Theory of Mind and the Ability to Make Emotional Inferences Among Children with High-Functioning Autism Spectrum Disorders

THEORY OF MIND AND THE ABILITY TO MAKE EMOTIONAL INFERENCES AMONG CHILDREN WITH HIGH-FUNCTIONING AUTISM SPECTRUM DISORDERS

A Dissertation presented

by

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DEDICATION

I would like to dedicate my dissertation to my family, both old and new, who have been so supportive, loving and helpful in this process.

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ABSTRACT

THEORY OF MIND AND THE ABILITY TO MAKE EMOTIONAL INFERENCES AMONG CHILDREN WITH HIGH-FUNCTIONING AUTISM SPECTRUM DISORDERS

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Perspective-taking skills are central to the successful navigation of social situations. Children need perspective-taking skills to help them correctly interpret different cues and accurately assess social situations so they can determine how to best respond. Children with Autism Spectrum Disorders (ASD) exhibit marked impairments in this area. In order to develop successful social skills interventions for this population, it is critical that we have a strong understanding of the nature of their deficits. While there is robust evidence that children with ASD experience difficulty making inferences about the beliefs of others, research on their ability to infer emotions has had more mixed results (Baldwin, 1991; Baron-Cohen, 1991; Happe, 1994; Hillier and Allinson, 2002; Kaland et al., 2005; Joliffe & Baron-Cohen, 1999; Serra et al., 2002; Williams & Happe, 2010). This study examined how well children with autism spectrum disorders are able to make emotional inferences using three different measures of emotion attribution. The measures were administered to a clinical sample of participants with high functioning-autism spectrum disorders (HF-ASD) and a comparison sample of typically developing participants to determine whether individuals with HF-ASD experienced more difficulty making emotional inferences from different cues than their typically developing peers. The hypotheses that children with HF-ASD make fewer spontaneous emotional inferences and have lower levels of emotional awareness than their typically developing peers were also tested. Finally, performance on these emotional inferencing measures was examined to determine whether they were able to reliably discriminate between participants with different levels of autism-related symptomatology. Participants with autism performed as well as their peers on all measures of emotion attribution in this study. These findings and their implications are explored.

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CHAPTER 1

INTRODUCTION, BACKGROUND, AND PURPOSE

Background on Perspective Taking Deficits Among Individuals with ASD

The ability to communicate effectively and to relate to others lies at the foundation of our society. For most people, the process of learning to navigate the social world occurs naturally as we grow older and experience different social situations. This is not true for individuals with Autism Spectrum Disorders (ASD). According to the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (2000), individuals on the autism spectrum have a "qualitative impairment in social interaction." These social deficits have important implications throughout their development. Children with autism experience difficulty with verbal and nonverbal communication and engaging in pretend play. They often fail to respond to social initiations and many lack imitation skills. As they grow older, individuals with ASD continue to experience difficulty as they are expected to navigate more nuanced social encounters. They often have trouble initiating and sustaining conversations, demonstrating empathy, and responding to the social cues of others. Individuals with ASD also report difficulty forming and maintaining friendships (National Institute of Mental Health, 2008). Children with ASD continue to have difficulty with social interactions and perspective-taking tasks as they grow older.

There is some evidence that these social deficits may be linked to higher rates of anxiety and depression, especially among students with High Functioning Autism (HFA) and Aspergers Syndrome (AS; Church, Alisanski, & Amanullah, 2000; Elder, Caterino, Chao, Shacknai, & De Simone, 2006; Kalyva, 2010; Mazurek & Kanne, 2010). Not only is it difficult for them to make and maintain close friendships, but students on the autism spectrum are also more likely to experience bullying and peer rejection. Due to their average and above average intelligence levels, students with HFA and AS are generally aware of, and consequently upset by, their social status (Elder et al., 2006; Rao, Beidel, & Murray, 2008).

A number of theories have been developed to explain the social deficits exhibited by individuals on the autism spectrum. Among the most prominent and well researched is the theory that people with autism have an underdeveloped TOM (TOM; Baron-Cohen, Leslie & Frith, 1985). TOM, a concept first introduced by Premack and Woodruff (1978) in their work with chimpanzees, has been defined in a number of different ways but generally refers to a meta-awareness that all individuals experience the world subjectively. Baron-Cohen (2001), a prominent researcher in this field, defines TOM as the ability to make inferences about the "full range of mental states (beliefs, desires, intentions, imagination, emotions, etc.) that cause action….[the ability] to reflect on the contents of one's own and other's minds" (p. 3). Similarly, Hutchins & Prelock (2008) conceptualize TOM as "the ability to reason about the thoughts, feelings, and intentions of the self and others" (p. 340). The underdeveloped TOM theory suggests that difficulty understanding the mind of others underlie the social deficits seen among individuals with autism (Baron-Cohen, 2001).

Social Information Processing Theory and Emotional and Belief-Based Inferences

The Social Information Processing Theory (SIP) can be used to help frame how impairments in the ability to make inferences about what others are thinking and feeling can lead to social difficulty in everyday situations among children with autism. Crick and Dodge (1994) first developed SIP Theory to examine the role of cognitive processes in aggressive interactions between children, but it can also help identify the mechanisms by which impaired TOM abilities can inhibit individuals with autism from successfully engaging in social situations. The theory posits that there are five different cognitive phases or steps that occur when a child acts in a social situation. These steps follow one another in a cyclical fashion and include: 1) encoding of cues, 2) interpretation of cues, 3) clarification of goals, 4) response access or construction, and 5) response decision. These five steps lead to step 6) behavioral enactment (Crick & Dodge, 1994).

The ability to make inferences about the beliefs and feeling of others is critical in the first two steps of the model. During these phases, children selectively attend to and interpret important cues such as facial expressions, body language, and tone of voice, as well as other contextual information in order to develop a deeper understanding of a given situation. They use what the authors refer to as their "database" of stored information to help them interpret these cues; the database includes memories of past experiences, social knowledge, and social schemata. Social schema and social knowledge refer to the way that individuals cognitively group and organize socially relevant information about people and situations to help process new data more efficiently. An example of a social schema might be the generalization that most children love birthday parties. Understanding that most people feel nervous when they meet someone new for the first time might be part of the social knowledge a person acquires during childhood. Children use this more general knowledge to help them interpret the specific cues and information they perceive in a situation in order to make inferences about what the other person likely thinks and feels in the given situation.

TOM abilities also play a key role in the response decision phase of the SIP model. In order to make a decision about how to best respond to a situation, children must make inferences about how the people with whom they are engaging will likely perceive their behavior and react to it (Crick & Dodge, 1994). At this phase, it is important that children are able to accurately infer both how their behavior will make others feel and what others will believe about them based on their behavior. The ability to accurately predict how others will perceive their response is critical; not only does their decision have short-term consequences in shaping how the interaction will play out, but it may also have long-term consequences in shaping how the other person will perceive them moving forward (Winner, 2007).

As shown in the SIP model, the ability to understand the subjective experience of others and to make inferences about their mental states and emotions is central to the ability to successfully navigate social situations. Furthermore, these inferences are often made in a dynamic setting where the child is flooded with information that they must attend to, process, and make sense of to successfully respond to the situation.

TOM Abilities and Social Deficits Among Individuals with Autism

Baron-Cohen, Leslie and Frith first introduced the theory that individuals with autism have impaired TOM abilities in their seminal study on autism and TOM published in 1985. In the study, participants watched two dolls act out the following scenario known as the false-belief task: Sally has a basket and Anne has a box. Sally places a marble in the basket and then leaves to take a walk. While she is gone Anne takes the marble out and puts it in the box. Sally comes back from her walk and the participant is asked where Sally will look for the marble. Of course the correct response is that she will look inside the basket. However, to provide this answer, the participant must ignore what s/he knows to be true in order to make an inference about what Sally would believe. Baron-Cohen et al. (1985) found that children with autism performed significantly worse on this task than both a comparison group of typically developing children and a group of children with Down Syndrome. They were far more likely than their peers to provide the actual location of the marble, suggesting that it was more difficult for them to ignore what they knew to be true to make an inference about what the character would likely believe in that situation (Baron-Cohen, Leslie, & Frith, 1985).

Since Baron-Cohen et al. (1985) first demonstrated that individuals with autism display an impaired ability to make inferences about the beliefs of others, the theory that autism is characterized by underdeveloped TOM abilities has become pervasive. Based on this theory, many educational programs have been developed to teach TOM-related skills to children with ASD. Given the complexity of TOM, they target a wide range of skills from how to recognize one's own emotions to how to make inferences about the intentions, desires, beliefs, and emotions of others (e.g. *How to MindRead: A Practical Guide for Parents and Teachers*, Howlin & Baron-Cohen, 1998; *Navigating the Social World*, McAfee, 2002; *Model Me Kids,* Model Me Kids LLC, 2004). However, research has not yet substantiated that children with autism show impairments across all these TOM-related areas. In fact, studies in these areas have been mixed. Studies that examine how well individuals with ASD are able to reason about the thoughts, beliefs, and intentions of others have consistently found that they perform worse than their peers on these tasks (Baron-Cohen, 1989a; Baron-Cohen et al., 1985; Baron-Cohen, Leslie & Frith, 1986; Happe, 1995; Leekam & Perner, 1991; Perner, Frith, Leslie & Leekam, 1989; Reed & Peterson, 1990). Studies that examine how well individuals with autism are able to make emotional inferences have been far less consistent. A brief review of the research in both these areas is presented below.

Mentalizing Abilities

The term "mentalizing abilities" will be used in this study to refer to the ability to reason about the thoughts, beliefs, and intentions of others and to distinguish these TOM-related abilities from the ability to make emotional inferences. The finding that children with autism have impaired mentalizing abilities when compared to their typically developing peers has been consistent across studies. In the time since the Baron- Cohen et al. (1985) first demonstrated that individuals with autism appear to be impaired in their ability to infer the beliefs of others, their findings have been replicated many times. There are two well-known versions of the false belief task: the change in location scenario and the unexpected contents scenario. The change in location test was described earlier and is also commonly known as the "Sally-Anne task." This story can be told verbally, using pictures, or acted out with dolls (Wimmer & Perner, 1983). In the unexpected contents scenario, the participant is shown a container, a box of crayons for example, and asked what s/he thinks is inside. After answering, the participant is shown that the container is actually filled with an unexpected item such as paper clips or candy. The participant is then asked what someone just entering the room would think was inside the box (Astington & Jenskins, 1999). The correct response is crayons, but before children develop a TOM, they respond that the person will think there are paper clips/candy inside. In both the change of location and unexpected contents false belief tasks, the participant is asked to ignore what they know about a given situation and predict how another individual would perceive it. These tasks examine the participant's ability to reflect on the mental processes and perceptions of others. There is a robust body of evidence that individuals with autism show significant impairments on these tasks compared to same age peers (Baron-Cohen, 1989a; Baron-Cohen et al., 1985; Baron-Cohen, et al., 1986; Leekam & Perner, 1991; Perner, Frith, Leslie & Leekam, 1989; Reed & Peterson, 1990). Whereas most typically developing children pass the false belief and appearance reality tasks when they reach a verbal mental age (VMA) of four (Miller, 2006), the average age when children with autism pass these tasks is at a VMA of nine (Happe, 1995).

Other studies that have used alternative methodologies to examine mentalizing abilities have also found that individuals with autism are impaired when compared to their peers. Baron-Cohen et al. (1994) found that children with ASD had more difficulty distinguishing words that describe what the mind does (ie. think, dream, pretend) from distractor words than their peers. Similarly, Tager-Flusberg (1992) analyzed spontaneous speech samples gathered from children with autism and a control group of children with Down Syndrome matched for verbal ability over the course of one to two years. Utterances related to perceptions, emotions, desires, and cognitions of the self and others were counted. The results showed that while children with autism used as many desire, perception, and emotion terms as the control group, they made significantly fewer references to cognitions. Finally, studies have found that individuals with autism perform worse than their peers when asked to make inferences about the desires and intentions of others based on their eye gaze (Baron-Cohen, Campbell, Karmiloff-Smith, Grant, &

Walker, 1995; Baron-Cohen & Cross, 1992; Hobson, 1984). Research on individuals with ASD and mentalizing abilities will be reviewed further in Chapter 2.

Emotional Inferences

Studies that examine how well individuals with autism are able to make emotional inferences have had more mixed results. Although there is some evidence that individuals with autism may have a less sophisticated understanding of other people's emotions (Begeer, Terwogt, Rieffe, Stegge, & Koot, 2007; Schwenck et al., 2012), research that has included an examination of how well individuals with ASD are able to make emotional inferences from specific cues on isolated tasks has not demonstrated consistent impairments in this area. Most of these studies have focused on visual cues, such as facial expressions, body language, and tone of voice. There is some evidence that individuals with autism spectrum disorders perform significantly worse than their typically developing peers or individuals with other developmental disabilities when asked to make inferences about an individual's emotions based on visual and aural cues (Bolte & Poustka, 2003; Hobson, 1986a, 1986b; Golan, Baron-Cohen, Hill, & Rutherford, 2007; Golan, Baron-Cohen, & Hill, 2006), but there are also a number of studies that have found no differences between groups on these tasks (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Castelli, 2005; Ozonoff, Pennington, & Rogers, 1990).

A limited number of studies have also been conducted to examine how well individuals with ASD are able make emotional inferences from situational cues and these have also had mixed results. When presented with narratives describing characters in different situations, Serra, Loth, van Geert, Hurkens, and Minderaa (2002) found that children with ASD were worse at making situation-based emotional inferences than their peers. In contrast, in a similar study, Baron-Cohen (1991) found that participants with ASD performed as well as their typically developing peers when asked to make situation-based emotional inferences. Additional research on individuals with ASD and the ability to make emotional inferences will be presented in Chapter 2.

Problem Statement

In order to successfully interact with others, it is critical that individuals are able to make accurate inferences about the beliefs and emotions of others so they can react appropriately in social situations (Crick & Dodge, 1994). The impaired TOM theory suggests that the social deficits seen among individuals with autism can be explained, at least in part, by their difficulty making inferences about the "beliefs, desires, intentions, imagination, emotions, etc." of others (Baron-Cohen, 2001, p. 3). However, studies suggest that individuals with ASD may not show the same level of deficits across all these areas. While there is robust evidence that individuals with ASD experience deficits in their ability to make inferences about the thoughts, intentions, and beliefs of others, there is a clear need for additional research on how well individuals with autism are able to make emotional inferences. Studies are needed to gain a better understanding of the nature and degree of impairments in this area. This research is especially important as many educational programs aimed at children with autism dedicate a portion of their curriculum to emotion recognition and inferencing skills based on the assumption that children with autism have general deficits in this area (e.g. *Faceland,* Don Johnston Inc., 2009*: Mind Reading: an interactive guide to emotions,* Jessica Kinsley Ltd., 2004*: Model Me Kids,* Model Me Kids LLC*,* 2004*),* even though this has not yet been substantiated by research. To inform the development of more targeted, evidence-based intervention programs it is critical, therefore, to determine whether individuals with autism do indeed have general impairments in their ability to make emotional inferences. If they do not show consistent impairments in this area, it is important to identify the circumstances under which individuals with autism experience greater difficulty inferring the emotions of others. This study was designed to explore this area further. The research questions and corresponding hypotheses are summarized below:

1. Do individuals with high-functioning autism spectrum disorders have more difficulty making accurate inferences about other people's emotions than their typically developing peers?

Two measures were used to look at the ability to make accurate emotional inferences: the Assessment of Children's Emotion Skills (ACES; Schultz & Izard, 1998) and the Levels of Emotional Awareness Scale for Children (LEAS-C; Bajgar & Lane, 2003). These emotion attribution instruments were used to capture how well children with high functioning autism spectrum disorders were able to make emotional inferences from different types of cues and with different levels of scaffolding.

It was hypothesized that the children with high-functioning autism spectrum disorders would perform worse than their typically developing peers when asked to make emotional inferences from situational cues based on the robust evidence that individuals with autism show an impaired ability to engage in mentalizing tasks. It was assumed that the act of making an emotional inference from situational cues requires a person to first infer how someone else would likely perceive a given situation (which requires mentalizing abilities). There is some support for this assumption from previous studies that have found that the ability to make situation-based emotional inferences is correlated with the ability to pass false-belief tasks among typically developing participants (Guajardo, Snyder& Petersen, 2009; Weimer & Guajardo, 2005; Weimer, Sallquist, & Bolnick, 2012).

The null hypothesis for this research question was: participants with HF-ASD will perform as well as their typically developing peers when asked to make accurate emotional inferences from different cues. The alternative hypothesis was: participants with HF-ASD will perform significantly worse than their typically developing peers on measures that assess how well participants are able to make accurate emotional inferences from situational cues, but not from other cues.

2. Do individuals with high-functioning autism spectrum disorders make fewer spontaneous emotional inferences about others than their typically developing peers?

The second research question was designed to examine whether participants with HF-ASD were less likely to spontaneously make emotional inferences about others when not explicitly prompted to do so. To test this hypothesis, participants were asked to create a narrative to match a wordless story told through a series of images depicting a number of different characters interacting with one another.

The null hypothesis for this research question was: participants with HF-ASD will make the same number of spontaneous emotional inferences as their typically developing peers. The alternative hypothesis was: participants with HF-ASD will make a significantly fewer number of spontaneous emotional inferences than their typically developing peers.

3. Do individuals with high-functioning autism spectrum disorders show lower levels of emotional awareness than their typically developing peers?

Given that emotional awareness is central to successful social experiences and individuals with autism show consistent social deficits in their daily interactions, this question was designed to examine whether children with high-functioning autism spectrum disorders would show lower levels of emotional awareness when compared to their typically developing peers.

The null hypothesis for this research question was: participants with HF-ASD will show the same level of emotional awareness when compared to their typically developing peers. The alternative hypothesis was: participants with HF-ASD will show significantly lower levels of emotional awareness when compared to their typically developing peers.

4. Is the ability to infer emotions related to overall levels of impairment for children with high-functioning autism spectrum disorders?

This last research question was designed to examine the relationship between severity of autism spectrum symptomatology and level of impairment in making emotional inferences. It was hypothesized that the ability to make inferences from situational cues and emotional awareness scores would be negatively correlated with level of overall impairment. It was hypothesized that the ability to make emotional inferences from visual cues would not be correlated with overall impairment

CHAPTER 2

LITERATURE REVIEW

Theory of Mind and Autism Spectrum Disorders

There are three traditional assessments of TOM: the appearance-reality, false belief, and second-order false belief tasks. The appearance-reality task measures how well participants are able to reflect on their own mental processes and perceptions. The latter tasks measure how well participants are able to reason about the mental processes and perceptions of others. Participants with autism do worse on all three measures than their typically developing peers.

In the appearance-reality assessment, the participant is given an object to examine that is painted or otherwise camouflaged to look like something else. The participant is then asked 1) what the item is and 2) what the item looks like. Typically developing children are able to recognize and discuss the object's deceptive qualities, distinguishing what it looks like from what it is (Flavell, Green & Flavell, 1986). When presented with a similar task, Baron-Cohen (1989a) found that children with autism were able to identify the object, but had difficulty describing its deceptive features.

In the false belief assessment, as was described in the introduction, the participant is provided information about a potentially deceiving scenario and asked what another person or character would think in the situation. Between four and six years of age, the probability of passing false belief tasks increases from .55 to .80 for typically developing children (Happe, 1995). As described in the introduction there is a robust body of evidence that individuals with autism show significant impairments on these tasks compared to same age peers (Baron-Cohen, 1989a; Baron-Cohen, Leslie & Frith, 1985;

Baron-Cohen, Leslie & Frith, 1986; Leekam & Perner, 1991; Perner, Frith, Leslie & Leekam, 1989; Reed & Peterson, 1990).

In the second-order false belief tasks, participants are told a story about a character that has a false belief about another character. While most typically developing children pass second-order false belief tasks by the age of six, participants with autism who have passed the first-order false belief tasks continue to perform significantly worse than their peers on this task (Baron-Cohen, 1986b).

The Development of Theory of Mind Related Abilities

Theory of Mind development is thought to be a cumulative process, in which each stage stems from the skills and abilities acquired in the stage before. In his review of TOM development literature, Wellman concludes that TOM "requires considerable learning and development based on an infantile set of abilities to attend to and represent persons (Wellman, 2002)." The imitation skills that infants display virtually at birth reflect an underlying mental representation of "other" (Meltzoff, 2002). In his book titled "The Developing Mind," Siegel (1999) contends that children first formulate an understanding of their own mental states by observing the mental states of their caregiver. They assess their caregiver through the observation of various nonverbal cues, including eye contact, facial expressions, and tone of voice. Within the first six months, children are able to maintain eye contact and at about nine months of age in normative development, children begin to engage in the process of shared communication via joint referencing with another person (Hutchins & Prelock, 2008). Joint referencing occurs when two individuals attend to the same stimulus; each one has an awareness of the other's engagement with and reaction to it. Individuals enter episodes of joint attention through verbal communication, pointing, or by referencing another person's eyes to determine what they are looking at. Because it reflects an awareness of another person's experience, Baron-Cohen (1991) posits that joint attention abilities serve as the foundation for TOM development.

Children with autism appear to show delays or impairments across all the stages of TOM development. Impairment in the use of multiple nonverbal behaviors, such as eye-to-eye gaze is among the DSM-IV diagnostic criteria for autism and multiple studies have found that failure to engage in joint attention is a central deficit among children on the spectrum (Baron-Cohen, 1991; Ozonoff & South, 2001). This has important and far-reaching implications. Hutchins and Prelock (2008) contend that the ability to engage in joint attention is "involved in every aspect of Theory of Mind." The ability to engage in joint attention underlies pretend play and social communication, both of which facilitate the continued maturation of TOM (Siegel, 1999).

At about twenty-four months, most children begin to engage in acts of symbolic play. Rutherford and Rogers (2003) note that during pretend play, children learn to engage in a complex, shared mental experience. Taking on the roles of different characters, children enact, and therefore must learn to understand, different social roles. Through social play, children learn to more accurately interpret the intentions of their playmates and connect with them on a more sophisticated level (Rutherford & Rogers, 2003). Intentional social communication develops before a child turns one, progressing from rudimentary to more complex interactions (Robertson et al., 1999). The discussion of one's thoughts, beliefs, and emotions helps children sharpen their awareness of their own mental processes, and the way they relate to others, thus further facilitating TOM development (Siegel, 1999).

Children with autism show impairments in their ability to engage in both pretend play and social communication. There is some evidence that this weakness may stem from an early failure to engage in joint referencing activities. Rutherford, Young, Hepburn, and Rogers (2007) found that measures of joint attention at two years of age predicted pretend play abilities two years later for children with autism. Similarly, Shumway and Weatherby (2009) found that communication for the purpose of initiating joint attention at two years of age was predictive of social communication skills at three for children with autism.

Gutstein and Whitney (2002) discuss the importance of experience-sharing activities that require an individual to attend to and interpret the emotions and actions of their playmate. By participating in experience-sharing activities during pre-school and early elementary school, children learn how to initiate and maintain friendships. The authors contend that by the time they enter elementary school, children with AS and autism have missed out on hours of social development and by the time they leave elementary school, they are far less socially competent than their peers (Gutstein &Whitney, 2002).

Most children undergo a period of important development in their perspective taking abilities between the ages of three and five years old (Baron-Cohen, 2001). During this period, they begin to show an ability to identify intentions and to reason about the relationship between beliefs and emotions (Harris, Johnson, Hutton, Andrews & Cooke, 1989; Phillips, Baron-Cohen & Rutter, 1998). Children on the autism spectrum do not appear to go through this period of rapid growth in their TOM. They continue to fail traditional TOM tasks far past the age of five, and many never pass them at all (Baron-Cohen, 2001; Baron-Cohen, Leslie, & Frith, 1985).

The conceptualization of autism as a disorder characterized by impaired TOM abilities has thus been adopted as one of the most well-supported theories explaining the social deficits seen in this population. Although this theory was originally based upon studies that examine how well children with autism are able to make inferences about the beliefs of others, the concept of TOM encompasses a far broader range of abilities. These include “the ability to reason about the thoughts, feelings, and intentions of the self and others (Hutchins & Prelock, 2008).” Inherent in the “impaired Theory of Mind” theory, therefore, is the assumption that individuals on the autism spectrum show impairments across these different areas. When examined more closely, however, the research does not always support this assumption. Instead, while studies have consistently found that individuals with ASD show significant impairments when asked to make inferences about the beliefs and intentions of others (referred to here as mentalizing abilities), the findings are more mixed for studies that examine emotional inferencing abilities.

Mentalizing Abilities and Emotion Based Inferences

When interacting with others, individuals use a number of different cues to make inferences about the emotions and thoughts of others. They synthesize information gathered from physical cues such as facial expressions, eye gaze, tone of voice, and posture with information about the situation, what they know about the person, and their own social knowledge and schemata to develop a hypothesis about how the other person is feeling and what they likely believe about a situation (Crick & Dodge, 1994). Research on how individuals make inferences about what others are feeling and thinking can be loosely divided into two groups based on the type of cues used to make the inferences. Some studies look at how well participants are able to make emotional and/or belief-based inferences from more easily accessible, visual or aural cues.[1] Others examine inferences made based upon situational or context cues which require a greater degree of interpretation.

Research on Mentalizinging Abilities

Inferring Beliefs/Intentions from Visual Cues

There are a limited number of studies regarding the visual cues used to make inferences about what other people are thinking because, unlike emotions, there are not as many outward signs of our thoughts, beliefs, or intentions. Most studies in this area have examined how well participants are able to make inferences about what another person wants or is thinking about based on their eye gaze. Studies show that children with autism are not as successful as their peers when asked to make these inferences. This may be partially because they less reliably attend to the eyes of those they interact with (Pelphrey & McPartland, 2012). In a recent study, for example, Vivanti et al. (2011) found that while children with autism performed comparably to their typically developing peers at predicting the behavior of an agent using other cues, when the agent signaled her intention to engage in an unexpected behavior through her eye gaze, children with autism did worse then their peers. The authors found that they were worse at predicting the agent's behavior because they failed to attend to her eye gaze and thus missed this visual

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[1] Although there are a number of interesting studies that examine tone of voice as an important cue, this review will be limited to studies on the use of visual cues in emotion and belief-based inferences

cue. However, findings that individuals with autism are worse at making inferences about the desires and thoughts of others holds true even when they are able to correctly identify what the person is looking at (Baron-Cohen, Campbell, Karmiloff-Smith, Grant & Walker, 1995).

Inferring Mental States from Situational Cues

In the time since the Baron- Cohen et al. (1985) first demonstrated that individuals with autism appear to be impaired in their ability to infer the thoughts/beliefs of others, their findings using the false-belief and change in location measures have been replicated many times. Although it was originally thought that the inability to correctly respond to these measures was a stable characteristic of individuals with autism, later studies have shown that some children with high functioning autism do eventually pass these tasks (Baron-Cohen, 2001; Happe, 1995).

For individuals with autism, verbal ability is highly predictive of performance on these measures. In her 1995 study, Happe looked data from 70 subjects with autism and 70 control subjects on two false-belief measure and found that the control subjects had a fifty percent change of passing both false-belief tasks at a verbal mental age of four years of age, but that the subjects with autism needed to reach a VMA of nine years two months before they had a fifty percent chance of passing both tasks. Furthermore, she found that while the youngest control subject to pass both false belief tasks had a VMA of 2-10, the youngest subject with autism had a VMA of 5-6. In discussing the results, Happe (1995) hypothesizes that they may indicate that subjects with ASD use a verbally based cognitive strategy to solve the false-belief task while their peers process the information using a more direct and immediate cognitive process.

A study by Senju (2012) provides some additional support for this hypothesis. Senju (2012) argues that there may be a more automatic TOM-related response that is not captured by traditional ToM tasks but that remains impaired even after individuals with ASD develop the compensatory mechanisms needed to pass traditional false belief tasks. He refers to two studies he conducted with colleagues to provide some evidence for this contention. The first was a study conducted with two year olds that examined anticipatory looking behavior on the false belief task (Southgate, Senju, & Csibra, 2007). In this study, a group of infants were shown a video involving an actor and a puppet. During the training phase of the video, the actor watched the puppet place a ball in one of two boxes. After a visual and auditory signal, the actor reached in and removed the ball. In the false belief portion of the study, the puppet moved the ball to the other box while the actor was turned away. When the signal went off, the researchers tracked eye gaze to determine whether the infants expected the actor to look for the ball in the old location or to look in the new, accurate location. Data from the eye-tracking device indicated that they correctly anticipated that the actor would look in the box where the puppet had originally placed it. The research team replicated this study with adults with Asperger's Syndrome and a control group of typically developing adults two years later (Senju, Southgate, White, & Frith, 2009). Both groups were able to pass standard false belief measures. However, the eye tracking data showed that while the participants in the control group, like the infants described in the previous study, engaged in anticipatory looking behavior toward the original box while watching the video, the adults with AS showed no bias in their gaze. Senju (2012) interpreted these results as evidence that individuals with ASD may continue to have an impaired ability to engage in spontaneous reasoning about the mental states of others, even after they develop compensatory mechanisms that allow them pass traditional TOM-measures.

This impairment in the ability to demonstrate more spontaneous TOM-related abilities may help explain why, even after they are able to pass traditional TOM measures such as the false belief and change in location tasks, individuals with autism continue to show TOM- related impairments in their daily, social interactions (Baron-Cohen, 2001; Baron-Cohen et al., 1985). Baron-Cohen (2001) argues that the impaired ability to engage in “mindreading” tasks is stable across the lifespan for individuals with autism, but can only be captured using developmentally appropriate measures.

In response to this need for more a more subtle, complex measure of mentalizing abilities, Happe (1994) developed the Strange Stories Measure. This instrument is made up of a series of vignettes which describe scenarios involving one of the following themes: Lie, White Lie, Joke, Pretend, Misunderstanding, Persuade, Appearance/Reality, Figure of Speech, Sarcasm, Forget, Double Bluff, and Contrary Emotions. A picture accompanies each scenario, along with a comprehension question that measures how well participants are able to infer the beliefs, desires, and/or intentions of the characters in each situation. Happe (1994) compared the performance of three groups on this task and traditional TOM tasks; adults with autism, adults with intellectual impairment, and control groups of typically developing children and adults. She found that participants with autism performed worse overall on the Strange Stories than both comparison groups. She also found that even individuals with autism who had passed the first and second-order false belief tasks performed worse overall on the Strange Stories measure than the control group (Happe, 1994). These findings have since been replicated by a number of other studies (Kaland et al., 2005; Joliffe & Baron-Cohen, 1999; Spek, Scholte, & Van Berckelaer-Onnes, 2010) providing further evidence that individuals with autism continue to experience difficulty with mentalizing tasks even after they are able to pass the traditional TOM tasks. Relevant to the next section, stories on contrary emotions were one of only two types of stories (the other was figures of speech stories) where participants with autism did not make significantly more errors than the comparison groups.

Research on Emotional Inferences

Inferring Emotions from Visual Cues

Studies have found that in typical development, most children are able to identify facial expressions displaying joy, sadness, and fear and have begun to develop the ability to label anger and surprise as well by the time they enter school (Widen and Russell, 2003). Research conducted on whether children with autism are impaired in their ability to read people's emotions based on their facial expressions has been mixed, with some studies showing a marked deficit in this area and others showing none (Baron-Cohen, Jolliffe, Mortimore, &Robertson, 1997; Bolte & Poustka, 2003; Castelli, 2005; Hobson, 1986a, 1986b; Ozonoff, Pennington, & Rogers, 1990).

In an attempt to tease apart the mixed findings cited above, recent studies have begun to use more sophisticated measures of emotional recognition. In one study, for example, Law Smith, Montagne, Perrett, Gill, and Gallagher (2010) looked at how well participants on the autism spectrum were able to identify people's emotions when their expressions show less than 100% intensity. They used the Emotions Recognition Task (Montagne, Kessels, DeHaan, & Perrett, 2007), a computer program designed to show faces expressing each of the six basic emotions at varying intensities. They compared the performance of participants with AS to a control group and found that the participants on the spectrum were worse at identifying anger and surprise at intensities lower than 100% and disgust at all intensities when compared to the control group.

In another study, Humphreys, Minshew, Leonard, and Behrmann (2007) presented a series of computer-generated faces with mixed expressions to a group of participants with autism and a control group. The measure presents each possible pair-wise combination of the six basic emotions at different ratios (i.e., 60% surprise and 40% disgust). The authors found that the individuals with autism were impaired on this more nuanced measure of emotional recognition when compared to the control group. They had more difficulty accurately identifying expressions of fear, happiness, and disgust (Humphreys, Minshew, Leonard, and Behrmann, M. (2007).).

A number of studies have also examined how well individuals with autism spectrum disorders are able to identify more complex emotional and mental states. Heerey et al. (2003), for example, found that children with autism were significantly worse at predicting shame and embarrassment from nonverbal cues in images. Baron-Cohen and Wheelwright (2001) developed the Reading the Mind in the Eyes task to look at the ability to infer more complex emotional/mental states.[2] In this task, participants are presented with a series of photographs of people showing different expressions. Only the eye region is visible and participants are asked to identify the person's emotional/mental state from a selection of four words. The complex emotional/mental states represented on

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[2] The Reading the Mind in the Eyes task was originally called the Eye Task (Baron-Cohen, Campbell, Karmiloff-Smith, Grant, & Walker, 1995).

this measure include regretful, thoughtful, desire, playful, and cautious among others. The children's version of this task is similar but includes only simple emotional and mental state (i.e., surprised, angry, worried). While a number of studies have found that children and adults with High-Functioning Autism (HFA) or Asperger's Syndrome (AS) have more difficulty on this measure than their typically developing peers (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Brent et al., 2004), other studies have not seen this difference (Bach, Ropar, & Mitchell, 2007; Ponnet, Roeyers, Buysse, de Clercq, & van der Heyden, 2004).

Finally, researchers have also looked at whether individuals with autism have more difficulty recognizing some emotions than their peers but not others. Most of the measures in these studies have used images of faces showing the six basic emotions: happiness, anger, sadness, fear, disgust, and surprise (Ekman, 1992). Ellis and Leafhead (1996) found that individuals with autism had more difficulty recognizing anger and disgust, whereas Pelphrey et al. (2002) and Howard et al. (2000) found that participants with ASD showed a relative weakness in their ability to recognize fear. In another study, when shown images of people expressing surprise, happiness, and sadness, participants with autism experienced greater difficulty recognizing surprise than their peers but showed no difference in their ability to recognize the other two emotions (Baron-Cohen, Spitz, & Cross, 1993).

Using Visual Cues in a Naturalistic Setting

As described by Crick and Dodge (1994) in their Social Information Processing theory, children must process a number of different environmental and interpersonal cues when engaging in a social interaction with another person. The studies cited above explore how well individuals with autism are able to make emotional inferences from isolated cues. However, there are also some studies that look at how well individuals with autism are able to make emotional inferences in more naturalistic situations.

Golan, Baron-Cohen, and Golan (2008) conducted a study where they showed participants with ASD and typically developing participants clips from a children's movie showing scenarios selected to portray a complex emotion or mental state (i.e., guilty, relieved, tempted). They then asked participants how the character was feeling and gave them multiple-choice options for response. The authors found that participants with ASD performed worse on this task than typically developing peers. To help explain the difference in performance, they point to previous studies that have shown that providing social-emotional information in a multi-modal fashion, as its delivered in real world situations, may actually have a detrimental affect on how well individuals with autism are able to process important emotional cues. Pierce, Glad, and Schreibman (1997), for example, found that when participants with autism were asked social perception questions based on one cue they performed as well as the control group, but when they were asked to answer the question based on multiple cues, they performed worse than both their typically developing peers and their peers with intellectual impairments.

There is also a body of research that has found that individuals with autism attend less to emotionally salient cues. Numerous studies have found that individuals with autism attend less to facial expressions than their peers (Kikuchi, Senju, Tojo, Osanai, & Hasegaw, 2009; Riby and Hancock, 2008). In their study, for example, Riby, Brown, Jones, and Hanley (2012) found that when instructed to find a butterfly among an array of images, control participants performed worse when a face was among the images shown.

Participants with autism, however, show no difference in performance suggesting that, unlike their peers, they were not distracted by the presence of a face. The authors contend that this finding demonstrates that individuals with autism lack the attentional bias towards faces that typically emerges early on in development. It is this bias that ensures that individuals will see important emotional cues such as facial expressions when interacting with others. Thus, individuals with autism may present as less emotionally aware than their peers not because they are unable to process emotional cues as successfully, but because they fail to attend to them in the first place.

Findings by Klin, Jones, Schultz, Volkmar, and Cohen (2002) support this hypothesis. They also found that individuals with ASD show atypical patterns of attention in naturalistic environments. The authors conducted a single participant study comparing the visual tracking of a typically developing adult and an adult with autism while watching emotionally loaded scenes in a movie. They found that the participant with autism attended less to the important social dynamics than the typically developing participant. Whereas the typically developing participant would scan all the characters in a given scene, the individual with autism tended to focus on the person talking. The authors refer to this as a failure to engage in important “social monitoring” and claim that the individual with autism missed a lot of information in the reaction of the other characters. They also found that whereas the typical participant was biased in his attention toward the characters and important social-emotional cues, the participant with autism did not display this same bias, attending to physical cues, such as character and camera movement, over facial expressions, postures and other social-emotional cues.

It is clear that examining how well individuals on the autism spectrum can infer emotions from facial expressions and other visual cues is a complicated task. While it appears individuals with autism are able to perform as well as their peers on some measures of emotion recognition, they do seem to show relative weaknesses on others. Continued research in this area will help provide a better understanding of the nature and degree of this impairment.

Inferring Emotions from Situational Cues

During social interactions, individuals use specific information about the people they are interacting with, in addition to their more general social knowledge and schemata, to develop a hypothesis about how the person is likely to feel given the situation they are in (Crick &Dodge, 1994). The role of situational and context cues becomes increasingly more important as children grow older, and their peers learn to mask the physical expression of their emotions. In more complex situations, in order to develop a hypothesis about how another person is feeling, children must first take on the perspective of the other person. What would the other person have wanted in this situation? What are their perceptions of the situation?

In normative development, children are able to recognize facial expressions before they develop the ability to recognize the causes for these emotions (Pons, Harris, & de Rosnay, 2004). Children are able to infer basic emotions stemming from the fulfillment of desires by age two and a half (Wellman et al., 2000). By five years of age, they are able to infer sadness, anger, happiness, and fear from situational cues (Ribordy, Camras, Stefani, & Spaccarelli, 1988). By six years of age, they understand that people might express one emotion even while experiencing a different one (Harris, Donnelly, Guz, & Pitt-Watson, 1986).

There are mixed findings on the degree to which children on the autism spectrum are impaired in their ability to infer the emotions of others based on situational cues. Most measures designed to examine this question use written vignettes. They present a story designed to invoke a specific emotion and ask the participant to identify how a character would feel in that situation. Sometimes, the narrative also provides information about what the character wants or believes about a situation and asks participants to make inferences based on those cues. Items designed to test inferences made from desire-based cues present narratives that explicitly state what a character wants. An example of an item that measures emotional inferences based on desires is, “Jack wants candy. Jack’s mom gives him some candy. How does Jack feel?” Items designed to test inferences based on beliefs present narratives in which the character believes something about the situation that the reader knows is not true. An example of an item that measures emotional inferences based on beliefs is, “Jack wants candy. Alice gives him a box that looks like it has candy inside but really it has paper clips. How does Jack feel when Alice first gives him the box?” Finally, items designed to test inferences made based on purely situational cues present narratives in which a character is placed in a situation assumed to invoke a universal emotion. An example of an item that measures emotional inferences from situational cues alone is, “Mary is at a birthday party, how does she feel?” On these items, the participant must either take on the characters perspective and/or use their “database” of stored information and social schemata to make assumptions about how the character would likely perceive the situation and how s/he would likely feel based on that perception (i.e., most children enjoy birthday parties so Mary likely wants to be there and is therefore happy).

Baron-Cohen (1991) conducted a study designed to compare the performance of participants with autism, participants with intellectual impairment, and typically developing participants on their ability to infer happiness and sadness based on beliefs, desires, and situational variables. In the study, the participants were introduced to a doll named Jane. They were then told a story about Jane designed to invoke the target emotion and asked how Jane would feel in that situation. Participants with autism did worse than their typically developing peers when asked to make emotional inferences based on desires and worse than both groups when asked to make emotional inferences based on beliefs. All three groups displayed the same level of performance, however, when asked to make emotional inferences based on situational cues.

In a similar study, Serra, Loth, van Geert, Hurkens, and Minderaa (2002) presented a number of different vignettes to a group of children diagnosed with PDD-NOS and a control group of typically developing children approximately four to six years old. The tool was composed of a series of stories designed to measure the participants' ability to recognize or infer happiness, sadness, surprise, curiosity and a neutral emotion. In contrast to what Baron-Cohen (1991) found, in this study, the group with ASD were worse at inferring emotions based on all three cues (situational, desires, and belief) than their typically developing peers.

McHugh, Bobarnac, & Reed (2011) also found evidence that children with ASD experience difficulty inferring emotions from situational cues. In their single-subject study designed to examine how well children with ASD were able to learn how to predict situation-based feelings, the authors found that none of the three five-year old subjects with ASD were able to make these predictions before training began.

Some researchers have also looked at how well children with ASD are able to make inferences about complex or social emotions from situations when compared to their peers. Hillier and Allinson (2002) found that participants with autism did worse when asked to identify scenarios that invoke embarrassment than their peers. This supports findings from an earlier study that participants with ASD experienced more difficulty when asked to relay their own experiences with pride and embarrassment than their peers (Capps, Yirrniya, & Sigman, 1992).

Finally, Dennis, Lockyer, and Lazenby, (2000) examined how well children with HFA were able to identify the real and deceptive emotions of characters in complex narrative vignettes. In this study, the term "deceptive emotions" was used to refer to emotions that a character in the story chose to display, although they contrasted with what the character truly felt, it in order to achieve a desired result. In the example cited in the article, the character felt sick but wanted to go outside and knew that his mother wouldn't let him go outside if she knew he was sick. Participants were asked to identify how the character felt, what facial expression he would show and why he would show that facial expression. The authors found that children on the spectrum performed worse on all three of these questions when compared with typically developing peers. They also found that severity of autism was related to the ability to identify the character's deceptive emotions.

These studies show that there is mixed evidence regarding how well children with ASD are able to infer the emotions of others from visual and situational cues. These contradictory findings may result from the lack of methodological conformity across studies. Age, level of functioning, and the type of emotion (i.e., simple vs complex) may all influence how well participants are able to perform on these tasks. They also point to the need to continue to conduct studies that explore how well individuals with autism are able to make emotional inferences from various cues on isolated tasks.

The Relationship Between the Ability to Make Inferences About Beliefs and the Ability to Make Emotional Inferences

The studies reviewed above provide evidence that children with autism consistently show impairments when asked to engage in mentalizing tasks, although the nature and degree of these impairments varies across age and level of functioning within the population. Furthermore, these impairments are found when participants are asked to make inferences from both visual cues, such as eye gaze, and from situational cues. However, research on how well individuals with ASD are able to perform when asked to make emotional inferences from isolated visual and situational cues have been more mixed, with some studies finding significant impairments in this areas and others showing none.

Findings that individuals with ASD may not be as impaired in their ability to make emotional inferences as they are in their ability to engage in mentalizing tasks, or that this impairment manifests in naturalistic situations but not always on isolated tasks, adds an important level of nuance to the impaired TOM explanation for the social deficits seen among individuals with autism. It may be that the ability to make inferences about the beliefs of others, as measured by traditional TOM tasks, and the ability to make emotional inferences are distinct but related abilities. Placing deficits in these areas under the same umbrella of a larger TOM impairment may hide important distinctions that can help us better understand the social cognitive difficulties often found among individuals with autism.

Over the last two decades, there have been a number of the studies published that examine the relationship between mentalizing abilities and the ability to make emotional inferences. As children typically develop these critical social abilities between the ages of three and five, most of the studies discussed below use participants in this range. Unfortunately, at this time, all studies in these areas have been conducted with typically developing children. In one study, Hughes and Dunn (1998) found that the ability to recognize and label emotions more generally and the ability to pass false-belief measures were correlated. Similarly, in a longitudinal study designed to look at the relationship between emotion knowledge and traditional TOM tasks, O'Brien et al. (2011) found that emotion knowledge develops first at an early age and that performance on emotion knowledge activities early on predicts how well children will perform on TOM tasks later on. Cutting & Dunn (1999), however, failed to find a relationship between the ability make inferences about the beliefs of others and the ability to recognize and label emotions.

When studies have looked more specifically at the ability to pass false belief tasks and the ability to make emotional inferences from situational cues, there is more consistent evidence that there is a positive relationship between the two; multiple studies have found that the ability to make situation-based emotional inferences is correlated with the ability to make belief based inferences (Guajardo, Snyder& Petersen, 2009; Weimer & Guajardo, 2005; Weimer, Sallquist, & Bolnick, 2012).

It is therefore possible that the same mechanisms underlie the ability to make an inference about what someone believes and the ability to take on their perspective in a given situation to infer how they might feel (when no visual cues are available). Approaching this question in a different way, Harwood and Farrar (2006) examined how well typically developing participants were able to make emotional inferences from narratives in which they and the other character had either matching (happy-happy) or conflicting (happy-sad) feelings. They found a relationship between the participant's performance on false belief tasks and on the conflicting emotion tasks, but not the matching emotion tasks. This suggests that the ability to ignore what you know to make an inference about what someone else believes might be similar to the ability to ignore how you feel to make an inference about how someone else feels.

Findings from Brain Imagining Studies

Studies that examine the brain activity of both typically developing subjects and subjects with autism when making inferences about the thoughts and feelings of others provides important insight regarding the degree to which individuals with autism experience impairments in these areas. By identifying the brain regions implicated in each of these activities, it is also possible to assess the degree to which these activities rely on the same underlying pathways.

Mentalizing Tasks

Only a limited number of studies have been conducted using functional magnetic resonance imaging (fMRI) to look at brain activity during activities where participants are required to attend to the thoughts, beliefs, and intentions of another individual. In one study, Rilling, Sanfey, Aronson, Nystrom, and Cohen (2004) looked at how brain activity differed when participants believed they were playing a computer game against a computer opponent vs. a human opponent. To play the game in the latter condition, participants had to make predictions about what their opponents were likely thinking and what they intended to do. The authors found that different neural pathways were activated, or the same ones were activated more strongly, when participants believed they were playing against a human opponent compared to when they believed they were playing against a computer. In other studies, researchers have used stories, pictures, and games to look at brain activity during traditional TOM activities. Three regions have been consistently associated with TOM processes: temporal poles, the posterior superior temporal sulcus (STS), and an area in the medial pre-frontal lobe (mPFC) (see Gallagher & Frith, 2003 for a review). Studies have shown that, when engaging in mentalizing tasks, brain activity in these regions is different for individuals with autism when compared to their typically developing peers (Assaf et al., 2010; Colich et al., 2012; Marsh & Hamilton, 2011).

Inferring Emotions

Inferring Emotions from Visual Cues

There are two types of brain studies in the area of emotional inference abilities. The first group of studies looks at the neurological activity that occurs when participants observe visual cues of an emotion. A number of studies have found that mirror neurons are activated when facial expression expressions are observed (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Leslie, Johnson-Frey, & Grafton, 2004). Once the mirror neurons have been simulated, the signal is then sent to the amygdala to be further processed (Carr et al.,2003). Neuroimaging studies have found that, when engaged in a facial recognition task, areas of the brain associated with attention to different relevant and irrelevant facial features are activated among individuals with autism, rather than the regions of the amygdala activated for their peers. Some theorists argue that this suggests that while their peers process facial expression in a holistic way, individuals with autism attend to different parts of the face and then try and synthesize the information together (Santos, Rondan, Rosset, Da Fonseca, & Deruelle, 2008; Wang, Dapretto, Hariri, Sigman, & Bookheimer, 2004). This finding supports the "weak central coherence" theory, which suggests that individuals with autism may have difficulty processing social information holistically. The theory posits that individuals with autism tend to look at perceptual cues separately and then try and piece them together to make sense of a social situation. This process is referred to as "systematizing" (Baron-Cohen, 2003).

To test this hypothesis and determine whether individuals with autism need additional time to attend to and process different parts of the face, Tracy, Robins, Schriber, and Solomon (2011) presented a sample of children with ASD and a control group with pictures depicting the six basic emotions of anger, disgust, fear, happiness, sadness, and surprise as well as two social emotion expressions: contempt and pride. In the study, participants were given one of the eight emotion words listed above, shown an image of someone experiencing an emotion, and asked to determine whether the image matched the target emotion. They were given 1,500 milliseconds to see the image and to provide and answer. The authors found that the participants with autism performed no differently than their peers on this task. This suggests that, even if they process expressions in different ways, individuals with ASD seem to be as efficient at recognizing facial expressions as their peers.

Inferring Emotions from Situational Cues

The second group of studies has looked at the neurological activity that occurs when individuals make inferences about how another person feels based upon the situation they are in. Studies in this area have mainly focused on affect sharing. Affect sharing occurs when an individual observes someone else having an experience and their brain responds as though they were having it. As participants are often also exposed to visual cues in these studies, they cannot be seen as pure measures of brain activity during the process of making emotional inferences from situational cues alone. However, as of today there are no studies that control for visual cues.

The "shared network" model of the empathetic response is one theory that explains how people process the way others respond emotionally to different situations. This model suggests that humans use the same neural processes to understand and recognize our own affective responses that we use to represent the emotional responses of others (Singer et al., 2004a). Some studies have found evidence to support this theory. Wicker et al. (2003), for example, used functioning magnetic resonance imaging technology to determine that people experience similar neural activity both when smelling something disgusting and when they see a picture of someone smelling something disgusting. Similarly, when Singer et al. (2004a) administered a series of shocks to a group of participants and their partners, the authors found that the bilateral AI, the rostral anterior cingulate cortex (ACC), brainstem, and cerebellum were all activated both when the individual experienced pain themselves and when they observed their partner experiencing pain. These parts of the brain are associated with the affective response to situations (this does/does not feel good). Reviewing these studies, Singer

(2006) hypothesizes that the empathetic response may have developed from the human capacity for meta-awareness about what we feel and how different situations trigger these feelings.

Many studies that have tested the “shared network” model of empathy and how it relates to autism have also looked at the role of alexithymia. Alexithymia is a personality trait characterized by a pervasive difficulty identifying and describing ones own emotional experiences. While the rate of alexithymia is less than ten percent among the general public (Fukunishi, Berger, Wogan, & Kuboki, 1999), studies have found that up to 85% percent of individuals with autism may also be alexithymic (Hill, Berthoz, & Frith, 2004). To test the shared network hypothesis that the ability to understand and reflect upon ones own emotions and the ability to recognize and empathize with the emotions of others both rely on the same neural processes, Bird et al. (2010) looked at the “empathy for pain” response among individuals with and without autism. The authors recruited participants for both groups who were and were not alexithymic and used functional magnetic resonance imaging technology to examine brain activity while they and a partner where given small electric shocks. The study showed that higher levels of alexithymia were associated with reduced levels of activation in the insular cortices. This difference was found in both the group with autism and the control group. Furthermore, when alexithymia was controlled for, autism alone was not predictive of neural activities in the insular cortices.

Other studies have also shown that individuals with alexithymia and autism display different patterns of brain activity than individuals with autism only when engaging in emotion-related tasks. For example, Silani et al. (2008) found that when subjects with autism and control subjects were asked to engage in an interoceptive activity (which requires attending to ones own emotional state), levels of alexithymia predicted brain activity in the anterior insula in both groups. Control subjects and subjects with autism but without alexithymia showed the same neural activity during the interoceptive task (Silani et al., 2008).

Thus, unlike for the studies that have looked at brain activity while processing facial expressions, studies that have looked at brain activity while participants are asked to make emotional inferences from situational cues, have found no difference in activity between participants with autism and their typically developing peers. Instead, differences have been observed between participants with and without alexithymia, regardless of ASD diagnosis.

The Relationship Between the Ability to Engage in Mentalizing Tasks and the Ability to Make Emotional Inferences

The studies outlined above suggest that different brain regions are associated with the act of making different types of inferences. The temporal poles, the posterior superior temporal sulcus (STS), and an area in the medial pre-frontal lobe (mPFC) are implicated in inferences about intentions and beliefs (Gallagher & Frith, 2003). Studies on the neural activities that underlie empathetic responses or inferences made about how others are feeling point to the role of the amygdala, the rostral anterior cingulate cortex (ACC), brainstem, anterior insula and cerebellum (Carr et al., 2003; Singer et al., 2004a).

However, there is some overlap as well. In their study, Mier et al. (2010) looked at the relationship between emotion recognition abilities and what they term "affective TOM" capabilities. They showed participants images of people with emotional facial expressions and asked questions about both their emotions (the emotion recognition task) and alternatively, their intentions (the affective TOM task). The authors used fMRI technology to determine that there were areas of overlapping brain activity during the emotion recognition and the affective TOM tasks. They found that areas that were activated during the emotion recognition task showed even stronger activation during the affective TOM task. This suggests that the two activities are related and the authors hypothesize, the act of engaging in an emotion recognition task may prime or trigger the activation of pathways involved in affective TOM processes. To further examine this hypothesis, they measured how long it took participants to respond after being shown the stimuli. They found that it took participants longer to engage in the TOM task than the recognition task. The authors contend that this may result from the increased difficulty of the task. When given an emotion recognition task immediately before an affective TOM task, however, reaction times were shorter on the TOM task than when they were shown something else before the task, a finding that is in keeping with their hypothesis (Mier et al., 2010).

Moriguchi et al. (2006) conducted a study in which students with high and low levels of alexithymia watched an animation sequence in which two nonhuman characters interacted with one another. Participants were asked to think about what the characters had done and thought after viewing the film while being given an fMRI scan. They were then asked to describe the animation to an experimenter. Their narratives were scored for the degree to which they ascribed intentions and deliberate actions to the nonhuman characters as a measure of TOM capabilities. The authors found that high alexithymia was associated with decreased performance on the TOM task and with decreased activity in one of the brain regions associated with mentalizing tasks, suggesting that there may be a relationship between the ability to recognize and describe emotions and to engage in mentalizing tasks for individuals with alexithymia.

Summary

There is robust evidence that individuals with autism perform worse than their typically developing peers when they engage in isolated mentalizing tasks where they are asked to make inferences about the thoughts, beliefs, and intentions of others. Functional magnetic resonance imaging shows that their brain activity actually looks different than their peers when they are engaging in these tasks. Research on how well individuals with autism are able to make emotional inferences on isolated tasks, however, has been mixed. Studies that have looked at the ability to make emotional inferences from visual and situational cues have had conflicting results, with some studies showing that individuals with ASD perform worse on these tasks than their peers and other studies showing no difference. Brain imaging studies have been no more conclusive. While at least one study suggests that individuals with autism infer emotions from visual cues using different cognitive processes than their peers, another study found that these processes appear to be no less accurate or efficient than those used by typically developing participants. Furthermore, other studies have found that, when controlling for alexithymia, participants with autism show the same brain activity as their typically developing peers when asked to make inferences from situational cues.

Taken together, these studies suggest that individuals with ASD appear to show a more consistent level of impairment on tasks that require mentalizing abilities than on tasks that require them to make emotional inferences. More research is needed on emotional inferencing abilities among individuals with ASD to better understand where these weakness lie and how they contribute to the general social deficits seen in this population.

Practical Implications in Educational Programming

Autism is the fastest growing developmental disability in the United States of America. According to the US Centers for Disease Control and Prevention (CDC), one out of every 54 boys and one out of every 252 girls is diagnosed with autism. The prevalence rate of the disorder is increasing by 10-17% each year (Autism Speaks, 2008). One effect of this sharp increase in diagnoses has been the increased prevalence of students with autism entering the school system. Autism has become the fastest growing special education category and it is critical that educators today are prepared to work with students with autism.

The assumption that individuals with autism have impaired TOM abilities that affect not only their ability to make inferences about the beliefs and desires of others, but also their emotions is pervasive. It has informed the development of measures designed to assess the severity of autism-related symptoms such as the *Theory of Mind Inventory* (ToMI; Lerner, Hutchins, & Prelock, 2011) which includes items that examine how well subjects are able to interpret emotional facial expressions in addition to how well they are able to make inferences about the beliefs and intentions of others.

This theory has also informed the development of numerous social skills programs designed for individuals with autism. Some programs have focused on teaching facial expression recognition skills in isolation. *Faceland* (Don Johnston Inc., 2009*)* for example, is a computer program designed to teach children with autism to recognize the expressions of surprise, anger, fear, sadness, happiness, and disgust. Similarly, the video-modeling program, *ModelMeKids* (Model Me Kids LLC, 2004) includes an entire video devoted to teaching children with ASD to recognize different emotional facial expressions. Other programs are designed to teach children with autism how to infer the emotions of others from a variety of different types of cues. A program called *Mind Reading: an interactive guide to emotions* (Baron-Cohen, 2004) for example, teaches children with autism to recognize the emotions of others based on their voice, facial expressions, and situational or context cues (ie. stories). Similarly, *Language Builders Emotion Cards* (Stages Learning Materials, 2012) offers images of people in variety of settings to help teach the range and complexity of emotional experiences. In addition to these individual programs dedicated to teaching children with autism how to recognize and infer the emotions of others, many websites designed to help teachers work with students on the autism spectrum recommend lessons dedicated to this topic and offer resources to help them teach these skills (i.e. creative spectrum.com, educateautism.com, behavior*.org, autismworld.com).*

If children with autism are not, in fact, as impaired in their ability to infer emotions as they are in their ability to infer beliefs, or if their ability to make emotional inferences is impaired in naturalistic situations but not on isolated tasks, these programs might be a misuse of resources and social-emotional instructional time.

This study was designed to provide additional insight into how well children with autism are able to make emotional inferences from various cues. The hypothesis was that the study would replicate some previous findings that children with autism perform no differently from their peers when asked to make inferences about the feelings of others from facial expressions or other visual cues. Given the robust findings regarding their impaired ability to engage in mentalizing tasks, the study predicted that individuals with autism would perform worse then their peers when asked to make emotional inferences based on situational cues alone. As noted above, this is an important skill to have as children learn to mask the physical manifestations of their emotions as they get older. This study was conducted with the hope that increased clarity around how impaired individuals with autism are when it comes to processing different cues to make emotional inferences will help inform the creation of more effective, targeted social skills interventions.

CHAPTER 3

METHODS

Research Design

A nonequivalent, single factor group design was used to answer the research questions (Heppner, Kivlighan, & Wampold, 1999). Participants in the clinical group were selected based on their diagnosis of a High-Functioning Autism Spectrum Disorder (HFA, AS or PDD-NOS). The control group was composed of typically developing participants. Participants in both samples were administered measures of emotion attribution abilities and performance on these measures was compared to examine whether children on the autism spectrum experience more difficulty making emotion-based inferences about others. For participants in the clinical sample, data were also collected on level of autism-specific impairment. Performance on the emotion inference measures was correlated with level of impairment to determine whether these measures can be used to reliably discriminate within the subpopulation of children with HF-ASD.

Participants

A Priori Power Analysis

To calculate how many participants would be needed for the study, a power analysis was conducted using *G*Power3* software (Faul, Erdfelder, Lang, & Buchner, 2007). In order to control for verbal ability, it was assumed that comparisons of the mean performance on the emotion attribution measures would be analyzed using Analysis of Covariance (ANCOVA) tests. It was also assumed that the Holm procedure would be used to decrease the risk of making a Type One error when comparing group means on the three sections of one measure, the Assessment of Children's Emotion Skills (ACES;

Schultz & Izard, 1998). Therefore, a power analysis was run using the most stringent alpha level of .0167. Although other statistical analyses were ultimately used, as will be explained further in Chapter 4, the power analysis was run using the assumptions of the originally planned data analyses. A moderate to large effect was predicted for group differences on situation-based emotional inferences given the robust findings that individuals with ASD show marked impairments in their ability to make belief-based inferences (Baron-Cohen, 1989a; Baron-Cohen, Leslie & Frith, 1985; Baron-Cohen, Leslie & Frith, 1986; Leekam & Perner, 1991; Perner, Frith, Leslie & Leekam, 1989; Reed & Peterson, 1990) and previous findings that the ability to make situation-based emotional inferences is correlated with the ability to pass false belief tasks (Guajardo, Snyder& Petersen, 2009; Weimer & Guajardo, 2005; Weimer, Sallquist, & Bolnick, 2012). The *G*Power 3* software computed that with an alpha level of .0167 and a power of .80, thirty participants would be needed to detect a large effect size, $f\,(V)$ =.8. When run using a moderate effect size, $f\,(V)$ = .6, with all other parameters remaining the same, the analysis computed a sample size of n = 68. To increase the likelihood of finding group differences and decrease the risk of making a Type Two error, a sample of forty-eight students was used in this study.

Eight to eleven years old were recruited from a number of different regions across Connecticut, Massachusetts, and New York. This age range was selected because, although emotional development occurs at different rates across individuals, research suggests that most typically developing children are able to identify simple and complex emotions, pass false-belief tasks, and infer emotions from thoughts by eight years of age (Baron-Cohen, 2001 & Baron-Cohen, 2004).

The sample was made up of two groups: a clinical group and a group of typically developing participants. The clinical group was composed of participants with High Functioning Autism, Pervasive Developmental Disorder-Not Otherwise Specified, and Asperger's Syndrome. This study specifically targeted the high functioning end of the autism spectrum, rather than a broader sample of children with ASD for a number of reasons. General intellectual impairment is common among children with autism and studies have identified rates of co-morbidity ranging from 25-75% (Dawson, Mottron, Gernsbacher, 2008). In addition, language delays are characteristic of classical autism and many individuals with autism have limited or no verbal ability (National Institute of Mental Health, 2008). It would have been inappropriate to look at the more nuanced aspects of social-emotional awareness using the measures employed in this study with students who have significantly limited verbal and/or cognitive abilities. Furthermore, in order to better understand the social skill deficits uniquely associated with autism, it was important to control for comorbid factors (such as language and cognitive impairment) often found among students with more severe forms of autism that may contribute to the presentation of social skill difficulties above and beyond what can be accounted for by the autism spectrum disorder. Finally, this study originated from the perceived need to gather more information on how children on the autism spectrum process social-emotional situations in order to inform the development of more effective social skills interventions for students with ASD in mainstream settings. The goal was to gather information in this study that might help inform the creation of programs designed for children who have the requisite verbal ability and communication skills to benefit from higher-level social skill training. To best inform the creation of successful social-skill interventions for high functioning children with ASD, therefore, it was important to gather data from participants representative of the target audience.

Sampling Procedures

A set of inclusionary criteria was used to identify the students eligible for inclusion in the clinical sample. The first criteria was a formal diagnosis of autism, Asperger's syndrome, or pervasive developmental disorder-not otherwise specified (PDD-NOS), given by a psychologist, psychiatrist, neurologist, or pediatrician. One participant was diagnosed by a Speech and Language Pathologist, as his school district formally recognized this diagnosis, and the principal investigator ensured that the SLP met the American-Speech-Language-Hearing-Association (ASHA)'s position statement that "speech-language pathologists who acquire and maintain the necessary knowledge and skills can diagnose ASD" (ASHA, 2006). Of the final clinical sample of 24 participants with HF-ASD, eight participants were diagnosed with Asperger's syndrome (33.33%), two participants were diagnosed with autism (8.33%) and fourteen participants were diagnosed with pervasive developmental disorder-not otherwise specified (58.33%).

The second inclusionary criterion for students with PDD-NOS or autism was an IQ score above 70. While high-functioning autism (HFA) is not a formal diagnostic label, the term is typically used to refer to children with autism who have an IQ score of 70 or greater (Klin, 2006). This inclusionary criterion was important since the recruitment process was intended to target higher functioning students. The IQ score was not needed for students with Asperger's disorder as the *DSM–IV–TR* (2000) criteria specifies that a child cannot be diagnosed with AS if they show symptoms of a cognitive delay. Children with autism or PDD-NOS, in contrast, may have a wide range of cognitive abilities.

While children with PDD-NOS are often thought of as showing less severe symptomatology than students with autism, the *DSM–IV–TR* (2000) criteria does not preclude the inclusion of children with cognitive delays or impairment. When IQ scores were not available, the investigator used placement in a mainstream setting without 1:1 support and the High-Functioning Autism Screening Questionnaire (Ehlers, Gillberg, & Wing, 1999) as alternative evidence that participants met the criteria to be considered high-functioning.

The third piece of inclusionary criterion originally used by the investigator called for students with ASD and no comorbid diagnoses. However, after it proved difficult to find participants that met this criterion, the principal investigator adjusted the inclusion criteria to allow students with co-morbid diagnoses to participate. This reflects the reality that many children with an ASD diagnosis carry with them additional, comorbid diagnoses. Studies suggest that 11-84% percent of students with autism also have anxiety problems (White, Oswald D, Ollendick, & Scahill, 2009) and although the *DSM–IV–TR* (2000) criteria precludes the co-diagnosis of autism and attention deficit hyperactivity disorder, estimates suggest that 30-80% of children with autism also carry a diagnosis of ADHD (Leyfer et al., 2006). Given the high rates of comorbid diagnoses among children with autism, expanding the sample to include students with comorbid diagnoses was critical to recruiting a representative sample of children with HF-ASD.

Finally, age was also used as an inclusionary criterion. When the study first began, students 8-11 years old, who were in third to fifth grade, were considered for inclusion in the study. However, in order to increase the sample size, the investigator eventually expanded the grade range in order to include additional participants who fell in the correct age range but were in second or sixth grade.

Participant Recruitment

The recruitment process took place across two phases. In the first phase, the investigator sent e-mails to school districts and autism service organizations across Massachusetts, New York, and Connecticut describing the study and requesting permission to recruit participants through the school/organizations. Once permission had been granted, the autism organizations communicated information about the study to their members and other interested parties via a recruitment ad delivered in an e-mail, a newsletter, or posted on their website. The two schools that agreed to participate in the recruitment process both sent a letter home to the parents of children they believed would meet the criteria for inclusion in the HF-ASD group. The letter described the purpose of the study, the measures that would be used, and the time required for participation. If an individual contacted the investigator after seeing an ad circulated by one of the autism organizations, they were sent a similar letter before ensuring consent for participation (Appendix A).

The second phase of recruitment began once approximately 3/4 of the students with ASD had been recruited and assessed. This phase of recruitment focused on typically developing 8-11 year old students; the principal investigator began this phase later in order to try and recruit a matched sample for age, gender, and comorbid diagnoses. In this phase of recruitment, the principal investigator sent e-mails to professional and personal contacts across New York, Connecticut, and Massachusetts describing the study and requesting help in distributing a recruitment letter to friends and family that might be interested in participating in the study. The recruitment letter was a slightly edited version of the one created for the HF-ASD sample. The investigator also contacted the families of participants in the HF-ASD sample for help recruiting participants for the control group and two siblings of children in the clinical group entered the study as participants in the control group. An effort was made to match the samples for age, gender, and comorbid diagnoses. While the samples were matched relatively well for age and gender, the clinical group had a higher percentage of students with one or more comorbid diagnoses. Demographic information for both groups can be found in Table 1.

Table 1.
Sample Demographics

	Clinical Group	Control Group
Age		
8	9	5
9	3	8
10	8	6
11	4	5
Gender		
Male	22	21
Female	2	3
Comorbid Diagnosis		
ADHD	11	2
Anxiety	2	2
Depression	2	0
Mood Disorder	2	0
Apraxia	1	0
Oppositional Defiant Disorder	1	0
Obsessive Compulsive Disorder	1	0
Sleep Disorder	1	0
Learning Disability	1	0

Research Measures

Selection Measure

The High-Functioning Autism Screening Questionnaire (HFASQ; Ehlers, Gillberg, & Wing, 1999), along with placement in a mainstream environment, was used as a selection measure for participants with autism or PDD-NOS who were unable to provide IQ scores. One-third of the participants in the clinical group fell into this category. The questionnaire has a parent and teacher version and is designed to identify students for further testing; it is not a diagnostic measure. There are twenty-seven items on the questionnaire and items address many of the overlapping features seen among children with high-functioning autism and Asperger's syndrome in domains including socialization, daily living skills, physical presentation, communication style, and academic performance. Respondents are asked to select whether the child appears different from their peers in the way described by each item. Response options include No = 0, Somewhat = 1, and Yes = 2, providing a total possible score of 54. The measure has strong psychometric properties. It has a test-rest reliability coefficient of .94 and the inter-rater reliability coefficient for children on the autism spectrum is .77. Furthermore, the measure has strong concurrent validity with scores reliably differentiating children with autism spectrum disorders from children with attention-deficit disorder and children with learning disabilities (Ehlers, Gillberg, & Wing, 1999).

A cut-off score of 22 was used as recommended by the authors to decrease the chances of making a Type One error (Ehlers et al., 1999). Many of the items on the HFASQ, such as "makes naïve and embarrassing remarks" and "uses language freely but fails to make adjustments to fit social contexts or the needs of different listeners" are designed to reflect the idiosyncratic communication and social characteristics of children on the high-functioning end of the autism range. Thus, combined with the criterion of participation in an inclusion setting, it is unlikely that participants with more severe impairments were mistakenly identified for inclusion in the HF-ASD group.

Dependent Variables

The Assessment of Children's Emotion Skills (ACES)

The Assessment of Children's Emotion Skills (ACES; Schultz & Izard, 1998) is composed of three distinct scales designed to measure children's emotion attribution accuracy and anger attribution tendencies. The first part of the measure is made up of twenty-six photographs of children making facial expressions designed to represent happy, angry, sad, or scared. Ten of the pictures are intentionally ambiguous showing a mixture of sad and angry to elicit children's anger attribution tendency. The second part of the ACES contains fifteen short narrative vignettes that describe different social situations designed to invoke the emotions happy, sad, angry, or scared. This section contains four items designed to clearly invoke each emotion and three additional ambiguous items designed to elicit children's emotion attribution tendencies. The third part of the ACES contains fifteen narrative vignettes that describe characters behaving in ways designed to reflect that they are feeling happy, sad, angry, or scared. This section also contains four items designed to clearly invoke each emotion and three additional ambiguous items designed to elicit children's emotion attribution tendencies. In each section, the items are presented in a random order.

The scale allows for the calculation of an emotion attribution accuracy score and an emotion attribution biases. Only the attribution accuracy score is relevant for the purpose of this study. The emotion attribution accuracy score is calculated by summing the number of non-ambiguous items answered correctly across all three sections. In this study, the scores were calculated in a slightly different way. To increase reliability, all items were scored for attribution accuracy. For items designed to be intentionally ambiguous, any emotion with the appropriate valence was considered correct. For example, for the item "Adrian's parents are having a fight in the bedroom. He can hear them yelling. Do you think Adrian feels happy, sad, mad, scared, or no feeling?" the responses mad, sad, and scared were all considered correct.

The psychometric properties for this measure have been shown to be adequate. The items that make up the emotion attribution accuracy score cohered moderately well with Cronbach's alpha = .68 (Schultz, Izard, & Bear, 2004). Correlations of the ACES with other emotion tasks range from .48 to.60 (Schultz & Izard, 2001 as cited in Faul, 2006).

<u>The Levels of Emotional Awareness Scale for Children</u>

The Levels of Emotional Awareness Scale for Children (LEAS-C; Bajgar & Lane, 2003) is a measure designed to look at emotional awareness among children. The scale is composed of twelve items all designed to invoke the emotions happy, sad, angry, or scared. For each item, a narrative is presented which places the reader and another character into an emotionally charged social situation. The participant is asked to infer how he/she would feel and how the other character would feel in each situation. An example of an item on LEAS-C is "The teams are being chosen and most of the players have been picked. There are two kids left over and you are one of them. But they only need one more player. How would you feel? How would the other kid feel (Bajgar & Lane, 2003)?"

Items on the LEAS-C are scored based on the complexity of response rather than on whether the response is correct. For each item, a score is given for the emotion the reader reports that they would feel and a score is given for the emotion they would attribute to the other character. These are called the Self Awareness and Other Awareness scores, respectively. The higher of the two scores is considered the Total Awareness score. In this study, only the Other Awareness scores were analyzed as they serve as a measure of emotional inferencing ability. Going forward, these scores will be referred to as Emotional Awareness scores for the purposes of this study.

Each response is scored on a 5-point scale, with 1 reflecting very little emotional awareness and 5 reflecting the highest level of emotional awareness. A Level 1 response might fail to identify any emotions or might refer to a somatic response. A Level 2 response might describe a behavior or action. Responses that describe a single emotion would be scored as Level 3 responses whereas responses that reflect more nuanced descriptions or mixtures of emotions would fall at the top two levels (Bajgar & Lane, 2004). For more detailed description of the scoring procedure see the Levels of Emotional Awareness Scale for Children (LEAS-C): Scoring Manual Supplement (Bajgar & Lane, 2004).

The LEAS-C is still in the development phase, so data are still being gathered on its psychometric properties. An early validity study on a sample of fifty students found some preliminary evidence for the construct validity of the LEAS-C. The Other Awareness score was found to correlate significantly with the Emotion Expressions (Izard, 1971) and

Emotion Comprehension (Cermele, Ackerman, & Izard, 1995) measures with coefficients of .30 and .25 respectively. There is also some evidence that performance on the LEAS-C correlates with some measures of social behavior and some assessments of depression and anger. There are currently no data available on the reliability of the measure (Bajgar & Lane, 2004).

Along with the standard LEAS-C scoring procedures, the responses for how the other person would likely feel were also assigned a second score for the purpose of this study referred to as an Emotional Accuracy score. While the Emotional Awareness score reflects the level of depth and sophistication of emotion understanding, this second score was designed to measure the accuracy of the inference. The principal investigator created a rubric for this purpose (Appendix B). The question "*Is this a reasonable inference to make about how the character would likely feel in the given situation without any additional information?"* was used as the main criteria. The five basic emotions of anger, sadness, joy, fear, and surprise formed the foundation of the rubric. For each item, the basic emotions that could be considered reasonable inferences to make about how the character might feel were categorized as correct responses; the others were categorized as incorrect. For scenarios where a negative emotion might be experienced, both sadness and anger were considered correct in order to control for anger attribution biases. For example, for the item: "Your dad tells you the family dog has been run over by a car. How would your dad feel?" the responses "scared, sad, mad, or surprised" were considered reasonable inferences and therefore correct. "My dad would feel happy*"* was considered an unreasonable inference and therefore categorized as incorrect. However, if additional information was provided to justify an incorrect inference (ie. "My dad hates our dog"), these responses were also considered correct.

Not all responses included one of the five basic emotions. After reading through some sample responses in the manual, the investigator added a series of decision rules to the rubric to address other responses such as "I don't know" or physical states such as "tired." Additionally, some of the narratives did not describe a situation that would evoke a strong emotional response so an inference of "no feeling" was added to the rubric as correct for these items. Since the LEAS-C is an open response measure, it was not feasible to design a rubric that included decision rules for every possible response. Thus, when scoring responses not explicitly covered by the rubric, the rubric specified that ratings should be made based on the central criteria identified above; "*Is this a reasonable inference to make about how the character would likely feel in the given situation without any additional information?*

In order to control for bias in coding, all participants were assigned a random number and then placed in numerical order according to the randomly assigned number. This ensured that the principal investigator would be unaware of the participants' condition when coding responses. The principal investigator also enlisted a second coder, who was completely blind to the conditions of the participants, to score all the data. While it is typical to enlist a second coder to calculate inter-rater reliability coefficients, most studies only examine reliability on a portion of the data. In a similar study that examined narratives produced by adults with autism and control subjects, for example, inter-rater reliability was calculated on only 25% of the samples (Colle, Baron-Cohen, Wheelwright, & van der Lely, 2008). However, given the smaller sample size, and the fact that the primary investigator had also conducted all of the data collection, there remained a risk that the primary investigator would remember some of the responses and associate them with a specific participant. Thus, the decision to be more conservative and calculate inter-rater reliability on all of the data was made to help control for this risk.

The investigator met with a second rater, a doctoral student in the School Psychology program at UMASS Amherst, for a one and a half hour training session on the rubric. During this time, the investigator and the second rater went over the scoring rules. The investigator made some changes to the rubric during this session to integrate the second rater's input around clarifying some of the decision rules in order to increase consistent coding. Both raters then used the revised rubric to practice on sample items provided by the LEAS-C manual until they reached 88% agreement as calculated using the following formula:

Agreements/ (Agreements +Disagreements) X 100

The raters then scored the data set separately. Inter-rater reliability on the final data set was calculated using Cohen's Kappa, which controls for chance, and found to be K =.918. The raters discussed the items they had scored differently and were able to come to consensus decisions for how they should be scored.

<u>The Peabody Picture Vocabulary Test-Fourth Edition</u>

Verbal ability has been shown to predict TOM abilities for children with autism in a number of different studies (Happe, 1995; Astington and Jenkins, 1999; Hale and Tager-Flusberg, 2003). In one study, referenced in Chapter 2, that compared children with MR and autism to typically developing children on two false belief tasks, Happe (1995) found that when children with autism do pass false belief tasks, it is not until they have a verbal mental age (VMA) of 5 years and 6 months, while typically developing children begin to pass the test at a VMA of 2 years and 10 months. She interpreted these findings to suggest that verbal ability has a more important role in TOM abilities for children on the spectrum than their peers (Happe, 1995). A number of studies have since replicated these findings (Astington & Jenkins, 1999; Hale & Tager-Flusberg, 2003). Further evidence supporting the unique relationship between verbal ability and performance on TOM tasks for children on the autism spectrum can be found in studies that fail to find a similar relationship for typically developing children with specific language impairments (Leslie & Frith, 1998) and studies that show no relationship between nonverbal ability and performance on false belief tasks for children on the autism spectrum (Charman & Baron-Cohen, 1992; Happe, 1993).

To control for verbal ability, participants were administered the Peabody Picture Vocabulary Test-Fourth Edition (PPVT-IV; Dunn & Dunn, 2007). The PPVT-IV measures oral receptive vocabulary and is designed to be used with individuals two and a half years old and older. Items on the PPVT-IV sample from a broad span of subject areas and parts of speech and cover a wide range of difficulty levels. For each item, participants are provided a set of four images and asked to identify the one named by the test administrator. The measure takes approximately fifteen minutes to administer.

The Peabody Picture Vocabulary Test-Fourth Edition is a norm-referenced measure and performance can be reported as a standard score or percentile rank. In this study, standard scores will be used. The PPVT-IV has strong psychometric properties. It has average split-half reliability coefficients of .94 and .95 for Form A and Form B, the average alternative form reliability coefficient is .89 and the test-retest reliability coefficient is .93 with a range of .92 to .96 (Dunn & D. Dunn, 2007). The PPVT-IV was correlated with the Expressive Vocabulary Test, Second Edition (EVT-2; Williams, 2007) and with the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001) to examine construct validity. The correlation for these measures is .82 and .63 respectively.

<u>The Edmonton Narrative Norms Instrument</u>

Participants were asked to create a story to accompany a series of pictures using The Edmonton Narrative Norms Instrument (ENNI; Schneider, Dubé, & Hayward, 2005). The ENNI was developed to measure story-telling skills among students four to nine years old.

During the administration of the ENNI, participants are given a series of pictures in a binder and asked to tell the administrator a story that matches the pictures. The participant is instructed to hold the binder so that the administrator is unable to see the pictures and is asked to tell the story well so the administrator can understand it. Each set of pictures was developed using the Story Grammar model of storytelling. The Story Grammar model includes a number of standard components that research suggests are often found in "good" stories (Stein & Policastro, 1984). These include a main character, a goal the main character has, and the action s/he takes over the course of the story to achieve this goal. Most stories end, according to the Story Grammar model, with a happy resolution (Schneider, Dubé, & Hayward, 2005).

When traditionally administered, the ENNI includes one training story where the administrator is able to provide prompts that model good story-telling processes and then a set of three stories that the participant is asked to tell with minimal prompting. For this study, however, participants were only administered the training story and one additional story. The second narrative was analyzed to calculate an emotional inference count. Participants were not provided additional prompting on the training story as the investigator was interested in measuring spontaneous descriptions of emotions without additional scaffolding. These samples may be analyzed to look at different aspects of story-telling and expressive communication in future studies.

The ENNI includes norms for a number of different analyses typically used in expressive language assessments. Narratives from the ENNI can be analyzed to calculate scores on a number of different aspects of story-telling such as story information, referring expressions, number of different words, Mean Length of Communication Unit, and Subordination Index. There is some evidence of concurrent validity as correlations between the grammar subtest scores for the ENNI and performance on The Clinical Evaluation of Language Fundamentals (CELF-preschool; Wiig, Secord, & Semel, 1992; CELF-III, Semel, Wiig, & Secord, 1995) range from .39 to .70 with the highest correlations found for Expressive Language. There are currently no reliability data on the ENNI.

To calculate an emotion frequency count, the primary investigator adapted the rubric used for the Emotional Accuracy coding on the LEAS-C to identify emotional inferences made on the ENNI (Appendix C). An inference was defined as any feeling that is attached to a character (i.e., “the dog was sad”). Physical descriptions such as “dizzy” or “tired” were not counted as emotions but more general references to emotions such as “he had mixed feelings” were. Descriptions of displays of emotion such as screaming or crying were not counted as emotional inferences. Each emotional inference made about a character was assigned a point. If an emotion was attributed to more than one character, or if the same emotion was attributed to a character more than once, each incident of emotion attribution was considered a separate inference.

The same method cited above was used to randomize the participant data and decrease the risk of bias in coding. It was again decided that a second rater, blind to diagnosis, should be enlisted to code all the data. The investigator met with another doctoral student in the School Psychology program at UMASS Amherst for a half hour training session on the rubric. During this time, the investigator and the second rater went over the scoring rules and the investigator answered questions brought up by the second rater. They then each scored the data set separately. The primary investigator calculated an inter-rater reliability of 94.1 % agreement using the formula:

Agreements/ (Agreements +Disagreements) X 100

The two raters discussed the items they had scored differently and were able to come to consensus decisions around how they should be scored.

Procedures

Assessment Procedures

The principal investigator contacted parents interested in participation via phone or email to ensure that their children met the inclusionary criteria. For students with a diagnosis of autism or PDD-NOS but without an IQ score, the HF-ASQ was administered to the parent either over the phone or sent via e-mail and completed before the testing session was scheduled. Other parents filled out the HF-ASQ during the session.

The primary investigator conducted all the sessions. Sessions took place in either the participants' home, a home-office in NY, an office in Boston, or at a speech and language lab at the University of Massachusetts Amherst. The sessions lasted between forty-five minutes and two hours. Before the sessions began, the investigator explained the study to each participant and obtained verbal assent for his/her participation. Participants were told that they could take breaks if needed and that they were free to terminate the session at any time. The investigator also asked students periodically if they needed a break or wanted to continue during the session. The large range in how long the sessions lasted reflects both the variability in how long it took participants to complete the measures and in how many breaks they asked to take. To control for differences in reading ability, all measures were administered verbally to the participants. In addition, research suggests that students with Asperger's syndrome struggle more with handwriting compared to their peers (Myles et al., 2003). To control for this impairment, student responses on the LEAS-C were recorded and transcribed later for analysis.

When the sessions were over, families were compensated for their time. Participants were given a ten-dollar gift certificate to Barnes and Noble and parents were told that they would receive the results of their child's performance once the data had been scored.

Data Analysis

Group means on the Facial Expressions, Behaviors, and Situations sections of the ACES and the LEAS-C Emotional Accuracy scores were compared to examine how well participants with HF-ASD performed on measures that assessed their ability to make accurate emotional inferences from different cues when compared to their peers.

It was hypothesized that participants with HF-ASD would perform significantly worse than their peers when asked to make accurate emotional inferences from situational cues, but not from other cues. Mean group emotion frequency counts on the ENNI were also compared to test the hypothesis that participants with HF-ASD make a significantly fewer number of spontaneous emotional inferences than their typically developing peers. Finally, mean Emotional Awareness scores were compared between groups to determine whether individuals with high-functioning autism spectrum disorders showed lower levels of emotional awareness than their typically developing peers.

The data were first graphed and examined using visual inspection to determine what analyses should be conducted to compare group means to answer the first three research questions. To examine whether verbal ability correlated with emotional attribution ability, and should therefore be controlled for as a covariate in the analysis, performance on each measure and verbal ability as measured by the PPVT-IV were graphed and the graphs were inspected for linearity. To determine whether the data fit the assumptions for a parametric test, the data from each of the six measures were then plotted on a histogram. The graphs were assessed for normality within each group; the investigator looked for skewness, kurtosis, and outliers in the data. The results of the visual inspection were used to determine whether to control for verbal ability and whether to use parametric or nonparametric tests when comparing group means.

Correlations were also conducted to examine the relationship between the Emotional Accuracy, Emotional Awareness scores, and ACES scores and scores on the HF-ASQ . The purpose of these analyses was to examine whether the ability to infer emotions related to overall levels of impairment for children with high-functioning autism spectrum disorders. Finally, the data were analyzed qualitatively in an effort to capture group differences that might not have surfaced in the quantitative analyses.

CHAPTER 4

RESULTS

Quantitative Analysis

In contrast to previous research (Happe, 1995; Astington & Jenkins, 1999; Hale & Tager-Flusberg, 2003), when emotional attribution measures were graphed against PPVT-IV scores to determine whether verbal ability correlated with performance on these measures, a nonlinear relationship and/or extreme outliers were revealed in all cases. This was true when the data was graphed from both groups and from the clinical group alone. As a result, PPVT-IV scores were not used as a covariate when comparing group means for the first three research questions. Descriptive statistics for performance on the PPVT-IV by group can be found in Table 2.

In determining whether to use a parametric or nonparametric test to analyze group means, visual inspection revealed that at least one group showed a non-normal distribution for all six measures. It was therefore determined that a Mann-Whitney U test, a nonparametric statistical hypothesis test, would be the appropriate statistical tool to examine group differences across measures. All were compared to a .05 level of significance.

Table 2.
Descriptive Statistics for the Peabody Picture Vocabulary Test (PPVT-IV)

	Clinical Group	Control Group
Peabody Picture Vocabulary Test (PPVT-IV)	103.33 (18.17)	117.38 (12.43)

Question One

1. Do individuals with high-functioning autism spectrum disorders have more difficulty making accurate inferences about other people's emotions than their typically developing peers?

In order to determine whether participants with HF-ASD performed significantly worse than their typically developing peers when asked to make emotional inferences from different cues, a one-tailed Mann-Whitney U test was conducted on each of the three sections of the ACES and the LEAS-C Emotional Accuracy scores. It was hypothesized that participants in the clinical group would show impairments on measures that asked them to make emotional inferences from situational cues, but not from other cues. In comparing group means on the three sections of the ACES, the Holm procedure would have been used to split the alpha level and decrease the risk of making a Type 1 error due to shared variance across the sections. However, as none of the p-values fell below .05, this proved to be unnecessary. The Mann-Whitney U test found no significant difference between the clinical and control groups on the Facial Expressions section, $Z = -1.048$, $p = .147$. The common language effect size was calculated for this comparison. This provides the proportion of scores in one group that were greater than the scores in the other group. For the Facial Expressions section, $\hat{P}$(clinical<control)=.42. No significant difference between the clinical and control groups was found on the Behaviors section, $Z = -1.254$, $p = .105$. For the Behaviors Section, $\hat{P}$(clinical<control)=.604. Finally, the Mann-Whitney U test found no significant difference between the clinical and control groups on the Situations section, $Z = -.316$, $p = .376$. For the Situations section, $\hat{P}$(clinical<control)=.52. The difference in mean Emotional Accuracy scores

also failed to reach statistical significance, $Z = -1.119$, $p = .132$, indicating that the clinical group performed no worse than the control group when asked to make emotional inferences from situational cues in an open-response format. The common language effect size was also calculated for this comparison, $\hat{P}$(clinical<control)=.59. The null hypothesis was therefore accepted: subjects with ASD performed as well as their typically developing peers when asked to make accurate emotional inferences from different cues. Descriptive statistics for group performance on all emotion attribution measures can be found in Table 3.

Table 3.
Mean Performance by Group on each Emotion Attribution Measure (with Standard Deviations in Parentheses)[3]

	Clinical Group	Control Group
Assessment of Children's Emotion Skills		
Facial Expressions	23.33 (2.10)	22.71 (2.27)
Behaviors	10.21 (2.34)	11.17 (1.76)
Situations	12.50 (2.13)	12.92 (1.41)
The Levels of Emotional Awareness Scale for Children		
Emotional Awareness	29.71 (8.05)	33.00 (4.13)
Emotional Accuracy	9.00 (2.10)	10.13 (1.51)
Edmonton Narrative Norms Instrument		
Emotion Frequency Count	3.21 (2.43)	2.63 (1.91)

Question Two

Do individuals with high-functioning autism spectrum disorders make fewer spontaneous emotional inferences about others than their typically developing peers?

To answer the second research question and examine whether participants with high-functioning autism spectrum disorders made fewer spontaneous emotional inference

[3] *Note:* Total possible scores for each measure are as follows: ACES Facial Expressions= 26, Situations = 15, and Behaviors = 15; LEAS-C Total Awareness = 60 Emotion Attribution Accuracy = 12

about the characters in their narratives, a one-tailed Mann-Whitney U test was conducted to compare mean ENNI emotion frequency counts between groups. The difference between groups was not statistically significant, $Z = -.641$, $p = .261$. The common language effect size was also calculated for this comparison, $\hat{P}$ (clinical<control)=.44. The null hypothesis was therefore accepted: participants with HF-ASD made the same number of spontaneous emotional inferences about the characters in their narratives as their typically developing peers.

Question Three

3. Do participants with high-functioning autism spectrum disorders show lower levels of emotional awareness than their typically developing peers?

To answer the third research question and examine whether participants with high-functioning autism spectrum disorders showed lower levels of emotional awareness than their typically developing peers, a one-tailed Mann-Whitney U test was conducted to compare the Emotional Awareness scores on the LEAS-C for each group. It was hypothesized that subjects with HF-ASD would perform worse on this measure than their typically developing peers. The Mann-Whitney U test failed to find a statistically significant difference between groups on this measure, $Z = -1.458$, $p = .073$. The common language effect size was also calculated for this comparison, $\hat{P}$ (clinical<control)=.67. The null hypothesis was therefore accepted: participants with HF-ASD showed the same level of emotional awareness when compared to their typically developing peers.

When reviewing the results of the first three research questions it is important to note that, while the group with HF-ASD did not perform significantly worse than their peers in any of the comparisons, their performance was more variable on all measures except Facial Expressions (see standard deviations in Table 3). The groups showed the greatest difference in variance on their LEAS-C Emotional Awareness scores. The ratio of the variances was 64.80/17.06, indicating that the variability in the clinical group was almost four times as great as the variability in the control group. Levene's test for equality of variances was conducted to determine whether the difference in the variances between groups was statistically significant. The difference in variances approached significance, $F = 3.651$, $p = .062$.

To determine whether the inclusion of participants with PDD-NOS into the HF-ASDs added greater variability to the clinical sample, and therefore made it more difficult to see group differences between the samples, mean scores on all measures were also recalculated for the clinical sample using only the participants with Asperger's syndrome and autism. The means were not significantly different from those calculated using all participants, indicating that the lack of difference in group performances across measures can not be attributed to the inclusion of participants with PDD-NOS in the clinical sample.

Question Four

To answer the fourth research question and determine whether these measures discriminated within the subpopulation of participants with high-functioning autism spectrum disorders, a number of correlations were run comparing performance on emotion attribution tasks and level of impairment as measured by the HFASQ. Emotional Awareness scores and Emotional Accuracy scores for the LEAS-C and scores on each of the three sections of the ACES were correlated with scores on the HFASQ. A summary of the correlation statistics can be found in Table 4. All the correlations were small, ranging from .068 to .221 and only the Facial Expressions and Situations scales were negatively correlated with scores on the HFASQ.

Table 4.
Correlations Between Performance on the Emotion Attribution Measures and Scores on the High Functioning Autism Spectrum Questionnaire (HFASQ)

	HFSAQ
Assessment of Children's Emotion Skills	
Facial Expressions	-.221
Behaviors	.216
Situations	-.122
The Levels of Emotional Awareness Scale for Children	
Emotional Awareness	.107
Emotional Accuracy	.068

Finally, in addition to answering the research questions, a number of correlations were run to examine the validity of the ACES and LEAS-C as measures of emotion attribution abilities because they are relatively new measures with limited information available about their psychometric properties. Scores on each of the three sections of the ACES were correlated with the Emotional Awareness and Emotional Accuracy scores on the LEAS-C. Furthermore, the Emotional Accuracy scores were correlated with Emotional Awareness scores on the LEAS-C. Scores on all three sections of the ACES and both the Emotional Awareness and Emotional Accuracy scores on the LEAS-C were correlated with performance on the PPVT-IV. Correlation results are summarized in Table 5. As would be expected, there was a large correlation between the LEAS C-Emotional Accuracy and Awareness scores. There were also medium correlations between performance on the PPVT-IV and the ACES Behaviors and Situations sections. All other correlations were very small.

Table 5.
Correlations Between Performance on the Emotion Attribution Measures and Scores on the Peabody Picture Vocabulary Test (PPVT-IV)

	PPVT-IV	Awareness	Accuracy
LEAS-C Emotional Awareness	.126		
LEAS C- Emotional Accuracy	.169	.764	
ACES Facial Expressions	-.101	.022	.167
ACES Behaviors	.333	.073	.144
ACES Situations	.418	.085	.200

Qualitative Analysis

The ACES, LEAS-C, and ENNI were all analyzed qualitatively to look for group differences not captured in the statistical analysis. Responses were examined at an item level to determine whether it was possible to observe differences in emotional inferencing abilities that were not captured by comparing group means.

The Assessment of Children's Emotion Skills

When analyzing the ACES, the investigator first identified the items on which the groups showed the greatest difference in scores (where at least four more participants in one group answered correctly than in the other group) to determine whether there were any patterns in the responses. On all three sections of the measure, the items where there were the largest differences between the clinical and control group performance fell across the range of four emotions. The groups also did not appear to significantly differ in the rate with which they endorsed "No Feeling" on the Behaviors and Situation sections of the measures. Thus, as with the statistical analysis, the qualitative analysis suggests that this measure did not capture group differences in emotion attribution abilities when comparing children with HF-ASD and their typically developing peers. Rather, children with HF-ASD appeared as easily able to correctly identify which basic emotion a character would feel in situations designed to elicit all four of the basic emotions as their typically developing peers.

The Levels of Emotional Awareness Scale for Children

Although the difference was not statistically significant, the mean Emotional Awareness scores on the LEAS-C were higher for the control group than for the clinical sample. When looking at the awareness scores, the biggest group differences were found in Level 0, 1, and 4 responses. Participants in the control group gave fewer Level 0 and Level 1 responses (10 vs. 22 and 25 vs. 39, respectively) and more Level 4 responses (35 vs. 15) than participants with HF-ASD (see Table 6). The two groups provided Level 2 and Level 3 responses at approximately the same rate.

Table 6.
Number of responses on the LEAS-C at each level by group.

	Clinical Group	Control Group
Levels		
Zero	22	10
One	39	25
Two	20	27
Three	192	191
Four	15	35

To better understand potential group differences it is helpful to look at the group performance at each of these levels separately. According to the LEAS-C manual, an inference is considered a Level 0 response if the participant refers to a thought or mental state rather than a feeling or gives no response (Lane, Quinlan, Schwartz, & Walker, 1990). For this study, nonsensical responses were also scored as Level 0. There were no cases of a lack of response and when the data were further examined, eight out of the twenty-two Level 0 responses in the clinical group were given by the same participant. Thus, when controlling for his data, both groups appeared to have provided thought/mental state and nonsensical responses at about the same rate.

The manual describes a Level 1 response as one in which the participant communicates that either 1) the other person would feel nothing in the situation, 2) they don't know how the other person would feel, or 3) they provide descriptions of physical sensations such as *pain* or *tingling.* Emotional Accuracy scores were used to interpret the significance of the higher rate of Level 1 Emotional Awareness scores among the clinical group. Both the Emotional Accuracy rubric (developed for this study) and Emotional Awareness rubric (Bajgar & Lane, 2005) score a response of IDK or of physical sensation as a zero. However in the Emotional Accuracy rubric, unlike the Emotional Awareness rubric, responses of "no feeling" are scored in a context-dependent way. If the narrative describes a situation that would be emotionally charged for both people, this response is scored as incorrect. Otherwise it is considered correct. If participants in the clinical group inappropriately endorsed "no feeling" at a significantly higher rate than participants in the control group, their Emotional Accuracy scores would have been significantly lower than their peers. The same would be true if they had endorsed "I don't know" or "physical sensations" at higher rates. Thus, as there were no significant differences between groups on their Emotional Accuracy scores, it is likely that the higher rate of Level 1 responses among the clinical group reflects the inclusion of a greater number of appropriate endorsements of "no feeling" by this group and therefore should be interpreted with caution.

The biggest group difference was seen on Level 4 responses. According to the

LEAS-C manual, to qualify as a Level 4 response, the subject must 1) communicate that the other person would feel more than one qualitatively different or opposing emotions or 2) give more than one reason to explain how the other person would feel in the situation described. The lower rate of Level 4 responses among the clinical group (15 vs. 35 for the control group) suggests that the inferences made by participants with HF-ASD were more simplistic and less differentiated than the inferences made by their typically developing peers. They tended to endorse only one emotion or one reason to explain how the person would feel, while the participants in the control group were more likely to endorse more than one feeling or reason. For example, one item describes the following situation: *You are running in an important race with a friend you have trained with for some time. As you get close to the finish line you twist your ankle, fall to the ground and can't continue. Your friend goes on to win the race*. *How would your friend feel?* Many participants in the HF-ASD group responded with the accurate conclusion that the friend would feel happy. A more complex answer given by a typically developing participant was "little sad that he just left me there but proud … because he finished the race."

<u>The Edmonton Narrative Norms Instrument</u>

Finally, the ENNI was examined using qualitative analysis to look at differences in the narratives not captured by the emotion count. The analysis focused on determining how well the participants understood the characters, their relationships to one another, and the events being depicted in the images. The ability to "read" different social situations is critical to the ability to make accurate emotional inferences about how other people likely feel in different situations.

Towards the end of the story a character is introduced that the majority of participants in both groups inferred was the rabbit's mother. While some participants in both groups failed to draw this conclusion, slightly more participants in the control group failed to make this inference (10) than in the clinical group (7). This is surprising in light of the prevailing theory that posits that children on the autism spectrum have more difficulty using context cues to get the "big picture" when compared to their peers (Winner, 2011). Also contradicting this theory, participants in the clinical sample were as likely to identify the relationship between the main characters as one of friendship as their typically developing peers and as likely to provide a coherent storyline as their peers. Here, a coherent storyline is defined as a narrative that closely matches the images shown and that is organized around a beginning, middle, and end. Finally, the narratives were also examined for perspective of the storyteller. One control group participant used first person; all other participants used third person to tell the story. Overall, as captured by the emotion count, the group narratives did not appear to differ in significant ways when analyzed for an understanding of the characters and their relationships to one another.

CHAPTER 5

DISCUSSION

The ability to make inferences about the emotions of others is central to successful social interactions. It is critical to our ability to predict how our behaviors will affect others and to respond appropriately to their emotional experience. Weak or underdeveloped social skills seen among individuals with autism have often been attributed to a general TOM impairment that assumes deficits in their ability to make inferences about both the beliefs and emotions of others. However, while there is strong evidence that individuals with autism have an impaired ability to engage in mentalizing tasks, previous studies have led to mixed findings regarding the degree to which they experience difficulty when asked to make emotional inferences. This study was designed to explore this topic further. The goal was to examine whether individuals with ASD perform worse than their typically developing peers when asked to make accurate emotional inferences about others using different cues. It was hypothesized that participants in the clinical group would show impairments on measures that asked them to make accurate emotional inferences from situational cues, but not from other cues. The study was also designed to test the hypotheses that children with HF-ASD make fewer spontaneous emotional inferences about others and that they have lower levels of emotional awareness when compared to their typically developing peers. Finally, performance on emotional inferencing measures was examined to determine whether they were able to reliably discriminate between participants with different levels of autism-related symptomatology.

ACES Facial Expressions and Behaviors Scale Results

In keeping with hypothesized findings, participants with autism performed as well as their typically developing peers when asked to make inferences about the emotions of characters based on their facial expressions and behaviors on the ACES. Previous research regarding how well participants with ASD are able to infer emotional states from facial expressions has been mixed and the results of this study replicate numerous studies that have also found no differences between participants with autism and their peers (Baron-Cohen, Jolliffe, Martimore, & Robertson, 1997; Castelli, 2005; Ozonoff, Pennington, & Rogers, 1990), while contradicting other studies that have found group differences (Bolte & Poustka, 2003; Hobson, 1986a, 1986b). Unfortunately, it is not possible to compare the results of performance on the behaviors scale to previous research. There are a limited number of studies that have looked at how well individuals with autism are able to make emotional inferences based on the behavior of others and none that have used descriptions of behaviors in this way.

Mentalizing abilities are not needed to make an inference from an outward manifestation of emotion such as a facial expressions or behavior. Instead, children likely learn that certain visual cues such as a down-turned mouth or crossed arms signify that a person is angry. There is vast evidence suggesting that children with autism are highly responsive to visual cues. Classical autism is characterized by delayed or impaired language abilities (*DSM–IV–TR,* 2000) and visual cues appear to help individuals on the autism spectrum compensate for weaknesses processing language. In their single subject study on transition behavior, for example, Dettmer, Simpson, Myles, and Ganz (2000) examined how the introduction of visual prompts affected transition behavior among children with autism. They found that the visual supports increased the efficiency of the transition for both of the participants observed in the study. Similarly, Bryan and Gast (2000) found that the introduction of visual schedules increased on task-behavior among participants with ASD and West (2008) found that participants with ASD responded more successfully to pictorial cues than verbal ones when instructors sought to fade direct instructor-initiated prompts to build independence. Visual prompts have also been used to help participants with ASD engage in more successful social interactions. The two most common visual cues used to support social interactions are social stories and social scripts. Social stories describe and often illustrate the rules and norms associated with different situations (Gray & Garand, 1993). They are designed to make explicit the practices that most people assume are common knowledge (e.g. we ask for the ball if we want a turn). There is some empirical support for the use of social stories (Karkhaneh et al., 2011). Social scripts provide children with autism with language they can use to initiate conversations and respond to others in different social situations (Cohen & Sloan, 2007). Social scripts are often also illustrated or written in the form of a comic strip with visual cues for conversational turn-taking (Meadan, Ostrosky, Triplett, Michna, & Fettig, 2011). Preliminary findings in this area have shown that social scripts lead to an increase in spontaneous social speech and greater generalization for some participants with ASD (Hutchins & Prelock, 2006). Our findings that children with autism are able to make emotional inferences from visual cues such as facial expressions and body language is consistent with this previous evidence that children with autism successfully respond to visual cues across situations.

<u>ACES Situations Scale and LEAS-C Emotional Accuracy Score Results</u>

In contrast to hypothesized findings, participants with HF-ASD performed as well as control participants when they were asked to make accurate emotional inferences from situational cues on the Situations scale of the ACES and on the LEAS-C. The hypothesis that they would have more difficulty than their peers on these tasks was based on the assumption that, without visual cues to rely on, they would have to first take on the perspective of the other character to make an inference about how they would feel. There have been limited studies that have looked at how well individuals with autism are able to make emotional inferences from situational cues alone and those that have been conducted have found mixed results (Baron-Cohen, 1991; Serra et al., 2002).

There are a number of ways to explain and interpret these results. It could be argued that the items used to measure how well the participants were able to make emotional inferences from situational cues were too easy to capture differences between the two groups. Most items on both the scales described situations that would unambiguously inspire a given emotion. Items on the ACES designed to target the emotion happy for example include: *Kelly just finished coloring a picture. "You tell her that it looks nice. Do you think Kelly feels happy, sad, mad, scared, or no feeling?"* and "*Alex made a nice card for his friend Josh. Josh likes the card a lot. Do you think Alex feels happy, sad, mad, scared, or no feeling?* All items on the ACES had multiple-choice options, providing additional scaffolding on the task, and for some items designed to elicit a negative emotion, sad, mad, and scared were allconsidered correct. This degree of scaffolding led to high average scores of approximately 12.50 and 12.92 out of 15 for both the clinical and control groups, respectively. Most items on the LEAS-C were similarly clear, and for items that were more ambiguous, such as "*You and your friend decide to save your pocket money and buy something special together. A few days later your friend tells you that he has changed his mind and has spent his money. How would* *your friend feel?"* a wide-range of emotions were accepted as correct. The standard used to identify a correct response on the LEAS-C was that it met the threshold of being "reasonable" given the target situation; this led to a very generous scoring procedure. Again both groups performed well. The mean scores were 9.00 and 10.13 out of 12, for the clinical and control groups, respectively. It therefore may be that these items, and the way in which they were scored, created a baseline affect that made it difficult to measure true differences in how well individuals with autism are able to make inferences based on situational cues alone.

It is also possible that these findings are an accurate reflection of how well individuals with autism are able to make emotional inferences from situational cues when the task is broken down and isolated in this way. Perhaps, just as individuals with ASD are able to learn the visual cues associated with certain feelings, they may be able to learn the situational elements that inspire different emotions in others. As conceptualized in Crick and Dodge's SIP model, these results might reflect a well-developed "database" with social schemata and stored social knowledge that they can use to predict how others feel in different social situations. Findings from a study by Begeer, Terwogt, Rieffe, Stegge, & Koot (2007) support this hypothesis. The authors examined the degree of understanding participants with autism, PDD-NOS, and typically developing participants had regarding emotional experiences. They presented each child with a series of stories that described a character having an experience that would trigger a positive or negative emotion. The character then transitioned to a new location where he or she had an experience that would trigger a different emotion. The authors looked at the degree to which participants integrated the emotions experienced in the first situation into their predictions of how the characters would react to the second situation. They found that all participants were able to accurately identify the valence of the emotional experience and recognize that the emotional response to the first situation would have an influence on the character's reaction to the second situation. These findings are consistent with the results of our study and together they suggest that individuals with ASD have an understanding of how different situational variables inspire certain emotional reactions in others.

Edmonton Narrative Norms Instrument Results

Given their documented difficulty with social-emotional awareness in naturalistic environments, it was hypothesized that individuals on the autism spectrum would be less likely to focus on emotional information than their peers when not explicitly asked to attend to emotional cues. It was therefore hypothesized that they would make fewer spontaneous emotional inferences on the ENNI than their peers. In contrast to hypothesized findings, however, the clinical and control groups made the same number of emotional inferences in their narratives.

While previous research has shown that individuals with ASD tend to perform worse than their peers when asked to create narratives across different task demands (Happe, 1991; Manolitsi & Botting, 2011; Smith-Myles et al., 2003), studies that have specifically looked at whether participants with ASD make as many references about the emotional and mental states of the characters in their narratives as their peers, have had mixed results. Unfortunately, most of the studies that have been conducted in this area have looked at mental states alone and therefore are not directly relevant to this study. However, a limited number of studies have examined the frequency with which participants with ASD make inferences about both the mental and emotional states of characters in their narratives compared to their typically developing peers. Zaretsky et al.

(2010), for example, found that children with ASD used less emotion and thought-related language than typically developing children asked to create a narrative to accompany the wordless storybook *"Frog Where Are You?"* (Mayer, 1969). In contrast, in their a study on narrative discourse Colle, Baron-Cohen, Wheelwright, & van der Lely (2008) found that adults with Asperger's Syndrome and High-Functioning Autism made as many references to mental and emotional states as participants in the control group. While the findings from this study are therefore consistent with these latter results, there is clearly a need for additional research in this area.

As the ENNI narratives were created based upon a series of images, the finding that participants with HF-ASD made the same number of spontaneous emotional inferences on the ENNI as their typically developing peers also appears to support the results from the first research question. In both cases, participants in the clinical group performed as well as their typically developing peers when they made emotional inferences from visual cues.

LEAS-C Awareness Score Results

It was hypothesized that the difficulties individuals with autism have engaging in social interactions may result from a more superficial and less sophisticated emotional understanding than their typically developing peers. Therefore, it was hypothesized that participants with HF-ASD would have significantly lower LEAS-C Emotional Awareness scores. This hypothesis was supported by findings from some previous studies. In the same Begeer et al. (2007) study cited above, typically developing participants demonstrated an understanding that, when moving from a situation that inspired one emotional reaction to a situation that inspired a different reaction, negative initial emotions would have a greater influence on the character's later reaction than positive ones. Participants with PDD-NOS and autism, however, did not demonstrate this understanding. Negative emotions have greater saliency than positive ones and the authors suggest that control participants incorporated this knowledge from their own previous experiences into their predictions. (Harris, Olthof, Meerum Terwogt, & Hardman, 1987; Olthof, Meerum Terwogt, Van Eck, & Koops, 1987). The finding that the participants with autism did not do this, the authors argue, suggests that they may have a more rote understanding of emotions than their peers. While they demonstrated the knowledge that situational variables can inspire specific emotions in others, and that previous affective experiences influence later reactions, their level of emotional understanding appears to have been less sophisticated and less personalized than their peers.

In another study, Schwenck et al. (2012) looked at cognitive and emotional empathy abilities among participants with ASD, Conduct Disorder, and a control group. To measure perspective-taking abilities and empathic response, they showed the participants a series of emotionally loaded film clips and asked them to identify both how the target character felt and why. Their responses were scored on a scale of 0 to 2. They found that, while the participants with autism performed as well as their peers when asked to identify how the character felt, they did worse when asked to explain why.

Contrary to hypothesized findings, the difference in mean Emotional Awareness scores on the LEAS-C was not statistically significant. However, there is some evidence from the current study that participants with HF-ASD did demonstrate a lower level of emotional awareness than their peers. First, its important to note that the difference in mean performance did approach significance, $p = .073$, even though it did not meet the threshold of .05. It is also important to account for the high degree of variance in the clinical group (*mean = 29.71, SD = 8.05*), which was almost four times greater than the variance in the control group. When calculated using Levene's test for equality of variances, the difference in variance approached significance, $p = .062$.

Additional examination at the item level revealed that participants with ASD gave fewer Level 4 responses than participants in the control group. Level 4 was the most sophisticated level of response reached by any participant in this study and reflects an understanding that a character can feel more than one qualitatively different or opposing emotions or that there might be more than one reason for how a character feels. Participants in the control group provided more than twice as many Level 4 responses than participants in the clinical group (35 compared to 15). While these findings were not statistically significant, they do support the hypothesis that individuals with HF-ASD may lack the depth and complexity in their emotional understanding when compared to same age peers.

Results of the Correlations Between the HFASQ and the Emotional Inferencing Measures

The last research question was designed to test the hypothesis that performance on tasks requiring participants to make situation-based emotional inferences would be correlated with severity of autism symptoms for subject with HF-ASD. Scores on the High-Functioning Autism Screening Questionnaire were correlated with scores on the ACES and the LEAS-C to test whether higher HFASQ scores were predictive of lower scores on these measures. All of the correlations were weak; the highest correlation was -.221 between the HFASQ and the Facial Expressions scale on the ACES. In addition, in a completely counterintuitive result, the Behaviors scale on the ACES and both of the LEAS-C scores were positively correlated with the HFASQ, suggesting that the more autism-related symptoms the participants displayed, the better they did on these measures. This result can be interpreted a number of different ways. First, it is possible that HFASQ scores are not actually accurate representations of a participant's level of autism symptomatology. The HFASQ has only been validated for use as a screener measure; a cut-off score of 22 indicates that the child shows levels of autism-related characteristics high enough to warrant further evaluation. As a screener, the measure was not designed to distinguish between children with varying levels of symptomatology within the high-functioning ASD population and it is possible that the difference between scores is not very meaningful once the cut-off score has been reached. If HFASQ scores do not, in fact, accurately distinguish between individuals with different degrees of HF-ASD-related symptomatology, the correlations are rendered meaningless. Finally, however, it is also possible that the HFASQ scores do distinguish between children with varying levels of autism-related symptomatology and that the ability to make emotional inferences from specific cues, as measured in this study, is not correlated with level of autism symptomatology.

Results of the Correlation Between Verbal Ability and Emotional Inferencing Measures

There is substantial evidence from previous studies that show that verbal ability is uniquely predictive of the ability to pass false-belief tasks for children with autism. Therefore, it was hypothesized that it may also be related to the ability to make emotional inferences, especially when these inferences are made from situational cues. However, a visual examination of the graphs correlating PPVT-IV scores with scores on the other measures for both the combined sample and for the clinical group alone showed a nonlinear relationship or the presence of outliers in all cases. As a result, the PPVT-IV was not used as a covariate. This result suggests that verbal ability may not be as related to the ability to make emotional inferences from situational cues as hypothesized.

Results from fMRI studies suggest that different neural pathways are involved in the process of making inferences about the thoughts and intentions of others when compared to the process of having an empathic response to their affective state (Carr et al., 2003; Gallagher & Frith, 2003; Singer et al., 2004a). This suggests that even when visual cues are not used, different processes may underlie the ability to make inferences about the thoughts or beliefs of others and their emotions. As a result, while verbal ability has been shown to be extremely predictive of the ability to make inferences about the beliefs of others, it may be less important to the process of making inferences about their feelings.

Implications

The findings that individuals with autism were as able as their typically developing peers to make emotional inferences from a variety of different cues in this study challenges the assumption that there is a more general "impaired Theory of Mind" explanation for the social difficulties associated with this population. The results of the study indicate that children with autism do not show the same level of deficits across the different areas that are encapsulated under the term TOM. Instead, while previous studies show that participants with autism consistently demonstrate difficulty making inferences about the intentions and beliefs of others (Baron-Cohen, 1989a; Baron-Cohen, Leslie & Frith, 1985; Baron-Cohen, Leslie & Frith, 1986; Leekam & Perner, 1991; Perner, Frith, Leslie & Leekam, 1989; Reed & Peterson, 1990), when asked to make inferences about their emotions in this study, they performed as well as their typically developing peers.

This distinction is important as many social skills curricula aimed at the ASD population target the ability to make emotional inferences based on the assumption of more generalized TOM impairments. If children with HF-ASD are as successful at inferring emotions on isolated tasks as their peers, it may be a misuse of their time and of resources to concentrate efforts on programs that target this skill set.

Instead, programs designed to increase social-emotional abilities in this population should take into account research that suggests that children with ASD may have a less sophisticated understanding of emotional experiences than their peers. There are also a number of studies that suggest that success on isolated tasks do not generalize to natural setting and individuals with ASD often exhibit difficulty attending to, processing, and responding to emotional cues within real-word social situations (Garcia-Perez, Lee, and Hobson, 2007; Golan et al. 2008; Kikuchi et al., 2009; Riby and Hancock, 2008). Thus, programs designed to help teach social-emotional skills to children with ASD might be more effective if they targeted these more specific areas of impairment rather than assuming general deficits in the area of emotional inferencing abilities.

Finally, while these findings do replicate some previous research, this study had a number of limitations, which makes it important to interpret the results with caution. In order to better understand the deficits underlying the pervasive social impairments characteristic of this population, therefore, it is important to continue to do research that examines both mentalizing abilities and the ability to make emotional inferences among children with ASD; studies should continue to examine functioning in these areas separately and how they interact with one another to create the social impairments seen among children with autism in real world situations.

Limitations

One significant limitation to this study may have been the small sample size. A sample size of forty-eight was selected based on the assumption that there would be a moderate to large effect on tasks where the participants were asked to make emotional inferences based on situational cues. However, there may have been a small effect that was not detected. While both the mean LEAS-C Emotional Accuracy score and the mean ACES Situations score were higher for the control group than for the clinical group, the difference was very small (see Table 3). Thus, there is a possibility that there may be small but significant differences in how well children with autism are able to perform on these tasks when compared to their peers but the sample size was not large enough to detect it.

Another limitation may lie in the heterogeneity of the sample. Children with diagnoses of Autism, PDD-NOS, and AS were all eligible for inclusion in this study. The diagnostic criteria for Pervasive Developmental Disorder, Not Otherwise Specified as defined in the DSM-IV is composed of only one paragraph stating that:

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific pervasive developmental disorder, schizophrenia, schizotypal personality disorder, or avoidant personality disorder... (American Psychiatric

Association, Diagnostic and statistical manual of mental disorders (2000) 4th ed., text rev.).

Hassan and Perry (2011) looked at the range of characteristics among a sample of participants diagnosed with PDD-NOS and found that the group was very heterogeneous. In their study Walker et al. (2004) also looked at characteristics associated with diagnosis and found that children with PDD-NOS could actually be categorized into three distinct groups based on the profile of their symptoms. The inclusion of children with PDD-NOS, therefore, may have diversified our clinical group, making it more difficult to see differences between the HF-ASD and control groups than if we had looked only at participants with autism and Asperger's Syndrome. As reported in the results section, some of the means were recalculated without the participants with PDD-NOS to see if they differed from the intact clinical group means to test this hypothesis. While the means remained similar after removing the data for participants with PDD-NOS, this should not be over-interpreted as the sample size had been considerably reduced.

The samples also differed in terms of comorbid diagnoses. The clinical group had more participants with ADHD and a number of other externalizing and internalizing disorders than the control group (see Table 1). This likely contributed to the greater heterogeneity of the clinical sample, making it more difficult to see group difference than if they had differed on presence of an autism diagnosis alone. Furthermore, due to this heterogeneity, the group differences that did emerge in this study regarding the number of Level 4 responses on the LEAS-C cannot be reliably attributed to the presence or absence of an HF-ASD diagnosis alone.

A third limitation lies in the fact that subjects were matched for chronological rather than verbal mental age. Previous research has found that verbal ability is a more powerful predictor of Theory of Mind abilities than chronological age for individuals with ASD (Happe, 1995; Astington and Jenkins, 1999; Hale and Tager-Flusberg, 2003). Although the PPVT-IV was used to control for verbal ability, another tool would have better served this purpose as the PPVT-IV only measures receptive verbal ability. A more comprehensive tool such as the Clinical Evaluation of Language Fundamentals (CELF-4; Semel, Wiig, & Secord, 2003) would have provided a more accurate means of quantifying verbal ability. This score should have then been used to match subjects on verbal ability.

A fourth limitation lies in the failure of this study to control for socioeconomic status across groups. Research suggests that exposure to the variables associated with growing up in poverty can be a risk factor for poor social-emotional development. In this study the term risk factor is being used according to Masten and Powell's (2003) definition: conditions or experiences for which there is "good evidence that [they] predict high rates of negative or undesirable outcomes (pp. 7)." In one study, household income was found to correlate with cooperative play skills; children who grew up in lower income households showed less developed play skills than their peers (Thomas, 2006). In another study, children who were living in more disadvantaged neighborhoods were found to display higher levels of aggression than their peers (Atkar & Tolan, 1994). Finally, Bolger, Patterson, Thompson, and Kupersmidt (1995) found that children who came from low-income households were more likely to experience difficulty having pro-social peer relations and were more likely to display behavioral problems than their peers.

Given these findings, failing to control for socioeconomic status is an important limitation in this study and threatens the generalizability of the results.

Inclusion in previous interventions was also not controlled for among the HF-ASD sample and this serves as the fifth limitation. Differences in how many services participants have received may have significantly contributed to how well they did on these measures and this would have been important information to have in interpreting the results. Specifically training in social pragmatics and social skills would likely increase performance across measures

A sixth limitation lies in the recruitment process. In order to participate in the study, parents had to contact the investigator and arrange to either bring their child to a testing location or allow the investigator to come to their home. This created a self-selected group in both the clinical and control conditions. It could be argued that there may be something different about the group of children whose parents signed them up to participate in the study after seeing a recruitment letter or flier vs. those whose parents did not.

A final and important limitation of this study results from the lack of psychometrically sound assessment tools designed to examine the ability to make emotional inferences. As a result, this study adapted three different measures (the ACES, the LEAS-C, and the ENNI) to use for this purpose. As these tools were not designed to measure the ability to make emotional inferences from different types of cues, rubrics had to be created for both the LEAS-C and the ENNI to code for the information relevant to this study. This resulted in a number of threats to reliability and validity. Given the limited sample size and number of raters it was impossible to establish the reliability of the rubrics more generally; instead, inter-rater reliability was used to establish the reliability of results in this one dataset only.

The study also failed to establish internal validity, and there is a chance that even if reliable, the tools may not have measured what they were designed to measure. This is true for both the LEAS-C Emotional Accuracy Scores and the ENNI Emotion Frequency Count. To increase inter-rater reliability and to decrease the level of inferences made in the scoring process on the LEAS-C, the criteria used to judge the accuracy of a response was that it was a "reasonable" inference to make about how someone might feel in the situation described without further explanation. This ended up restricting the range of responses on the LEAS-C and may have broadened the definition of a correct response so widely that the rubric did not distinguish between responses that reflected the ability to make accurate emotional inferences and those that did not in a meaningful way. On the ENNI, any emotion word attributed to a character was counted as an emotion attribution. This is a limited way to examine emotional inferencing abilities that allowed for greater inter-rater reliability, but may not have best captured individual or group differences in ability to make emotional inferences.

Future Research

Given the small sample size, there is a need to replicate these findings both using the same and different tools. In conducting future research with the same tools, it will be important to gather a large enough sample to examine the reliability of the rubrics created for this study. It will also be important to look at the validity of these newly developed rubrics by correlating performance on the measures to performance on other measures of emotional understanding or competence. Once the validity and reliability are established, a future study might examine whether the results found in this study generalize to a larger sample size.

Given the limitations of the analyses conducted in this study, it will also be important to re-examine the data gathered in this study using different methods. One approach to examining the LEAS-C emotional accuracy data might be to control for whether the situation described in each item would likely elicit similar feelings for the subject and the second character or different feelings. It is possible, given that they require more sophisticated emotional inferencing skills, that a performance difference between groups would be seen on the latter items, but not the former. In another approach, the rubric might be redesigned in a future study to better distinguish between the range of responses that would more accurately capture differences in emotional inferencing abilities.

There are also alternative ways of examining the data collected using the ENNI that will be important to explore in future studies. Colle et al. (2008) argue that comparing frequency counts of references to mental or emotional states often fails to capture perspective-taking deficits that are reflected in narratives in other ways. Tager-Flusberg (1995), for example, found that while individuals with autism were able to label emotional and mental states as easily as their peers, they used less language indicating an understanding of these states than their typically developing peers. Similarly, Colle et al. (2008) argue that perspective-taking deficits can be observed in the degree to which a narrator is sensitive to the perspective of their audience. In their study, they found that the participants with autism were less likely to use linguistic devices that reflected an understanding of the audience's perspective and that helped the audience follow the narrative than their peers. Although it fell outside the scope of this study, it will be interesting in a future study to re-analyze the ENNI narratives for sensitivity to audience and depth of understanding of mental states.

A future study might also use a different tool to look at emotional inferencing ability. This study tried to use the LEAS-C and the Situations Scale on the ACES to present participants with scenarios where, in order to make an emotional inference about a character, they had to first make an inference about how the character perceived the situation they were in. The goal was to assess whether individuals with autism experience more difficulty on this type of task than their peers. However, as described above, it is likely that the scenarios described were easy enough that the participants were able to use their social schemata and social knowledge to make these inferences without needing to use their mentalizing abilities. Thus, to truly examine this question, it will be important to not only to replicate these findings using the same tools, but to also conduct studies using other measures that may be better able to examine how well participants are able make emotional inferences when they must first make inferences about the beliefs/perceptions of others. As such a tool is not currently available, a measure would first have to be created for use in this way.

In addition to examining how the ability to engage in mentalizing tasks relates to the ability to make emotional inferences, it will be also important to conduct studies that determine whether performance on both these tasks predict social success. The Social Information Processing theory would predict that, regardless of diagnosis, difficulty making accurate inferences in isolation should result in greater difficulty navigating social situations in real time. It will be important to test this hypothesis with both participants with autism and their typically developing peers to determine similarities and differences in how these component skills predict success in social interactions.

Finally, this study was limited to an examination of the ability to make emotional inferences on isolated tasks. It is still not fully understood which component skills are needed to be successful in social interactions and the specific areas where children with autism show deficits. There is a critical need to continue to examine different component skills both in isolation and within a social context. This will make it possible to design social skills programs for children with autism that target areas of real weakness and teach skills that can lead to increased social success.

APPENDIX A

PARENT RECRUITMENT LETTER

UNIVERSITY OF MASSACHUSETTS
AMHERST
358 North Pleasant Street
Amherst, MA 01003

Dear Parent or Guardian,

My name is Abigail Leibovitch and I am a doctoral student at the University of Massachusetts researching perspective-taking skills among children with autism. I am seeking your permission to allow your child to participate in a study to explore how well children with autism are able to make emotion-based inferences when compared to their peers. I will be the principal investigator under the supervision of my dissertation advisor Dr. William Matthews, professor, School Psychology Program, School of Education, University of Massachusetts.

Participation in the study will involve a commitment of approximately one hour to one hour and a half. Sessions can take place at UMASS Amherst, at an office space in the South End of Boston, or in your home, depending on your preference. During this time, your child will be administered a number of different measures designed to examine their expressive and receptive language ability and their ability to make emotion-based inferences from written and visual cues. You will be provided the results of the study to review upon its completion.

Your decision for your child's participation in the study is completely voluntary. You may decline to have your child participate, if you wish. Your child will be assigned a number that will be used to identify all of their material and the data collected from this study will be analyzed in the aggregate, making it highly unlikely that your child's name will be linked to their data. Performance on measures administered in this study will not be a part of your child's school records. There are no anticipated costs and only a minimal risk associated with participation for your child. The risk arises from the potential for some students to feel discomfort when thinking about and discussing emotions. However, your child will also be asked for his/her verbal assent before the administration session begins and he/she will retain the right to terminate their participation at any point during assessment procedure.

We believe that this research will help us to better understand perspective-taking skills among children with autism and we hope to use these results to help shape future social skills programming that targets this population. Your child's participation is very valuable and greatly appreciated. As a token of our appreciation, we will be giving each participant a $10 gift certificate to Barnes and Nobles.

If you would like your child to participate in this study please contact me at 845-863-9011 or at abileibovitch@gmail.com.

If you have any questions or concerns, I would be happy to discuss the project with you further. I can be reached at the above e-mail address and phone number. My advisor, Dr. William Matthews, can be reached at shamrock@educ.umass.edu or at 413-545-1192.

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APPENDIX B

SCORING RUBRIC FOR EMOTIONAL ACCURACY ON THE LEAS-C

Must meet two criterion:

Is there a feeling labeled?

- If they use the word feel, but there are no feelings communicated, just thoughts, its incorrect
    - ie. "they would feel like that they would they'd changed in a way that there life affected them, changed them"
- Mark descriptive words for a physical pain- hurt, dizzy, etc. mark as incorrect
- Mark verbs- like crying- as incorrect
- If the emotion is communicated as though the character was talking to someone (ie. "he would be like 'I feel sad'") mark it as correct
- If the emotion is communicated as though the character is making a vocalization (ie. "he would be like 'waah") mark it as incorrect
- Mixed/conflicted feelings count as correct
-

Is it appropriate/ could it make sense as a response to the situation?

To determine if an item is correct, the rater should ask the question, "*Is this a reasonable inference to make about how the character would likely feel in the given situation without any additional information?"*

A scoring rubric has been created that classifies the appropriateness of each of the five basic emotions (fear, sadness, joy, anger, surprise) for each situation.

Given the ambiguity of many of the situations described, most of the emotions will be marked as correct. However, for each item, one or more of the basic emotions would be a very unlikely or inappropriate response to the situation and therefor it would not be a reasonable inference to make. If the student subscribes this emotion without giving an explanation, it should be marked incorrect. For more complex or social emotions (embarrassed, etc.) the rater will use their discretion regarding how appropriate it would be as a response to the situation.

- If the subject subscribes an emotion to the character that would not typically be appropriate to the situation but they provide a valid explanation, mark it as correct
    - Ie. Your dad tells you that the family dog has been run over. How would your dad feel
        - Happy= incorrect
        - Happy because he hates the dog=correct

- *No feeling* is an acceptable response for items where the scenario may not directly affect the character emotionally– (items 3, 4, 6, 7, 8, 11)- otherwise it should be marked wrong
- If the subject subscribes an emotion to the character that would not be appropriate to the situation, mark the item as wrong even if they also endorse an emotion that would be appropriate to the situation
- If the subject subscribes an emotion to the character that would be appropriate to the situation, but they justify it in a way that suggests that they do not understand the scenario or if the justification is incomprehensible, still mark it as correct

Item	Correct- 1	Incorrect- 0
1	Joy, Sadness, Surprise, Anger, Fear	No Feeling
2	Sadness, Surprise, Anger, Fear	Joy, No feeling
3	Joy, Sadness, Fear, Anger No feeling	Surprise
4	Joy, Fear, Sadness, Anger	Surprise, No feeling
5	Sadness, Surprise, Anger, Fear	Joy, No feeling
6	Sadness, Surprise, Anger, Fear, No feeling	Joy
7	Sadness, Surprise, Anger, Joy, No feeling	Fear
8	Sadness, Surprise, Anger, No feeling	Joy, Fear
9	Sadness, Joy, Anger, Fear	Surprise, No feeling
10	Sadness, Surprise, Anger, Fear	Joy, No feeling
11	Anger, Sadness, Joy, No feeling	Fear, Surprise
12	Joy	Sadness, Surprise, Anger, Fear, No feeling

APPENDIX C

SCORING RUBRIC FOR EMOTION COUNT ON THE ENNI

Criterion for an emotional inference:

- If a feeling is labeled it must be attached to a character to count as correct.
- Descriptive words for a physical pain- hurt, dizzy, etc. don't count.
- Verbs- like crying-don't count.
- Mixed/conflicted feelings count as correct.
- If the subject reports that two characters felt a particular emotion (ie. "they both felt sad"), count it as 2 points, because the subject is making two inferences. If the subject says "they all" or "everybody felt sad," refer to the corresponding picture in the story to determine how many characters they are referring to and give the subject one point for every character.
- If the subject endorses more than one emotion for a character (ie. the character felt________ and __________ OR _________ or ________) count them both as utterances.
- Count each utterance of an emotion word separately. If the subject reports that the character feels sad three times in a row, count all three as correct.

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