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Recognizing Emotions from Facial Expressions: A Computer-Assisted Video Intervention for Young Children with Asperger Syndrome

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Abstract

Recognizing Emotions from Facial Expressions: A Computer-Assisted Video Intervention for Young Children with Asperger Syndrome

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The effective encoding and interpretation of facial expressions is critical to inferring the intentions, motivation, and emotional state of others. Asperger syndrome (AS) is a pervasive, neurodevelopmental condition characterized by significant deficits in social interaction, impaired use of language, and stereotyped interests and activities. Deficient encoding and interpretation of facial expressions is likely related to the social difficulties experienced by those with AS. A video-based intervention administered via Internet is proposed for young children with AS. This research hopes to clarify the questions (1) are young children with AS able to interpret simple emotions and (2) can they learn the skills necessary to interpret complex emotions. Data will be analyzed using multivariate analysis of covariance.

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INTRODUCTION

Humans communicate emotions and provide information critical to the accurate perception of social intent by means of facial expression (Carlson, 2007). As far back as Charles Darwin, the biological significance and innate function of facial expressions in communicating emotion has been shown to be universally understood in interpersonal exchange (Darwin, 1872; Ekman, 1993; Ekman & Friesen, 1971). Effective social communication is reciprocal in nature and requires proficiency in such skills as recognizing emotion from facial expressions (Deeley, Daly, & Surguladze, 2007). For children who experience deficits in reading the affective messages of others, competent social interaction and communication are likely to suffer.

Asperger syndrome (AS) is a pervasive developmental disorder (PDD) that includes impairments in social and communicative functioning, as well as the presence of repetitive behaviors (APA, 2000). Impairments in social and communicative functioning, thought to be the hallmark of the syndrome, are manifested as a lack of social competence and subsequent inability to develop and maintain age-appropriate social relationships. The term social competence refers to the ability to integrate and apply affective, cognitive, and behavioral knowledge to interpersonal exchanges in the prosocial behaviors more likely to facilitate effective interpersonal exhange (Bierman & Welsh, 2000). For children with AS, it is a deficiency in accurately encoding the affective message of others from facial cues that is associated with their social competence deficits. Individuals with AS have also been found to exhibit neuropsychological difficulties with visual-perception, nonverbal concept formation, and the ability to integrate and adapt to novel or complex stimuli—in turn, these skills are thought to contribute to impaired development in the behaviors necessary for social competence (Rourke & Tsatsanis, 2000).

In addition to social and academic problems, children with AS are often at risk for psychological difficulties, such as anxiety and depressive disorders (Ghaziuddin, Ghaziuddin, &

Greden, 2002). Although the factors contributing to these internalizing problems are poorly understood (Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; Green, Gilchrist, & Burton, 2000; Howlin, 2000; Kim, Szatmari, & Bryson, 2000; Tonge, Bruce, Brereton, & Gray, 1999), the high rates of comorbid anxiety and depression seen in children with AS may be partially explained by deficits in social competence (Meyer, Mundy, Van Hecke, & Durocher, 2006).

Concerning the diagnosis of AS, criteria have been in place for over a decade (APA, 1994), yet much confusion and deliberation about the validity of the syndrome as a distinct condition within the broader umbrella of other pervasive developmental disorders (PDD) remains (Freeman, Cronin, & Candela, 2002; Mayes & Calhoun, 2003). As a result, much of the available literature concerning AS includes children with similar conditions (e.g., high-functioning autism, nonverbal learning disability), despite uniqueness in the social, cognitive, and language profiles among these groups. This grouping of related, yet distinct, subtypes of PDD makes the interpretation of findings in AS research difficult at best (Klinger, Dawson, & Renner, 2003). Prevalence estimates for AS vary from an estimated low of 0.3 in 10,000 in 1998, to a high of 48.7 in 10,000 in 1999. Despite a lack of agreement on the incidence or causes of AS, an apparent rise in individuals diagnosed with AS is undeniable.

Attempts to understand the underlying social and communicative impairments in AS continue to develop. Crick and Dodge (1994) proposed a six stage model of social information-processing (SIP) that may be particularly useful to understanding the interrelationships among the behaviors, social adjustment, and impaired social competence associated with AS. The model describes two specific cognitive processes, encoding and interpreting social cues, which may be salient to this understanding. In the development of the prerequisite behaviors necessary for social competence, it is thought that children approach social situations with a set of predetermined biological capabilities and a store of social experiences (Dodge, 1986). Deficiencies at any one stage or set of stages in the SIP model are likely to lead to difficulties in effectively navigating

social exchanges. The accurate perception and integration of nonverbal social cues has been consistently demonstrated as impaired in AS and is likely a significant contributor to their social competence deficits (Voeller, 1994). With this in mind, it is the encoding and interpretation of facial expressions in AS that will be the focus of this study.

The face provides us with the basis from which to evaluate the internal emotional state in others. The interpretation of emotions from facial expressions involves a complex system of brain structures and cortical pathways (see for review, Haxby, Hoffman, & Gobbini, 2000; Posamentier & Abdi, 2003). It is believed children's ability to decode emotions improves until about age 10, after which the accuracy of emotion decoding for children and adults tend to be fairly equal (Custrini & Feldman, 1989). Research suggests a clear dissociation between the processing of identity and emotions from faces (Posamentier & Abdi, 2003) and it has been found that deficits in processing facial expressions of emotion for children with AS is not related to a problem in processing face identity (Hefter, Manoach, & Barton, 2005). Processing of emotion from facial expression is also thought to be a lateralized function, primarily occurring in the right-hemisphere. It is suggested that right-brain dysfunction in these structures leads to the impaired processing of facial expressions and subsequent social competence deficits evident in AS (Rourke & Tsatsanis, 2000).

Emergent research for emotion recognition ability in AS has focused on the perception and evaluation of nonverbal cues (e.g., facial expression, body language, and gestures). Research suggests that nonverbal cues provide a more valid signal of others' emotional states than verbal cues (Rothman & Nowicki, 2004). This finding is particularly relevant to AS, as these children frequently over-rely on the verbal aspects of communication (Sturm, Fernell, & Gillberg, 2004; Grossman, J., Klin, A., Carter, A., & Volkmar, 2000).

Studies investigating the ability of children with AS to recognize emotions are mixed. While children and adolescents with AS have not been shown to exhibit impairments in

recognizing basic emotions, such as happiness, sadness, anger, fear, surprise, and disgust (Grossman, et al., 2000; Loveland, Tunali-Kotoski, Chen, Ortegon, Pearson, Brelsford, & Gibbs, 1997), it is suggested that, instead of recognizing emotions from the face, these results were related to children with AS using the response items (i.e., word labels) to verbally mediate their selections (Grossman et al., 2000). In contrast, impaired abilities in recognizing complex emotions are broadly accepted (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Baron-Cohen, Wheelwright, & Joliffe, 1997; Baron-Cohen, Wheelwright, & Hill, 2001; Golan, Baron-Cohen, & Hill, 2006).

Research investigating the efficacy of emotion recognition intervention in children with AS remains limited. Attempts to teach emotion recognition has primarily focused on social stories or social skills groups (Barnhill, Tapscott-Cook, Tebbenkamp, & Myles, 2002; Howlin & Yates, 1999; Ozonoff & Miller, 1995; see for review, Attwood, 2000). Most of these studies were restricted to static stimuli and focused on teaching basic emotions. Some have incorporated the use of self-as-model video feedback combined with social stories to teach emotion recognition (Bernad-Ripoll, 2007). Others have used a multi-sensory, drama-based approach in group settings, addressing emotion recognition amongst other prosocial skills (Glass, Guli, & Semrud-Clikeman, Wilkinson, 2000). Recently, computer assisted teaching of emotion recognition has been used with adults with autism (Silver & Oakes, 2001, Boelte, Feineis—Matthews, Prvulovic, Dierks, & Poustka, 2000), as well as adults with AS or HFA (Golan, Baron-Cohen, & Hill, 2006).

Although research examining the effectiveness of teaching emotion recognition suggest positive changes, the majority of studies pair varying pervasive developmental disorders as a homogeneous group—as a result, results from these studies should be interpreted with caution. More, weak research designs call into question the validity of their findings. The majority of reported research is based on single-case designs or small sample sizes, and investigators rarely include random assignment or a control condition. Although the social processing deficits in AS

are highly related to social competence (Custrini & Feldman, 1989; Egan, Brown, Goonan, Goonan,& Celano, 1998), research on the emotion recognition abilities specific to children with AS and the effectiveness of teaching these skills is clearly lacking.

The current study proposes the use of a software-based intervention designed to teach emotion recognition skills, the Children's Understanding of Emotion (CUE) program. This study is unique in its examination of the effectiveness of using interactive, video-based instruction for children with AS. The intervention will incorporate a randomized controlled trial design including three conditions: an experimental group of children with AS, a control group of children with AS, and a typically developing control group. Emerging work in computer-assisted treatments for emotion recognition suggest this method may provide an effective, individualized, strengths-based, and cost effective approach for teaching children with AS to recognize emotion in others from facial expressions. The CUE program allows for treatment to be adaptive and developmentally tailored to each child, providing peer-aged stimuli matching emotions to pre-treatment emotion recognition skill level. Results of the study may provide a better understanding of the emotions children with AS are able to recognize as well as typically developing peers and to what extent they can be taught to recognize "complex" emotions (e.g., amused, bothered). The proposed study will be the first randomized controlled trial investigating the efficacy of an adaptive, web-based, and video-assisted intervention using child actors to teach the recognition of emotion from facial expressions to children with AS.

INTEGRATIVE ANALYSIS

The integrative analysis reviews the hallmark difficulties associated with Asperger syndrome (AS) with an emphasis on the contribution of impaired emotion recognition from facial expressions and its relation to social competence. First, this analysis will define the term social competence. Implications for developmental outcomes, the components of social competence, and models of behavior related to social competence will also be reviewed. Second, a relevant historical background regarding AS will be provided, as will description of diagnostic criteria, social functioning, and neuropsychological functioning. In addition, what is known about the origin and prevalence of the syndrome, as well as theoretical models for understanding its manifestation will be discussed. Third, the relevance of the face in communication will be reviewed. This will include background on the recognition of emotion facial expressions, the neuropsychological specialization for emotion recognition, and findings for an impaired processing of facial expressions in AS. Finally, the efficacy of teaching emotion recognition skills to individuals with AS will be reviewed.

Social Competence

DEFINING SOCIAL COMPETENCE

In the development of the behaviors necessary for social competence, it is hypothesized that each child brings a predetermined set of biological capabilities (e.g. temperament, neuropsychological functioning) to their environment (Crick & Dodge, 1994). It is thought these capabilities are modified by and adapted to the child's environment and reciprocally influence the environment (Belsky, Rosenberger, & Crnic, 1995). It is suggested that social competence

may be conceptualized as the interaction between these biologically determined capabilities and the demands of the individual's environment (Dodge, 1986).

Social competence is an evaluative term that can be conceptualized as encompassing several key constructs, including social skills, social communication, and interpersonal behavior (Gresham, 1997). Social skills are the ability to take another's perspective in a situation, learn from past social experience, and apply learning to new opportunities during social exchange (Custrini & Feldman, 1989). Social communication can be described as the performance of communication behaviors in interactive social contexts (Rubin & Lennon, 2004). Adeptness in demonstrating empathy, cooperation, and responding appropriately to another's offer for social interaction is also crucial (Roberts & Strayer, 1996). Finally, socially competent behavior is dependent upon an individual's ability to flexibly respond and adapt to the ever-changing challenges of their social environment.

DEFINING SOCIAL PERCEPTION

What is considered socially competent behavior is based on the evaluations of others in regard to adequacy of performance. In fact, it is the child's parents, peers, and teachers that decide whether social behaviors are contextually adequate. Whether a child is able to adequately perform, however, relies heavily on their perception of the social environment (Spence, 2003). Social perception is the ability to attend to and interpret the most salient cues available during interpersonal exchanges, including affective signals. The child that is able to accurately identify these social signals is more likely to demonstrate appropriate reciprocity in social exchanges (Hamilton, Wolpert, & Frith, 2004). Accurate perception of both verbal (e.g., prosody) and nonverbal cues (e.g., facial expressions of emotion, gestures) in interpersonal exchanges is a necessary prerequisite for constructing a complete picture of social interactions and is essential to the performance of socially competent behavior (Nowicki & Duke, 1994). In fact, the ability to

accurately identify, interpret, and respond to nonverbal aspects of communication has been proven essential to social competence (Myklebust, 1975).

SOCIAL COMPETENCE OUTCOMES

Children's social competence has implications for mental and physical health (Spitzberg, 2003). Successful, independent interaction with same age peers is a predictor of later mental health and well-being, beginning during preschool and continuing through the grade school years when peer reputations solidify (Denham &Holt, 1993; Parker & Ashe, 1987, Robins & Rutter, 1990). Social competence is increasingly recognized as pertinent to a child's school readiness, grades, and achievement (Birch & Ladd, 1997; Carlton & Winsler, 1999; Ladd, Birch, & Buhs, 1999). Positive attitudes regarding school and teachers, positive feelings of self resulting from healthy school relationships, affect knowledge and regulation, social skills, and positive peer status have all been shown linked to academic success (Carlton, 2000; Howes & Smith, 1995).

COMPONENTS OF SOCIAL COMPETENCE

Components necessary for social competence have been described to include the adequate use and interpretation of verbal and nonverbal language, including the specific skill of having a conversation (Garfield, Peterson, & Perry, 2001). When language abilities are controlled for, however, it is the perception of nonverbal signals (e.g., facial expressions, gestures) that accounts for deficits in social reciprocity (Joseph & Tager-Flusberg, 2004). Skills involved in the development of healthy social functioning include adept encoding and interpretation of facial expressions. The ability to encode and interpret facial expressions develops early and is likely available for use in social interactions by the preschool years (Nowicki & Mitchell, 1998). Proficiency with these skills is thought to make the understanding of mood states in others and appropriate behavioral adaptation more likely (Singh, Ellis, Winton, Singh, Leung, & Oswald, 1998).

Researchers have developed comprehensive models integrating these mental processes and behaviors in an attempt to better understand children's social behaviors and competence. Two prominent conceptualizations modeling the social-cognitive and behavioral prerequisites for social competence are reviewed next.

MODELS OF SOCIAL COMPETENCE

Three-Tier Model. Cavell, Meehan, and Fiala (2003) described the skills necessary for social competence as consisting of three-tiers of underlying behavior. *Social adjustment*, the most advanced level, is a developmentally appropriate use of social behavior, as reflected by parent, teacher, and peer evaluations. Most children are able to meet these behavioral standards, yet instances of failed social adjustment lead to peer judgment that the child is awkward or different and may lead to social rejection or isolation. The second tier is *social performance*, described as how well the child performs in social situations. Social performance is comprised of the child's style of interacting with others, their social problem-solving skills, and efficiency in navigating social situations. The first and most basic tier is comprised of *social skills*. Social skills are considered the specific abilities a child brings to social situations and is similar to the social cognitions involved in Crick and Dodge's (1994) social information-processing (SIP) steps of encoding, interpreting, and enactment.

Social Information-Processing. Dodge (1986) proposed a SIP model of predominantly linear cognitive processes and behaviors, known as stages, which occur during children's social interactions (see Appendix A). Difficulties with social interaction and subsequent social competence are thought to be the result of cognitive deficits at one or more of these stages. These processes occur in real time and out of the child's consciousness. Social stimuli are encoded and interpreted (e.g., child is approached to play at recess), followed by a mental search for possible responses. These responses are subsequently evaluated for their appropriateness and enacted,

upon judgment of the response with the most likely favorable outcome. At any given age, the model indicates that a child's biologically determined capabilities and database of experiences up to that point influence the *initial* input encoding process (e.g., recognition of facial expressions, nonverbal gestures), an area thought to be affected in AS.

A reformulation of the original model (see Appendix B) proposed six stages of cognitive processes and behaviors children engage in during social interactions (Crick & Dodge, 1994). The model is based on an underlying assumption that deficits at *any* one stage or combination of stages can negatively influence social interactions. In addition, the model indicates that individual biological capabilities and experiences mediate performance at *all* stages. The social information-processing steps include: (1) encoding external (e.g., facial expressions, gestures) and internal cues (e.g., anxiety); (2) interpretation and mental representation of those cues (e.g., causal analysis, inference of intent, evaluation of prior experiences); (3) clarification or selection of a goal, including the possibility of real-time revision of goals; (4) access to possible responses or construction of new ones in novel situations; (5) response decision (i.e., evaluation and selection of most rewarding response); and (6) behavioral enactment.

Although the work of Cavell and colleagues (2003) and Dodge (1986; Crick & Dodge, 1994) provide similar conceptualizations of the cognitive processes and behaviors related to socially competent behavior on a global level, it is the specificity of the SIP model that has made it the prominent model for understanding children's social behavior. In fact, defining the behaviors necessary for effective social interaction into exclusive, yet interdependent components has proven valuable to understanding and predicting and childhood adjustment, social competence, as well as providing guidance to the intervention efforts of researchers for myriad of social difficulties (Crick & Dodge, 1994; Dodge, 1986; Fontaine & Dodge, 2006; see for review, Gifford-Smith & Rabiner, 2004).

ASSESSMENT OF SOCIAL COMPETENCE AND PERCEPTION

Social Competence. The assessment of social competence has typically relied on various methods from a collection of sources, including (1) ratings by a child's peers, teachers, and parents, (2) peer-referenced assessment, and (3) observational methods (Gresham, 1995). Sociometric rating scales and peer nominations have proven useful in the assessment of a child's social status, yet these measures fail to reveal the processes leading to status (Bienert & Schneider, 1993). The use of direct observation in naturalistic and simulated settings has been used extensively (Vaughn & Haager, 1994; Magill-Evans, Koning, Cameron-Sadava, & Manyk, 1995). These methods allow for the observation of a child in their natural home, school, and play environments and provide a setting with more experimental control by the researcher. In addition, interviews with the child, their parents, or teachers have also been used to provide personal, detailed information regarding a child's social functioning (Schneider, 1993).

Social Perception. The concurrent assessment of distinct abilities and overall functioning related to social perception has proven difficult, although a recently developed measure appears promising. The Psychological Processing Checklist (PPC) is a teacher-completed ratings scale of 35 items purported to measure difficulties with processing for children in kindergarten through fifth grade (Swerdlik, Swerdlik, & Kahn, 2003). Scores from the PPC provide both an overall index of psychological processing, as well as individual subscales measuring a ability to (1) make sense of what is heard in the environment and includes auditory memory and auditory discrimination (Auditory Processing); (2) make sense of what is seen in the environment and includes visual memory and visual discrimination (Visual Processing); (3) use motor movements to reproduce visually perceived stimuli (Visual-Motor Processing); (4) interpret nonverbal cues in interactions with others (Social Perception); (5) organize and mentally manipulate verbal and nonverbal information (Organization); and (6) focus and sustain attention (Attention).

Other measures of social perception focus on more distinct abilities related to social perception. The Diagnostic Analysis of Nonverbal Accuracy (DANVA2) assesses the ability to decode facial expression and the ability to infer nonverbal information from prosodic cues separately (Nowicki & Carton, 2003). The Child and Adolescent Social Perception Measure (CASP; Magill-Evans, Koning, & Cameron-Sadava, 1995) is another social-perceptual measure used to assess a child's ability to detect nonverbal cues of emotion and infer their associated mental states.

EMOTIONAL COMPETENCE

In addition to the multiple components of social information-processing thought to influence children's social behavior, competence in emotion is also associated with social competence (Denham, 2006). In fact, it is rare that a child exhibits social competence without proper emotional understanding. Emotional competence can be described as having a strong grasp on affective expressiveness, effective regulation of emotion, and knowledge crucial to effectively interact and form relationships (Saarni, 1990). Thus, the skills necessary for emotional competence relate closely to those for effective social information-processing and subsequently contribute to the behavioral prerequisites for social competence.

As with social competence, emotional competence develops throughout the lifespan. By preschool, children are able to able to discern and discuss their own affective states, the affective states of others, and are able to regulate their emotions depending on the social goals they hope to achieve (Denham, 1998; Saarni, 1990). Despite being closely related, emotional competence and social competence are considered separate constructs (Denham, Blair, DeMulder, Levitas, Sawyer, Auerbach-Major, & Queenan, 2003). In fact, social competence is the evaluation of how effective a child is in performing specific social, emotional, and cognitive tasks, whereas emotional competence is considered proficiency in emotional knowledge (Buckley, Storino, &

Saarni, 2003). At this specific level of processing, the link between components for emotional and social competence becomes clearer.

Affective Social Competence. Halberstadt Denham, and Dunsmore (2001) described a theoretical model of skilled understanding, regulation, and communication of one's own affect as well as successful interpretations and responses to the affective messages of others, named affective social competence (ASC; Halberstadt et al., 2001). The model is comprised of three integrated and dynamic components: sending, receiving, and experiencing affective messages (see Appendix C). Within each component, four progressive abilities essential to successful social interaction exist, including a child's (1) awareness of affect; (2) identification of affect; (3) ability to flexibly adapt within a social context; and (4) management and regulation of their own affect. It is thought that ASC is a central developmental task for children, allowing for the effective negotiation of interpersonal exchanges and the regulation of affective experiences crucial to social competence (Halberstadt et al., 2001).

SUMMARY

Although numerous explanations and theoretical orientations for socially competent behavior exist, their content essentially suggests the same prerequisites, the adept perception, recognition, and response to verbal and nonverbal affective social stimuli. In addition, socially desirable behaviors, such as the ability to take another's perspective in a social interaction and the ability to regulate ones emotion before enacting a response, appear linked to effective social interactions. For some children, these skills are lacking and negatively affect their ability to navigate social situations.

Asperger Syndrome

HISTORY

Asperger syndrome (AS) is one of a family of pervasive developmental disorders (PDD) that is characterized by impairments in social interaction, reciprocal communication, and restricted and unusual patterns of interest and behavior (American Psychiatric Association, 1994). Although autism is the most thoroughly studied PDD, AS has received much attention in recent years. The study of children exhibiting the profile of AS dates back to the early clinical work of Hans Asperger (1944), who provided an account of four cases with clinical characteristics unique to the descriptions of Kanner's autism (Kanner, 1943). These early descriptions remain salient today and include symptomatic impairments in social relationships, clumsiness, pedantic or idiosyncratic speech, unique and specific interests, and typical to early language development. In addition, Asperger emphasized the existence of average to high average intelligence within these individuals, yet he also believed the syndrome could manifest in individuals with mental retardation (Asperger, 1944/1991).

Since the descriptions of Asperger, attempts to define and refine AS diagnostic criteria did not emerge until the last 15 to 20 years. Lorna Wing (1981) first popularized and coined the syndrome as a set of characteristics differentiated from autism. To date, numerous diagnostic conceptualizations of autism exist (Volkmar, Lord, & Bailey, 2004). Wing's (1981) original criteria include: (1) pedantic speech that may include pronoun misuse, neologisms, and or repeated words or phrases; (2) impaired non-verbal communication and social interaction; (3) repetitive behaviors; poor motor coordination; and intense, restricted interests. Tantam (1988) described individuals whose (1) language use was not appropriately adjusted to the social context; (2) who exhibited a desire for friendships, but failure to relate to peers; (3) had idiosyncratic and engrossing interests; (4) had impairments in nonverbal communication; and (5) were considered clumsy. Early epidemiological work conceptualized the condition as including children exhibiting

impairments in reciprocal social interaction, stereotyped and circumscribed interests, delayed language development, and significant impairments in nonverbal communication skills (Gillberg, 1998). Szatmari, Bartolucci, and Bremner (1989) provided similar descriptions, but did not require a delay in language development and added the requirements of a lack or disinterest in friendships and a general avoidance of others.

DIAGNOSTIC CRITERIA

Since becoming "official" in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; APA, 1994), diagnostic criteria for AS have become more clear and stringent; however, much of the existing research concerning AS has been published using inconsistent diagnostic criteria making the interpretation of findings difficult (Klinger, Dawson, & Renner, 2003). More recently, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition –Text Revision* (DSM-IV-TR) and *International Classification of Diseases, Tenth Revision* (ICD-10) list virtually identical diagnostic features (APA, 2000; WHO, 2007). Both publications require (1) qualitative impairments in social interaction, (2) a restricted, repetitive repertoire of interests and activities; (3) specify typical development in areas of language and cognitive abilities; and (4) utilize a precedence criterion, such that an individual with early developmental delays and communication impairments that meets diagnostic criteria for autism must be diagnosed as such, even if current behavior is more consistent with a diagnosis of AS. Despite consistency in DSM-IV-TR and ICD-10 diagnostic criteria, a lack of consensual diagnostic clarity on the syndrome remains and research on AS frequently includes participants identified with similar, yet diagnostically distinct profiles, including high-functioning autism (HFA), nonverbal learning disability (NVLD), and pervasive developmental disorder not otherwise specified (PDD-NOS). The subsequent implications of inconsistent diagnostic criteria among these profiles are not yet known (Rourke & Tsatsanis, 2000; Klin & Volkmar, 1997). AS

is thought to occur in 48 of every 10,000 births (Kadesjo, Gillberg, & Hagberg, 1999; American Psychiatric Association, 1994; Ehlers & Gillberg, 1993); however, inconsistent diagnostic criteria have likely contributed to inaccurate prevalence estimates.

SOCIAL FUNCTIONING

Children with AS are characterized by sustained, pervasive difficulties in the domain of social information-processing that lead to social competence deficits. They consistently approach others in an inappropriate manner, demonstrate poor social reciprocity, and appear incapable of understanding the perspective of others (Myles & Simpson, 2002; Klin & Volkmar, 1997; McLaughlin-Cheng, 1998; Volkmar & Klin, 2000; Wing, 1991). The development of restricted and repetitive patterns of behavior and interests also appears to negatively affect their social functioning. Children with AS exhibit difficulty in decoding nonverbal cues of emotion, including facial expressions, body language, and tone of voice (Myles & Simpson, 2002; Klin & Volkmar, 1997; Wing, 1991). Additionally, these children often experience difficulty with novel learning experiences and changes in routine.

This blend of difficulties related to social functioning has serious, long-term implications for children with AS (Barnhill & Myles, 2001). Socially competent behaviors have been shown to elicit positive responses and foster healthy peer relations. Conversely, those exhibiting poor social competence have been shown to experience peer ridicule and social isolation manifested as a lack of friendships (Myles & Simpson, 2001). Differing from children with autism, those with AS actively seek out the development of friendships and their lack in the skills necessary for socially competent behavior results in repeated, pervasive failures in the social arena—this pattern of social difficulties may subsequently contribute to the development of secondary problems with anxiety and depression (Frith, 1991; Ghaziuddin, Ghaziuddin, & Greden, 2002).

NEUROPSYCHOLGICAL FUNCTIONING

It is suggested that AS is a disorder rooted in impaired functioning of the right hemisphere (Semrud-Clikeman & Hynd, 1990; Gunter, Ghaziuddin, & Ellis, 2002). Specifically, it has been posited that difficulties with white matter in the right hemisphere interfere with inter-hemispheric communication, resulting in impairment in the processing and integration of complex spatial information and novel material (McKelvey, Lambert, Mottron, & Shevell, 1995). Further, it has been found that right-hemisphere functioning in AS is significantly impaired compared to controls, yet left-hemisphere functioning is typical (Volkmar et al., 1996), consistent with their over-reliance on verbal information in social exchange.

ETIOLOGY

Although the causes of AS remain unclear, it appears that neurobiological and genetic components are at play. Symptoms associated with AS are often observed to a non-clinical degree in the relatives of those diagnosed with AS (e.g., social awkwardness, poor eye contact, restricted interests), and studies suggest possible multiple underlying genes (Rinehart, Bradshaw, Brereton, & Tonge, 2002; Pennington & Ozonoff, 1996, Volkmar, Lord, & Bailey, 2004). It has also been found that 19% of fathers and 4% of mothers of children with AS also met diagnostic criteria for the syndrome (Volkmar, Klin, & Pauls, 1998). Twin studies investigating a broader autism phenotype that includes communication and social disorders reported concordance rates up to 92% in monozygotic pairs, compared to up to 10% in dizygotic pairs (Bailey, Le Couteur, & Gottesman, 1995). Additionally, siblings of children with AS have been found to be twice as likely to have a PDD (Volkmar, Klin, & Pauls, 1998). Epidemiological research indicates that AS is unrelated to immigrant status, race, and social class and occurs more frequently in males than females at a rate of 4 to 1 (Ehlers & Gillberg, 1993; Fombonne, 2003).

Several conceptual models for understanding AS exist (Dunn, Saiter, & Rinner, 2002; Frith, 1989; Pennington & Ozonoff, 1996; Baron-Cohen et al., 2000) and two of the most prominent models will be further discussed next.

THEORETICAL MODELS

Executive Dysfunction Hypotheses. One hypothesis attempting to explain the deficits characteristic of children with AS involves impaired executive functioning (Damasio & Maurer, 1978; Ozonoff & Jensen, 1999). Executive function is thought to entail a system of neurological processes in the frontal lobe responsible for psychomotor output, including the dorsolateral prefrontal cortex (PFC) and anterior cingulated cortex (ACC). Several problem solving tasks are thought to be a function of these processes, including (1) the initiation of behaviors while inhibiting responses that may interfere with effective problem-solving, (2) the ability to filter distracting stimuli to maintain attention to tasks during problem-solving, and the ability to manipulate mental representations of a task for application on subsequent tasks (Pennington & Ozonoff, 1996). In children with AS, dysfunction in executive processes are likely manifested as impairments in inhibiting responses, trouble with planning and organization, rigidity in thoughts and actions, and an impaired ability to adapt to novel situations (Mundy & Stella, 2000). This is supported by correlations between severity of executive dysfunction and abnormalities in neuronal integrity of the prefrontal lobe in individuals with AS (West, Murphy, & Armilio, 2002).

Central Coherence Model. Frith (1989) introduced the term "weak" central coherence to describe the social-cognitive deficits exhibited in AS. Central coherence that is "strong" is defined as the ability to integrate multiple modes of information for a more *global*, higher-level understanding of stimuli. It is suggested that individuals with AS exhibit a bias towards weak, or *local*, processing of details of stimuli. Cognitive bias in AS for local information has been found in the processing of facial features (Deruelle, Rondan, & Gepner, 2004), as well as a bias for

verbal over environmental cues (Grossman, Klin, & Carter, 2000). As a result of local processing, children with AS often fail to attain the overall meaning of stimuli, contributing to ineffective perception of social situations (Frith & Happe, 1994). For example, a child with AS may fail to recognize being teased by another when simply interpreting an interpersonal exchange based on the information of the other words. In contrast, the child with AS may misinterpret another child's attempt to engage in a game of tag as an aggressive gesture when not attending to global cues of others playing tag on the playground. It is thought this bias toward local processing negatively affects social and cognitive development and may underlie the narrow interests and preoccupations evident in AS (Briskman, Happe, & Frith, 2001). Further, this processing bias may contribute to the cognitive strengths for rote memory and superior performance on specific cognitive tasks (e.g., Block Design, Embedded Figures) observed in AS (Baron-Cohen, 1997).

Emotion Recognition

HISTORY AND RELEVANCE

Cross-cultural studies have identified the basic emotions of disgust, surprise, happiness, fear, anger, and sadness to be universally understood (Ekman, 1994). The display of affect is believed to guide social interactions and human behaviors toward either approaching or avoiding certain situations (Lang, Bradley, & Cuthbert, 1990). How one responds during interpersonal exchanges often depends on their ability to accurately encode facial expressions and interpret the associated emotional meaning. Skill deficits in the ability to accurately recognize and effectively respond to facial expressions can often lead to miscommunication, resulting in negative social interactions that, with repeated failure, may ultimately impair interpersonal relationships.

DEVELOPMENT

Our ability to make sense of the human face and discern the affective messages it signals is apparent from day one and rapidly develops to provide us with information crucial to social interaction. In fact, newborns exhibit a preference for the human face over non-human objects (Johnson &Morton, 1991) and differentially respond to their caregiver's emotional states a mere 10 weeks later (Haviland & Lelwica, 1987). At 3-months, infants are sensitive to the valence (i.e., continuum of positivity/negativity of emotion) of emotional states (Kuchuk, Vibbert, & Bornstein, 1986), whereas the ability to match their own expressions and emotional state in response to others' emotional signals (i.e., regulation) emerges at 10-months (Camras, Dunn, & Izard, 1994; Walker-Andrews, 1986). By the end of the first year, children begin to associate emotional expressions with environmental events, as evident in social referencing (Kochanska & Thompson, 1997).

By the end of their third year, children are typically able to differentiate between most pleasant and unpleasant emotions. They are, however, less accurate at identifying expressions of fear, surprise, and disgust than those corresponding to the expression of happy, angry and sad emotional states (Borke, 1971; Posamentier & Abdi, 2003). By age 5, children are able to recognize and label basic emotions (Widen & Russell, 2003). Most studies have found that children begin to master the base skills for emotion understanding by the end of their preschool years and that these skills become stable during this time (Brown & Dunn, 1996; Denham, 1998). In fact, individual differences in emotion understanding in children 3 years of age were found to be the same at age 6 years old, such that those children who were the most skilled or delayed remained so three years later (Brown & Dunn, 1996). The recognition of complex emotions (e.g. amused, bothered, and nervous) is thought to emerge by age 8 and continues to develop through adolescence in regards to fluency (Harris, Olthof, & Terwogt, 1987). Concerning children's

accuracy in identifying emotions, it is thought they are able to decode emotions as well as adults by age 10 (Custrini & Feldman, 1989).

THE FACE

Effective encoding and interpretation of facial expressions of emotion requires the coordinated activity of a complex network of neural systems (see Appendix D). Haxby and colleagues (2000) proposed a model for the organization of systems involved in processing information from faces. The model is organized in a hierarchical fashion with delineation between a core visual system in the extrastriate visual cortex and an extended network of cognitive systems involved in the extraction of meaning from faces. The model emphasizes a distinction between two important tasks thought to underlie the facilitation of effective social communication, the representations of the (a) invariant aspects of faces and those for the (b) changeable aspects of faces. Deficient functioning within any or all of these systems is thought to negatively impact social communication.

In the model, it is proposed that early and automatic processing of the face involves perception of highly salient facial features. This occurs in the inferior occipital gyri and face processing is then delineated into two distinct routes responsible for the invariant and changeable aspects of the face. A representation of invariant aspects of faces (e.g., face structure) allows for the identification of individuals. This processing is mediated by the lateral fusiform gyrus. Next, the superior temporal sulcus is responsible for the representation of changeable aspects of faces, such as an individual's eye gaze, movements of the brow and lips, and facial expression of emotion. In addition, extended systems acting in concert with the core system mediate the processing of more detailed information from face. This includes such vital information as the processing of emotions in others, processing identifying information (e.g., name, biographical information), spatially directed attention to faces, and the perception of prelexical speech.

As outlined in the Haxby (2000) model, the development of face-processing is progressive and structured. It is suggested the processing of invariant and changeable aspects of faces is performed by distinct neural networks. Studies of the processing of invariant aspects of faces in children with AS indicate intact functioning (Hadjikhani et al., 2004; Hefter, Manoach, & Barton, 2005). Thus, it is likely that the core visual analysis of changeable aspects of the face, a process vital to interpreting and responding to nonverbal facial information, may be linked to AS. This is consistent with studies of children with AS exhibiting a tendency for slower and less proficient holistic processing of the changeable aspects of the face (Barton et al., 2001). It is also possible that spatially directed attention is at play. Studies tracking the processing of faces in children with AS indicate abnormal processing emphasizing the mouth and irrelevant regions of the eye area; this is in sharp contrast to the characteristic t-shape emphasis on the eyes and then the mouth seen in typically developing individuals (Pelphrey Sasson, Reznick, Paul, Goldman, & Piven, 2002). Finally, studies have found the amygdala, limbic system, and insular cortex to play a role in the processing of facial expressions and it is posited these systems partially account for emotion recognition deficits in AS—a belief supported by links between the limbic system and cognitive-emotional integration (Hadjikhani et al., 2004).

Currently, it is not known which specific components or interconnections are affected in AS (Hadjikhani et al., 2004). Their implications for deficient processing in one or all of these tasks, however, is sure to result in a significant degree of impaired social competence, that which is characteristic of individuals with AS. Attempts to address social information-processing deficits in are discussed next.

TEACHING EMOTION RECOGNTION

The instruction of emotion recognition skills has traditionally been delivered as an adjunct component to more general interventions related to social competence and the most

common approach with children and adolescents has been the use of social skills training. Social skills programs guide, model, and shape behaviors based on a mixture of social learning, coaching, cognitive-behavioral, and operant conditioning approaches (Matson, Sevin, & Box, 1995). Examples of behaviors targeted include general skills, such as approaching others, working cooperatively, and expressing feelings, to more specific skills, such as establishing eye contact and recognizing emotions in others (Kavale & Mostert, 2004). The underlying assumption in social skills training is that children with social difficulties exhibit deficits in the performance of skills that can be enhanced by means of direct instruction (e.g., peer, teacher, and video modeling, role-play, and problem-solving) (Gresham, 1997).

Despite the wide acceptance, implementation, and studies published for social skills programs, meta-analyses investigating their effectiveness provide minimal empirical support (Bellini, Peters, Benner, & Hopf, 2007; Hughes & Sullivan, 1988; Kavale & Forness, 1996; Kavale & Mostert, 2004). In fact, the evidence suggests that low effect sizes for social skills training are consistent across self-, peer-, parent- and teacher-based assessments of treatment effectiveness (Kavale & Forness, 1996); long-term change and generalization is limited (Bellini, Peters, Benner, & Hopf, 2007; Hughes & Sullivan, 1988); and the ability of social skills programs to enhance skills related to social competence is minimal (Kavale & Mostert, 2004).

Similar findings for limited efficacy have been found for social skills studies focusing specifically on children with AS. The first published social skills training trial with the AS population targeted interpersonal skills, self-esteem, and peer experiences of adolescents and adults with AS (Mesibov, 1984). Treatment consisted of modeling, coaching, and role-playing. Findings reported no objective pre-post data, but noted promising qualitative gains, based on the impressions of the participants, family, and staff. Knott, Lewis, and Williams (1995) reported the results of a 4-year social skills intervention that focused on teaching perspective taking, conversation ability, use of voice tone, flexibility in interactions, and listening skills. Qualitative

results suggested some progress in friendship and no progress in perspective taking. Talking with peers, initiating a conversation, using appropriate facial expressions, and fluency of speech, however, were found significantly enhanced. In another study, a four-and-a-half-month social skills training program was found to lead to improvements in perspective taking beyond a control group, yet these improvements were not shown to generalize (Ozonoff & Miller, 1995).

Marriage, Gordon, and Brand (1995) investigated the effectiveness of a short-term social skills group teaching skills via role-playing, video-taping, prompting with cards, viewing movies, and playing games. Results for parent ratings showed little improvement after the intervention, but qualitative improvement in self-confidence and social skills acquisition were noted. An 8-week, nonverbal skills training program was investigated for its effectiveness in increasing social perception skills (Barnhill, Tapscott-Cook, Tebbenkamp, & Myles, 2002). Participants were administered the Diagnostic Analysis of Nonverbal Accuracy (DANVA2) at pre- and post-treatment. Non-significant results were reported, though two unexpected outcomes were noted: social relationships were developed and maintained during the course of treatment and continued for half of the eight participants several months after the intervention; and qualitative reports of increased nonverbal communication in natural settings were noted after the intervention. Another social skills investigation found reductions in parent stress, but failed to find significant results for child measures of recognition and expression of emotion in self and others, conflict resolution, use of nonverbal communication, and initiating and maintaining conversations (Elder, Caterino, and Virden, 2006).

In sum, the available literature for direct social skills interventions provide some evidence for effectiveness, yet these findings are lacking in regard to effect sizes and the ability of treatment to facilitate lasting, generalizable skills. The majority of published work lacks an appropriate control condition, is based on single-case designs or very small sample sizes, and rarely incorporates random assignment. Many also teach skills in a group format that likely

presents itself as an anxiety-provoking learning environment for individuals with AS. Finally, social skills treatments are limited by a lack of systematic teaching of emotion recognition. Instead, these programs appear to focus on general social behavior, such as perspective taking and expressing emotions. These facts compromise the ability to derive certain conclusions for their effectiveness and are particularly concerning for children with AS considering a recent survey indicated that 78% of mothers of children with AS rated social skills training as extremely important for their child (Little, 2003).

TEACHING EMOTION RECOGNITION WITH COMPUTERS

Gresham, Sugai, and Horner (2001) provided a list of limitations in the available treatments addressing the social functioning of children. These include (1) a lack of tailoring treatments to specific deficits; (2) a lack of intensity in treatment dosage; (3) limited instruction in the child's natural setting; and (4) a lack of attention to the fidelity of treatment implementation.

Recent research for computer-based interventions has improved upon these limitations through the instruction of specific information-processing skills. Although computers have been used for learning-related purposes for decades, the idea of providing direct instruction via a computer is a relatively new concept. It has been proposed that high levels of interaction, an ability to direct the curriculum and make choices, multimedia animation, and sound features available in computer-assisted instruction are particularly salient features when considering their benefits for use as teaching tools (Lahm, 1996). For children with social difficulties, it has been noted these features make computers a particularly appropriate option for providing highly individualized instruction (Moore & Calvert, 2000). Specific to children with AS, the use of computers may be a useful method for several reasons, including: (1) computer programs can be developed to incrementally build on small steps for skill acquisition; (2) computers provide a structured, predictable mode of instruction; (3) computers are free from social demands and

thereby reduce anxiety; (4) computers allow for unlimited practice until mastery is achieved; and (5) materials presented via computers can be matched to the user's ability (i.e., adaptive).

The vast majority of computer-assisted emotion recognition treatments have involved individuals with autism and predominantly incorporated the use of labeling expressions for static stimuli (e.g., Ashwin, Wheelwright, & Baron-Cohen, 2005; Begeer, Rieffe, Terwogt, & Stockmann, 2006; Castelli, 2005; Dawson, Webb, & Carver, 2004; Shalom, Mostofsky, & Haslett, 2006; Wang, Dapretto, Hariri, 2004). The use of teaching emotion recognition to individuals with autism using dynamic stimuli has also received attention, including the use of videotaped actors (Bell, & Kirby, 2002; Loveland, Tunali-Kotoski, & Chen, 1997) and other multimedia modalities (Bishop, 2003; Golan & Baron-Cohen, 2006; Moore, Cheng, McGrath, & Powell, 2005). Despite the knowledge that children with AS exhibit early impairments in emotion recognition that are unique to those for autism, the examination of computer-assisted intervention in children with AS is virtually non-existent. In fact, only a single study was found that investigated the effectiveness of teaching emotion recognition skills to children with AS using computer-assisted.

LaCava, Golan, Baron-Cohen, and Myles (2007) investigated the effectiveness of a multimedia software program in teaching children with AS emotion recognition skills. Participants included 8 children ages 8 to 11. All children participated in the 10-week treatment, with 3 completing treatment on computers at their school and the remaining 5 at their home. Treatment was administered using Mind Reading: The Interactive Guide to Emotions^{TM} (Baron-Cohen, Wheelwright, & Hill, 2004). The Mind Reading program consists of several components, including an emotions library, learning center, and games zone. Emotions are demonstrated by actors in pictures, videos, short movie clips. Demonstrations can be loaded into the learning center for practice, and the games zone is intended to work as a motivator. Experimental measures included: (1) the Cambridge Mindreading Face-Voice Battery for Children (CAM-C;

Golan & Baron-Cohen, 2006c); (2) the Child Feature-Based Auditory Task (C-FAT; Golan, 2006); and (3) the Reading the Mind in Films Test-Children's Version (RMF-C; Golan, Baron-Cohen, & Golan, 2006). The CAM-C was used to assess the recognition of 15 emotional concepts from facial expression video clips and audio clip segments for speech, the C-FAT to assess the recognition of complex emotions from speech, and the RMF-C to assess the ability to recognize emotion in characters in social scenes taken from four children's movies.

The Mind Reading intervention program is an adaptation of the Cambridge Mindreading (CAM) Face-Voice Battery, an individually administered software program intended to teach the recognition of emotion from the face and voice. Users are exposed to brief video clips of actors demonstrating verbal and nonverbal expressions of emotion. The Mind Reading program differs from the CAM battery in that it provides recognition instruction related to the extensive "library" of emotion demonstration videos and that the user is able to freely select, view, and practice at their discretion. The Mind Reading program also includes emotion-related games that the user may play, but is limited to using no more than a third of session times.

Results from the study indicate significant improvement from pre- to post-test performance for all experimental tasks, suggesting the Mind Reading program is an effective tool for improving the recognition of basic and complex emotions in faces and voices for children with AS. Although these results appear promising, interpretation and generalization should proceed with caution. This study is limited by several methodological flaws, including a small sample size (N=8), and a lack of an AS or typical control group allowing for comparison of treatment gains to no intervention and typically developing children. Taking this into account, coupled with a clear dearth of studies investigating the effectiveness of teaching emotion recognition to children with AS, additional research is needed.

SUMMARY AND RATIONALE FOR PROPOSED STUDY

Social deficits are a hallmark feature of individuals with AS. Individuals with AS exhibit impairments in the accurate encoding and interpretation of nonverbal cues during social interactions, with particular impairment in the ability to read emotion from facial expressions. Extant literature suggests these impairments exist in the recognition for complex emotions, yet findings are mixed for basic emotion.

Individuals with AS have biologically based limitations in social information-processing that contribute to impaired social functioning. Repeated failure in the social arena is reciprocally related to further impairment with social competence. In contrast to the socially withdrawn behavior observed in autism, individuals with AS are not solitary by choice. In fact, a desire to develop social relationships and friendships, coupled with a deficit in the skills necessary to do so, puts individuals with AS at risk for social rejection and isolation that may lead to secondary internalizing problems common within the population (Ghaziuddin, Ghaziuddin, & Greden, 2002; Meyer, Mindy, Van Hecke, & Durocher, 2006).

Despite the widespread knowledge that children with AS exhibit specific emotion recognition impairments with serious long-term implications, little research has focused on enhancing these skills. In fact, the majority of research available is either conducted using treatments tailored to the needs of autism, has been implemented in group settings, focused on general skills (e.g., taking turns, regulating feelings), or is limited to the use of materials with little ecological validity (e.g., static photos, illustrations). Meta-analyses investigating the effectiveness of these approaches suggest little effect in producing skills that are maintained after treatment or generalization of gains. Unfortunately, the same is true for most studies specifically addressing the social difficulties in AS.

It has been proposed that some of the limitations in these approaches can be attributed to implementing non-individualized treatments, teaching general social skills, and not providing

appropriate levels of treatment dosages. When these approaches are individualized, however, they typically involve single-subject designs and much of the remaining literature is subject to the limitations of small sample sizes and non-experimental designs. In regard to a lack of calibration of treatment dose to match the need of the child, it is possible that time and logistical constraints in research are at play. What these findings suggest, is the need for future emotion recognition treatments to implement more rigorous research designs and provide explicit instruction tailored to the needs of the population. In addition, future research would benefit from increased dosages of instruction that is readily accessible with high level of acceptance.

The use of computer-based instruction, although in its infancy, may be exceptionally tailored to meet these needs. Computer assisted instruction has the capability to provide highly portable, individualized instruction, including unlimited opportunity for repetition at the user's own pace. Specific to the needs of children with AS, the use of computers provides a predictable, structured learning environment that is free of the social demands that contribute to their difficulties. To date, only a single study has been conducted investigating the effectiveness of teaching emotion recognition skills to children with AS. Although findings for teaching emotion recognition to children with AS are promising, small sample sizes and a lack of a control group make interpretation difficult and generalization limited.

The current study will attempt to address gaps in the emotion recognition literature by investigating the ability of young children with AS to recognize simple emotions compared to their typically developing peers, as well as their ability to learn emotion recognition for complex emotions to the level of their typically developing peers. This study is unique in additional ways. It will be the first randomized controlled trial investigation of the effectiveness of computer-assisted emotion recognition instruction for children with AS. In addition, it will be the first to investigate the gains following computer-assisted treatment relative to matched and typically developing controls. Finally, the proposed intervention is likely to be more ecologically valid

than the vast majority of studies teaching emotion recognition, as the stimuli will include age-matched humans demonstrating emotional expressions via video. Results from this study may provide a more precise understanding of emotion recognition abilities in children with AS, as well as add to the literature base by investigating the ability of this population to learn the skills necessary for recognizing complex emotions from facial expressions.

PROPOSED RESEARCH STUDY

Statement of Purpose

The purpose of the proposed study is to investigate on emotion recognition from facial expressions in children with AS. The study seeks to answer two questions: (a) Do children with AS differ significantly from their typically developing peers on a task of recognizing facial expressions of "basic" emotions; and (b) can children with AS learn to recognize facial expressions of "complex" emotions to the level of their typical peers? This study, therefore, aims to clarify the research base for emotion recognition abilities in children with AS and evaluate the effectiveness of an intervention explicitly teaching children with AS the necessary skills to recognize more complex facial expressions of emotion.

The specific groups under analysis in this study will be a set of children with AS assigned to a treatment condition, children with AS assigned to a minimal-contact control condition, and typically developing children assigned to a minimal contact control condition. These children will be assessed on their ability to recognize emotions from facial expressions using the Cambridge Mindreading Face–Voice Battery for Children (CAM-C; Golan & Baron-Cohen, 2006c). Administration of the CAM-C will occur for all conditions as a pre- and post-test. For children in the treatment condition, they will additionally participate in a 10-week intervention for recognizing emotions from facial expressions using the Children's Understanding of Emotions (CUE) training program.

Methodological considerations for this study include age, gender, condition assignment, group status (e.g. treatment, diagnosis), and pre-test scores on the CAM-C. For this study, only children ages 10 years, 0 months to 12 years, 11 months will be included. Research suggests that

children's ability to decode emotions improves until about age 10 (Custrini & Feldman, 1989). Restricting participant ages from a minimum of 10 years, 0 months to 12 years, 11 months will help ensure that children are able to recognize complex emotions, in addition to keeping groups homogeneous and increasing statistical power. Research indicates AS is a condition predominantly identified in males (Ehlers & Gillberg, 1993). It has also been found that females are better at detecting emotions than males (Dimberg & Lundquist, 1990). To increase the homogeneity of groups and power to detect a treatment effect, participants will be restricted to males.

The current study seeks to gain the participation of 40 children with AS and 40 typically developing children. Upon agreement to participate, 20 children in the AS group will be randomly assigned to a treatment or minimal-control condition. Only half of the typically developing group agreeing to participate will be included in the study, with 20 randomly assigned to a minimal-control condition. In addition, analysis will control for any affects of age on emotion recognition, as positive correlations between age and emotion decoding tasks in children with AS have been found (Egan et al., 1998; Golan & Baron-Cohen, 2006; Ozonoff, Pennington, & Rogers, 1990). Thus, controlling for age would likely remove a portion of the variance that is shared between diagnostic status and emotion recognition ability. Finally, in assessing change as a result of participation in the CUE program, controlling for pre-test performance on the CAM-C will allow for a better understanding of the effect of intervention at post-test.

RESEARCH QUESTIONS AND HYPOTHESES

Research Question - Study 1

Do children with AS exhibit significant mean differences for Emotion Recognition (ER) compared to typically developing peers, when holding age constant?

Hypotheses 1

a) It is hypothesized that children with AS will not exhibit significant mean differences from typical controls in the recognition of basic emotions, while holding age constant, as measured by the facial ER score (*score1*) on the CAM-C at pre-test.

b) It is hypothesized that children with AS will exhibit significant mean differences from typical controls in the recognition of complex emotions, while holding age constant, as measured by the facial ER score (score1) on the CAM-C at pre-test.

Rationale 1

Current research on the ability of children with AS to recognize basic emotions from facial expressions is mixed. Most of the emotion recognition research is published on findings from heterogeneous groups of pervasive developmental disorders (PDD) (Klinger, Dawson, & Renner, 2003). A recent study, however, has shown that children with AS do not significantly differ from their typical peers in recognizing basic emotions (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). In contrast, research for the recognition of complex emotions in children with AS suggests impaired function (Baron-Cohen, Wheelwright, & Joliffe, 1997; Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson, 2001; LaCava, Golan, & Baron-Cohen, 2007).

Research Question - Study 2

Will children with AS exhibit significant mean differences for Emotion Recognition (ER) compared to typically developing peers, while holding initial differences and age constant, after completing the CUE training program?

Hypotheses 2

a) It is hypothesized that children with AS will not exhibit significant mean differences from typical controls in the recognition of complex emotions, while holding age and *score1*

constant, upon completion of the CUE training program, as measured by the complex ER score (*score2*) on the CAM-C at post-test.

b) It is hypothesized that children with AS will exhibit significantly higher mean differences from AS controls in the recognition of complex emotions, while holding age and *score1* constant, upon completion of the CUE training program, as measured by the complex ER score (*score2*) on the CAM-C at post-test.

Rationale 2

Emerging research for adults and children with AS or HFA suggest they are able significantly improve their ability to recognize complex emotions from facial expressions (Golan, Baron-Cohen, Hill, 2006 & Baron-Cohen, 2006c; LaCava, Golan, & Baron-Cohen, 2007). Whether these improvements match the ability of typically developing children, however, has not been established.

Method

PARTICIPANTS

Participants will be 60 male children, ages 10 years, 0 months to 12 years, 11 months, who attend school in one of four urban Texas school districts. Students will be recruited and selected in the fall and participate in the study the following spring. Participants who meet DSM-IV-TR criteria for AS will be randomly assigned to a treatment (n=20) or waitlist control (n=20) condition. For the typically developing participants, 40 students will be recruited of which 20 will be randomly assigned to a control condition (n=20) and the remaining students will not participate in the study (n=20).

Inclusion criteria. Participants recruited as having AS must have received a diagnosis of AS from a licensed psychologist using established criteria (APA, 2000; WHO, 2007). The parents

of all students will complete the Gilliam Asperger's Disorder Scale (GADS; Gilliam, 2001). Students previously diagnosed with AS must receive an Asperger's Disorder Quotient (ADQ) score of > 80 on the GADS. Typically developing controls must receive an ADQ score of <70. Participants are required to have access to the Internet, either at home or in the school system. Participants with AS must also demonstrate a minimum of average intelligence, defined as a minimum score of 85 on an acceptable measure of intelligence (see *Instrumentation* below). All participants must be willing to delay treatment until the beginning of the spring semester following study initiation during the first week of the school year. All participants with AS must be willing to be randomly assigned to either a treatment or minimal-contact control condition. Typically developing participants must be willing to agree to the random assignment condition, in that only half of the volunteers will be asked to participate.

Exclusionary criteria. Children diagnosed with AS with an ADQ score < 80 will not be included in this study. Typical controls with an ADQ score of $\geq$ 70 will not be included in this study. Females will not be included in the study. Children with AS who display below average intelligence, as defined by a score below 85 on an acceptable measure of intelligence, will not be included in this study. Individuals who are not willing to be randomly assigned to the above-described conditions will not be included in the study.

INSTRUMENTS

Assessment data from prior evaluation will be used to determine cognitive functioning and study inclusion. All participants with AS will be administered the following measures.

*Cambridge Mindreading Face–Voice Battery for Children (*CAM-C; Golan & Baron-Cohen, 2006c*).* The CAM-C will be used to assess post-treatment changes in emotion recognition. The CAM-C assesses the recognition of six basic emotions (happy, sad, angry,

afraid, disgusted, and surprised) and nine complex emotions (loving, embarrassed, undecided, unfriendly, bothered, nervous, disappointed, amused, and jealous).

The CAM-C is a two-part assessment of children's recognition of 15 emotional concepts from facial expression video clips and speech segment audio clips. The CAM-C was developed on the concepts of the Cambridge Mindreading (CAM) Face-Voice Battery (Golan, Baron-Cohen, Hill, 2006). The CAM-C assesses the recognition of six basic emotions and nine complex emotions. The CAM-C consists of two subtests—Face ER and Voice ER— each involving 45 questions, for a total of 90 items. It provides ER scores for faces (max = 45) as well as for the number of emotions recognized correctly (max = 15). These are also available separately for basic and complex emotions. The current study will only use the CAM-C Faces subtest. The CAM-C Faces subtest presents the stimuli in random order, thus only one form is necessary. After an emotion clip is presented, participants are asked to choose from four emotion words best describing the emotion the actor was expressing.

The CAM-C is based on the adult version of the same instrument (Golan, Baron-Cohen, & Hill, 2006). Information on the reliability and validity for the CAM-C is limited as it is a relatively new instrument. Golan and Baron-Cohen (2006c) described the CAM-C as having significant external validity as its complex ER scores for faces positively correlated ($r=0.35$, $p<.01$) with scores from another measure of complex emotion recognition (Baron-Cohen et al., 2001). Age positively correlated with all CAM-C basic and complex scores, but verbal IQ was only positively correlated with complex emotions ($r=0.42$, $p<.01$). Test-retest reliability was found to be good for the CAM-C Faces subtest ($r=0.79$, $p<.001$) and for the number of emotion groups passed ($r=0.77$; $p<.001$). The length of time between pre- and posttest was between 10 and 15 weeks.

Gilliam Asperger's Disorder Scale (GADS; Gilliam, 2001). The GADS is an individually administered checklist of 32 items designed for use with individuals ages 3 to 22. Four subscales

of Social Interaction, Restricted Patterns, Cognitive Patterns, and Pragmatic Skills, and a Parent Interview Form sum to Asperger's Disorder Quotient (ADQ). The Asperger's Disorder Quotient has a mean of 100 and a standard deviation of 15. The subscales have a mean of 10 and a standard deviation of 3. Higher ADQ scores support the presence of Asperger's Disorder, with an ADQ of < 69 indicates Low/Not Probable, 70-79 indicates Borderline, and > 80 indicates High/Probable probability of the presence of the disorder as indicated in the interpretation guide.

Nonclinical staff can administer and score the GADS. Interpretation requires persons trained in test administration. The GADS demonstrates adequate internal consistency with a variety of diagnostic groups. For the four subscales, coefficient alphas were .70 or higher. Moderate to strong alphas were reported for the Asperger's Disorder Quotient (ADQ), suggesting the GADS is appropriate for use in most educational and clinical settings for the diagnosis of Asperger's Disorder (McGregor, 2003). Results of a discriminative validity analysis supported correct diagnosis of group membership 83% of the time.

Cognitive Measures. The following measures are individually administered, norm-referenced, batteries used in the assessment of cognitive ability:

Woodcock-Johnson Test of Cognitive Ability- Third Edition (WJ Cog III; Woodcock, McGrew, & Mather, 2006). The WJ III is appropriate for administration to children as young as 2 years of age and to adults to age 90. (Cizek, 2003). Consistent with Cattell-Horn and Carroll (CHC) conceptualization of cognitive abilities, the test provides a measure of a general factor of cognitive ability (General Intellectual Ability or GIA), as well Verbal Ability, Thinking Ability, and Cognitive Efficiency clusters (Sandoval). The battery has good reliability, with most tests showing strong reliabilities of .80 or higher and most clusters showing reliabilities at 90 or higher (Cizek, 2003; Sandoval, 2003)

Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2004*).* The WISC-IV is appropriate for the use with examinees ages 6 years to 16 years 11 months. The

test yields a Full Scale IQ (FSIQ) and four index scores: Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI). Average standard scores for the FSIQ range from 85 to 115. Internal consistency coefficients for the core subtests ranged from .79 to .90 and .90 and .96 for FSIQ.

Kaufman Assessment Battery for Children, Second Edition (KABC-II; Kaufman & Kaufman, 2007*).* The KABC-II is appropriate for the use with examinees 3 years to 18 years. The test was developed on a dual theoretical foundation, guided by Luria and Cattell-Horn-Carroll (CHC) models for cognitive abilities. The CHC model yields a global measure of intelligence, the Fluid-Crystallized Index (FCI) as well as five ability scales, including Short Term Memory (Gsm), Visual Processing (Gv), Long-Term Storage & Retrieval (Glr), Fluid Reasoning (Gf), and Crystallized Ability (Gc) scales. The Luria model yields a global measure of intelligence known as the Mental Processing Index global scale, based on four scales, including Sequential Processing, Simultaneous Processing, Learning Ability, and Planning Ability. Subtest reliability coefficients are good (.80) to excellent (.90), with lower coefficients ($\leq$.70) for younger children. Global and individual scale stability coefficients are mostly fair to excellent (.72 to .95).

*Stanford-Binet Intelligence Scales, Fifth Edition (SB5).*The SB5 is appropriate for the use with examinees ages 6 years to 85 years. The SB5 yields a Full Scale IQ, two domain scores (Nonverbal IQ and Verbal IQ), as well as five factors of cognitive ability, including Fluid Reasoning, Knowledge, Quantitative Reasoning, Visual-Spatial Processing, and Working Memory. The SB5shows high reliability coefficients for composite and factor scores (>.91) and subtest scores (>.84).

Differential Ability Scales, Second Edition (DAS-II). The DAS-II is appropriate for the use with examinees ages 6 months to 17 years 11 months. The DAS-II yields an overall measure of cognitive functioning, General Conceptual Ability Score (GCA), and four indexes of Verbal

Ability, Nonverbal Ability, Nonverbal Reasoning Ability, and Spatial Ability. Internal consistency for the GCA is .95.

PROCEDURE

Approval by the Human Subjects Committee. This study will be in compliance with the ethical issues and standards of research set forth by the American Psychological Association and the Institutional Review Board for the Protection of Human Subjects at the University of Texas at Austin. Prior to this study, all materials will be submitted for approval to the Departmental Review Committee of the Department of Educational Psychology and the Institutional Review Board of the University of Texas at Austin. Participation in this proposed study would be voluntary and contingent upon parental consent and participant assent.

Recruitment of participants. Participants will be recruited and selected from public elementary schools in Austin, Dallas, Houston, and San Antonio, Texas. Materials outlining the proposed study will be presented to the Office of the Superintendent for each district. Upon approval, the primary investigator will meet with relevant staff and teachers to explain the study and provide feedback for any outstanding questions. Parents of prospective participants referred by each school district will be contacted through the school by means of a letter describing the study and procedures, including a parental consent form (see Appendix E & F). Upon receipt of the signed consent form, screening procedures will begin.

Data collection. For all participants, parents will be administered the GADS to determine the likelihood of AS and exclude non-diagnosed individuals with scores indicating a high probability of AS. Volunteers meeting inclusion criteria will be invited to participate in the pre-treatment assessment (Time 1) using the CAM-C. Volunteers who do not meet inclusion criteria will thanked for their time and willingness to participate. For the typical group, 20 will be

randomly selected to participate and the remaining 20 volunteers will thanked for their time and willingness to participate.

Prior to Time 1 assessment, children with AS will be randomly selected to participate in either a treatment or control condition. Typically developing children will be a control group. Time 1 assessment will occur assessment will occur at a predetermined school within each school district. The principal investigator or a trained graduate student will be in attendance to supervise the administration of the CAM-C. Children will be scheduled at separate times during a single day for administration at Time 1 and the same at Time 2, 10 weeks later. Each assessment will take approximately 1 hour.

The day following Time 1 assessment, all children will be invited back to the school for a preview of the CUE program. This will take approximately 1 hour. The principal investigator or a trained graduate student will use this time to demonstrate to children how they will access and logon to the program, including a demonstration of how the tasks will be administered. As children will be asked to use the software by themselves, either at home or at school, attendance for the preview will be required. After the preview, children will be told that they can begin to use the CUE program at home or school starting that day. At this time, they will also be reminded of the requirements outlined in the procedures for inclusion. Children will be asked to commit to use the program 3 times per week, for a minimum of 15 minutes per session, over a period of 10 weeks, for a minimum of 450 minutes over the course of the study.

Treatment integrity. Fidelity of implementation will be monitored from data provided by the CUE program. The principal investigator will have daily access to information logs regarding the amount of participant logins to the CUE program, the time spent using CUE per session, as well as the amount and type of items administered per session. Each week, logs will be checked to validate participant use of the CUE program. For children who have not used the program for at least 2 times or 30 minutes for two weeks, the principal investigator will contact and remind

the family of the minimum requirements for participation. In addition, these participants will be asked to supplement additional time until a total for minimum requirement up to that point is attained.

Materials. Treatment will use the Children's Understanding of Emotions (CUE) training program, a web-based pilot program available for cross-browser and platform use. The program provides systematic instruction of emotion cue recognition (ECR) for 6 basic and 9 complex emotions. Basic emotions include expressions of anger, disgust, fear, happiness, sadness, surprise; complex emotions include expressions of amused, bothered, disappointed, embarrassed, jealous, loving, nervous, undecided, and unfriendly.

Children will access CUE from an internet-accessible computer, either in their school or at home. Children will be required to access the CUE website and login with an account set up by the investigator. After logging in, children will select the "Start Looking for Cues" prompt on the welcome page. Children will be administered 5 second video vignettes of child actors demonstrating facial expressions corresponding to basic and complex emotions. Basic emotions include expressions of anger, disgust, fear, happiness, sadness, surprise; complex emotions include expressions of amused, bothered, disappointed, embarrassed, jealous, loving, nervous, undecided, and unfriendly.

Each emotion demonstration will be validated, using a panel of 20 volunteers (10 children, 10 adults) from the general population. At least 80% agreement must be achieved to consider a demonstration valid. In addition, the principal investigator will validate emotion demonstrations using the Facial Action Coding System (FACS; Ekman, Friesen, & Hager, 2002), a manualized taxonomy of facial expressions and their associated emotional meaning. The manual provides guidance as to the exact movements that the face can perform, what muscles produce them, and what combinations of movements result in a particular emotional display.

After viewing an emotion, children are prompted to select one of four response labels that correspond to the demonstrated emotion. One label will correspond to the emotion expressed and the other three labels will be incorrect. Incorrect labels and the order in which they display will be randomly generated from a database of all of the emotions taught in the program. Administration of incorrect emotion labels will be grouped; that is, incorrect options for basic emotions will come from the basic database and those for complex from the complex database.

Correct labeling of an emotion results in a randomly selected administration of another emotion of the same grouping (e.g., basic, complex). Each emotion has 4 separate instances demonstrated by different actors. Thus, there will be 24 demonstrations of basic emotions and 36 demonstrations of complex emotions that will be randomly served to the user. Administration of emotions will begin with basic emotions and progress to complex emotions. Upon correctly labeling an emotion the first time, the use will not be administered the same emotion for that particular session. A child must correctly label all basic emotions before progressing to complex emotions.

Incorrect labeling of an emotion results in administration of a “remedial” demonstration for that emotion. Remedial demonstrations consist of viewing of the same video, with the inclusion of narration and video filter (Adobe Premier) highlighting the relevant facial cues associated with that emotion. Development of remedial video demonstrations for emotions will be guided by the FACS taxonomy (Ekman, Friesen, & Hager, 2002.

Data Analyses and Expected Results

PRELIMINARY ANALYSIS - POWER

Prior research providing suggested effect size estimates for emotion recognition skills for AS do not exist. A recent meta-analysis of differential effects of social skills training with antisocial youth based on group versus individual treatment conditions suggests an overall effect size estimate of .62, with the range of .78 for individual treatment to .60 for group treatment (Ang & Hughes, 2002). Caution should be taken, however, in generalizing the effect sizes obtained from this meta-analysis when determining an appropriate level of power for individuals with AS, as the underlying causes for social deficits and the measures used differ between the populations and the current study. Thus, it may be more appropriate to determine a desired power level on Cohen's classification of moderate effect, at an ES of .50 (Cohen, 1992). Based on this estimate, 42 participants will be needed to detect a moderate effect size at the desired level of power, .80, and alpha level of .05.

DATA ANALYSIS

Age has been shown to affect emotion recognition ability. Due to this expected correlation, a 2 (diagnosis) X 1 (score) factorial Analysis of Covariance (ANCOVA) design will be used to evaluate the relationship between group membership and emotion recognition ability at pre-test while controlling for age for Study 1. For Study 2, a 3 (group) X 1 (score) factorial Analysis of Covariance (ANCOVA) design will be used to evaluate the relationship between group membership and emotion recognition ability at post-test while controlling for age and pre-test score. The independent variables include *group* (AS treatment, AS control, Typical control) score1 (CAM-C, pre-test Concept score), and *diagnosis* (AS, Typical). The dependent variable for Studies 1 will be *score1* and Study 2 will be *score2*.

Prior to conducting the ANCOVA, a preliminary analysis of the homogeneity of slopes assumptions will be conducted to indicate whether the relationship between the covariate and the dependent variable differ as a function of the independent variable. If the assumption is met, an ANCOVA *F* test will be conducted to evaluate whether population means on the dependent variable (score), adjusted for differences on the covariate (age), differ across level of the factor (group). If the main effect is significant, a post hoc analysis on the adjusted means will be conducted using a Bonferroni adjusted Tukey HSD for pairwise comparisons.

If a significant interaction for the homogeneity of slopes assumption is found, differences on the dependent variable between groups vary as a function of the covariate and ANCOVA cannot be used. Accordingly, follow up tests will be used to assess mean differences between groups for particular scores on the covariate (simple main effects).

HYPOTHESIS 1 ANALYSIS AND EXPECTED RESULTS

(a) A main effect for *diagnosis* on basic emotions is not expected from the ANCOVA, suggesting that the different diagnostic groups will not display different performance on the recognition of basic emotions from faces.

(b) A main effect for *diagnosis* on complex emotions is expected from the ANCOVA, suggesting that the different diagnostic groups will display different performance on the recognition of complex emotions from faces.

HYPOTHESIS 2 ANALYSIS AND EXPECTED RESULTS

A main effect for *group* is expected from the ANCOVA, suggesting that the different conditions (i.e., AS treatment, AS control, Typical control) will display perform differently on the recognition of basic emotions from faces task. It is expected that post hoc Bonferroni-adjusted pairwise comparisons will demonstrate that children with AS in the control condition perform more poorly than any other group at post-test. It is also expected that post hoc Bonferroni-

adjusted pairwise comparisons will demonstrate that children in the AS treatment condition do not differ from typical controls at posttest, suggesting gains are the result of a treatment effect.

DISCUSSION

Summary and Limitations

This study will examine the ability of children with AS to recognize basic emotions. It will also investigate the effectiveness of a computer-assisted intervention to teach the recognition of complex emotions. Results will provide a more thorough understanding of what skills children with AS have available as well as what can be achieved. It is hypothesized that the nature of the treatment will be highly tailored to the needs and abilities of this population and likely result in meaningful enhancements in their social information-processing. This study is unique in that it is the first to use a more rigorous treatment design in a research area that is still in its infancy.

There are several limitations to this study. The first relates to the use of computer-based tasks to teach emotion recognition. Although this approach is advantageous in providing a more controlled and structured environment, in addition to improvements compared to the ecological validity of the majority of emotion recognition treatments, learning to recognize emotions from videos is still quite different from the requirements of everyday social interactions. As a result, findings for enhanced emotion recognition should be considered with caution.

A second limitation is related to treatment fidelity. The proposed intervention is advantageous in that it can be easily accessed and implemented, as long as an Internet connection and computer are available. This flexibility, however, limits the reliability of treatment adherence. It is possible that children will not access the program as intended or use it as often as prescribed. Although the functionality of the program will allow for tracking each child's usage patterns, variations in the learning environment will be likely impossible to control for.

Finally, as the CAM-C battery is similar in nature to the tasks taught with the CUE program (i.e., video demonstrations of facial expression), the current study results would be

limited to measures of close generalization. Although the CUE program will teach the recognition of combinations of cues on the face that are associated with particular emotions, as opposed to holistic face-processing, generalizations of results from the CAM-C should be interpreted with care.

Implications and Directions for Future Research

Children in with AS are expected to perform as well as typically developing peers on the basic emotion recognition task. Children with AS are expected to perform significantly worse than typical peers prior to treatment. At post-treatment, it is expected that children will no longer significantly differ from their typical peers in complex emotion recognition. If the results for basic emotions are found, it will provide support for clarity to mixed research findings. Specifically, as the current study is nonverbal in nature, previous findings for verbal mediation of task performance will be addressed and provide evidence for ability, while controlling for a verbal bias. Pre-treatment results for complex emotion recognition will likely confirm extant research indicating impairments for children with AS. If expected results for post-treatment emotion recognition are found, it will provide evidence that these skills can be taught in a relatively brief, easily accessible matter.

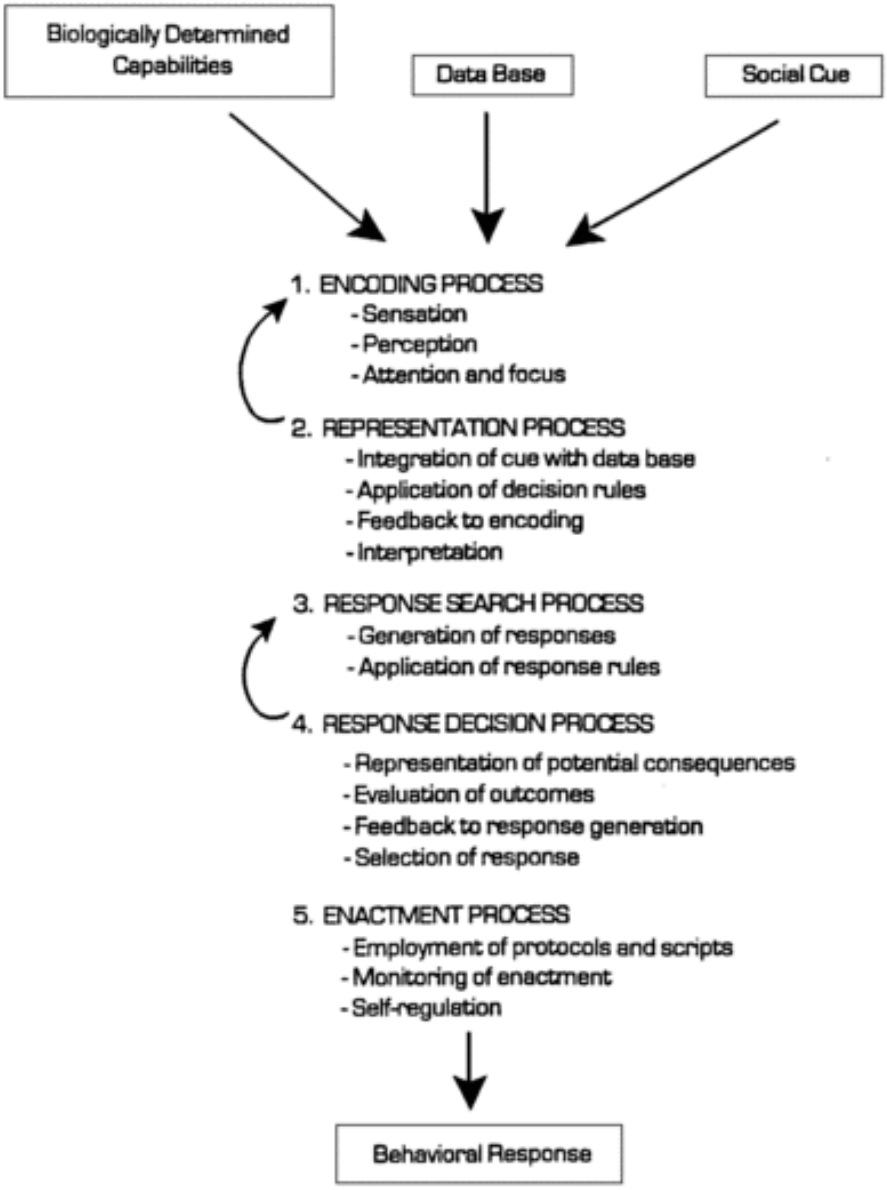
Future studies need to continue to examine AS as a distinct diagnostic category. Inclusion of similar conditions, such as HFA, NVLD, and PDD-NOS, has limited the utility and interpretation of research findings. Future research should also examine the effectiveness of emotion recognition across genders in AS. As typical females have been shown to more adept than males in emotion recognition, it would be relevant to understand these abilities in females with AS. Finally, future research needs to measure the effects of emotion recognition treatments

on social-perceptual functioning. One option for this would be using the Psychological Processing Checklist (PPC).

In sum, the current proposed study will attempt to address an underlying set of skills conceptualized in the majority of models for social and emotional competence. As the use of computer-assisted instruction is still emerging, future research should continue to incorporate the use of highly structured, individualized instruction to teach skills necessary for social competence to individuals with AS.

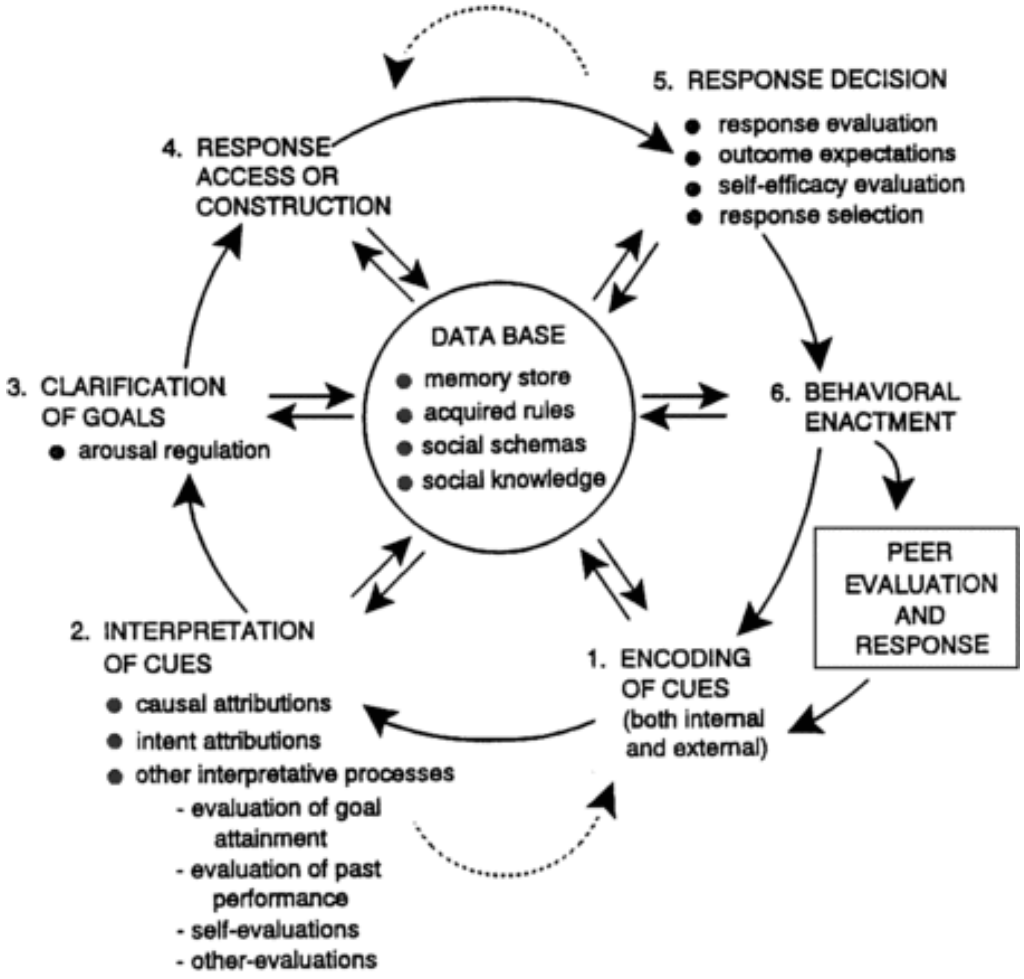
APPENDICES

Appendix A.



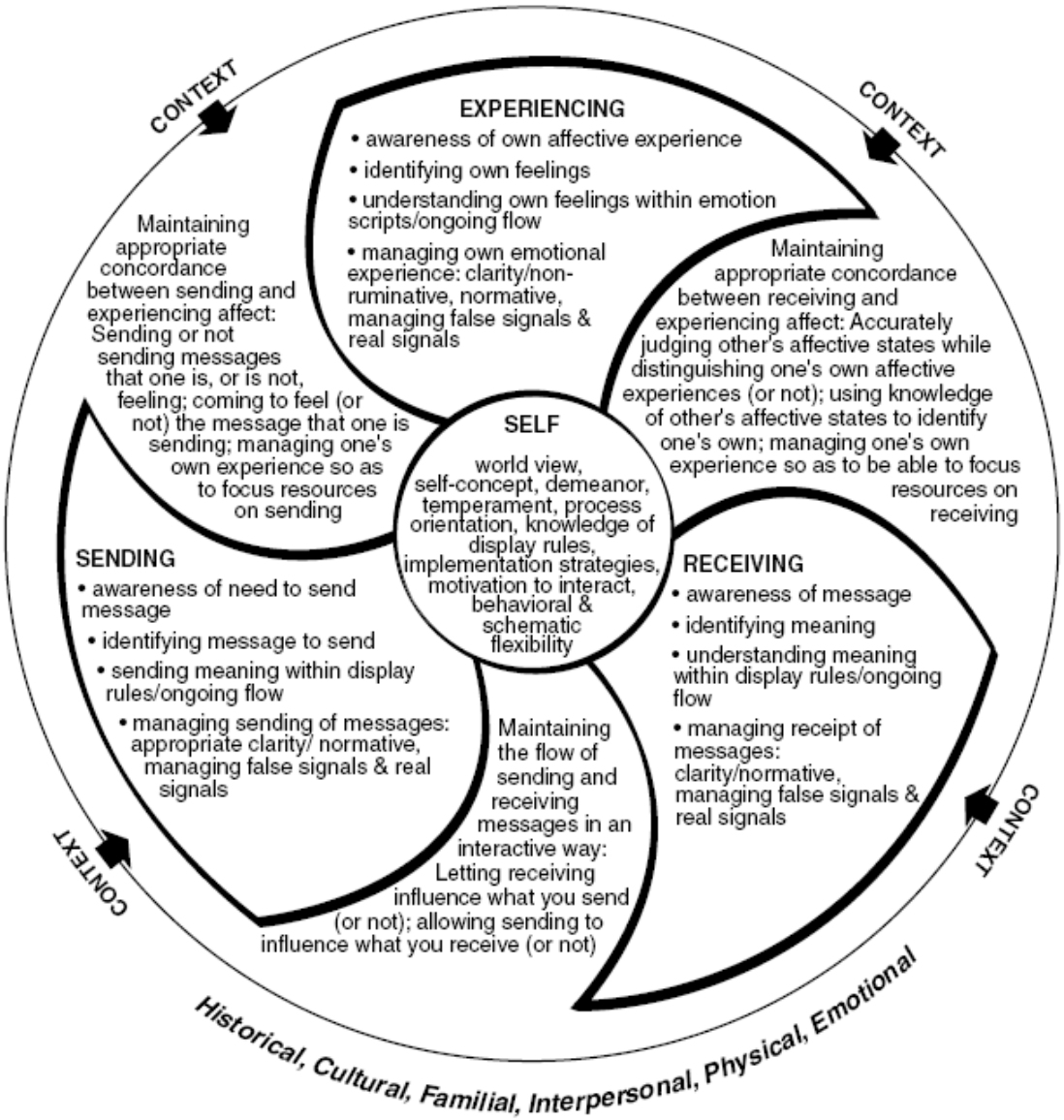
Dodge model of social information-processing (Dodge, 1986)

Appendix B.



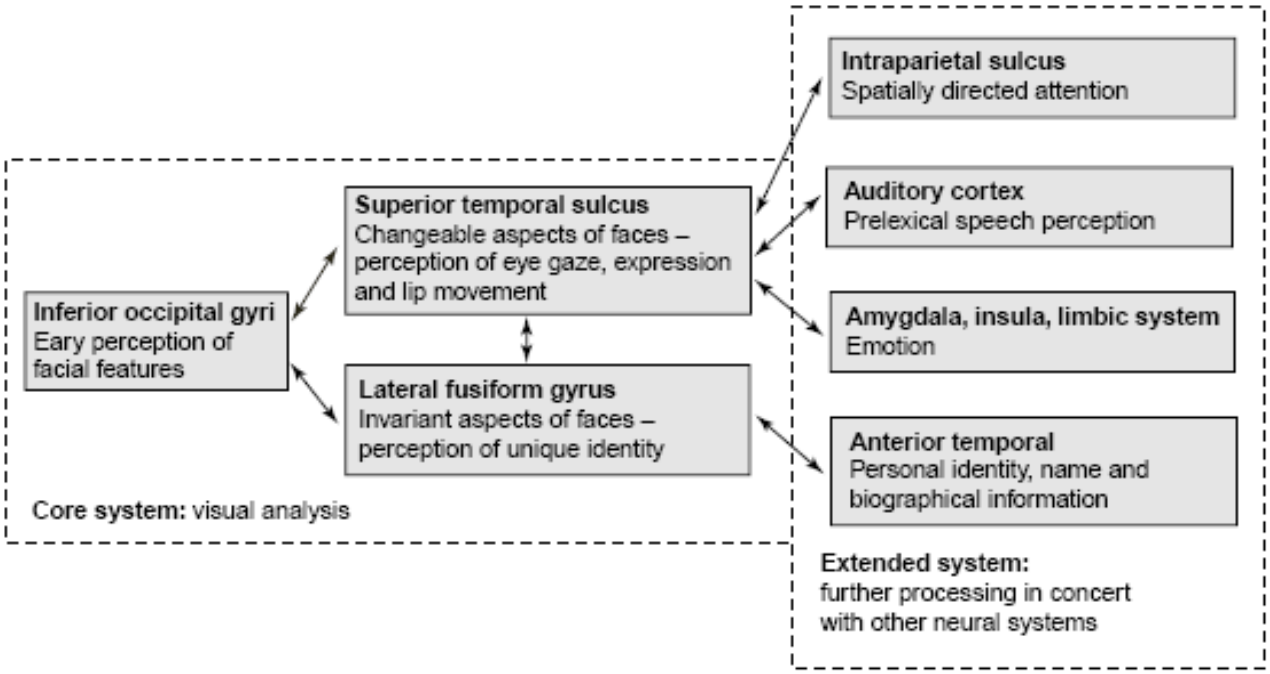
A reformulated social information-processing model of children's social adjustment (Crick & Dodge, 1994).

Appendix C.



Pinwheel depiction of affective social competence (Halberstadt, Denham, & Dunsmore, 2001).

Appendix D.



Model of the distributed human neural system for face processing
(Haxby, Hoffman & Gobbini, 2000).

Appendix E.

Letter to Parents

Dear Parent,

Your child is invited to participate in a study investigating emotion recognition skills in children with Asperger's syndrome. My name is Daniel Garrison and I am a doctoral student in School Psychology at the University of Texas at Austin, Department of Educational Psychology. The present study is investigating the abilities of children with Asperger syndrome to accurately recognize simple emotions from facial expression. In addition, this study is investigating how well they can learn to recognize more complex emotions from facial expressions.

In general, I would like to know what emotions from facial expressions children with Asperger syndrome are able to recognize compared to their peers and, if not, how well the skills to do this can be taught. This study will use brief video clips of child actors to both determine these abilities as well as teach the skills necessary to recognizing them.

If you decide to allow your child to participate, a questionnaire called the Gilliam Asperger's Disorder Scale and instructions for completing the questionnaire will be sent home with him. The questionnaire will take approximately 20 minutes to complete and asks questions about the way your child thinks about things, his interests and activities, and his actions in social situations. The purpose of this questionnaire is to identify the degree to which these behaviors match a diagnosis of Asperger syndrome.

The benefits from the study include an improved understanding of emotion recognition capabilities in children with Asperger syndrome, as this information will be used to design programs to help prevent the social difficulties associated with Asperger syndrome.

Your child's performance during this study will not be associated with his name or your name in any written or verbal report of this research project. Participation in this study is completely voluntary, and you may withdraw your child from the study at any time. Your choice to allow your child to participate will not influence current or future relationships with The University of Texas at Austin or the school that your child attends. If you have any questions about the study, please call me at 471-0179.

Sincerely,

Daniel Garrison, B.A.
Doctoral Student in School Psychology
University of Texas at Austin

Appendix F.

Parental Consent Form

_____
Student's Name

You are making a choice about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have chosen to allow your child to participate in the study. If you later decide that you wish to withdraw your consent for your child to participate in the study, simply call me. You may discontinue his participation at any point during the study.

____ YES, I do want my child to participate in this study.

____ NO, I do not want my child to participate in this study.

_____ Date_____
Signature of Parent or Legal Guardian

_____ Date _____
Signature of Primary Investigator

** Please ask your child to return this form to their teacher **

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