EMOTIONAL CONTAGION IN CHILDREN WITH AUTISM AND WITHOUT AUTISM

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Abstract

According to the theory of emotional contagion, people automatically mimic and coordinate facial expressions, body gestures, tone of voice, and postures with those of others, and feedback from muscles activated in these imitations affects how emotion is experienced. People are predisposed to acquiring the emotions of others as a result of this feedback. Past studies show that people with autism are less likely to attend to social cues or respond similarly to the expressions of others. This study investigated susceptibility to emotional contagion in children with and without autism as mediated by attention. It was hypothesized that children with autism would be impaired in matching facial expressions on a nonverbal task, would display less facial mimicry, and would catch the emotions of others less often than typically developing children. This study also hypothesized that with a visual attention-getting stimulus, attention to facial cues would increase facial mimicry and emotional contagion for 20 children with autism and 20 typical children, ages five to 17 years, matched on mental and chronological age. Analyses revealed that children with autism were impaired in matching facial expressions and were less likely to experience contagion. Children with and without autism were not rated as portraying different or less intense emotions. Performance did not improve for either group with an attention-getting stimulus. This study provides support for previous claims that children with autism are impaired in their ability to match facial expressions and experience empathy. This study did not support a dynamic color cue as an attention-getting stimulus which facilitates contagion. The role of attention in emotional contagion deserves further attention in future studies.

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Chapter 1
Introduction

Autism is a developmental disorder that has been sweeping the globe. As cases of autism become more and more prevalent, there is a growing interest in and need for research that helps define the diagnosis and leads to improved outcomes for this population. The following literature review will give a description of the disorder, outline theories behind its causes, and summarize research that supports a deficiency in social and emotional functioning. A review of the major theories of emotion will lead to a discussion of the theory of *emotional contagion* as it relates to typically developing individuals and those with autism. Attention to the facial expressions and emotion states of others may mediate emotional contagion, and a description of research on mimicry and attention to emotional cues for children with autism will be presented before describing the current study.

Autism

Autism is a *Pervasive Developmental Disorder* (PDD) that affects social and emotional development. The term "pervasive" arises out of the fact that autism is a disorder that lasts from birth until death and encompasses all aspects of that individual's adaptive life (Minshew, Johnson, & Luna, 2001). Major characteristics of this condition include qualitative impairments in social interactions and communication along with the occurrence of stereotypical behaviors according to *DSM-IV-TR* (*Diagnostic and Statistical Manual, fourth edition text revision*; American Psychiatric Association [APA], 2000). In 1943, Leo Kanner created the first diagnosis of autism for 11 children who displayed an unusual set of symptoms, which included extreme aloneness, language abnormalities, and an intense desire for sameness (Kanner, 1943). Although Kanner's original description of the criteria for autism is now a subgroup of high-functioning autism, the underlying

impairments have remained the same (APA, 1994; Fombonne, 1999; Hobson, 1993). The following descriptions of autism have been adapted from the *DSM-IV-TR* (APA, 2000), Filipek and colleagues (1999), Hobson (1993), Newsom and Hovanitz (1997), Strock (2004); and the World Health Organization (1993) as well as from personal experience.

People who work with this population often consider impairments in social functioning to be the most distinguishing feature of autism. Individuals with autism have problems with nonverbal social behaviors such as eye contact and simple greetings. Some children are able to make eye contact, but do not use it to direct attention to objects or situations that interest them; therefore, there is no reciprocal sharing with the eyes during interaction. Social interactions may also be atypical in that a child may not respond to a familiar person, may not initiate interactions with others, and may not be aware of social conventions such as approaching or touching total strangers. Peer relations are often lacking or absent. A child with autism may not have any age-appropriate friends, or may have an inappropriate understanding of the term "friend" which lacks the defining factors of friendship such as trust, affection, social sharing of interests, and reciprocity. Additionally, individuals with autism may not spontaneously share their interests, ideas, and successes through verbalizations, pointing, or eye contact. Interactions such as these create an opportunity for two people to share a common focus, known as *joint attention*, which is also impaired in individuals with autism. Finally, these children often lack or are disinterested in social and emotional reciprocity, tending to observe the actions of others, play by themselves, or play alongside others in parallel play. Some children may be able to participate in games or repetitive types of play that are highly stereotyped and have set "rules" which define participant roles, but these children have difficulty engaging in activities where spontaneous actions would seem more natural.

Communication deficits for individuals with autism fall within a wide range of impairments: from complete mutism to comprehension difficulties. In terms of spoken language, some children may suffer from a delay in the development of language while others may not develop discernable language at all. An important feature of this verbal impairment is that individuals with autism often do not attempt to communicate using facial expressions or gestures as compensation for a lack of language. Children who have verbal abilities may show marked impairments in their ability to initiate or sustain conversations in a fluent manner that allows for mutual turn-taking in discussing a topic of common interest. Stereotyped or repetitive use of language is another symptom of autism which can include immediate or delayed *echolalia* – the repetition of previously heard phrases or words spoken by another. Children may use immediate echolalia to answer questions by simply repeating the last word of the question as an affirmative. Commonly, an individual incorporates delayed echolalia into appropriate conversations in the form of memorized scripts, such as "how are you today?" "I am fine, thank you." However, the use of such scripts often lends an automated quality to the conversation, and these individuals may not have a clear understanding of the concepts they are repeating. Furthermore, communication deficits also encompass a lack of developmentally appropriate social imitative play, which includes spontaneous make-believe and flexible representational play. When imitative play is present, it tends to be repetitious and follow memorized scripts.

The final category of symptoms includes repetitive, restricted, and stereotyped interests, behaviors, and activities. Some children may play with the same toy in the same way day after day, while others may become overly interested in one topic, such as trains, which preoccupy their thoughts, behaviors, and conversations with others regardless of

whether the other person shares this special interest. This can also extend to ritualized behaviors and routines which can result in major tantrums or emotional uproar when any aspect of the routine is changed. For example, a child may eat only bologna sandwiches on white bread. If the family has run out of white bread, a tantrum may ensue or the child simply will not eat. Another example is the child who insists on taking off his shoes whenever entering a building, regardless of whether it is a supermarket, classroom, bus station or his home. Some individuals may also display obvious stereotyped or repetitive motor movements such as finger flapping, hand waving, or spinning. Last but not least, individuals with autism may exhibit a fascination with parts of objects. Some children might turn their head to stare at objects or parts of objects from the corner of their eyes. They may demonstrate this fascination through behaviors such as spinning the wheels of a toy car instead of rolling the car across the floor, flicking lights on and off, or lining up toys and staring at the individual parts. What is perhaps most interesting is the inherent joy these behaviors can bring, often inciting laughter much like one would experience when sharing a joke with a friend or watching something funny on TV.

Autism is just one of five disorders included in the *DSM-IV-TR* as Pervasive Developmental Disorders, now more commonly referred to as *Autistic Spectrum Disorders* (ASD) (Strock, 2004). Newsom and Hovanitz (1997, p. 410) give a very succinct account of the differences between each of the five PDDs. They state:

> Autistic Disorder is the category that applies to most cases of severe behavior disorders first evident in infancy. Rett's disorder characterizes children who begin to exhibit several specific deficits after a period of normal development. Childhood Disintegrative Disorder describes children who show a marked regression in many areas following a period of normal development. Asperger's Disorder applies to

children who show the same kinds of social impairments and restricted, stereotyped interests as autistic children, but not the language impairments. Pervasive Developmental Disorder Not Otherwise Specified is a residual category for children who show pervasive impairments, but do not fully meet the criteria for one of the other categories.

These five disorders, currently classified by *DSM-IV-TR* as PDD, are accordant with the *International Classification of Disease,* 10th edition (ICD-10), which is widely used internationally (WHO, 1993). Due to the wide variability of symptoms and difficulties in quantifying these symptoms, the *DSM-IV-TR* classifies these disorders together under one diagnostic umbrella based on similar deficits in the three areas of social functioning, communication, and restricted interest.

The age of onset for a diagnosis of Autism Spectrum Disorder in the *DSM-IV-TR* is between zero to three years (APA, 2000). Of 1,800 children seen at the Treatment and Education of Autistic and related Communication handicapped Children Division (TEACCH), parents identified 76% of children with autism by 24 months of age and 94% by 36 months (Short & Schopler, 1988). Similarly, a study by Mars, Mauk, and Dowrick (1998) examined home videos depicting social interactions for 25 children later diagnosed with one of the Pervasive Developmental Disorders and 25 age-matched typically developing children. They concluded that the children later diagnosed with a PDD were noticeably different from their peers in terms of specific abnormalities in social and communicative behaviors, social interaction, and joint attention before the age of 30 months. However, if a child is older, an interview with a parent or caregiver who can estimate the age when they first noticed the appearance of strange or peculiar behaviors can help determine the diagnosis (Newsom & Hovanitz, 1997).

Previous population studies estimate that approximately 10 to 20 incidents of autism occur out of every 10,000 live births in the U.S. and England; however, current incidence rates illustrate that the number of individuals diagnosed with autism is rising. According to a 2003 study in Atlanta, Georgia, researchers reported that ASD prevalence rates were 3.4 for every 1,000 children, or about 30 per every 10,000 live births (Yeargin-Allsopp, Rice, Karapurkar, Doernberg, Boyle, & Murphy, 2003). In a study conducted in the United Kingdom, rates were even higher, with prevalence rates reaching 58.7 per every 10,000 children (Chakrabarti & Fombonne, 2005). The cause for the upsurge in autism cases remains a mystery. A study by the University of California concluded that the increase in autism in the state of California was not due to misclassification, criteria changes, increased migration of children with autism into the state, or other demographic factors (University of California, 2002). Conversely, an extremely convincing article by Eric Fombonne (2003) refuted the arguments for an "epidemic" of autism by stating that prevalence rates of over 30 per 10,000 are likely due to diagnostic sensitivity, changing criteria, methods for case finding, increased availability of services and the use of inconsistent case definitions across studies. A recent review by Fombonne (2005) included 37 surveys conducted in 14 countries since 1997. His results yield a much more conservative prevalence estimate, lying somewhere between 10/10,000 to 16/10,000 for Autism Disorder specifically and 36/10,000 for all Pervasive Developmental Disorders combined.

Although there are more individuals diagnosed with autism now than there were 30 years ago, thus far there have not been any thoroughly convincing studies to support the notion that an increase in incidence is due to environmental exposures or epidemiological causes. Perhaps one of the most popular of these beliefs is the notion that vaccines which

contain thimerosal, a preservative used since the 1930's, cause autism. An eight year study conducted in Denmark examined this association in 537,000 children. The researchers found no significant difference in the incidence of ASD between groups that received MMR vaccinations (for measles, mumps and rubella) and those that did not (Madsen, Hviid, Vertergaard, Schendel, Wohlfahrt, Thorsen, Olsen, & Melbye, 2002). Additionally, several studies have demonstrated no association between thimerosal and autism (Heron & Golding, 2004; Parker, Schwartz, Todd, & Pickering, 2004; Pichichero, 2002). To this day, researchers continue to search for a viable cause for the increase in the incidence of autism across the globe.

Currently there are several theories as to the etiology of autism. In recent years, these include theories regarding genetic predispositions, neurological foundations, and cognitive characteristics. This review will describe genetic perspectives, current neurological research, theories from the area of cognitive neuroscience, and social theories regarding affect and social-orienting.

Genetic Theory

The possibility that a genetic contribution may underlie autism is a widespread belief held by many researchers. As autism is a spectrum disorder, the social, emotional, cognitive and behavioral abnormalities that characterize this disorder may be the result of atypical brain development caused by genes. Twin studies have found concordance rates for monozygotic twins to range between 36 - 60% and zero to five percent for dizygotic twins (Folstein & Rutter, 1977). Furthermore, a twin study examining 28 autistic twin pairs in addition to the 19 original twin pairs studied by Folstein and Rutter concluded that the heritability for a broader autism phenotype exceeded 90% in monozygotic twins (Bailey, Le Couteur, Gottesman, Bolton, Simonoff, Yuzda, & Rutter, 1995).

The process of identifying specific genes and markers has thus far been very challenging. Although researchers continue to employ association studies, linkage studies, and genome screens with the hopes of discovering specific genetic markers that may increase susceptibility, none of these methods has unearthed reliable candidate genes for autism despite the fact that they hold great potential for future studies (Rutter, 2005; Veenstra-VanderWeele & Cook, 2004). Monozygotic twins concordant for autism or ASD exhibit a wide range of social and communication deficits along the autism spectrum, lending support to the possibility of the contribution of several genes that affect development at different critical stages (Bailey et al., 1995; for a more detailed review of genetic studies conducted from the 1960's to the early 21st century, see Rutter, 2005). One study in particular explored the broader autism phenotype through the family history of 25 families with multiple-incidence autism (i.e. families with more than one sibling with autism) as these families may have a higher genetic liability for autism and may be less likely to have autism as a result of non-genetic causes. The researchers concluded that parents of children with autism were significantly more likely to show social deficits and stereotyped behaviors. Mothers of children with autism were more likely to display communication deficits as well (Piven, Palmer, Jacobi, Childress, & Arndt, 1997).

Despite the broad autism phenotype and the possibility that several gene markers may increase susceptibility to autism through combinations of genes and proximity, researchers are making progress toward understanding the etiology of other Pervasive Developmental Disorders. Gene studies have identified a genetic origin for Rett's Disorder. Rett's Disorder is associated with severe reductions in social interaction, interest in the social environment, and motor coordination following a period of normal functioning. These individuals also show severe impairments in their receptive and

expressive language (*DSM-IV-TR*; APA, 2000). As Rett's Disorder occurs almost exclusively in females, genetic analysis revealed that a rare X-linked chromosomal mutation underlies the susceptibility for this pervasive disorder (Yamashita, Kondo, Fukuda, Morishima, Kusaga, Iwanaga, & Matsuishi, 2001; Hoffbuhr, Devaney, LeFleur, Sirianni, Scacheri, Giron, Schuette, Innis, Marino, Philippart, Narayanan, Umansky, Kronn, Hoffman, & Naidu, 2001). Past studies lead genetic research on autism into new directions with an emphasis on behavioral genetics to examine broad phenotypic features and the association between sex-linked chromosomal disorders and autism (Feinstein & Reiss, 1998). Future genetic studies will attempt to unravel the potential genetic basis for abnormal neural and social development through linkage studies, analysis of chromosomal anomalies, and research examining translocation and association of candidate genes.

Neurological Theory

Research on neurological theories of autism arise from the assumption that brain development in the early stages of life refines the neural circuitry and neural communication pathways essential for language acquisition, self awareness, and the capacity for complex information processing. As brain volume, brain weight and head circumference are all related measures of brain development, several studies examined brain size abnormalities in individuals with autism, but found varying results. A meta-analysis conducted by Redcay and Courchesne (2005) compared the findings from 15 studies on head circumference and brain volume, combined with data from 55 post-mortem brain weights from patients with autism. This study represents the most cohesive understanding of the inconsistent findings reported in earlier studies. Comparisons with control subjects revealed a largely consistent pattern of brain size differences as a function of age, where individuals with autism had slightly reduced brain size at birth, significantly

larger brain size between the ages of two and five years, and then a plateau of arrested development that led to brain sizes that fell in the normal range by adulthood (Redcay & Corchesne, 2005).

Additional studies utilized structural magnetic resonance imaging (MRI) to examine brain configuration and differences between typically developing individuals and those with autism. Findings are largely inconsistent and have low rates of replication due to differences in design, analysis, and control. Numerous studies have examined the amygdala complex as research has found possible associations between social behavior and animal lesions in that area of the brain. Although studies seem to implicate enlarged amygdala and hippocampal volume, no firm conclusions exist due to disparate findings (Cody, Pelphrey, & Piven, 2002). One particularly stringent study conducted by Nacewicz and colleagues (2006) measured amygdala size blind to diagnosis in 25 males with autism and matched typically developing controls. Although the study did not find significant differences in amygdala size between participants with autism and controls, smaller amygdala volume was a significant predictor of slower judgment time in identifying emotional expressions, decreased eye fixation, and increased childhood social impairment for the experimental group diagnosed with autism (Nacewicz, Dalton, Johnstone, Long, McAuliff, Oakes, Alexander, & Davidson, 2006). Another study examined the basal ganglia, an area located near the amygdala complex, in 35 participants with autism and 36 comparable controls (Sears, Vest, Mohamed, Bailey, Ranson, & Piven, 1999). This region of the brain may be the neural basis for repetitive and ritualistic behaviors often observed in patients with autism, obsessive-compulsive disorder and Tourette's syndrome. Sears and colleagues (1999) discovered significantly enlarged caudate size, an area of the basal ganglia, in individuals with autism as well as significant correlations between caudate

volume and stereotyped repetitive behaviors, compulsions and rituals, difficulties in changes to environment or routine, and complex repetitive motor behaviors.

The frontal lobe is another area of the brain scrutinized in autism research due to its role in social and emotional functioning, communication, language development and higher-order thinking (Courchesne & Pierce, 2005). Using diffusion tensor imaging (DTI), one important pioneer study found impaired neural connectivity in the frontal lobes and areas adjacent to the amygdala as measured by fiber density, diameter, and degree of myelination in seven males with autism compared to matched controls (Barnea-Goraly, Kwon, Menon, Eliez, Lotspeich, & Reiss, 2004). Other studies have scrutinized the brainstem, hippocampus, corpus callosum, and cingulated gyrus (Cody et al., 2002). More recent studies have focused on the mirror neuron system as an area involved in emotion recognition and social cognition. Hadjikhani and colleagues (2006) identified decreases in the amount of gray matter in areas belonging to the mirror neuron system (MNS) in individuals with ASD. Additionally, cortical thinning of the MNS was highly correlated with symptom severity in the group with autism (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2006).

Research clearly illustrates a connection between autism and neurological development. Unfortunately, areas implicated are numerous and have the potential to affect some characteristics of the disorder and not others. Although no consistent assumptions can be drawn from these studies, neurological research has the potential to characterize brain phenotypes in autism and provide evidence for the relation between specific brain configurations and behavior.

Cognitive Theory

Emerging theories of cognition contend that the cognitive architecture of the human brain is species specific and evolved over evolutionary time to adapt to biological information-processing problems in our environment (Cosmides & Tooby, 1992; Pinker, 1997). The area of cognitive neuroscience leads to interesting theories which arise from an extension of cognitive theories, neurological research and evolutionary psychology. It is now a widely accepted belief that abnormal neurological development leads to the deficits in cognitive and social functioning commonly associated with autism (Minshew, Sweeney, Bauman, & Webb, 2005). Research on individuals with autism spans cognitive deficits in abstract reasoning, attention shifting, executive function, and complex information processing (Minshew, Johnson, & Luna, 2001). Many cognitive theories suggest that certain features of cognition, mainly associated with social information processing, are impaired in individuals with autism while other aspects of information processing remain intact.

The theory of executive dysfunction has received much attention in the last two decades. This theory contends that individuals with autism display deficits that resemble those of patients with damage to their frontal lobes which include the inability for flexible thought, planning, impulse control, and the capacity to hold a mental representation in working memory. Damasio and Maurer first suggested this theory in 1978, describing it as a dysfunction in the neural structures of the frontal lobes. However, a longitudinal study which compared preschoolers with and without autism over the course of one year found no group differences in performance on eight executive function tasks (Griffith, Pennington, Wehner, & Rogers, 1999). Additionally, the researchers noted that the

children with autism initiated fewer social interactions and less joint attention, indicating that cognitive deficits may lie in areas of social functioning.

Baron Cohen wrote a book entitled *Mindblindness* (1995), which built on the idea put forth by Alan Leslie (1987) that children with autism suffer from a deficit in *theory of mind* – the ability to attribute mental states to self and to others and to predict behavior on the basis of such states. Baron-Cohen (1995) asserts that there are four mechanisms involved in the human mindreading system, which allow humans to create a *metarepresentation* – a mental representation of another person's mental/emotional point of view. These include the *intentionality detector* (ID), that interprets self-propelled movement in terms of a goal state; the *eye-detection detector* (EDD), which detects eye direction and infers that if the eyes of an organism are looking at an object, then that organism sees that object; the *shared-attention mechanism* (SAM), that uses information from EDD to build triadic relationships that specify shared attention; and finally the *theory-of-mind mechanism* (TOMM), which, as explained earlier, builds a metarepresentation to create a connection between mental states and action. An example of this process could be that child A sees child B walking toward a chair (ID-motion is interpreted as a primitive desire state). Child B is looking up at a cookie jar on the table (EDD-detection of the direction of the eyes), thus child A concludes that Child B will climb the chair because he wants to reach the cookie jar (SAM-eye direction interpreted as a mental state or goal for Child B). Child A can now conclude that child B wants to get to the cookie jar because he believes there are cookies inside (TOMM-a mental state is attributed to child B). This thought process can progress one step further. For example, if child A knows that the cookie jar is empty, he would then deduce that child B's mental state is incorrect, which is known as a *false belief.* One of the major postulations of this theory is that the theory of

mind mechanism is part of the basic architecture of the human brain, such that impairments to this mechanism severely affect social learning (Leslie, Friedman, & German, 2004).

Much research dedicated to theory of mind exists, as TOM may be necessary in understanding, explaining, predicting, and manipulating the behavior of others. A meta-analysis published in 1998 found over 40 separate published experiments comparing theory of mind capabilities in individuals with autism with matched control subjects (Yirmiya, Erel, Shaked, & Solomonica-Levi, 1998). Current searches yield over 2000 published works relating autism to deficits in theory of mind. Research strongly supports the conclusion that individuals with autism experience core deficits in TOM, often measured using a task that tests an individual's ability to understand false beliefs (Baron-Cohen, 1991, Baron-Cohen, 1995; Happe, 1994; Yirmiya et al., 1998). This theory makes the assumption that not having a well developed theory of mind leads to dysfunctions in social awareness, social reciprocity, and imagination (Baron-Cohen, 1990). Additionally, patients with acquired bilateral amygdala lesions and those with bilateral damage to the frontal cortex show impairments in theory of mind tasks which resemble those of individuals with ASD (Stone, Baron-Cohen, & Knight, 1998; Stone, Baron-Cohen, Calder, Keane, & Young, 2003). A more detailed review of studies pertaining to this theory can be found in *Mindblindness: An essay on autism and theory of mind* (Baron-Cohen, 1995).

Although tests of theory of mind help to explain impairments in socialization and imagination, they have not shed light on early developing deficits on non-social tasks for individuals with autism. The *weak central coherence* theory first postulated by Uta Frith and colleagues is an additional cognitive theory that attempts to explain these abnormalities (Frith & Happe, 1994). Central coherence theory suggests that individuals with autism process information in a piecemeal fashion, focusing more on details and less on the

context. Researchers believe that weak central coherence can lead to impaired social communication, stereotyped play, and deficits in social information processing. Joliffe and Baron-Cohen (2001) tested the ability to integrate objects in a scene and the ability to identify inappropriate objects in a scene in 17 individuals with high-functioning autism, 17 with Asperger syndrome, and 17 normal adult controls. They observed impairments in the ability to integrate objects together to form a coherent scene, to describe scenes, and to identify inappropriate objects within a scene for individuals with ASD, which indicates deficits in global context processing. A later study found that compared to matched controls with intellectual disabilities, individuals with autism and comorbid severe mental impairments perform better on tasks requiring detail-focused processing which supports weaker central coherence for this population (Van Lang, Bourma, Sytema, Kraijer, & Minderaa, 2005).

Theory of mind and weak central coherence are distinct theories, each postulating specific predictions and explanations. A two year longitudinal study of high-functioning children with autism and matched controls examined the relation of central coherence and theory of mind across two TOM tasks and four measures of central coherence (Burnette, Mundy, Meyer, Sutton, Vaughn, & Charak, 2005). The study found support for both theories, as well as moderate correlations between the two. However, another study looking at central coherence abilities across joint attention and pretend play, two behaviors allegedly underlying TOM, found that weak central coherence, poor joint attention, and low verbal ability independently made significant predictions of ASD group membership (Morgan, Mayberry, & Durkin, 2003). Thus, it is possible that several independent cognitive deficits underlie autism, which may include theory of mind and weak central coherence.

Social Theory

Social impairments are a well documented symptom fundamental to the diagnosis of autism. The affective theory, first detailed by Kanner (1943), puts forth that children with autism have an inherent deficiency disturbing their affective systems. Kanner stated that "they possess an innate inability to form the usual affective contact" (Kanner, 1943, p. 1). This view was further developed by Hobson (1993), who argued that individuals with autism have an innate disinterest in interpersonal relations. This indifference develops early in life and prevents them from developing later, more complex expressions of emotion and social understanding. He wrote, "Autistic children's deficient or aberrant capacity for intersubjective engagement with others is what causes their limitation in understanding minds" (Hobson, 1993, p. 11).

Early beliefs that autism entailed an absence of emotional expression and indifference to others contrast with more recent findings that support a combination of strengths and weaknesses in affective abilities. One study examining personal accounts of emotional experience in 28 children with autism and 22 comparisons found that children with autism were able to describe basic and complex emotional experiences (Losh & Capps, 2006). However, their descriptions were systematically different from typically developing children, suggesting that the children with autism could have affective experiences that are qualitatively distinct.

In a review of studies, Baron Cohen (1988) considered both the affective and the cognitive theories as they relate to autism and concluded that the although affective theory provides a better explanation of deficits in emotion recognition, the cognitive theory helps to explain the splintered social skills characteristic of autism, suggesting that the two theories may need to be incorporated in the future. Interestingly, a study by Shamay-

Tsoory and colleagues (2005) proposed that theory of mind may be comprised of both affective and cognitive components utilized for specific tasks. The researchers examined responses to three well established TOM tasks (second-order false belief, detection of irony, and identification of social faux pas) in patients with well-defined acquired cortical lesions and matched controls. They found that the experimental group had no difficulty on false-belief tasks (tasks that require cognitive understanding of beliefs about belief), however they were impaired on irony and *faux pas tasks* (tasks which require understanding about beliefs about emotion). Additionally, performance on tasks requiring cognitive affect was highly correlated with measures of empathy (Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2005). Although current studies examining "affective" TOM in individuals with autism do not exist, this experiment raises the question of whether impaired TOM in individuals with autism is due to an inability to coordinate two separate processes necessary for the performance on some, but not all TOM tasks.

Mundy and Neal (2001) propose another social model which suggests that initial neuropathological processes cause early deficits in social-orienting and joint attention in individuals with autism and may contribute to a subsequent lack of processing social information at critical stages of development during infancy. The social-orienting model is a transactional approach that builds on the idea of neural plasticity. The theory postulates that behavioral symptoms of autism result in a severe impoverishment of social information during early development. This leads to a failure in experience-expectant processes that organize the brain for later social behaviors and social cognitive development. Several studies demonstrate that autistic brains respond differently to faces and social stimuli (Ashwin, Wheelwright, & Baron-Cohen, 2005; Bailey, Braeutigam, Jousmaki, &

Swithenby, 2005; Dawson, Toth, Abbott, Osterling, Munson, Estes, & Liaw, 2002; Pierce, Muller, Ambrose, Allen, & Courchesne, 2001). Neural connections select and store information about what is happening in the environment, thus a deficiency in the ability to attend to and process social information arrests further social development (Greenough, Black, & Wallace, 1993).

Individuals with autism often seem disinterested in the social world around them. Researchers observed significantly fewer social and joint attention behaviors in one-year-old children later diagnosed with autism as measured through pointing, sharing, looking at others and orienting to name (Osterling & Dawson, 1994). Children with autism also more frequently fail to orient to social stimuli compared with age matched typically developing children and those with Down syndrome, and this failure is an extreme contrast to their ability to orient toward nonsocial stimuli (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Interestingly, some studies demonstrate impairments in brain activation in response to familiar versus unfamiliar faces, a phenomenon researchers did not observe when individuals with autism viewed familiar versus unfamiliar objects (Dawson, Carver, Meltzoff, Panagiotides, McPartland, & Webb, 2002). Further analysis reveals a significant correlation between performance on social-orienting tasks and the ability for joint attention (Dawson et al., 1998). These findings support a theory that impairments in social developmental processes, namely joint attention and social orienting, may be the result of a fundamental error in selective attention to social stimuli.

Impairments in social-orienting can create a problem. Developmental theory suggests that children learn through their experiences, which include experiences to which children react and those they initiate for themselves (Piaget, 1952). A major proposition of the social-orienting theory lies in the idea that brain systems utilized in social perception

may be different from those employed in social initiation (Mundy & Burnette, 2005). Individuals with autism experience difficulty in forming reciprocal social relations and some believe this has to do with communication impairments. However, one study found that three- and four-year-old children with autism were impaired in social-orienting, joint attention, and attention to another's distress in non-communicative interactions (Dawson, Toth, Abbott, Osterling, Munson, Estes, & Liaw, 2004). The researchers also identified joint attention as the most significant predictor of current language ability in the group with autism. Another study conducted by Charman and colleagues (2001) examined joint attention, imitation and play behaviors in infants at 20 months and followed up with language, IQ and theory of mind measures at 44 months. Findings associated imitation abilities with expressive, but not receptive language abilities at 44 months of age. Additionally, joint attention gaze switches between an adult and an active toy were longitudinally associated with theory of mind abilities, which suggests that joint attention, imitation, language and theory of mind may be part of a social communicative system that becomes more specialized through social development (Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2001).

Mundy & Neal (2001, p. 151) wrote, "Insensitivity to social reward early on leads to an imbalance where the infant with autism fails to engage in social approach behaviors and underemphasizes social information processing, while, perhaps through compensatory mechanisms, overemphasizes nonsocial information processing." Indeed, when describing emotional experiences, children with autism often rely on descriptions involving observations of behavior or visually discernable facial indices of emotion, which contrast completely with typical children who rely on contextual social cues and self evaluation (Losh & Capps, 2006). This proposal suggests that the lack of spontaneous attention to and

processing of facial expressions and social information that is characteristic of people with autism, coupled with their disinterest in initiating social interactions, contributes to deficiencies in later developing social processes.

Emotion

In 1872, Charles Darwin wrote *The Expression of Emotion in Man and Animals.* In this book, he first introduced the provocative idea that emotions and emotional expressions may be innate across cultures and species. His observations also led him to the conclusion that imitation of facial expressions may be an instinctual communication of emotion (Darwin, 1872). This work incited over one hundred years of research on emotions, emotional development, emotional expressions, emotion perception and the function of emotions. There exist over 30 historically significant theories on emotion which differ in fundamental assumptions, stress various aspects of emotion and in many cases place emphasis on more than one facet of emotion making them difficult to categorize (Strongman, 1987). This may be because the idea of emotion as a single process cannot encompass the vast amount of data gathered on emotions. The next section will summarize research on emotions from evolutionary, developmental, functional and structural perspectives before introducing the theory of emotional contagion as it relates to the current study.

Evolutionary Perspective

Since Darwin's initial proposal, the evolutionary perspective of emotion puts forth that emotions are an outcome of the evolutionary process, which serves as a basis for a growing area of contemporary emotion research (Ekman, 1992; Izard, 1993; Tooby & Cosmides, 1992). According to this theory, emotions evolved to mobilize the human mind and body to meet particular challenges in the environment that affect the natural selection

process (Pinker, 1997). Researchers theorize that for ancient hominids, emotional mechanisms in the architecture of the brain developed specifically to address adaptive problems involved with communication, sexual arousal, mate selection, mate guarding, parenting, parental investment, kin detection, aggression and altruism (Tooby & Cosmides, 1992). Thus, evolutionists believe that emotions are innate and universal across all cultures and that emotional expressions are associated with specific emotion states, sometimes referred to as the *innateness-universality* hypothesis (Izard, 1994). One landmark study supporting the innateness of human expression was conducted by Ekman, Sorenson, and Friesen (1969) and demonstrated that preliterate New Guinea tribes people identified a number of emotional facial expressions similar to those identified by participants from the literate cultures of Japan, Brazil, and the United States. Since that time, a substantial body of research has shown that certain prototypic facial configurations are identified across a variety of cultures as expressions of the six basic emotions of joy, fear, anger, surprise, sadness, and disgust (Ekman & Oster, 1979; Izard, 1994). An alternate view posed by Russell (1995) hypothesizes that at the least there exists a *minimal universality* in that all humans can at least infer some information about others through their facial behavior.

According to Cosmides, Tooby, and Barkow (1992), humans evolved the ability to interpret the mental states of others due to the intensely social, competitive and cooperative nature of our species, which over time developed specific neurological modules in our perceptual systems for reliably reading the outward and observable signs of internal mental states. Research supports the idea that evolution hardwired the brain to process emotional cues. Several studies have shown that specific areas of the brain activate when processing the emotional expressions of others (Adolphs, Damasio, Tranel, & Damasio, 1996; Breiter, Etcoff, Whalen, Kennedy, Rauch, Buckner, Strauss, Hyman, & Rosen, 1996; Gur,

McGrath, Chan, Shroeder, Turner, Turetsky, Kohler, Alsop, Maldjian, Ragland, & Gur, 2002; Nakamura, Kawashima, Ito, Sugiura, Kato, Nakamura, Hatano, Nagumo, Kubota, Fukuda, & Kojima, 1999; Winston, Henson, Fine-Goulden, & Dolan, 2004) and different areas activate in response to different emotions (Blair, Morris, Frith, Perrett, & Dolan, 1999; Suzuki, Hoshino, Shigemasu, & Kawamura, 2006). This lends support to the theory that neural design features evolved specifically to decode the emotions of our companions.

According to a review of studies by Posamentier and Abdi (2003), evidence of a specialized perceptual system to process facial expressions, which functions independently from systems used for identity recognition, lies in the existence of a condition known as *prosopagnosia* where individuals are impaired in their ability to recognize familiar faces, but can still read emotional cues. Additionally, a study conducted by Winston and colleagues (2004) identified an anatomical dissociation between areas of the brain utilized in encoding identity and those utilized for encoding expressions using functional MRI scans of 16 healthy adults. Batty and Taylor (2003) also examined the speed of emotion processing in humans and came to the conclusion that the speed of localized brain activity in response to the six basic emotional expressions of happy, sad, fear, surprise, anger and disgust supported the idea that the decoding of emotions was rapid and automatic.

Theories that emotional expression and recognition evolved through natural selection make sense as humans communicate facial expressions very quickly, which would have been appropriate for non-verbally inferring the emotional state of individuals in close vicinity. Language studies also support the idea that major conceptualizations of emotion are similar worldwide, despite fine-grained distinctions in representation and emphasis which occurs at secondary levels (Shaver, Upekkha, & Fraley, 2001). Evolutionary perspectives have now expanded to reflect on social prejudice, social

perceptions between different cultural groups, and impressions gained from facial cues (Montepare, 2003).

Evolutionary theories of emotion are not without criticism, as some researchers feel the approach confines the area of study to the current products of adaptive efforts, relies heavily on inference and conjecture, and is described in abstract but seemingly apparent theories of inclusive fitness and reproductive success. Additionally, it may neglect anthropological data which suggest that in many ways, humans differ quite extensively from their predecessors (Langs, 1996). Despite these criticisms, an evolutionary basis for the development of basic emotions is now widely integrated into the foundations of other well known emotion theories.

Developmental Perspective

The developmental perspectives propose that emotions, emotional expressions, self awareness of feeling states and the ability to understand the emotion states of others develop over the course of the lifespan. Although emotions are an innate quality of human existence, humans are not born with a fixed collection of emotion skills. An influential perspective was one of Bridges in 1932 which suggested that an infant is born with undifferentiated emotional expressions that become increasingly distinct as a function of age (Strongman, 1987). In fact, the capacity for humans to voluntarily control emotional expressions implies that the social complexity of our species forced humans to adapt the capacity for social-cognitive development (Izard, 1994). This perspective incorporates the idea that individuals get better at appraising and responding to emotions in socially appropriate ways as they mature. Additionally, emotional development is associated with psychobiological maturation, self control, and the awareness of social conventions (Thompson, 1999).

The developmental perspective is rooted in the assumption that emotions are a product of human evolution and natural selection which may help to explain why emotions develop very early in life. Developmental psychologists interested in studying emotion have naturally looked toward the development of facial expressions and emotion regulation in infants. Research on early facial expression suggests that age differences in facial displays may be the result of both maturational and social development. A study by Campos and Emde (1979) found that infants responded to situations which elicit happiness, surprise and fear with blends of emotional expressions rather than discrete facial muscle patterns. However, observers were able to identify the emotions accurately even without the presence of contextual cues. In another study, eleven-month-old infants exposed to an expectancy-violating event did not produce more surprise-related facial muscle movements, but instead were rated as producing more body-stilling and facial-sobering which was highly correlated with observer ratings of surprise and interest (Camras, Meng, Ujiie, Dharamsi, Miyake, Oster, Wang, Cruz, Murdoch, & Campos, 2002). These findings imply that observers can interpret bodily movements as emotions from an early age and that the production and regulation of discrete facial expressions, such as surprise and fear, may develop later in life.

Developmental theory has emphasized the emergence of emotional affect and research aimed at identifying a timetable for the development of different emotional expressions and elicitors of these reactions. In a study by Camras and colleagues (1992), researchers observed the negative expressions of Japanese and American infants at five months and 12 months in response to an arm restraint procedure. They found that older infants responded more quickly and more negatively across both cultures and suggested that the development of an experience-expectant understanding of self propelled motor

movement may have made the experience more negative at an older age. The researchers believed that experience-expectant understanding coupled with expression refinement and maturational development of reaction time, contributed to these results (Camras, Oster, Campos, Miyake, & Bradshaw, 1992). The development of expectations has elicited affective responses in younger children as well. An earlier study also observed negative emotional responses to violations of a previously learned expectation (sucrose delivery through classical conditioning) in two-day-old infants through increased crying behaviors (Blass, Ganchrow, & Seiner, 1984). Thus, although the experience of an emotion may remain relatively the same throughout the lifespan, its causes and consequences may change as the individual develops and matures. Conversely, the activation of certain emotions may be dependent on cognitive development, as is the case with shame and guilt (Izard, 1991).

Emotional developmental perspectives also encompass social learning aimed at controlling and modifying emotional expressions. Emotional learning begins in early infancy through interactions with caregivers and has observable effects on expressiveness as mediated by culture, gender and familial demands by the first year of life (Malatesta & Haviland, 1982). Ekman and Freisen (1975) describe this phenomenon as the learning of display rules which are described as procedures learned early in life for the management of affect displays, including deintensifying, intensifying, neutralizing or masking an affect display. Malatesta and colleagues (1986) examined emotion socialization and expressive development in preterm and full term infants through videotaped interactions with their mothers. Their research identified significant learning effects in infant expressions as a function of maternal modeling and patterns of contingent responding to expressions of positive and negative affect by their infant.

The development of emotions continues into early and middle childhood in terms of more effectively managing emotions through cognitive means and behavioral strategies (Thompson, 1999). According to developmental and social-learning theories, display rules for the expression of emotion are taught through social interactions and therefore can vary between different cultures. Although some theorists initially proposed that different ethnicities were inherently more or less expressive by nature, current research supports the idea that social experiences influence the development of emotional expressiveness and that this occurs within members of the same ethnic group. A recent study examined the facial expressions of Chinese and European American girls in reaction to emotionally evocative slides and odors (Camras, Chen, Bakeman, Norris, & Cain, 2006). European American girls smiled more than mainland Chinese girls and Chinese American girls, and they were also more expressive in general compared to mainland Chinese girls. Additionally, self-reports of maternal strictness, aggravation, positive expressiveness, cultural identification, and number of siblings in the home correlated with children's facial responses, suggesting that culture and family environments influence facial expressivity and help account for differences among children of the same ethnicity.

The ability to understand emotions also develops throughout childhood. For example, a study by Donaldson and Westerman (1986) described the developmental progression of children's understanding about situations that can simultaneously elicit conflicting emotions such as happy and sad. They found a significant relationship between children's understanding of emotions and age and determined that most children were able to understand conflicting emotions by about age nine or ten. Children also learn to understand how display rules affect expressive behavior. Saarni (1979) conducted a study with 60 school-aged children and concluded that the older children have a greater

understanding of display rule usage and reasons why people use them in different situations.

As humans mature into adulthood, emotional development takes a new turn, as the significance of social relationships and influence change with age (Thompson, 1999). One study examining emotional expressions in younger and older adults found that younger participants (mean age = 28 years) scored significantly higher on self-consciousness ratings and were more inhibited in their facial expressions. Conversely, older aged adults (mean age = 69 years) scored higher on a social desirability scale and were rated as more emotionally expressive across a range of emotions (Malatesta-Magai, Jonas, Shepard, & Culver, 1992). Additionally, a study of age matched young, middle-aged, and older women found that individuals were better at decoding the emotional expressions of like-aged peers (Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986). The researchers also discovered that older adults were the least accurate in decoding the expressions of others and displayed the most difficult expressions to decode because of age related changes in the face. Thus, it seems that emotional development follows a pattern of rapid growth in childhood which evens out and eventually declines in the later years of life.

Developmental theories of emotion received criticism for a variety of reasons. One valid criticism is that emotions develop around the same time as other processes, such as maturational (biological), social, and cognitive development as well as self understanding and social awareness (Thompson, 1999). These processes may be integrally related and nearly impossible to tease apart, making it difficult to extract clean assumptions about emotional development specifically. Additionally, infant studies assumed that the researchers were able to determine what infants were feeling despite limited verbal and cognitive abilities (Strongman, 1987). To date, the concept of emotional development

continues to receive a lot of attention. This area of research has expanded into the realm of education where instructional methods aimed at fostering the development of "*emotional intelligence*" in children remain popular (Salovey & Sluyter, 1997; Shapiro, 1997). Themes from emotional development have also contributed to the continued refinement of classic theories related to the structure and functions of emotions.

Structuralist Perspective

Structuralist perspectives define emotion as physiological reactions, the subjective experience of those reactions, and expressive outcomes. Accordingly, researchers categorize emotional experience into distinct emotion states, such as anger and fear, each with distinctive patterns of arousal, appraisal and feeling. Structural emotion theorists also consider emotions to be the result of human evolution, as each constellation of visceral, subjective and expressive components mobilize the body and enhance reproductive success (Thompson, 1999).

Structural accounts of emotion, also known as constructivist accounts, changed dramatically since their initial inception. William James's 1884 theory of emotion, initially included in the *Principles of Psychology,* was one of the first to deal with the biological mechanisms and processes that produce feelings. His ideas paved the way for new directions in psychological research for the 20th century (Strongman, 1987). Incorporating similar assumptions proposed by Carl Lange, the theory came to be known as the *James-Lange* theory of emotion and was one of the first and most influential theories of emotion , specifying that instinctive bodily reactions were the basis for emotion. To summarize, this theory put forth that an individual's awareness of visceral bodily changes, aroused by the perception of an exciting fact, object or thought, determined the experience of emotion (Mandler, 1990). For example, Mandler, Mandler, and Uviller, (1958) examined

autonomic responses to an anxiety producing situation and found that self reported perceptions of arousal positively correlated with measurements of autonomic reactivity, indicating that individuals were indeed aware of the visceral body changes that occurred during emotionally charged situations.

One of the main points stressed by James was the idea that perception and arousal preceded emotional experience (Strongman, 1987). At that point in history, psychologists did not have the skill to test such a hypothesis; however the original ideas of James and Lange inspired emotion research to seek out visceral patterns associated with certain emotions. Since that time, researchers discovered that distinct patterns of autonomic nervous system (ANS) arousal are highly correlated with specific emotional categories (Fehr & Stern, 1970; Gellhorn, Cortell, & Feldman, 1940) and emotional expressions (Dimberg, 1987; Ekman, Levenson, & Friesen, 1983, Hess, Kappas, McHugo, Lanzetta, & Kleck, 1992). Indeed, when participants viewed emotionally eliciting films in a study by Christie and Friedman (2003), specific patterns of ANS activity accompanied the self reported emotions of amusement, anger, contentment, fear and sadness. Overall, research has provided solid evidence for ANS specificity, especially for distinctive arousal associated with the negative emotions, and for differences between positive and negative emotions (Ekman et al., 1983). Despite this later focus on the autonomic nervous system, questions remained as to whether specific patterns determined emotion or were simply the functional accompaniment to an emotion (Wagner, 1988).

Contemporary neo-Darwin theorists, such as Silvan Tomkins, Paul Ekman, and Carroll Izard, hypothesized that emotion programs exist in the brain to regulate arousal patterns; an idea first put forth by W. B. Cannon as an argument against the James-Lange theory (Strongman, 1987). The *Cannon-Bard* theory was one of the first to suggest the role

of neural structures in emotion. Cannon proposed that these structures regulated a general state arousal for all emotions. In contrast, contemporary neurological studies on emotion have distinguished specific sites of neural activity associated with the experience of different emotions (Damasio, Grabowski, Bechara, Damasio, Ponto, Parvizi, & Hichwa, 2000) and with the processing of different emotional expressions (Lobaugh, Gibson, & Taylor, 2006), more in line with the James-Lange theory. However, the early work of Walter Cannon and Phillip Bard sparked later theorists (such as Papez and Bindra) to speculate on more explicit, highly structured neural circuits. The amygdala and the prefrontal cortex are areas of the brain contemporary researchers hypothesize function as the two components involved in the central circuitry of emotion (Davidson, Jackson, & Kahn, 2000), however studies have also linked the brain stem, hypothalamus, thalamus, hippocampus, and the cingulate gyrus to emotion (Strongman, 1987).

One inconsistency in constructivist theories was Cannon's doubt of the role that William James dedicated to skeletal muscular responses in producing emotion (Wagner, 1988). Facial expressions utilize a muscle system that has received much attention in the last twenty years, and this research has formed the basis for the *facial feedback hypothesis.* Tomkins was one of the first theorists to put forth that facial expressions and awareness of facial responses were integral aspects of emotional experience, an idea incorporated into several later theories (Izard, 1990). Ekman and Friesen (1976) even created a procedure for measuring visually discernable facial movements based on the anatomical structure of facial muscles known as the *Facial Action Code,* whilst Izard created the *Maximally Discriminative Facial Movement Coding System.* Researchers, using measurements of facial electromyographic (EMG) activity, have found that changes in facial expression too slight to detect visually can differentiate between positive and negative emotional reactions

as well as the intensity of those reactions (Cacioppo, Petty, Losch, & Kim, 1986). Today, the structuralist perspective contends that individuals experience emotion through thoughts, behaviors, facial expressions, conscious or subconscious awareness of those expressions and the reactions of the Autonomic Nervous System (Myers, 2000).

The facial feedback hypothesis proposes that an individual's facial expression of emotion elicits corresponding feeling states even when the individual is unaware of the expressions manipulated by the experimenter. Laird (1974) was one of the first experimenters to test this hypothesis by instructing undergraduate students to form facial configurations of emotion without instructing them to do so explicitly. He found that expressions did indeed affect emotional experience. Later studies have corroborated the finding that a facial expression alone can induce appropriate ANS arousal levels associated with a particular emotion through facial feedback from activated muscles (Ekman et al., 1983). Individuals in Ekman's study reported feeling emotions associated with the expressions they were posing, and Ekman suggested they may judge the intensity of their emotions based on their perception of subsequent levels of physiological arousal. Another study by Levenson and colleagues (1992) instructed participants from the Minangkabau of West Sumatra to form prototypic configurations of facial expressions. They found no significant differences between Americans and the Miningkabau in the production of distinctive patterns of ANS arousal associated with different emotions, indicating a cross-cultural consistency in this effect (Levenson, Ekman, Heider, Friesen, 1992). Levenson and Ekman (2002) then conducted an additional analysis of their earlier findings and concluded that neither the difficulty of facial configurations, time needed to produce facial configurations, nor the activation of other nonfacial muscles could account for differences in ANS arousal patterns for different emotions. Unlike Silvan Tomkins's initial

proposition that facial activity is always part of an emotion, Ekman believes that some emotions can occur without visible signs of facial activity, although they manifest the same autonomic responses (Ekman, 1993).

The *Discrete Emotions* theory postulated by Carroll E. Izard also received a lot of attention in emotion research as it attempted to incorporate evolutionary, developmental, structural and neurophysiological views of emotion. According to this theory, emotions are inherently adaptive and incorporate distinct neural, expressive and experiential components which influence a wide variety of behaviors, inner experiences, and cognitions (Izard, 1991; Izard, 1994). Interest, enjoyment, surprise, distress, disgust, anger, shame, fear and contempt are distinct emotion systems Izard believes produce the main motivational systems that determine human behavior (Izard, 1991). Contrary to developmental theorists, Izard postulates that evolutionary and genetic factors determine the facial expressions of emotion in infants as demonstrated by morphological stability in the expressions of anger and sadness during the first nine months of life (Izard, Fantauzzo, Castle, Haynes, Rayias, & Putnam, 1995). While neo-Darwinian constructivist theories vary in several respects, they commonly put forth a set of basic primary emotions, each with a unique corresponding set of neurophysiological processes, expressive responses, and internal phenomenological experience.

Functionalist Perspective

The functionalist perspective defines emotion in broad terms as person-environment transactions which can be conceptualized in different ways depending on the nature of the relationship (Thompson, 1999). The term "emotion" is derived from the Latin form *E-motion* which translates to "movement forth." Functionalists view emotions as inherently goal directed, adaptive, and functional for preparing an individual for action in response to

internal and external aspects of the environment (Strayer, 2002). For example, fear serves to mobilize the body for flight and functions to remove the individual from negative or uncertain situations (Frijida, 1989). Additionally, from this perspective, emotions function to regulate both intrapersonal and interpersonal processes and outcomes (Campos, Campos, & Barrett, 1989). Thus, emotion relates to situational appraisals, action tendencies, goal attainment, social relationships, self regulation and self understanding (Thompson, 1999).

The roles of cognition and appraisal were the focus of many studies on emotion. The *two factor* theory of emotion was one of the early influential theories that inspired later research on cognitive appraisals and arousal (Strongman, 1987). Schachter postulated that when individuals experience a general state of arousal, cognitions about their arousal and about the situational cues that help to explain their arousal, determine the emotion felt. In Schacter and Singer's (1962) now famous study, participants who received a stimulant (epinephrine) became angrier in situations with an angry informant and more euphoric in situations with a joyful informant when they received no information or misinformation about the effects of epinephrine. This led to the conclusion that situational cues could be used to manipulate a participant's cognitions which then determined the emotions experienced when they were physically aroused and had no other explanation for their arousal. Later criticisms of this theory agreed that the most important piece of information gleaned from this study was that both arousal and cognitions influence emotions (Izard, 1991; Strongman, 1987).

Lazarus postulated another theory of cognitive appraisal and coping that included thoughts on the motivational aspects involved in emotional experience. According to Lazarus, cognitive appraisal encompasses both *primary appraisal* and *secondary appraisal* which mediate emotional experience (Lazarus, 1991). Primary appraisal addresses the

motivational relevance of the situation: whether it is important to the individual's well-being. According to Campos and colleagues (1989), there are three things that make an event significant for an individual: how important the event is to the goals of the individual, if the event serves to communicate emotional information from significant others, and whether the event has hedonic content (either positive or negative). In other words, emotions will not arise in situations where the individual has no personal stake in the outcome (Frijida, 1988; Lazarus, 1991). Theoretically, social and cultural factors also exert influence on an individual's primary appraisals. Secondary appraisal considers what actions are possible in response to a situation and the amount of control the individual has in determining the outcome (Lazarus & Folkman, 1987). To put it all together, situations perceived as being very important (primary appraisal) with greater amounts of control (secondary appraisal), elicit impulses or tendencies (coping) that lead to emotional behavior.

From this view, coping is a mechanism for addressing the situation directly as well as a mechanism for regulating emotional responses. Indeed, researchers found a significant relationship between cognitive appraisals and coping that varied depending on what was at stake (primary appraisal) and what options were available (secondary appraisal) (Folkman, Lazarus, R. S., Dunkel-Schetter, C., DeLongis, A. & Gruen, 1986). Another study of 291 adults found that planful problem solving and positive reappraisal were coping strategies positively associated with confidence and happiness, while confrontational and distancing strategies positively related to anger and disgust (Folkman & Lazarus, 1988).

Frijida (1988) put forth that emotions arose in response to different meaning structures attributed to situations on an individual basis. Thus, environmental events alone cannot predict expected emotional outcomes, as any event can produce a multitude of

emotions based on how the event is construed by that individual (Campos, Frankel, & Camras, 2004). Additionally, Frijida (1988) postulated that meaning structures give rise to patterns of action readiness. From this perspective, emotions are processes which establish, maintain, change, or terminate the relationship between a person and their environment (Campos et al, 1989; Frijida, 1988). Frijida, Kuipers, and Schure, (1989) conducted two studies which examined the relationship between emotion states, cognitive appraisals and action readiness through questionnaires administered to 180 university students. In this study, the researchers defined action readiness as "the individual's readiness or unreadiness to engage in interaction with the environment" (Frijida et al., 1989, p. 213). They found significant relations between emotion categories, patterns of appraisal, and patterns of action readiness and determined that these patterns could reliably predict the emotions participants reported experiencing.

Functionalists also view emotions as they relate to goal attainment. Campos and colleagues (1989) view emotions as processes to achieve or maintain change in the environment and speculate that individuals will employ a variety of situation-appropriate means in order to attain their relational goals. Functional theorists explained that depending on the meaning structure attributed to a certain situation, the emotional measures utilized to attain relational goals may or may not include the production of prototypic facial expressions (Strayer, 2002). One study found that infants exhibited fear through a variety of behavioral responses that included increased heart rate, crying, circling, freezing and avoidance, despite a lack of facial expressions of fear (Campos, Bertenthal, & Kermoian, 1992). The authors theorized that the infants employed a variety of behaviors in an attempt to change their current fearful situation. Another study found that infants utilize social referencing when on the visual cliff to infer meaning about a

situation when the person-environment relationship was unclear and the infants wanted to cross the visual cliff (Sorce, Emde, Campos, & Klinners, 1985). When a mother posed facial expressions of happiness, many infants crossed the visual cliff; whereas when mothers posed expressions of fear or anger, very few infants crossed, indicating that emotions involved the use of social relationships to better define goals. Additionally, in this study, maternal emotional expressions served as a basis for communication that helped to regulate behavior in ambiguous situations. Theorists also suggest that when social referencing is repetitive in nature, as with caregivers, it creates individual dispositions for reaction which become the foundation of value systems and culture (Campos et al., 1989).

Emotion regulation is another area highlighted in functional emotion theories. As the relational nature of functionalist theory appreciates both appraisals of importance and reactions to a situation, emotion regulation becomes crucial in both the generation and control of affective response (Campos et al., 1989). A series of studies conducted by Gross and John (2003) found that the habitual use of reappraisal as an emotional regulation strategy related to the generation of positive versus negative emotions, greater interpersonal functioning, and greater well-being. Another study examining suppression as a form of emotion regulation determined that not only did suppression negatively impact communication and relationship formation; it also increased the blood pressure of both the individual regulating the emotion and the person they were interacting with at the time (Butler & Egloff, 2003). This finding is especially interesting as it suggests that emotions subconsciously affect individuals internally and externally in social relationships.

Unfortunately, a purely functionalist view of emotions makes it difficult to distinguish emotions from other motivational states (hunger, indifference, or arrogance) or from personality attributes (Thompson, 1999). An additional criticism of functional

theories relates to a lack of speculation on the existence of internal emotion control systems or alternative mechanisms for organizing emotional responses (Strongman, 1987). What is clear is that emotions serve us in many ways and they include the components of arousal, expressions, subjective experience, intra and interpersonal communication, and emotion specific action tendencies (Strayer, 2002).

The very concept of emotions being relational rather than absolute has altered scientific thinking about traditional response systems. Although autonomic responses are generally accepted as involuntary accompaniments to arousal or emotion, they are also powerful communicators that regulate intrapersonal and interpersonal relations. Broad conceptualizations of emotion strive to make sense of the vast research on emotions conducted in the last 100 years to mediate contradictions between major perspectives. The theory of emotional contagion is one that addresses the function of emotional signals and states of arousal in interpersonal relationships. This theory will be described at length as it relates to this study and to autism.

Emotional Contagion

The theory of emotional contagion contends that physiological factors may come in to play when interacting with other people and that people naturally catch the emotions of others. According to Hatfield, Cacioppo, and Rapson (1993), emotional contagion is a tendency to synchronize the expressive attributes of emotion with those of another person, leading to similar or complimentary emotional experiences. *Primitive emotional contagion* is the focus of this overview and refers to the automatic, uncontrollable and largely unconscious aspects of emotional contagion (Hatfield, Cacioppo, & Rapson, 1992). This theory has three major components: mimicry, arousal, and emotional convergence (Hatfield et al., 1993; Hatfield, Cacioppo, & Rapson, 1994).

According to the theory, emotional contagion begins when interacting people automatically mimic and coordinate their facial expressions, tone of voice, body gestures, and postures with those of others. In terms of primitive emotional contagion, facial mimicry is the automatic, reflexive process of matching the one's facial expression with the expression of the person observed (Hess & Blairy, 2001). Previous research has shown that babies as young as three months mimic other people's facial expressions (Haviland & Lelwica, 1987). A later and more in depth examination of infant imitation found that infants imitate familiar and unfamiliar models as well as static and dynamic stimuli; and this imitation does not disappear as the infant develops (Meltzoff & Moore, 1992). Experimenters also observed imitation of facial expressions in newborn infants from non-Caucasian cultures indicating that the capacity for facial imitation is present at birth for the human species (Reissland, 1988). This ultimately leads back to Charles Darwin's theory which suggested that emotional expressiveness is an innate form of communication and that imitation of these types of expression are also innate (Darwin, 1872).

When viewing static pictures of happy and angry faces, Dimberg (1982) found that adults unintentionally exhibited similar patterns of EMG activity depending on the expression viewed, with happy faces evoking increased movement of the cheeks and angry faces evoking increased movement of the brow region. A series of studies by Dimberg , Thunberg, and Grunedal (2002), helped to establish facial reactions as automatic and uncontrollable by asking subjects to either not react with their facial muscles or to react as quickly as possible. They found that EMG responses were significantly faster for voluntary reactions to positive and negative stimuli in areas of the face associated with those emotions (brow activation for negative stimuli) than for areas that conflicted with those emotions (smile activation for negative stimuli). Interestingly, though, even when

explicitly instructed not to react with their facial muscles at all, participants still produced facial muscle patterns that corresponded with presentations of angry and happy faces.

According to the theory of emotional contagion, automatic mimicry is not limited to facial expressions alone, but also affects responses to body gestures, tone of voice and posture (Hatfield et al., 1994). Indeed, researchers observed gestural imitation of head movements and a tongue protrusions in infants less than three days old (Meltzoff & Moore, 1989). These infants later produced the same gestures when the experimenter's display had stopped, leading the researchers to theorize that imitation is fundamentally important to early perception and helps infants to produce the behaviors they observe in others. A later study by Meltzoff and Moore (2002) discovered that infant's gestural imitations became successively more accurate, indicating that the babies were modifying their behavior toward the target behavior over time. Adults also tend to unconsciously mimic the gestures of others, even in situations with complete strangers (Chartrand & Bargh, 1999). The authors referred to the unintentional mimicry of mannerisms, behaviors, postures and expressions as the "chameleon effect" and found that mimicry facilitated smoother interactions between individuals and liking. Researchers have also linked gestural mimicry to group membership (Cheng & Chartrand, 2003) and affiliation strategies (Yabar, Johnston, Miles, & Peace, 2006) indicating that individuals are drawn to those who behave similarly. A review of studies by Cappella (1981) on interaction patterns supports the idea that individuals synchronize their speech patterns, tone of voice, postures and gestures. Cappella's conclusions indicate that during interactions, individuals mutually influence duration of speech, pauses, vocal intensity turn taking, and behavioral gestures.

Hatfield, Cacioppo, and Rapson (1994) provide an excellent review of literature relating to the occurrence of facial, vocal, and gestural mimicry in response to interactions,

observations, films and photographs. It may be important to note that all the instances described above involve face to face interactions or visual perception. In fact, a study by Richardson, Marsh, and Schidt, (2005) found that participants coordinated their limb movements and rhythms with another individual during interactions when visual information about the other person was present, but not in situations involving verbal interaction alone.

In recent years, research has begun to focus on mirror neurons as a neurophysiological explanation for mimicry (Jaffe, 2007). It seems that certain areas of the brain activate when an individual executes an action and when an individual observes another person executing the same action (Iocoboni, 2007). Researchers hypothesize that these neural structures are essential for imitation and, perhaps, empathy as well.

The second mechanism of emotional contagion involves feedback from the muscles activated during facial, vocal and gestural imitations affecting subjective emotional experience. Previous studies illustrated that facial feedback from muscles activated in the face elicit strong responses from the Autonomic Nervous System and affect how individuals experience emotion (Ekman, Friesen & Ellsworth, 1972; Ekman & Oster, 1979). As discussed earlier, there exist a number of studies that support the facial feedback hypothesis and its effects on emotional experience when facial muscle manipulation is covert (Ekman, 1983; Laird, 1974; Levenson et al., 1992). Another study found that unconscious production of a Duchenne smile (a real or felt smile involving activation of the muscles around the eyes) positively affected self reported emotional experiences while viewing pleasant or funny video clips (Soussignan, 2002). The participants who posed Duchenne smiles had significantly different patterns of autonomic activity than participants posing non-Duchenne smiles (smiles that do not involve activation of the muscles around

the eyes), lip pressing, or jaw dropping, suggesting that the contraction of the specific group of muscles associated with happiness contributed to an increase in positive emotional reactions and arousal.

Although these studies involved deliberate induction of facial expression, automatic facial mimicry should also affect emotional experience, according to the theory of emotional contagion. Research conducted by Surakka and Hietanen (1998) linked feelings of empathy to the initial facial and emotional reactions of observers viewing Duchenne and non-Duchenne smiles. The researchers deduced that a real or felt smile involving the activation of muscles around the eye induced pleasurable experience and empathy in the participants. Similarly, Dimberg (1987) found that individuals react to angry facial stimuli with a uniform negative emotional response pattern that included greater EMG activity in the brow region, heightened autonomic resistance and greater ratings of self-reported fear. Thus, rapid and automatic facial responses to emotional expressions appear to affect emotional experience through a facial feedback model for positive and negative emotions.

Ursula Hess and colleagues (1992) conducted a study which supports the facilitative effects of facial expression on the self generation of emotion. This study asked participants to feel four emotions without expressing them, to express the same emotions without feeling them, and to feel and express these four emotions simultaneously. The researchers found that EMG patterns and ANS arousal reliably differentiated between the four emotions for each of the three tasks. During the expression-only task, participants experienced ANS arousal and reported feeling the same emotion, which further supported the facial feedback model of arousal. However, participants were faster at generating the emotions during the feel and show task than during the feel task or the expression task

alone. This implies that facial feedback also facilitates the conscious generation of an emotion state.

Currently, considerably less research exists on postural and vocal feedback as it relates to subsequent emotional experience, perhaps due to early theoretical views which put forth that facial expressions are a central component of emotion. One study determined that peripheral feedback from adopting sad, angry and fearful postures increased feelings of the same emotion, especially for individuals who were more responsive to self-produced cues (Duclos, Laird, Schneider, Sexter, Stern, & Van Lighten, 1989). William Flack (2006) conducted a study examining the effects of facial expressions, body postures and vocal expressions on emotion. According to his findings, facial expressions and body postures indeed impacted participant ratings of felt emotions. However, Flack found only partial support for the impact of vocal feedback after participants read a list of non-emotional words in a tempo and tone associated with an emotion state. Vocal feedback demonstrated categorical effects in the magnitude of ratings of sad and angry emotions, but not happy and fearful emotions.

Alternatively, other studies have demonstrated notable effects of vocal feedback on emotional expression. As with studies on facial expressions, a series of two studies manipulated voices overtly (reading verbal passages with emotional content) and covertly (reproducing sound patterns) (Hatfield, Hsee, Costello, & Denney, 1995). It was determined from the first study that reading happy, sad, angry or loving scripts affected participant's facial expressions and self rated emotion states in a manner that differentially corresponded with the emotional content of the passage. In the second study, participants listened to sound patterns depicting the emotion states of love, sadness, fear, anger and neutral through rhythms, pauses and tones before reproducing each pattern as accurately as

possible and rating their emotional state of being. Twenty psychiatrists, psychologists and graduate students created the sound patterns which were reliably associated with the corresponding emotion by 60 undergraduate students. The researchers discovered that participants reported feeling the emotions which corresponded to the sound pattern (feeling sad when recreating sad sounds) to a greater extent. These results indicate that both verbal and nonverbal forms of vocal feedback seem to affect emotion states in a manner that corresponds with the emotional content of the message (Hatfield et al., 1995).

Another earlier study by Siegman and Boyle (1993) examined the effects of speech rate and volume on fear, anxiety, sadness and depression. They found that subjects reported being more anxious, fearful, sad or depressed when discussing corresponding emotional topics. These individuals also had the highest ratings of corresponding emotions and arousal when discussing anxious or fearful events in a loud and fast manner. Conversely, participants had the highest ratings of sadness and significant increases in blood pressure when discussing sad or depressing events in a slow and soft voice. Thus, it appears that both the content of the message as well as the manner in which it is delivered may mediate the effects of vocal feedback. Additionally, Heitanen, Surakka, and Linnankoski (1998) demonstrated that positive and negative vocal expressions differentially affected facial EMG responses which in turn mediated participants approach and withdrawal action tendencies.

Based on the literature, several studies support the second proposition of emotional contagion, that peripheral feedback affects subjective feelings of emotion states. In comparing the magnitude of the effects of facial expressions, bodily postures and speech on emotional experience, Flack (2006) determined that the effect of facial expressions was stronger than the effect of bodily postures which was in turn stronger than the effect of

vocal feedback. Additionally, patterns of emotional response were consistent for each emotion category across the three modalities tested.

According to Hatfield and colleagues (1994), the third proposition of emotional contagion theory contends that because of mimicry and subsequent arousal, people are therefore predisposed to "catching" the emotions of others. From the studies discussed above (Dimberg, 1987; Flack, 2006; Siegman & Boyle, 1993; Surakka & Hietanen, 1998) it is clear that the reactions of the autonomic nervous system and subsequent emotions experienced by individuals tend to match the emotion displays observed in others. Many studies have examined the occurrence of this emotional convergence in individuals and in groups.

In one study, researchers investigated the occurrence of emotional contagion in university classrooms by measuring students' perceptions of instructor non-verbal behaviors, judgments of how often the students engaged in similar non-verbal behaviors and self reported emotional experience (Mottet & Beebe, 2000). Instructor nonverbal behavior positively correlated with student nonverbal behavior, and student perceptions of instructor emotions correlated with their own self reported emotions. In support of emotional contagion through active mimicry, student nonverbal behavior was the strongest predictor of student emotions. This implies that instructors did not affect student emotions directly. Instead, feedback from the active mimicry of an instructor's nonverbal behavior stimulated emotional experience to a greater extent than passive observation.

Sy, Cote, and Saavedra (2005) examined group emotional contagion (the transfer of moods among people in a group) and its influence on work group dynamics in a study which found evidence for contagion effects after only seven minutes of working together on a group task. Individual members of a group with a leader in a positive mood were

significantly more positive at the end of the planning period, and members of a group with a negative leader were significantly more negative. Additionally, groups with leaders in a positive mood had significantly more positive affective tone as a whole and the opposite was true for groups with negative leaders, as measured by observations of physical behavior, speech content, voice tone, voice pitch and group member effort. Another series of studies established a strong link between the positive emotions of leaders, converging mood states of their followers, and ratings of effective leadership and leader attractiveness (Bono & Ilies, 2006). The positive or negative moods of leaders also differentially affect group effort, group coordination and group task strategies (Sy et al., 2005).

Emotional convergence occurs rapidly, but it also can occur over time. A series of three longitudinal studies of people in long-term relationships determined that individuals in dating relationships, self selected dorm mate relationships and randomly assigned dorm mate relationships self report feeling similar emotions as those of their partner during discussion tasks where they take turns listening and talking to each other about emotional experiences (Anderson, Keltner, & John, 2003). Six months later, the similarity correlations were significantly higher suggesting that continued emotional convergence occurred over time despite the fact that partners' personality traits remained the same.

The contagion concept first became popular as a descriptive and explanatory device for various social phenomena, such as the spread of hysteria, group aggression, consumer fads and rule breaking behavior. The inclusion of mimicry and feedback as mechanisms of emotional contagion stimulated specific and measurable biologically-based research, although not all studies supported the three mechanisms of emotional contagion described above. A study by Hess and Blairy (2001) found that subjects either reported feeling cheerful or somewhat irritated emotional states across all emotional displays and the

authors suggested that emotional contagion effects only modulated participant affective states which were mostly consistent with the experimental task. Additionally, the study did not find evidence to support a link between mimicry and emotional contagion. In spite of this, subjects still reported feelings emotions that corresponded with the emotion presentation to a greater extent and these results were significant (Hess & Blairy, 2001). Similarly, another study by Bump and Kulik (1997) could not find support for the role of mimicry in emotional contagion although these researchers also observed strong positive relationships between the emotions of participants and the emotions of the confederate researchers. Some researchers have suggested that mimicry is not solely an automatic process. Emotions can elicit complementary or corresponding emotions that influence rapid facial reactions to emotional stimuli, which explain why faces depicting fear can induce expressions of fear and/or anger (Moody, McIntosh, Mann, & Weisser, 2007).

Hatfield and colleagues (1994) consider emotional contagion to be multipli-determined. They theorize that stimuli which elicit emotional contagion can be innately determined, acquired through socialization, or stimulated by cognitive or emotional imagery. Additionally, emotional contagion can elicit similar feelings (a laughing person makes you feel happy) or complementary feelings (an angry person makes you feel scared) depending on the interaction. What is interesting is that despite the pervasive influence of contagion on biological and social processes, individuals are often oblivious to the effects of other's emotions on their own behaviors (Wang, 2006).

Thompson, Nadler, & Kim (1999), identify emotional contagion, mimicry, and emotional tuning as processes involved in social bargaining situations and business negotiations. For example, strategies for effective negotiation involve both the perception of the emotional states of others and the experience of emotion within oneself. In one

study, facial mimicry and emotional contagion facilitated individuals' ability to detect a change in facial expression earlier when they were in a similar emotion state (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001). Dr. Elaine Hatfield and colleagues (1994) contend that emotional contagion may be important in interpersonal relationships because it fosters a perpetual monitoring of the emotional states of others around us, even when not attending to this information consciously.

Goldman and Sripada (2004) put forth that mechanisms of emotional contagion also help individuals to identify and classify the emotions of others. Through a model they term *reverse simulation*, individuals first perceive a facial expression, mimic the expression, experience the same emotion, and then utilize the knowledge of their own emotion state to classify the emotion state of the other person. This implies that emotional contagion should facilitate emotion recognition through a process of catching the emotion experienced by another and subsequently being able to self identify with one's own feelings.

Goldman and Sripada (2005) also suggest that if an individual is impaired in the production of an emotion or even traces of an emotion, facial mimicry would not produce the appropriate neural responses needed to create the emotion, leading to impaired emotion recognition. Hatfield and colleagues (1994) propose a series of characteristics which they hypothesize make individuals more or less prone to emotional contagion. Individuals most susceptible to emotional contagion are aware of their own arousal levels and expressions, and make deductions on what others would do in a similar situation. Hatfield, Cacioppo, and Rapson (1994), make and support several hypotheses about the characteristics of individuals who are most susceptible to emotional contagion. First, people will be more likely to catch the emotions of others if they are paying attention to other people's

emotional states. Second, emotional contagion will be more likely if the individual sees himself or herself in terms of inter-relatedness to others instead of in terms of individuality and uniqueness. Third, people who are able to read the emotional expressions of others will be more likely to catch their emotions. Fourth, individuals who tend to mimic facial, gestural, vocal and postural expressions will be more susceptible to emotional contagion. Fifth, those people who are aware of their own physiological responses to emotions will be more likely to catch the emotions of others. Sixth, emotionally reactive individuals will be more vulnerable to catching other's emotions. Hatfield, Cacioppo, and Rapson therefore conclude that,

> people who do *not* attend to others, who construe themselves as distinct and unique from others, who are unable to read others' emotions, who fail to mimic, or whose subjective emotional experiences are unaltered by peripheral feedback should be fairly resistant to contagion (1994, p. 148).

Being in touch with one's own emotions and the emotions of others facilitates communication and social behavior, which are identified areas of deficiency for individuals with autism. Therefore, some individuals with autism may be unaffected by emotional contagion.

Emotions and Autism

Throughout the history of autism, people describe individuals with this disability as cold, unattached, distant, unexpressive, and off in their own world. This viewpoint suggests that individuals with autism do not feel emotions, which are a fundamental aspect of human experience. This review will describe research on emotions and autism, specifically focused on emotional expression and experience before moving to a discussion of how individuals with autism identify, understand, and react to the emotions of others.

Research on the facial expressions of individuals with autism is mixed. A clinical study described the facial expressions of children with autism as more flat and neutral than

non-autistic children with mental retardation (Yirmiya, Kasari, Sigman, & Mundy, 1989). The researchers also found a variety of ambiguous expressions not observed in the other children, leading them to conclude that patterns of emotional expression and interpersonal responses were atypical in children with autism. These findings suggest that individuals with autism may be impaired in their ability to "pose" facial expressions of affect in clinical environments. During an observation of naturalistic face-to-face interactions with their mothers, children with autism did not differ from controls in the frequency of smiling, duration of smiles, or amount of smiling in response to social versus nonsocial stimuli (Dawson, Hill, Spencer, & Galpert, 1990). However, a longitudinal study of child-parent interactions in the home showed reduced positive affect directed toward the mother, reduced attention to the mother, and reduced positive affect overall (Robert & Tager-Flusberg, 1997). Parents of children with autism also rate their children as displaying significantly more verbal and nonverbal expressions of negative affect than typically developing children (Capps, Kasari, Yirmiya, & Sigman, 1993). Thus, it seems that while individuals with autism indeed express emotions in naturalistic situations, they may not utilize these expressions for communicative purposes, and this affects how others perceive them.

People with autism may experience emotion states differently. One study examining personal accounts of emotional experience in 28 children with autism and 22 children without found that children with autism had systematically distinctive descriptions of complex emotions, suggesting that the children with autism could have affective experiences that are qualitatively distinct (Losh & Capps, 2006). This does not mean that individuals with autism do not genuinely experience emotion. A small case study of internet-based first-hand accounts by individuals who describe themselves as high

functioning autistic, revealed that alienation, frustration, depression, and fear or apprehension were core themes of their experience with autism (Jones, Zahl, & Huws, 2001). Dr. Temple Grandin, a well known adult with autism has also admitted publicly to experiencing anxiety attacks and taking anti-depressant medications (Grandin, 1996). Although the literature on this subject is limited due to the fact that not every adult with autism has the capacity to verbally communicate their experience of emotion, it appears that emotions are not absent in those with autism, as is sometimes assumed.

Evidence indicates that individuals with autism may differ in the way they their brains process emotional information. According to Geraldine Dawson (2001), director of the UW Autism Center, three- and four-year-old children with autism, unlike typically developing children of the same age, do not show differences in brain activity when viewing neutral expressions and those depicting emotions such as fear, to which our brains are presumably predisposed to react through natural selection. They also seem to have difficulty in recognizing facial signals and the emotions of others, suggesting a deficiency in the basic brain systems responsible for decoding emotions (Dawson, 2001). Research shows that different patterns of brain activation occur in response to viewing fearful and disgusting faces in individuals with autism compared to normal control participants (Ogai, Matsumoto, H., Suzuki, K., Ozawa, F., Fukuda, R., Uchiyama, I., Suckling, J., Isoda, H., Mori, N. & Takei, 2003). Researchers replicated this study by showing that individuals with autism experience differential activation of the social brain (i.e. the amygdala and the hypothalamus) in response to fearful expressions (Ashwin, Baron-Cohen, Wheelwright, O-Riordan, & Bullmore, 2007). They also demonstrated an absence of the expected neural response seen in typically developing brains when viewing expressions of different intensities.

Previous research has shown that people with autism are impaired in their ability identify and discriminate the emotional expressions of others (Celani, Battacchi, & Arcidiacono, 1999; Hobson, Ousten, & Lee, 1988; Weeks & Hobson, 1987). Researchers typically utilize sorting and matching tasks to examine these abilities in individuals with autism. A study by Hobson and colleagues (1988) showed that children with autism were not as able to identify emotions when certain cues, such as the mouth or forehead, were not present despite the fact that typically-developing individuals judge emotions accurately using information from the eyes alone. However, these children did very well when classifying the faces upside down, indicating that they had been sorting the pictures using facial feature characteristics, such as the shape of the eyebrows or mouth, and not through interpretation of the emotions portrayed. The authors concluded that the children with autism had been sorting the faces using perceptive strategies that did not involve emotional content despite the fact that the task instructed them to do so explicitly.

A later study by Celani and colleagues (1999) presented facial expressions of happy, sad, neutral or wry to children with autism. Pictures were black and white and cut into oval shapes to prevent the use of non-emotional feature cues, such as hair length, during the matching task. These children performed significantly worse on the emotion matching task compared to non-autistic mentally retarded children and typically developing children. The autistic children also performed worse when matching facial expressions (happy and happy) versus matching identity (John and John), which was the opposite of the control groups' performance. Thus, it seems that although facial expressions are more salient than identity for most people, this may not be the case for those with this disability.

Individuals with autism exhibit difficulties with tasks that require classifying emotions into distinct categories. Weeks and Hobson (1987) found that when given a

sorting task where subjects were able to sort the differences between headshots of people in categories of their choice, all 16 children without autism sorted by facial expression at some point, while only six children with autism did so. Again, this suggests that facial expressions may not be particularly noticeable or striking for this population. The remaining six children with autism could not sort or differentiate between facial expressions even when given specific instructions. Impairment in the ability to recognize and identify the emotional expressions of others has significant implications for recognizing and understanding the emotion states of others.

In terms of emotional understanding, research indicates that individuals with autism experience some proficiency and some impairment. One case study of spontaneous speech in children with autism and matched controls with Down's syndrome found that subjects were not significantly different in their use of emotion terms or ability to discuss emotions. However, the children with autism never mentioned more complex emotions such as surprise, nor did they speak of other's mental states involving knowledge, beliefs, pretence or deceit over the course of one to two years (Tager-Flusberg, 1992). Another study by Dennis, Lockyer, and Lazenby (2000) examined understanding of real and deceitful emotions in children with autism and in age- and gender-matched controls. Contrary to what has been found in other studies, these participants were equally skilled at distinguishing between happy and sad emotion labels and the intensity of those emotional expressions, as well as correctly matching these displays to prototypic situations which would elicit an emotional response. However, the children with autism were significantly less able to understand felt emotions in complex situations, deceptive emotions, or reasons for deceptions. They also made far more *realism* errors, where they correctly identified the

emotion a person should feel, but incorrectly identified what emotion the face would express.

Indeed, previous research demonstrates that individuals with autism experience greater impairments in complex emotion recognition and understanding. Golan and colleagues (2006) found that individuals with autism were less able to distinguish complex emotions and mental states from facial or vocal expressions. Finally, research has demonstrated that individuals with autism are more capable at using situational cues to predict emotion than cues which require an understanding of other people's mental states, which is necessary when appreciating the causes of more complex emotions (Baron-Cohen, 1995).

Some research puts forth that individuals with autism react differently to the emotional expressions and displays of other people. In a study looking at reactions to affect, children with autism did not exhibit expected changes in heart rate when an experimenter was highly distressed, a finding observed in the control group of children with mental retardation (Corona, Dissanayake, Arbelle, Wellington, & Sigman, 1998). However, the children with autism also paid less attention to the experimenter, leading the researchers to conclude that the children with autism failed to respond out of lack of interest or understanding. Research has demonstrated that people with autism also may be less susceptible to empathy. High functioning children diagnosed with autism scored significantly lower on empathy measures based on the level of agreement between the child's reported emotional response and the emotions of a protagonist in a videotaped story (Yirmiya, Sigman, Kasari, & Mundy, 1992). These children were also less able to assume the role and perspective of the lead character in the story and were worse at inferring

emotional states from verbal, nonverbal, and situational cues than their typically developing peers.

Children with autism also show marked impairments in their ability to utilize emotional information to make social judgments. Celani and colleagues (1999) found that children with autism did not use emotional expressions when making judgments of pleasantness or unpleasantness. Adolphs, Sears, and Piven (2001) also found that individuals with autism display some parallels to subjects with focal amygdala damage in impairments to social judgments, often attributing abnormally positive ratings of trustworthiness and approachability to facial expressions commonly given the most negative ratings.

Emotional impairment in individuals with autism may negatively affect their ability to comprehend and communicate nonverbal cues and facial expressions. This, in turn, may make it difficult to maintain social relationships with other people and lead fully autonomous lives. Indeed, adolescents and adults with autism participate in fewer social and recreational activities and have fewer peer relationships and true friendships (Orsmond, Krauss, & Seltzer, 2004). Difficulties in distinguishing expressions and understanding the emotional motives of others may also affect their ability to engage in interactions with other people, to receive reinforcement for those behaviors, and therefore to learn social norms for appropriate behavior. People constantly in tune with one another's facial expressions is a key both to communicating effectively and to comprehending the views and feelings of others (Hatfield et al., 1994). This review of the literature demonstrates that this is not necessarily the case for individuals with autism.

Emotional Contagion and Autism

Previous research demonstrates that individuals with autism are less susceptible to empathy (Lawson, Baron-Cohen, & Wheelwright, 2004; Yirmiya et al., 1992). Since people with this disability also display less external manifestations of emotion (Robert & Tager-Flusberg, 1997; Yirmiya, 1989), this may affect their physiological experience of emotion through the absence of feedback from muscles activated. This in turn may affect how individuals recognize emotions internally and employ this knowledge to deciphering the emotional states of others.

Individuals who are less susceptible to emotional contagion are presumed to pay less attention to the emotions of others, view themselves as unique or distinct, have difficulties reading emotional cues, tend not to mimic facial, vocal, gestural and postural expressions, and are resistant to the effects of feedback or are less emotionally responsive (Hatfield et al., 1994). Previous research demonstrates that individuals with autism are less attentive to others' emotional displays (Robert & Tager-Flusberg, 1997; Weeks & Hobson, 1987), feel a sense of loneliness and alienation (Jones et al., 2001), have difficulty deciphering emotional expressions and cues (Celani et al., 1999; Hobson et al., 1988; Weeks & Hobson, 1987) and are less emotionally reactive (Ashwin et al., 2007; Corona et al., 1998; Dawson, 2001; Ogai et al., 2003). Investigating the presence or absence of primitive emotional contagion may provide a biological perspective that helps to explain the pervasive emotional impairments so often observed in this population.

The first mechanism of emotional contagion is mimicry, which can be either voluntary imitation or uncontrollable and automatic. Research on elicited imitation in children and adults with autism found that these individuals performed comparably when imitating a battery of verbal and nonverbal vocal sounds, facial actions, gestures, and

symbolic actions involving objects (Beadle-Brown & Whiten, 2004). Researchers discovered that the adolescents and adults with autism were able to voluntarily mimic the facial expressions for happy and angry emotions when explicitly asked (McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006). However, the McIntosh study was significant in that it compared the ability to voluntarily imitate facial expressions with unconscious mirroring using EMG recordings. These researchers found that compared to participants matched by age and verbal ability, the group with autism was significantly impaired in their automatic mimicry and this was not dependent on the nature of the emotion presented.

Human beings appear to experience primitive contagion through the automatic, unintentional coordination of facial expressions, gestures and postures. In naturalistic interactions individuals with autism tend to have fewer spontaneous facial expressions, and are less likely to respond to others with similar emotions, facial expressions, or movements (Kasari et al, 1990; Dawson et al, 1990; Sigman et al, 1992). Additionally, children with this disorder smile in response to their mother's smiles much less frequently than typical children during interactions (Dawson et al., 1990). A measure of primitive contagion could illustrate how the perception of emotion affects the subsequent expression and experience of emotion for people with autism, although to date, no such study exists.

Measuring the first phase of the emotional contagion process, the amount of facial mimicry that occurs in school aged children with autism, may help to define the emotional deficiency commonly associated with this disability from a biological perspective. Researchers have begun to theorize that early deficits in a mirror neuron system can lead to the development of impairments characteristic of autism which include repetitive movements or gestures, echolalia, social cognitive function, and theory of mind abilities

(Williams, Whiten, Suddendorf, & Perrett, 2001). If children with autism exhibit less initial facial mimicry, it suggests that the emotional expressions of others may not affect these individuals to the same degree and therefore they may not experience emotional contagion.

Paying attention to the emotion states of others facilitates social awareness and emotion perception. Therefore individuals will be more responsive to the emotions of others if their attention is focused on those people and less responsive if they are unaware or oblivious (Hatfield et al., 1994). A study by Hess and Blairy (2001), found significant effects for emotional contagion and facial mimicry in response to dynamic facial expressions, presumed to be more attention-getting for individuals without autism. Their findings also supported the claim that people mimic facial expressions when they are interested and aware of the emotions of the expresser. As previously discussed studies have observed less interest in emotion displays for individuals with autism (Corona et al., 1998), it may be that a disinterest in the emotions of others makes them less susceptible to emotional contagion.

People with autism exhibit less attention and eye contact to social stimuli (Kasari et al, 1990). Studies of the brain have confirmed that anterior regions of the superior temporal gyrus in the brain selectively activate when interpreting emotions through eye contact, which implies that the emotion states of others are especially salient when individuals are looking at us (Wicker, Perret, Baron-Cohen, & Decety, 2003). One study examined videotaped reactions to an experimenter who faked being hurt or injured in children with and without autism (Charman, Swettenham, Baron-Cohen, Cox, Baird, & Drew, 1997). They found that children with autism were far less likely to look at the experimenter's face or make eye contact. They were also less likely to be rated as

expressing concern or empathy. Another study found that children with autism paid less attention to adults displaying expressions of negative affect than typically developing children and those with mental retardation (Sigman et al., 1992).

Present Study

The primary questions that the present study attempts to answer deals with how children with and without autism react to facial expressions, how proficient they are at matching those expressions, whether they report feeling a similar emotion after viewing an emotional display, and whether increased attention to facial cues used in reading emotions increases facial mimicry and emotional contagion. Specifically, this study attempts to answer four questions. First, are there differences between groups in their ability to match facial expressions? Second, are there differences between children with and without autism in the amount of facial mimicry that occurs after viewing facial expressions? Third, when asked to report how they felt after viewing emotional expressions do children with and without autism respond differently? Fourth, are there differences between groups in terms of facial expressions, emotion matching and reported feelings with the use of an attention-getting stimulus?

Chapter 2
Methods

Participants

Participants included 20 children with autism spectrum disorder, ages 5 years 9 months to 15 years 0 months, and 20 typically-developing children without autism, between the ages of 6 years 0 months to 16 years 0 months. Children were selected based on chronological age and nonverbal intelligence scores, as measured by the *TONI-3: Test Of Nonverbal Intelligence, Third Edition.* As the procedure was minimally language dependent, this study employed a non-verbal measure of intelligence.

The 20 typical children were individually matched with the 20 children with autism based on gender, chronological age, and estimated mental age as measured by TONI-3 nonverbal intelligence scores. *T*-tests revealed that the two groups did not differ significantly on chronological age, $t = .273$, $p > .05$, or estimated mental age, $t = .017$, $p > .05$. Table 1 depicts the characteristics of the sample.

Table 1. *Matching Criteria for Groups with Autism (A) and without Autism (NA)*

Group	Measure	*n*	*M*	*SD*
A	Age	20	11.40	2.81
	EMA	20	12.92	4.16
NA	Age	20	11.15	3.48
	EMA	20	13.03	4.20

This researcher and three undergraduate research assistants administered the TONI-3. As estimated mental age is a reflection of school-age equivalency, this study utilized a stepwise multiple regression to assure that mental age, as measured by the TONI-3, was the result of grade level and age, and not due to condition (autistic or typically developing) or examiner. The analysis revealed that only the first model that examined grade level as a

predictor of participants' mental age was significant, $t = 14.24$, $p < .001$ (See table 2). Age, condition, and examiner were not significant predictors of mental age in the following models and were therefore excluded.

Table 2. *Hierarchial Regression Analysis on TONI-3 Raw Scores*

Variable	*B*	*SE B*	β
Step 1			
Grade	1.31	0.09	0.92***
Step 2			
Grade	1.26	0.43	0.88
Age	0.05	0.44	0.04

*** $p < .001$

Although the expectation was that age would be a significant predictor of TONI-3 estimated mental age, over half of the children with autism in our sample (11) attend schools that group children by ability level rather than age, and this may have contributed to this finding. This study did not collect information on how many of the typically developing children may be in remedial or special education, which may have also been a factor. However, as stated previously, there were no significant differences between the two groups on chronological age or mental age as measured by the TONI-3, and the point of this regression analysis was to demonstrate that neither condition nor examiner differences contributed significantly to participant's estimated mental age.

Additionally, two undergraduate students and one professional psychologist who uses the TONI-3 regularly in his practice, rated a videotaped sample of the administration of the TONI-3 to determine that the delivery of the test was consistent. Raters used a 5-point, Likert-type scale to measure how well each examiner met 25 items adapted from the administration guidelines set forth the by the *TONI-3 Test of Nonverbal Intelligence*

Examiner's Manual (Brown, Sherbenou, & Johnsen, 1997). See Appendix A for a complete list of reliability items. An intraclass correlation using Cronbach's Alpha across average measures provided a coefficient of $\alpha = 0.797$. Ratings were consistently high for each item, averaging between 4.806 and 5.0. Therefore, examiners were consistent in meeting the guidelines for administration of the TONI-3.

The current study recruited children with ASD from various schools and community agencies in the state of Hawaii. Altogether, the recruitment efforts gathered 22 children with ASD from two local private schools that specialize in serving children with autism, a family support group run through Tripler Medical Center, and referrals from parents and care providers. This study also recruited typically developing children from local A+ after school programs, local Boy Scout troops, and by parent referral.

Parents provided psychological reports for all children with autism that supported a diagnosis in the autism spectrum from a licensed psychologist. Families that had more than one child with an ASD diagnosis were included. This study recruited fourteen participants with autism, six participants with Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS), and two participants with Asperger's syndrome.

All children had to be able to understand the verbal or gestured directions for the TONI-3, as illustrated by the five training items for the test, and had to be able to correctly answer two consecutive pre-experimental training items. Over the course of the study, it was necessary to exclude two qualifying children with ASD, the first due to behavior problems that caused the experimenter to terminate the session and the second due to problems with the laboratory equipment. In each case the study eliminated the corresponding matched child from the control group as well, bringing the final number of participants down to 20 children with autism and 20 children without autism.

The male to female ratio for the autistic group (and therefore the matched control group) was 4:1. This ratio was approximately equivalent to that obtained from a number of studies conducted in other metropolitan areas (Davidovitch, Holtzman, & Tirosh, 2001; Fombonne, 1999, 2005; Scott et al., 2002; Yeargin-Allsopp et al., 2003). Demographic data revealed that both groups contained members that represent all ethnicities enrolled in public schools for the 2005-2006 academic school year (Hawaii Department of Education, 2005), with the exception of African American and Native American Indian, which only comprise 2.4% and 0.2% of the population respectively (U.S. Census Bureau, 2001) and the groups did not differ considerably from each other on this dimension.

Materials

Pre-experimental Emotion Board

Materials for the pre-experimental tasks consisted of black and white still photographs of seven discrete emotions presented on one 8.5in. (21.59 cm) by 14in. (35.56 cm) white background. The photographs pictured the same Caucasian individual expressing happy, sad, angry, disgust, fear, surprise and neutral. Pictures measured 2.5 in. (6.35 cm) across by 3.25 in. (8.255 cm) in height (see Appendix B) and were from the NimStim Face Stimulus Set previously found to be reliable with adults and children (Tottenham, Borscheid, Ellertsen, Marcus, & Nelson, 2002). Pictures were pilot tested by asking four typically developing children, ages five, six, eight and ten years to correctly identify and label each emotion. All children were able to do so without difficulty.

Emotion Choice Board

The emotion choice board utilized the same seven pictures used during the pre-training procedure to assure that each child was familiar with the response choices he/she would be using throughout the experimental trials. Each expression had a printed label

centered directly under the picture (see Appendix C). The response board had a cover that the experimenter could lift to reveal the choices at the appropriate times during the experimental task.

Experimental Task Display

This study administered each experimental task by means of a computer, using *Super Lab Pro*, a computer program which controls the presentation of stimuli and records participant responses and response times. Participants saw faces displaying designated emotions presented on a 15 in. computer screen. The emotions were depicted by still photographs of males and females from Caucasian and Japanese backgrounds to better reflect the cultural diversity of the state of Hawaii and the sample population. Each photograph measured 5.75 in. (14.605 cm) by 5.75 in. (14.605 cm) presented against a white background. The emotional expressions used were color photographs taken from the *Japanese and Caucasian Facial Expressions of Emotion* (JACFEE) and *Japanese and Caucasian Neutral Faces* (JACNeuF) (Matsumoto & Ekman, 1993). Previous research demonstrated significantly high levels of cross-cultural agreement in emotion judgments for the JACFEE photo set by participants from Hungary, Japan, Poland, Sumatra, the United States, and Vietnam (Biehl, Matsumoto, Ekman, Hearn, Heider, Tsutomu, & Ton, 1997).

The attention-getting stimuli utilized during certain experimental trials consisted of spinning red diamonds superimposed on the salient facial features used in decoding expressions (eyes and mouth) for 1.37 seconds during half of the presentations. The diamonds measured 0.875 in. (2.2225 cm) tall and 0.875 in. (2.2225 cm) wide. A previous study of attention by Greenaway and Plaisted (2005) found that individuals with autism

were impaired in tasks which required top down modulation of onset stimuli (a visual cue that appears after a fixation screen), but were typical in their performance on tasks which required top down modulation of color stimuli (an onset cue that incorporated color). This study utilized a dynamic (spinning) color cue to draw attention to areas of the face that hold the most emotional information.

Procedure

Researchers met with all children twice for approximately 30 minutes. During the first session, the research team administered the TONI-3 Test of Nonverbal Intelligence, 3rd Edition. For the typically developing children recruited through local schools, the examiner administered the TONI-3 one-on-one, in quiet, private rooms at their individual schools that were comparable to the laboratory at the University of Hawaii. All other participants were administered the TONI-3 in the laboratory at the University of Hawaii in the Psychology Department.

During the second session, held at the University of Hawaii in the Psychology Department laboratory, parent(s) remained in a room across the hall with a research assistant to fill out consent forms, surveys, and demographic information. Participants went one at a time into a quiet room at the University of Hawaii with the researcher. Subjects sat to the left of the researcher in front of the computer screen to play a "computer game on emotional expressions".

The experimenter read a simplified version of the consent form provided to the parents aloud to each child, asked if they had any questions regarding what they heard, and told them that they could stop playing the game at any time. All participants agreed to participate and 43 completed the procedure.

Pre-experimental Tasks

Prior to beginning the experiment, the experimenter asked participants to identify the emotions of happy, sad, angry, neutral, afraid, surprise and disgust using the pre-experimental emotion choice board, by pointing to the black and white photograph depicting that particular emotional expression. If subjects picked incorrectly, the researcher would ask them to try again. If subjects picked incorrectly a second time, the researcher pointed to the correct expression and verbally repeated the emotion before asking them to point to that expression again and moving on. This procedure was to assure that subjects were familiar with the emotions presented in the experiment and that they could discriminate between the depictions used as their response choices.

After identifying each emotion, the researcher asked participants to give an example of a time when they might feel that particular emotion. If a subject was not able to provide an example, the researcher would provide one and ask the subject to try again. The majority of children were able to think of an example for each emotion. Five children with autism and one typically developing child were not able to think of an example for one or more of the emotions. All of these children were able to correctly identify the emotional expression by pointing. Only one subject was not able to correctly identify the neutral expression without prompting; however, he was able to correctly give an example of when he might feel neutral.

Experimental Training Items

All subjects were then administered a set of training items to ensure comprehension of the task. The researcher read a set of simple directions presented on the screen aloud. The training set consisted of 2 trials for the expressions of happy, sad, neutral and angry. Each experimental trial was comprised of two parts. The first part consisted of a 3 sec

presentation of one of the three facial expressions. Following the presentation of an emotional expression, the second part of the trial consisted of the original picture and the following questions: 1) "How does this person feel?" (*Q1*), and 2) "How do you feel?" (*Q2*). The trials presented each question visually in black text using a font size of 40.

Trials displayed the original emotion for a second time between Q1 and Q2 every time Q1 preceded Q2; so that each subject saw the original emotion display directly before the empathy question for every trial. The computer presented the facial expression for the duration of Q1 to allow participants to look at the face as long as necessary to make a judgment. During Q2, the computer screen presented the face for three seconds followed by a grey background as a visual cue that the question had changed and to allow participants to concentration on their own internal state. This study presented each training item in the same format as the trials used in the experiment proper, but without the attention-getting stimuli. Once a subject demonstrated that they could discriminate between Q1 and Q2 for two trials in a row, the experimenter ceased the training items and the experiment began.

Experimental Tasks

The researcher told participants that the "emotion game" would now begin. Prior to beginning, the researcher read the same directions used for the training items aloud and placed the emotion choice board in front of the computer. Each time a question appeared on the screen, the experimenter read the question aloud and lifted the cover of the emotion board to reveal the choices. Experimental trials were the same format as the training items. Participants saw four presentations of each emotion, half paired with the attention-getting stimuli and half of which were trials with reverse ordered questions. To control for any order and/or sequence effects due to the presentation of the expressions, this study balanced

the order of Q1 and Q2. The trials also balanced gender and ethnicity and all trials were presented randomly. Participants could respond either verbally or by pointing to expression of their choice. They were allowed as much time as needed to label the expression on the screen or reflect on their own emotion state. A hidden video camera placed to the left of the computer screen recorded facial reactions to viewing each emotion for later analysis.

Chapter 3
Results

This study utilized dichotomous data to capture correct and incorrect responses. Although this study collected data for two trials of each independent variable combination and summed these scores for each participant, this limited the range of values obtained for the dependent values. However, Lunney (1970) determined that analysis of variance can be an appropriate statistical test for analyzing even dichotomous dependent variables. Therefore, this study utilized ANOVAs to analyze correct/incorrect responses for the emotion-matching task as well as for the contagion task. To increase the range of values for the dependent measures, the data were analyzed using pairs of mixed analyses of variance to examine the effects of emotion display (happy, sad, or neutral) and condition (3 x 2), and to examine the effects of stimuli (attention-getting or none) and condition (2 x 2) for the emotion-matching task and contagion task. Orthogonal t-tests were used to analyze the ratings of facial mimicry. All subsequent tests involved simple pairwise comparisons, using Tukey's HSD at an alpha level of .05.

Emotion-Matching Task

A response was counted as correct if the subject correctly matched the emotion displayed on the screen (happy, sad or neutral) with one of the response choices of angry, happy, sad, neutral, afraid, surprise, and disgust. As mentioned above, each participant saw two presentations of each independent variable combination (two happy faces with attentional stimuli, two happy faces without). The researcher then summed these scores for analysis using ANOVAs across the independent variable of stimuli to test for the effects of emotion and across the second independent variable of emotion to test for the effects of the attention-getting stimulus. To adjust for running two ANOVA tests, significance was

determined using a conservative alpha level of .01 for all ANOVA tests to protect against experiment-wise error.

Effect of Emotion Presentation

Figure 1. *Performance on the Matching Task for Emotion Across Stimuli*

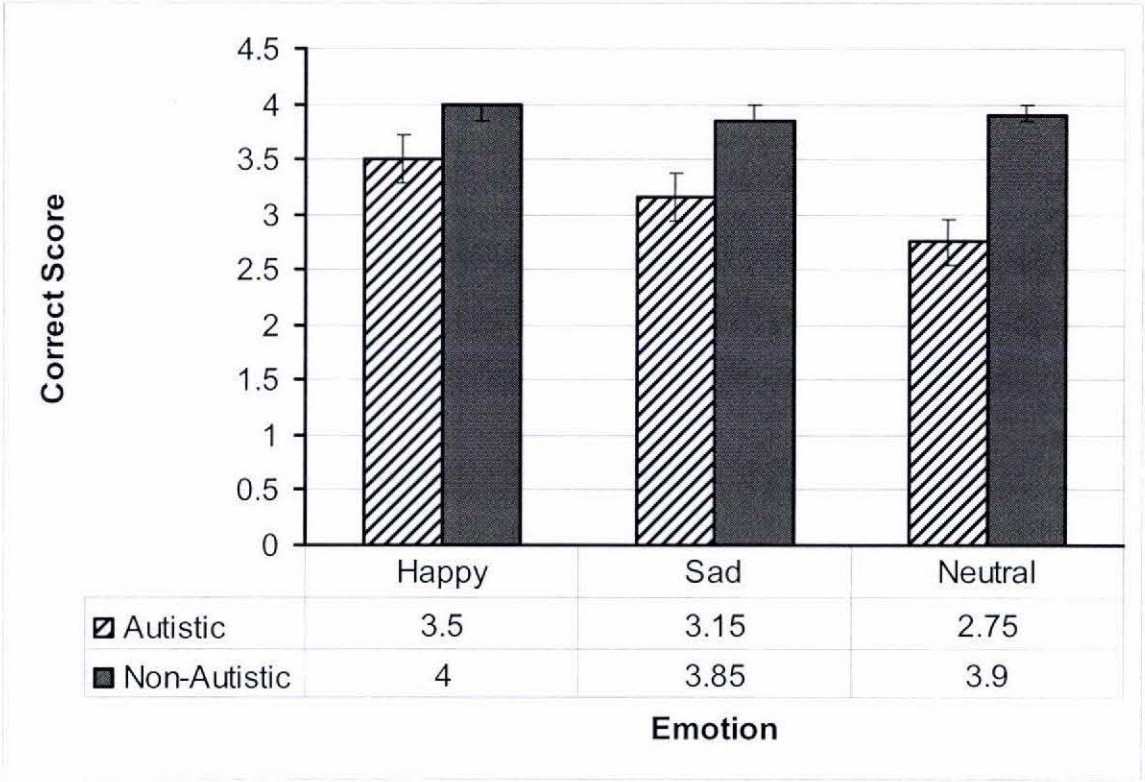

Figure 1. Sum of correct scores for the matching task by children with autism (n = 20) and typically developing children (n = 20) presented with standard error bars.

Figure 1 depicts the mean number of matching responses for each type of facial expression for autistic and non-autistic children. Overall, participants with autism were significantly less likely to correctly match facial expressions than control participants, $F(1) = 18.01$, $p < .001$, $M = 3.13$ for the autistic group and $M = 3.92$ for the non-autistic group. The particular emotion displayed did not significantly affect participant's ability to correctly match faces. Additionally, there was no significant interaction between type of participant and emotion displayed.

Effect of Attention-getting Stimuli

Figure 2. *Performance on the Matching Task for Stimuli Across Emotion*

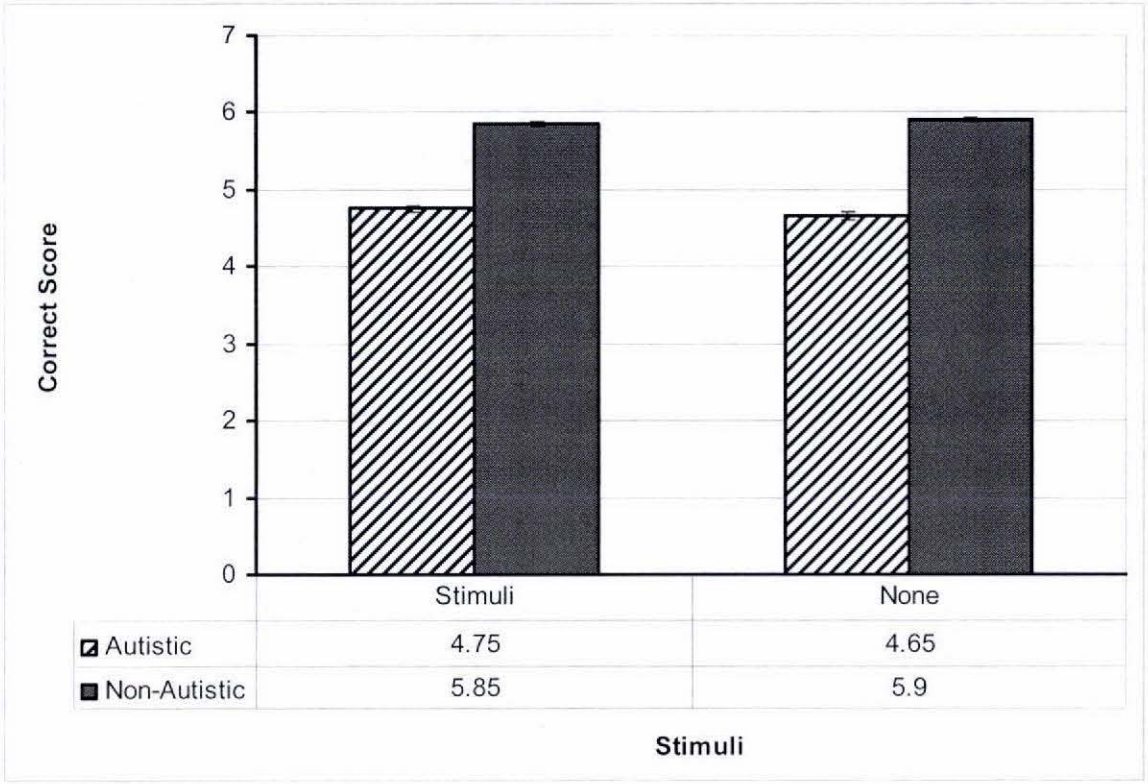

Figure 2. Sum of correct scores for the matching task by children with autism (n = 20) and typically developing children (n = 20) presented with standard error bars.

Figure 2 depicts the mean number of matching responses for displays with and without attention-getting stimuli for autistic and non-autistic children. The group with autism averaged 4.7 correct responses and the group without autism averaged 5.88 correct responses. As found in the previous analysis, participants with autism were significantly less likely to correctly match facial expressions of emotion when viewing facial pictures with and without the attention-getting stimuli, $F(1) = 18.01$, $p < .001$. The presence of the attention-getting stimuli did not significantly affect participant's ability to correctly match facial expressions and interaction effects also were not significant.

Contagion Task

The researcher assigned contagion scores according to the congruence of the emotion portrayed on the screen (happy, sad or neutral) with the emotion reported by the participant (angry, happy, sad, neutral, afraid, surprised, disgust). Thus, the analysis considered a response to be correct if a subject reported feeling sad after viewing a sad face, or neutral after viewing a neutral face. Again, participants saw two presentations of each independent variable combination (two sad faces with stimuli, two sad faces without stimuli). The researcher then summed contagion scores for analysis across the independent variable of stimuli and across the independent variable of emotion for separate analysis. To adjust for running two ANOVA tests, significance was determined using a conservative alpha level of .01.

Effect of Emotion Presentation

Figure 3. *Performance on the Contagion Task for Emotion Across Stimuli*

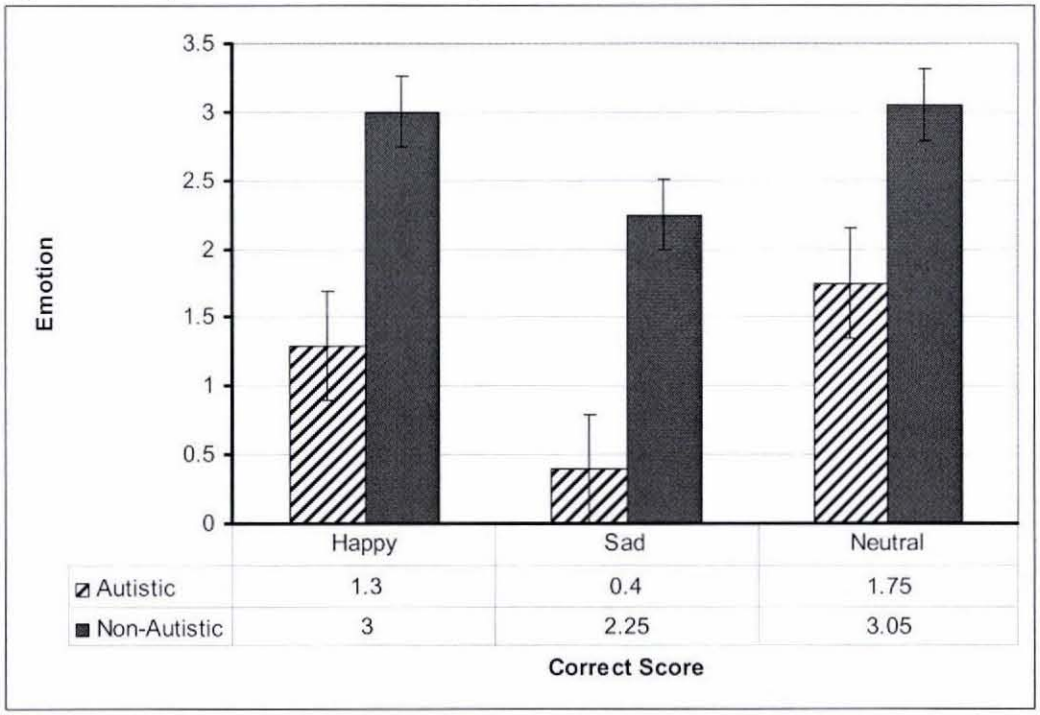

Figure 3. Sum of correct scores for the contagion task by children with autism (n = 20) and typically developing children (n = 20) presented with standard error bars.

Figure 3 depicts the mean number of contagion scores for each emotion for participants with and without autism. Participants with autism scored significantly lower on the contagion task compared with typically developing peers when viewing happy, sad, and neutral expressions, $F(1) = 33.97$, $p < .001$ (M = 1.15 with autism; $M = 2.77$ without autism). Additionally, the analysis revealed a significant effect for emotion, $F(2) = 7.01$, $p < .01$ (M = 2.15 happy; $M = 1.33$ Sad; $M = 2.40$ neutral). Interaction effects were not significant. Post hoc analysis revealed that the mean contagion score for each emotion (happy, sad, and neutral) differed significantly from the other two.

Effect of Attention-getting Stimuli.

Figure 4. *Performance on the Contagion Task for Stimuli Across Emotion*

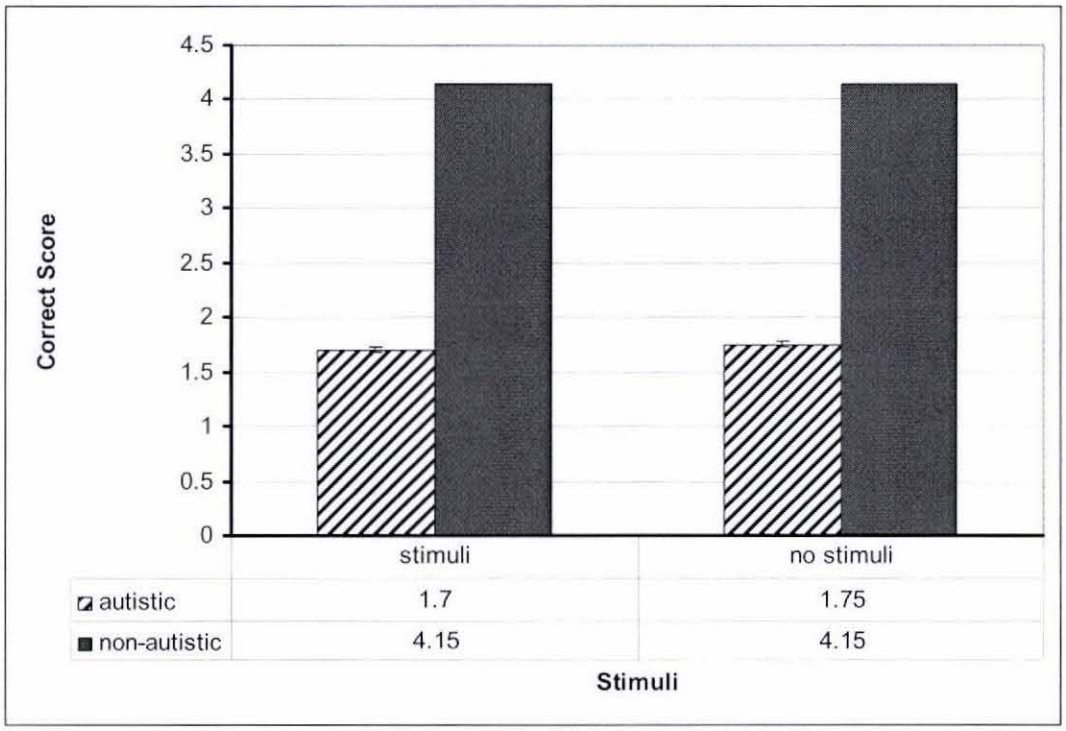

Figure 4. Sum of correct scores for the contagion task by children with autism ($n = 20$) and typically developing children ($n = 20$) presented with standard error bars.

The mean number of contagion scores for presentations with and without attention-getting stimuli for the groups with autism and without autism are pictured in figure 4. The

average contagion score for the participants with autism was 1.73 and 4.15 for the participants without autism. Children with autism were significantly less likely to report the same emotion as displayed on the screen compared to their peers, $F(1) = 33.97$, $p < .001$. The analysis did not find a significant main effect for stimuli. The interaction effect also was not significant.

Facial Mimicry

The current study examined the emotional reactions of participants when viewing presentations of happy, sad, and neutral emotions. Using a rater-based analysis of facial expressions, the researcher determined that spontaneous facial mimicry occurred if ratings of facial expressions corresponded with the emotion participants viewed on the computer screen. Therefore, participants would be rated as expressing more happy expressions when viewing happy faces and conversely, they would be rated as expressing more sad expressions when viewing sad faces. Although this study presented only happy, sad and neutral faces, participants could express any number of facial expressions in response to the emotions viewed. Thus, spontaneous facial expressions were measured using a seven-point Likert-type scale across the emotions of happy, sad, angry, neutral, fear, surprise, and disgust, with (0) = *not at all* and (7) = *extremely* (see Appendix D). Additionally, spontaneous facial mimicry can be very subtle. Consequently, raters were trained to be attentive to minute changes in facial expression. Following this line of reasoning, it was expected that participants may look mostly neutral, but might also express a small amount of other emotional expressions. The rating scale used in this study allowed raters to rate participants on the seven emotions simultaneously to capture this effect.

Three undergraduate research assistants, who were blind to the hypotheses of the study and blind to the diagnoses of the subjects, rated initial facial reactions to viewing the

emotional displays from videotapes obtained with a hidden camera. The orientation of the hidden camera also assured that raters were blind to which emotional display the participant viewed. To assure consistent rating, this study utilized the *MicroExpression Training Tools (METT) and Subtle Expression Training Tools (SETT)* created by Paul Ekman (2004) to train the research assistants. This tool consists of training exercises and a final test. Raters had to achieve a criterion score of over 90% to ensure that all raters were rating facial expressions based on the same criteria.

As this study examined primitive emotional contagion, raters measured the occurrence of facial expressions during the first portion of each experimental trial, which consisted of a three second display of the facial expression followed by the presentation of Q1 (how does this person feel?) or Q2 (how do you feel?). Previous research demonstrated that spontaneous facial mimicry occurs rapidly and the mean latency of these actions was less than 900ms after the onset of dynamic changes to facial expressions (Sato & Yoshikawa, 2007). In the current study, no response time was less than 15.8 seconds and average response time was 45.2 seconds.

To analyze interrater reliability, ratings of participant's facial expressions were intercorrelated across the three judges' ratings during happy, sad and neutral emotion displays. The Cronbach's Alpha intraclass correlation coefficient was $\alpha = 0.92$ for happy displays, $\alpha = 0.91$ for neutral displays, and $\alpha = 0.92$ for sad displays. This yielded an average intraclass correlation coefficient of $\alpha = 0.92$ across the three judges ratings.

Mimicry Ratings

To address the second and forth hypotheses it was first necessary to assess whether mimicry occurred. To do this, orthogonal *t*-tests analyzed the facial ratings for happy, sad and neutral expressions for each emotion display. The presence of mimicry was

determined if the mean rating of a facial expression was significantly higher when participants viewed that same expression versus other expressions. The analyses utilized average ratings across the three undergraduate raters. This study analyzed the data for each participant group separately. Significant effects were determined using an alpha level of .05, one-tailed. This researcher did not adjust the alpha level to correct for running multiple tests in order to be as liberal as possible in finding evidence for facial mimicry.

Table 3. *Mean Emotion Ratings for Participants without Autism*

	Emotion Ratings						
Emotion Display	Happy	Sad	Angry	Surprised	Afraid	Disgusted	Neutral
Happy	1.83	1.15	1.07	1.12	1.09	1.02	4.79
Neutral	1.72	1.30	1.08	1.14	1.10	1.12	4.49
Sad	1.78	1.24	1.15	1.10	1.13	1.11	4.41

Note. The values represent mean ratings of facial expressions for children without autism, (n = 20)

Mean emotion ratings for the participants without autism are presented in Table 3. For mimicry of happy expressions, an orthogonal *t*-test compared the mean of happy ratings during happy displays ($M = 1.83$, $SD = 1.10$) against the means of happy ratings during sad displays ($M = 1.78$, $SD = 1.79$) and neutral displays ($M = 1.72$, $SD = 0.67$) taken together. This test was not statistically significant, $t(58) = 0.48$, $p < .05$, one-tailed. For mimicry of sad expressions, the mean of sad ratings during sad displays ($M = 1.24$, $SD = 0.18$) was compared against the means of sad ratings during happy ($M = 1.15$, $SD = 0.17$) and neutral displays ($M = 1.30$, $SD = 0.25$). This test was not significant, $t(58) = 0.37$, $p < .05$, one-tailed. Finally, to analyze mimicry of neutral expressions, the mean of neutral ratings during neutral displays ($M = 4.49$, $SD = 1.19$) was compared against the means of

neutral ratings during happy displays ($M = 4.79$, $SD = 1.61$) and sad displays ($M = 4.41$, $SD = 1.49$). This test was not significant, $t(58) = -.011$, $p < .05$, one-tailed.

Table 4. *Mean Emotion Ratings for Participants with Autism*

	Emotion Ratings						
Emotion Display	Happy	Sad	Angry	Surprised	Afraid	Disgusted	Neutral
Happy	1.59	1.26	1.12	1.24	1.06	1.08	4.77
Neutral	1.67	1.31	1.19	1.21	1.03	1.06	4.65
Sad	1.59	1.35	1.09	1.3	1.04	1.04	4.79

Note. The values represent mean ratings of facial expressions for children with autism, (n = 20).

Mean emotion ratings for the participants with autism are presented in Table 4. For mimicry of happy expressions, an orthogonal *t*-test compared the mean of happy ratings during happy displays ($M = 1.59$, $SD = 0.56$) against the means of happy ratings during sad displays ($M = 1.59$, $SD = 0.70$) and neutral displays ($M = 1.67$, $SD = 0.67$) taken together. This test was not statistically significant, $t(58) = -0.32$, $p < .05$, one-tailed. For mimicry of sad expressions, the mean of sad ratings during sad displays ($M = 1.35$, $SD = 0.35$) was compared against the means of sad ratings during happy ($M = 1.26$, $SD = 0.23$) and neutral displays ($M = 1.31$, $SD = 0.33$). This test was not significant, $t(58) = 1.10$, $p < .05$, one-tailed. Finally, to analyze mimicry of neutral expressions, the mean of neutral ratings during neutral displays ($M = 4.65$, $SD = 1.06$) was compared against the means of neutral ratings during happy displays ($M = 4.77$, $SD = 1.09$) and sad displays ($M = 4.79$, $SD = 1.22$). This test was not significant, $t(58) = -0.60$, $p < .05$, one-tailed. As the analyses did not find evidence of mimicry in either group, further analyses of group differences and the effect of the attention-getting stimuli were not conducted.

Chapter 4
Discussion

The present study examined the ability to match, spontaneously mimic, and empathize with the facial expressions of others in children with autism and a matched control group. There were several specific questions this study sought to answer. First, are children with autism impaired in their ability to match facial expressions? Second, would children with autism exhibit less facial mimicry than their peers when viewing emotionally expressive faces? Third, do children with autism tend to catch the emotions of others? Fourth, would the use of an attention-getting stimulus increase facial mimicry, increase emotional convergence, and improve performance on the matching task? This researcher will discuss the findings as they relate to the specific hypotheses advanced in light of recent research concerning the development of emotional understanding for this population, followed by a consideration of the limitations of this study.

Hypothesis 1

The first hypothesis postulated that children with autism would be impaired in their ability to match facial expressions compared to children without autism. The analysis supported this hypothesis, as children with autism were significantly less able to correctly match facial expressions of happy, sad, and neutral than children without autism. This finding supports those of previous studies (Celani, et al., 1999; Dawson et al., 1990; Kasari, et al., 1990; Hobson, et al., 1988; Weeks & Hobson, 1987). Unlike other studies (Celani, et al., 1999; Hobson, et al., 1988) this study did not omit non-emotional cues such as eyebrows, allowing the children to utilize any perceptual strategy available to them. Despite this, the participants with autism performed worse than their age matched peers. The pattern of results implies that children with autism were impaired in matching all three

simple expressions, but they were more impaired in matching sad expressions and seemed to have the greatest difficulty when matching neutral expressions.

Hypothesis 2

The second hypothesis was that children with autism would display less facial mimicry when viewing pictures of people expressing emotion states. The analysis did not reveal significant evidence of facial mimicry in either group for presentations of happy, sad and neutral. Participants in both groups received ratings that identified them as looking more neutral than any other emotion. Emotion ratings followed a similar pattern regardless of the type of expression viewed. Figures 5 and 6 illustrate the pattern of results observed.

Figure 5. *Ratings of Facial Mimicry for Children With Autism*

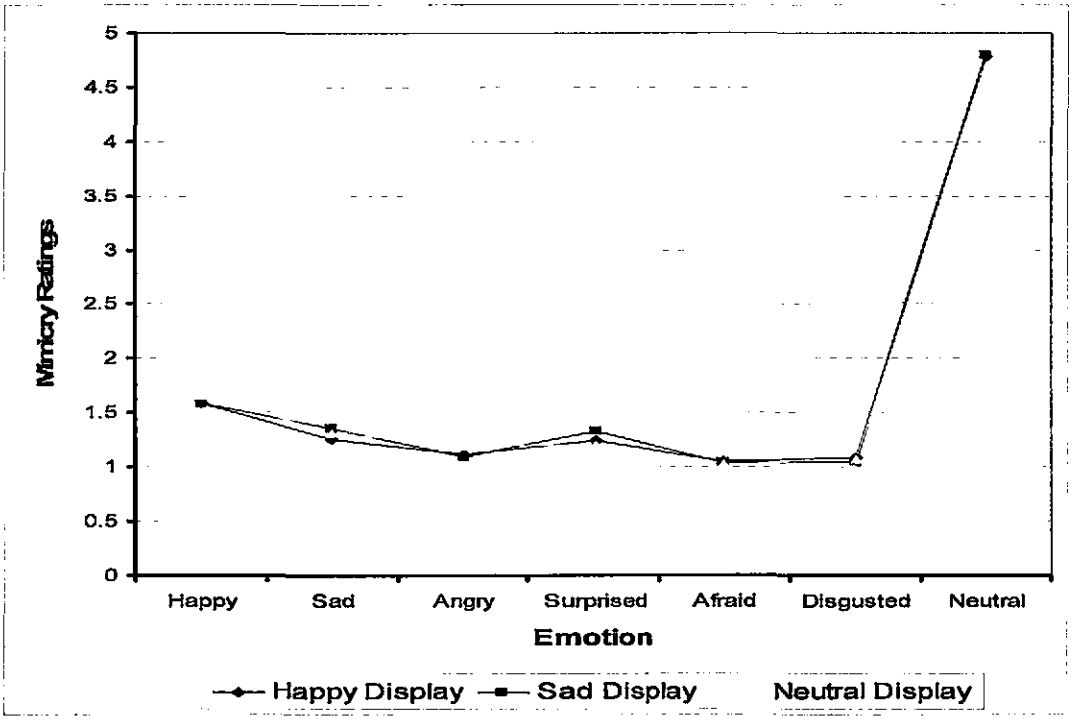

Figure 5. Pattern of ratings of facial mimicry when viewing happy, sad, or neutral faces.

Figure 6. *Ratings of Facial Mimicry for Children Without Autism*

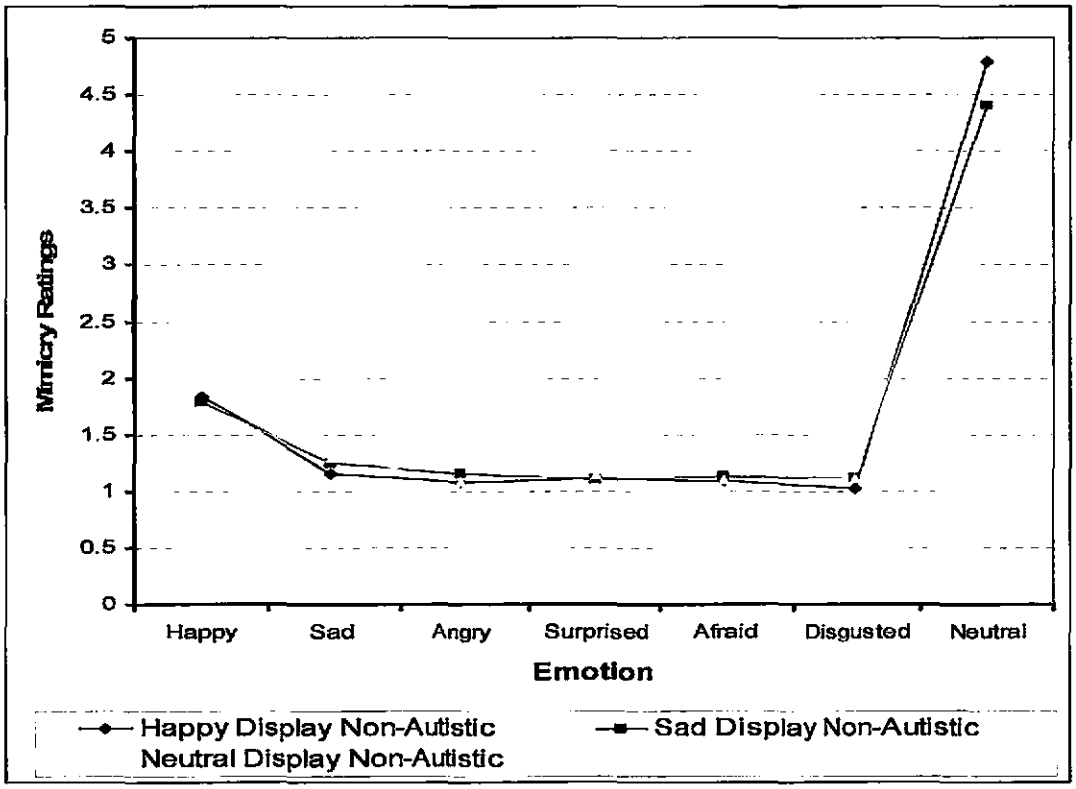

Figure 6. Pattern of ratings of facial mimicry when viewing happy, sad, or neutral faces.

Contrary to the belief that children with autism are less expressive than their peers, the autism and control groups were rated as expressing similar facial expressions. Although this finding seems to go against previous research on perceptions of facial expressions and emotional reactions for this population (Capps et al., 1993; Kasari et. al, 1990; Sigman et al., 1992, Yirmiya et al, 1989), other studies have not observed differences in facial expressiveness during natural settings (Dawson et al., 1990). There are several possible explanations that might help to explain the lack of facial mimicry observed in both children with and without autism. One possibility is that the presence of the researcher may have interfered with natural facial reactions to emotional expressions. A review by Ekman and Oster (1979) summarized two studies that found that when a person of authority is present, cultural display rules can affect natural facial reactions, causing

participants to smile more and show more facial control. As many of the participants in this study come from Asian and pacific island cultural backgrounds, this may have been an issue for the current study.

A second possibility to consider is that the facial expressions used in each display did not carry enough emotional intensity to elicit spontaneous mimicry. As this study utilized the Japanese and Caucasian Facial Expressions of Emotion (JACFEE) and Neutral Faces (JACNeuF) previously validated in several countries around the world (Biehl, Matsumoto, Ekman, Hearn, Heider, Tsutomu, & Ton, 1997) this seems unlikely. Additionally, studies have observed facial mimicry in response to facial expressions described as "weak" and "non-prototypical" (Hess & Blairy, 2001).

Finally, it may be that raters simply did not observe the facial muscle movements of participants. Many studies employ measurements of facial electromyographic activity to capture changes in facial expression too slight to detect visually (Cacioppo, Petty, Losch, & Kim, 1986). Furthermore, although ratings were highly reliable between raters, it may be that facial reactions were easily missed due to the nature of the rating system. Had this study employed a method such as the *Facial Action Code* which requires exhaustive training and a comprehensive test, raters might scrutinize minute changes more carefully. Additionally, the quality of the video tape obtained from the hidden camera was grainy due to its tiny size and this may have affected rater's ability to detect changes in facial expressions.

What is interesting about these results is that facial ratings of the six basic emotions followed very similar patterns for both children with and without autism. It raises the question of whether this finding was dependent on the clinical nature of the study, where participants enter into an unfamiliar setting to watch photographs of facial expressions on a

computer screen. The faces displayed were also not terribly exciting or dynamic and may not be as motivating for children, leading to dull and expressionless, facial reactions.

Hypothesis 3

The third question of this study addressed the issue of contagion by asking participants how they felt following the presentation of an emotional display. The analysis supported the hypothesis that children with autism would be less likely to report feeling the same emotion as the emotion displayed on the computer screen compared with age matched peers. This finding is generally congruent with previous studies that examined empathy in children with autism. A study by Yirmiya and colleagues (1992) scored children's abilities to label emotions, cognitively explain their decision-making process, and empathize with the emotions of others. They found that although the children with autism were quite good at labeling emotions, they still lagged behind peers in their performance on all three tasks. Additionally, these investigators were able to find a strong correlation between scores for the labeling task and scores for the empathy task. Based on the findings from our current study, we found similar impairments in labeling and contagion tasks

Hypothesis 4

Contrary to the hypothesis that the attention-getting stimuli would improve mimicry, matching, and contagion, the results showed no significant effects to support this proposition. The use of a dynamic color cue superimposed over the eyes and mouth did not improve performance on the matching task or facilitate emotional convergence for either group. Additionally, mimicry was not present in either group with or without the stimuli. Previous research has shown that individuals with autism view non-feature areas of faces significantly more often than core areas (eyes, nose, mouth) when viewing faces

and identifying emotions (Pelphrey, Sasson, Reznick, Paul, Goldman, & Piven, 2002). Although this study did not examine eye tracking, it would have been interesting to investigate how the attention-getting stimuli affected the scanning pathways of the participants.

Limitations of the Study

There were several limitations with the current study that may have contributed to findings contrary to those hypothesized. These include the variation within the sample population, possible procedural problems, and limitations with the emotional and attention-getting stimuli used in this experiment.

First, the sample population of children with autism included in this study included a wide range of ages and abilities along the autism spectrum, which also affected the selection of the control group. Although this may be par for the course when recruiting participants from special populations, a more uniform sample would have provided this study with greater validity for a specific ASD and age group. Despite this variability, correlations between raw scores on the TONI-3 Test of Nonverbal Intelligence, 3rd edition indicated that performance for the matching task was not associated with estimated mental age (maturity) and nonverbal intelligence (IQ).

Additional limitations include procedural constraints which may have affected effect sizes. Firstly, participants were playing a game that was highly repetitive. Thus, practice effects may have affected participant response in different ways. Some participants may have improved their performance over time while others may have experienced increased amounts of boredom as the game continued, leading to decreased motivation to try their best. Additionally, for the emotion matching task, half of the participants correctly matched all of the emotion displays, creating a ceiling effect that

affected the control group to a greater extent. Thus, statistical findings may not be as robust as they might have been otherwise. Third, as mentioned before, the clinical constraints of running an experiment in a laboratory has implications as to how natural the reactions of the participants were and how generalizable the results of the experiment are to real world experience. It may be that the presence of the experimenter, a new and unfamiliar environment, or a desire to do well on the task at hand affected how participants would react naturally to the facial expressions of others.

Last, it is important to address the potential limitations of the stimuli used in this experiment. The faces used in the emotional displays were still photographs depicting facial expressions, previously determined to be adequate examples of the basic emotions found cross culturally. However, these pictures are not the natural and dynamic social stimuli humans are exposed to in everyday life. Thus, it may be that the emotional content of the photographs was not strong enough to elicit recognizable patterns of facial mimicry. Humans are also accustomed to receiving social input in a variety of forms that include visual, auditory and gestural cues that may facilitate mimicry to a greater extent when occurring in combination. Furthermore, although research on attention supports the use of onset and color cues as visual primers, the attention-getting stimulus used in this experiment did not facilitate emotion recognition, mimicry, and contagion.

Conclusions

Taken as a whole, the results of this study provide some support for impaired emotion perception and empathy in children with ASD. This study successfully replicated previous findings that children with autism are impaired in their ability to match facial expressions compared to children without autism. Additionally, it was determined that children with autism are less likely to report the same feeling state as an emotional display,

which implies that they are less likely to experience emotional contagion. Finally, the children with autism did not express more or less facial mimicry than the typically developing children in this study; however it was impossible to evaluate their ability to mimic due to the failure to find mimicry in either population

Fortunately, this study does lend some insight into directions for future research on emotion perception and facial expressions. Future studies should look at using more natural and dynamic forms of social input such as movies and real world interactions which may elicit facial mimicry to a greater extent. Additionally, the use of the Facial Action Code or Electromyography (EMG) recordings may provide greater sensitivity for recording subtle facial reactions.

Future research examining the role of attention in expression recognition and emotional contagion may help to identify a technique that might improve social perception for individuals with autism. Although this study does not focus on the effects that increased facial mimicry and empathy might have on social and emotional outcomes, this might lead to increased physiological arousal, self-awareness of emotions, feelings of empathy and subsequent social understanding. People who work with this population could then develop teaching strategies that concentrate on attention to facial cues to enhance social skills for people with this disability.

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Appendices

Appendix A

TONI-3 Rating Sheet

Experimenter: _____

Rater: _____
Date: _____

1	**Not at all**
2	**Somewhat**
3	**Moderately**
4	**Mostly**
5	**Completely**

Rating Scale

The testing location:

1. Was the test environment comfortable? 1 2 3 4 5
2. Were there minimal distractions or interruptions? 1 2 3 4 5
3. Was the experimenter prepared? (table, test, chair, pen) 1 2 3 4 5
4. Was the subject tested alone? 1 2 3 4 5

Explaining the purpose of the TONI-3:

5. Did the experimenter say, "The Toni-3 will help us understand how you solve problems with your eyes." 1 2 3 4 5
6. Did the experimenter say, "Results of the TONI-3 will be used to recruit children for our study." 1 2 3 4 5
7. Did the experimenter say, "The TONI-3 is nonverbal, so I will not be talking. You can respond by pointing to your answer or gesturing in any way you can. 1 2 3 4 5

Administering the TONI-3:

8. Did the experimenter indicate that the test was beginning? 1 2 3 4 5
9. Did the experimenter repeat training items if the subject did not understand? 1 2 3 4 5
10. Did the experimenter praise or not praise consistently? 1 2 3 4 5
11. Did the experimenter praise the EFFORTS, not the accuracy of responses? 1 2 3 4 5
12. Did the experimenter control facial expressions and/or gestures that gave feedback to the child? 1 2 3 4 5
13. Did the experimenter control facial expressions and/or gestures that could be clues to correct responses? 1 2 3 4 5
14. Did the experimenter nod their head to show that they understood the child's nonverbal response? 1 2 3 4 5
15. Did the experimenter point to the empty square first? 1 2 3 4 5
16. Did the experimenter point to the response choices? 1 2 3 4 5
17. Did the experimenter point back to the empty square on and look/gesture questioningly? 1 2 3 4 5
18. For questions involving sequences, did the experimenter point to the entire sequence for each response choice? 1 2 3 4 5

19. Did the experimenter administer test items consistently? 1 2 3 4 5
20. Did the experimenter allow the child time to respond? 1 2 3 4 5

21. Did the experimenter redirect the child once if they were not paying attention or considering the response choices? 1 2 3 4 5

Concluding the TONI-3:

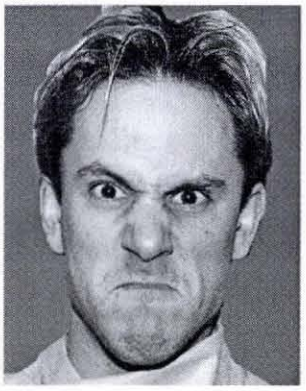
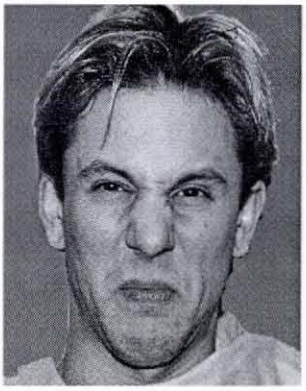
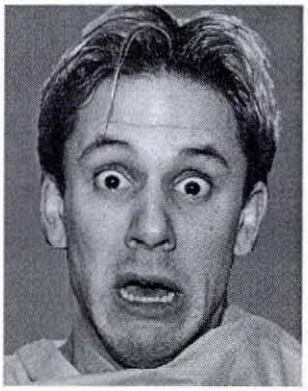
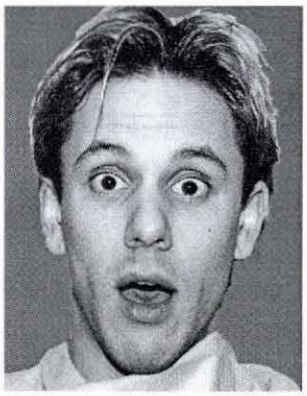
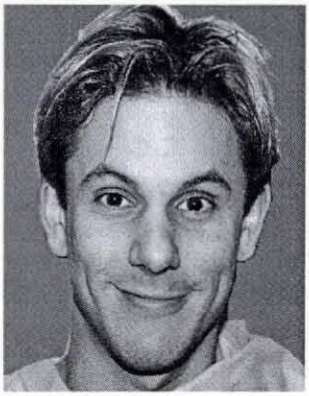
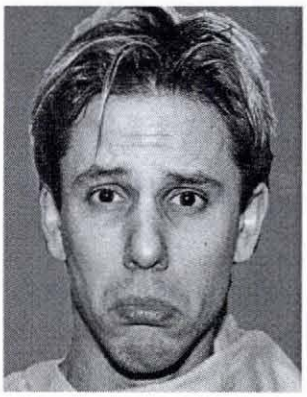
22. Did the experimenter end the test in a natural way that did not let on to the subject that testing was ended due to wrong responses? 1 2 3 4 5
23. Did the experimenter give the child positive feedback For their efforts? 1 2 3 4 5
24. Did the experimenter take precautions to keep the test results confidential? 1 2 3 4 5
25. Did the experimenter take precautions to keep the child's identity confidential? 1 2 3 4 5

Thank you!

Appendix B

Pre-experimental Emotion Board

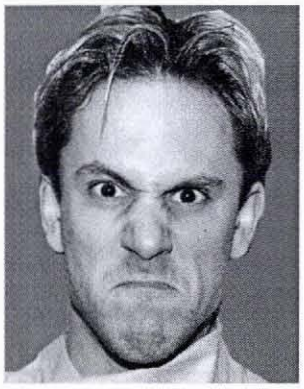
Materials for the pre-experimental task included black and white pictures of the same individual posing angry, disgusted, afraid, surprised, happy, sad, and neutral expressions. Pictures did not have labels as participants were to identify the emotions and describe a situation where they might feel each emotion state. These pictures are reduced in size from their original state.

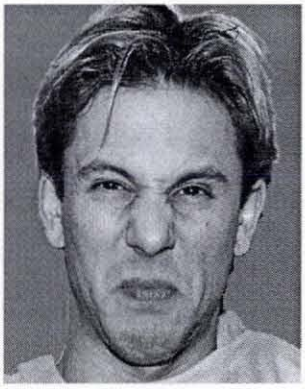

Appendix C

Emotion Choice Board

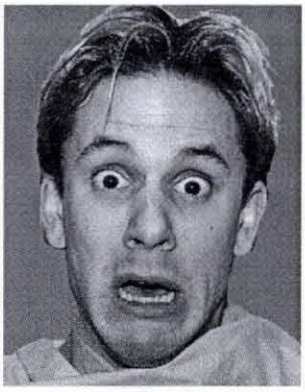
Materials for the emotion choice board used during the experimental task included black and white pictures of the same individual posing angry, disgusted, afraid, surprised, happy, sad, and neutral expressions. These pictures are reduced in size from their original state.



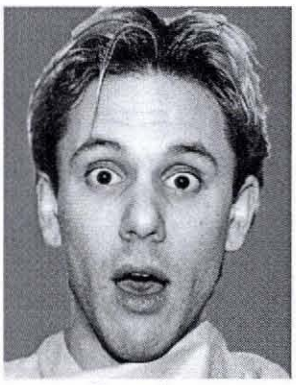
Anger



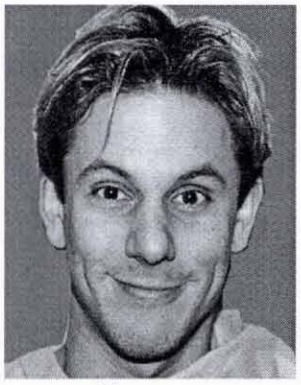
Disgust



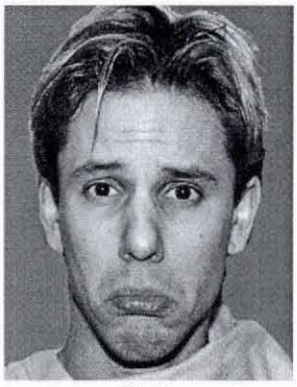
Afraid



Surprise



Happy



Sad

Neutral

Appendix D

Emotion Rating Sheet

Rating scale used by trained undergraduate researchers who were blind to the hypotheses of the study and blind to participant diagnosis.

Subject # _____ **Rater** _____ **Presentation #** _____

For each of the following items, please rate to what degree the individual's facial expression displayed the following emotions.

How **Happy** did they look?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Sad**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Angry**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Surprised**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Afraid**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Disgusted**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How **Neutral**?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely