 mo.	Not yet	Not yet
14			2 yrs.	2.5 yrs.	3 yrs.	3.5 yrs.	Not yet	4 mo.	2 yrs. 2 mo.	2.5 yrs.	2 yrs. 8 mo.	3 yrs.	4 yrs.
15			12 mo.	15 mo.	2 yrs.	3 yrs.	5 yrs.	12 mo.	15 mo.	2 yrs.	3 yrs.	2.5 yrs	3.5 yrs.
17			15 mo.	2-2.5 yrs.	2.5 yrs.	3.5 yrs.			2 yrs.	2.5 yrs.	4 yrs.	3-4 yrs.	Not yet
19				14 mo.	10-16 mo.	16-24 mo.		4 mo.	2 yrs.	2.5 yrs.	4.5 yrs.	2.5 yrs.	3 yrs.

*** AA – Reported as age-appropriate**
*** D – Reported as delayed**
*** NA – Reported as not applicable**

ypically Developing Group: Language

Subject #	Age	PPVT-IV	Responded to name	Pointed to pictures	Followed 1-step directions	Followed 2-step directions	Followed complex directions	Babbled	Spoke 1st words (not mama/dada)	2-wd. Phrases	Complete sentences	Spoke clearly for strangers	Relates happenings
16			6 mo.	12 mo.	12 mo.	18 mo.	21 mo.	6 mo.	8 mo.	2 yrs.	2.5 yrs.	3 yrs.	3 yrs.
18			4 mo.	12 mo.	12 mo.	18 mo.	2 yrs.	8 mo.	10 mo.	12 mo.	2 yrs.	18 mo.	2 yrs.
20			AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
21			7 mo.	12 mo.	18 mo.	2 yrs.	2.5 yrs.	4 mo.	7 mo.	12 mo.	18 mo.	18 mo.	
22			AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
23			8 mo.	12 mo.	18 mo.	2 yrs.	3 yrs.	4 mo.	12 mo.	18 mo.	2 yrs.	18 mo.	2 yrs.
24			6 mo.	9 mo.	11 mo.	15 mo.	2 yrs.	6-7 mo.	11 mo.	18 mo.	2 yrs. 3 mo.	3 yrs.	3-3.5 yrs.
25			6 mo.	2 yrs. 8 mo.	2 yrs.	3 yrs.	4 yrs.	6 mo.	10 mo.	12 mo.	2.5 yrs.	4 yrs.	4 yrs.
26			12 mo.	14 mo.				9 mo.	12 mo.	18 mo.	2.5 yrs.	3 yrs.	3 yrs. 5 mo.
27			6 mo.	12 mo.	11 mo.	11 mo.	18 mo.	5 mo.	7 mo.	10.5 mo.	15 mo.	2 yrs.	2 yrs.
28			12-24 mo.	18 mo.	2 yrs.	3-4 yrs.	4-5 yrs.	2-3 mo.	18 mo.	2 yrs.	3 yrs.	4 yrs.	5 yrs.
29			9 mo.	12 mo.	12 mo.	18 mo.	2 yrs.		15 mo.	18 mo.	2 yrs.	2 yrs.	2 yrs.
30			3 mo.	18 mo.	2 yrs.	2 yrs.	2.5 yrs.	3 mo.	11 mo.	14 mo.	18 mo.	14 mo.	
31			3 mo.		12 mo.	2 yrs.		6 mo.	10 mo.	14 mo.	2.5 yrs.	2 yrs.	3 yrs.
32			5 mo.		18 mo.	2 yrs.	3 yrs.	5 mo.	6-12 mo.	12 mo.	12mo.	2 yrs.	12 mo.
33				9 mo.	12 mo.	15 mo.	2 yrs.	7 mo.	12 mo.	15 mo.	2 yrs.	2 yrs.	< 2 yrs.
34			9-10 mo.					6 mo.	14-15 mo.	2 yrs.	3 yrs.	3.5 yrs.	3.5-4 yrs.

*** AA – Reported as age-appropriate**

APPENDIX 3: GENERAL LANGUAGE SKILLS

Autism Group: General Language

Subject #	Age	Request actions	Request objects	Label actions	Label objects	Label others' emotions	Label own emotions	Indicate desire for something	Request attention	Request assistance	Make eye contact when requesting	Gain attention prior to making request
3		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Usually	No
4		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Usually	Usually
5		Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Sometimes	Sometimes
6		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
7		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Sometimes	Not usually
8		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Sometimes	Sometimes
10		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Fleeting	Rarely
11		No	No	No	No	No	No	Yes	No	No	Yes	Yes
12		Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes
13		Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	A little	A little
14		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Sometimes	Sometimes
15		Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17		Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Sometimes	Sometimes
19		Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No

Typically Developing Group: General Language

Subject #	Age	Request actions	Request objects	Label actions	Label objects	Label others' emotions	Label own emotions	Indicate desire for something	Request attention	Request assistance	Make eye contact when requesting	Gain attention prior to making request
16		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
21		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
22		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Usually	Yes
25		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Usually	Sometimes
26		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
27		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
28		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
29		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
30		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
31		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Usually
32		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
33		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
34		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

APPENDIX 4: PLAY SKILLS

Autism Group: Play Skills

Subject #	Age	Played w/ dolls/stuffed animals	Created & acted out stories	Played in cooperation with other children
3		2.5-3 yrs.		4 yrs.
4		3 yrs	Not yet	Not yet
5			Not yet	3 yrs.
6		AA	Not yet	Not yet
7		4 yrs.	Not yet	4 yrs.
8		3 yrs.	3.5 yrs.	Not yet
9		4 yrs.	5 yrs.	Not yet
10		3 yrs.	Not yet	4 yrs.
11		NA	NA	NA
12		4 yrs.	Not yet	Not yet
13		3 yrs.	Not yet	Not yet
14		2 yrs.	Not yet	Beginning
15		3 yrs.	Not yet	Not yet
17		Not yet	Not yet	Tries to
19		Almost 5 yrs.	4 yrs.	3 yrs.

*** AA – Reported as age-appropriate**
*** NA – Reported as not applicable**

Typically Developing Group: Play Skills

Subject #	Age	Played w/ dolls/stuffed animals	Created & acted out stories	Played in cooperation with other children
16		7 mo.	3 yrs.	2.5 yrs.
18		18 mo.	2 yrs.	10 mo.
20		AA	AA	AA
21		Early	3 yrs.	2 yrs.
22		AA	AA	AA
23		2 yrs.	2.5 yrs.	2 yrs.
24		2 yrs.	3 yrs. 8 mo.	3.5 yrs.
25		3 yrs.	4.5 yrs.	Whole life
26		24 mo.	2.5 yrs.	12 mo.
27		18 mo.	3 yrs.	3 yrs.
28		3 yrs.	35.-5 yrs.	3 yrs.
29		12 mo.	2 yrs.	2 yrs.
30		2 yrs.	2 yrs.	2 yrs.
31		18 mo.	3 yrs.	2 yrs.
32		12 mo.	12 mo.	12 mo.
33		< 12 mo.	< 3 yrs.	< 12 mo.
34		1.5 yrs.	3-3.5 yrs.	1.5 yrs.

*** AA – Reported as age-appropriate**
*** NA – Reported as not applicable**

APPENDIX 5: SOCIAL SKILLS

Autism Group: Social Interaction

Subject #	Age	Prefer to play alone or with other CHILDREN	Prefer to play alone or with a familiar ADULT	Prefer to watch TV or play with others	Seek out parent to gain attention
3		Alone	Adult	TV	Yes
4		Alone	Alone	TV	No
5		Alone	Adult	TV	Yes
6		Alone	Adult	TV	Sometimes – for food
7		Alone	Adult	Others	Yes
8		Alone	Alone		Yes
9		Varies	Adult	TV	Yes
10		Alone	Adult	TV	Yes
11		Alone	Adult	TV or parent	Yes
12		Alone	Adult	Others	Yes
13		Alone	Adult	TV	Yes
14		Children	Adult	Varies	Yes
15		Alone	Adult	TV	No
17		Varies	Varies	TV	Yes
19		Varies	Adult	TV	Yes

Typically Developing Group: Social Interaction

Subject #	Age	Prefer to play alone or with other CHILDREN	Prefer to play alone or with a familiar ADULT	Prefer to watch TV or play with others	Seek out parent to gain attention
16		Children	Adult	Others	Yes
18		Children	Adult	Other	Yes
20		Both	Alone	Others	Yes
21		Both	Adult	Others	Yes
22		Children	Adult	Others	Yes
23		Both	Adult	Others	Yes
24		Children	both	Others	Yes
25		Children	Adult	Others	Yes
26		Children	Adult	Both	Yes
27		Children		Others	
28		Both	Both	Others	Yes
29		Children	Alone	Others	No
30		Alone	Adult	Others	Yes
31		Children	Adult	Others	Yes
32		Both	Adult	Others	Yes
33		Children	Adults	Both	Yes
34		Children	Both	Others	Yes

APPENDIX 6: TREATMENT

Autism Group: Treatment

Subject #	Age	ABA	Floortime	Speech/Language	OT	OT with Sensory Integration	PT	DT	School
3		Current		Current	Current	Current		Current	Regular Ed.
4		Current		Current	Current				Special Education
5		Current	Past	Current		Current			Special Education
6		Current	Current			Current			
7		Current		Current		Current		Past	Special Ed. – past Regular Ed. - current
8		Current		Current	Current	Current		Past	Special Ed.
9		Current							Special Ed.
10		Current		Current	Current	Current		Current	Regular Ed.
11		Current		Current	Current	Current			Special Ed.
12		Current		Current	Past				
13		Current		Current	Past			Past	Special Ed.
14		Current		Current	Current	Current	Current	Past	Regular Ed. & Special Ed.
15		Past	Past	Past	Current		Current	Past	Special Ed.
17		Current		Current	Past	Past		Past	Special Ed.
19		Current	Past						

*** ABA = Applied Behavior Analysis**
*** OT = Occupational Therapy**
*** PT = Physical Therapy**
*** DT = Developmental Therapy**

APPENDIX 7: PARENT QUESTIONNAIRE

DEVELOPMENTAL QUESTIONNAIRE

Child Name: _____ Date: _____

Name of Person Filling Out Questionnaire: _____

Relationship to Child: _____

Child's Date of Birth:_____

Child's Sex (please circle): M F

Developmental History

Domain	Child did the following:	Age:
Motor	1st Rolled Over	
	Sat without support	
	Crawled	
	Stood without support	
	Took first steps	
	Walked without assistance	
	Dressed self	
	Used a crayon	
	Rode a tricycle	
	Ate with a spoon	
Language: Receptive	Responded to name	
	Pointed to/touched pictures upon request	
	Followed 1-step directions	
	Followed 2-step directions	
	Followed complex directions	
Language: Expressive	Babbled	
	Spoke first words besides 'mama' & 'dada'	
	Said 2-word phrases	
	Spoke in complete sentences	
	Spoke clearly enough for strangers to understand	
	Could relate happenings well	
Play	Played with dolls/stuffed animals	
	Created and acted out stories	

	Played in cooperation with other children	

General Language:

Approximately how many words does your child say? _____

How does your child make requests (e.g., gestures/signs, single words, 2-word combinations, phrases, complete sentences)? _____

_____

Does your child use words to:

Request actions?	**Yes**	**No**
Request objects?	**Yes**	**No**
Label actions?	**Yes**	**No**
Label objects?	**Yes**	**No**
Label others' emotions?	**Yes**	**No**
Label own emotions?	**Yes**	**No**
Indicate desire for something?	**Yes**	**No**
Request attention?	**Yes**	**No**
Request assistance?	**Yes**	**No**

Does your child make eye contact when requesting? _____

Does your child gain your attention prior to making a request? _____

Social Interaction:

Does your child prefer to play alone or with other children? _____

Does your child prefer to play alone or with a familiar adult (e.g., a parent)?_____

_____

Does your child prefer to watch TV or to play with others? _____

Will your child seek you out to gain your attention? YES NO

If Yes, please explain_____

_____

_____

Diagnosis and Treatment (if applicable):

Diagnosis:_____

Who diagnosed your child?_____

At what age was your child diagnosed?_____

When did you feel your child was not developing typically? What were the signs?

_____

_____

_____

Does your child have any neurological or psychological disorders? If so, please list:

_____

_____

Please indicate past or present interventions, treatment, or remediation your child has received or is receiving.

APPROACH	RECEIVED AT	RECEIVED BY	DATE
Applied Behavior Analysis (ABA)			
Floor Time (FT)			
Speech & Language Therapy (SLP)			
Occupational Therapy (OT) (traditional)			
OT with Sensory Integration			
Physical Therapy (PT)			
Developmental Therapy			
Picture Exchange Comm. System (PECS)			
TEACCH			
Verbal Behavior			
RDI			
Medications			
Diets			
School (type of placement)			
Other			
Other			

APPENDIX 8: DIMENSIONS OF MASTERY QUESTIONNAIRE

Motivation Questionnaire

Child's Age_____Circle one: Boy Girl Today's Date_____
Years Months
Rater's Relationship to Child: Mother _____ Father _____ Other (please specify) _____

CIRCLE the number that best indicates how typical each statement is of this child. Think of a rating of 3 as an average child of approximately this child's age. Children vary; most are motivated to do some things but not others. Please try to answer all questions even if you are not sure.

		NOT AT ALL TYPICAL				VERY TYPICAL
1.	Repeats a new skill until he or she can do it well.	1	2	3	4	5
2.	Smiles broadly after finishing something.	1	2	3	4	5
3.	Gives up if he or she cannot do physical skills well.	1	2	3	4	5
4.	Solves problems quickly.	1	2	3	4	5
5.	Gives up easily if cannot do something.	1	2	3	4	5
6.	Is a little slow understanding things.	1	2	3	4	5
7.	Likes to try hard problems instead of easy ones.	1	2	3	4	5
8.	Enjoys talking with adults, and tries to keep them interested.	1	2	3	4	5
9.	If a toy or task is hard to do, stops trying after a short time.	1	2	3	4	5
10.	Is very good at doing things.	1	2	3	4	5
11.	Does not smile when he or she makes something happen.	1	2	3	4	5
12.	Tries to do well in physical activities even when they are hard.	1	2	3	4	5
13.	Has some difficulty doing things as well as other children his or her age.	1	2	3	4	5
14.	Tries to complete things, even if it takes a long time to finish.	1	2	3	4	5
15.	Tries hard to interest adults in playing with him or her.	1	2	3	4	5
16.	Likes physical games and tries to do them very well.	1	2	3	4	5
17.	Explores all parts of an object or toy with many parts before doing something else.	1	2	3	4	5

18.	Gets excited when he or she figures something out.	1	2	3	4	5
19.	Likes to play actively with me or other adults.	1	2	3	4	5
20.	Does things that are hard for children for his or her age.	1	2	3	4	5
21.	Is pleased when solves a hard problem.	1	2	3	4	5
22.	Tries hard to get adults to understand.	1	2	3	4	5

OVER PLEASE

		NOT AT ALL TYPICAL				**VERY TYPICAL**
23.	Works for a long time trying to do something hard.	1	2	3	4	5
24.	Tries to do hard cause and effect toys such as a jack-in-the-box.	1	2	3	4	5
25.	Gets very involved in pretend play with friends.	1	2	3	4	5
26.	Repeats skills like jumping or running until he or she can do them well.	1	2	3	4	5
27.	Tries hard to throw balls so he or she can do it well.	1	2	3	4	5
28.	Tries hard to make friends with other kids.	1	2	3	4	5
29.	Will work for a long time trying to put something together.	1	2	3	4	5
30.	Likes to “talk” with other children.	1	2	3	4	5
31.	Tries to complete toys like puzzles even if they are hard.	1	2	3	4	5
32.	Tries to get included when other children are playing.	1	2	3	4	5
33.	Gives up quickly when playing with adults.	1	2	3	4	5

34.	Looks down or away when he or she tries but cannot do something.	1	2	3	4	5
35.	Tries to keep play going for a long time when around other kids.	1	2	3	4	5
36.	Repeats motor skills, such as climbing, to do them well.	1	2	3	4	5
37.	Enjoys playing make-believe with adults.	1	2	3	4	5
38.	Lowers head or slumps over when he or she does not do well at something.	1	2	3	4	5
39.	Avoids getting involved with other children.	1	2	3	4	5
40.	Tries to do well at athletic activities like exercising or “dancing.”	1	2	3	4	5
41.	Smiles when he or she makes something happen.	1	2	3	4	5
42.	Avoids looking at others after failing at something he or she tried hard to do.	1	2	3	4	5
43.	Shows excitement when he or she is successful.	1	2	3	4	5
44.	Gets upset if he or she cannot do something after trying hard.	1	2	3	4	5
45.	Tries hard to get better at catching or retrieving things.	1	2	3	4	5

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