

EVALUATIVE CONDITIONING OF EMOTIONAL EXPRESSION
IN AUTISM SPECTRUM DISORDERS

by

MEGAN ELIZABETH CRISLER

LAURA KLINGER, COMMITTEE CO-CHAIR
JOHN LOCHMAN, COMMITTEE CO-CHAIR
MARK KLINGER
SARAH RYAN
ANGELA BARBER

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ABSTRACT

To appropriately respond to the emotional state of others, it is necessary to accurately perceive the emotion. To perceive an emotion's meaning suggests that a person has learned that a smile communicates happiness and a frown communicates anger. There is a growing body of literature indicating that individuals with Autism Spectrum Disorder (ASD) have significant difficulties understanding and differentiating emotional expressions and that this may play an integral role in the observable social impairments observed. The current study examined whether emotion perception difficulties in persons with ASD were related to impairments in the implicit learning of the relation between emotional expressions and information in the environment. Specifically, the current study used an evaluative conditioning task in which social-emotional and non-social neutral expressions were paired with neutral stimuli. It was predicted that typical individuals would prefer the stimuli associated with positive emotional expressions. In contrast, this learning was predicted to not occur in the ASD sample. Sixteen young adults with ASD were compared to fifteen young adults with typical development. Participants were administered a computer task that presented cartoon characters paired to faces exhibiting happy or angry expressions, or paired with a neutral gray box. Participants were then asked to provide preferences for characters and ratings for likeability. An explicit memory test was also conducted. Despite successful pilot testing, adequate learning of distinctive emotions was not observed in either diagnostic sample. However, a significant preference for non-social paired stimuli, as opposed to social-paired stimuli, was reflected in the ASD sample. A preference was not observed in the typically developing sample. Due to a lack of successful

implicit learning in the typically developing sample, conclusions may not be appropriately drawn from the performance of the ASD sample. However, patterns in learning styles and explicit memory results do suggest explicit learning in the ASD sample, as well as continued preference for nonsocial stimuli in adulthood. These findings lend support to theories of differing learning styles in ASD compared to typically developing peers. Research regarding the differing learning styles of those with ASD is important to consider in the development and implementation of interventions.

DEDICATION

This thesis is dedicated to all who have provided encouragement and support when it was most needed in the development of this thesis. To my parents and brother in particular; I am truly blessed to have the three of you as my constant source of inspiration, comfort, and courage. As you have each been available to listen and lean on when it was most needed, you have also been available to remind me of those things which are most important - family and God. Most of all, I would like to thank God for bringing this thesis to fruition and the many blessings He has granted along the way, including friends and loved ones who are always present at all of the right moments.

LIST OF ABBREVIATIONS AND SYMBOLS

<i>d</i>	Cohen's <i>d</i> : Measure of effect size for use with <i>t</i> -tests or ANOVA
<i>F</i>	Fisher's <i>F</i> ratio: A ration of two variances
<i>M</i>	Mean: the sum of a set of measurements divided by the number of measurements in the set
<i>SD</i>	Standard Deviation
<i>p</i>	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
η_p^2	Partial eta squared: Measure of effect size for use in ANOVA
<i>r</i>	Pearson product-moment correlation
<i>t</i>	Computed value of <i>t</i> test
<	Less than
>	Greater than
=	Equal to

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Chapter 1: Introduction

The recognition of emotional expression is a key, universal component in social interaction necessary for the display of appropriate response (Crick & Dodge, 1994; Ekman, 1997, 2003). There is a growing body of literature indicating that individuals with Autism Spectrum Disorder (ASD) have significant difficulties understanding and differentiating emotional expressions and that this may play an integral role in the observable social impairments that characterize this disorder. While previous research has documented difficulties in emotional perception, particularly those pertaining to identification and semantic understanding, few studies have examined the interaction between emotion perception and learning impairments in ASD (Castelli, 2005; Grossman, Klin, Carter, & Volkmar, 2000; Hobson, Ouston, & Lee, 1988; Ozonoff, Pennington, & Rogers, 1990). This current study seeks to examine the possible ramifications of impaired implicit learning on the ability to pair emotional information with novel contextual cues.

Autism spectrum disorder (ASD) is characterized by a triad of core symptoms, including deficits in communication, social impairments, and the presence of repetitive, restricted, and stereotyped interests (APA, 2000). Within the first year of life, delays of social orienting are often apparent, as documented by a number of retrospective studies including those analyzing archival video from first year birthday parties (Osterling & Dawson, 1994; Werner, Dawson, Osterling, & Dinno, 2000). Prospective early identification studies have jointly reported early signs of social deficits, including a lack of appropriate gaze, lack of response to name, lack of

warm, joyful expressions with gaze, and lack of eye contact observed in infants who were later diagnosed with ASD (Wetherby et al., 2004). Several of these early symptoms are suggestive of decreased attention toward emotional stimuli including decreased eye contact and decreased attention toward another's face in a reciprocal manner. These early developing deficits are thought to contribute to later social impairments (Mundy & Neal, 2001; Wetherby, Watt, Morgan, & Shumway, 2007). The decreased attention toward facial stimuli may interfere with the development of appropriate social skills by preventing adequate exposure to emotional expressions, thereby limiting the social learning opportunities as exposure to these expressions is necessary for understanding their meaning. Indeed, studies have indicated that individuals with ASD are impaired in the ability to accurately identify differing emotional expressions, lending support to the theory that learning of these emotions is not occurring (Capps, Kasari, Yirmiya, & Sigman, 1993; Hobson, 2004; Rump, Giovannelli, Minshew & Strauss, 2009). If a person cannot adequately understand the emotion being communicated by another's face due to social learning impairments, then it will be difficult to socially respond to others in an appropriate and sensitive manner. In summary, the results of these previous studies provide the foundation for a working theory to explain the observed impairments of emotion recognition in ASD.

Specifically, those with ASD are not observed to respond to emotional stimuli in similar manners as typical peers due to a primary learning impairment. The literature on how individuals with ASD attend to faces, perceive emotions, and learn new information is supportive of this working theory. Each of these research areas will be reviewed below.

Attention to Facial Stimuli

Studies comparing children's attention to social stimuli and to nonsocial stimuli, such as attention to faces versus objects, have reported atypical patterns in children with ASD with more

time being spent looking toward and responding to objects rather than faces (Dawson, Meltzoff, Osterling, Rinaldi, and Brown, 1998; Swettenham et al., 1998). For example, children with ASD were less likely to turn when their name was called than when a bell was rung. In addition to a reduction in attending to social stimuli, the manner in which individuals with ASD attend to social stimuli is unique, as well. Numerous studies have found reductions in both the time spent examining faces and in time spent examining certain features of the face. Additional studies have more specifically shown a reduced interest in attending to the eye region of faces and more interest in attending towards the lower or more non-central regions, such as the mouth or chin area (Klin, Jones, Schultz, & Volkmar, 2002; Pelphrey et al., 2002). If the manner of attention towards facial stimuli is altered in individuals with ASD, it is expected that their opportunity to extract emotional expression will also be reduced, as is suggested by social learning theory. As it happens, emotional recognition and perception is shown to be negatively affected in ASD populations, but the particular extent of this perception impairment is unclear.

Perception of Emotion in Faces

Studies of emotional perception in young children suggest that children, both with typical development and with ASD, exhibit both greater recognition and preference for stimuli that exhibit positive emotions (e.g., happiness), as opposed to negative emotions, such as faces or nonsocial stimuli displaying angry or fearful emotions (Adolphs, Sears, & Piven, 2001; Baron-Cohen, Spitz, & Cross, 1993; Baron-Cohen, Wheelwright, & Jolliffe, 1997; Field, 2006b; Grossman et al., 2000; Kamio, Wolf, & Fein, 2006; Volkmar, Sparrow, Rende, & Cohen, 1989). However, children with typical development tend to show increased attention toward faces displaying negative emotions through a process referred to as *threat detection*. Through threat detection, preference may be given for the positive emotions, but priority of attention is given to

negative emotions. In studies examining the either the concept of threat detection or the similar *anger superiority effect*, individuals are presented with a sea of faces in two configurations: a sea of happy faces with one angry face or a sea of angry faces with one happy face. Several studies have found that individuals with typical development are able to locate the angry face at a much faster rate than the happy face (Ashwin, Wheelwright, Baron-Cohen, 2006; Hansen & Hansen, 1988; Krysko & Rutherford, 2009). Hansen and Hansen (1988) hypothesize that the faster perception of negatively displayed emotion is due in part to an instinctual nature in humans to detect threat as a means of self-protection. Several studies have examined whether individuals with ASD are able to perceive negative emotions and whether they display the “anger superiority effect.”

While findings indicate that individuals with ASD are able to successfully discriminate positive emotions as compared to peers with typical development, the extent to which they can effectively discriminate various negative emotions remains in question. Specifically, there have been mixed findings regarding whether individuals with ASD can reliably discriminate between angry and fearful emotions (Ashwin, Baron-Cohen, Wheelwright, O’Riordan, & Bullmore, 2006; Dawson et al., 2004; Pelphrey et al., 2002). The mixture of results lending support for discriminatory abilities in ASD are based on a variety of factors including small sample size, demographic characteristics, differing forms of stimuli, and differing task procedures (see Harms, Martin, & Wallace, 2010 for a full review). Some task designs include contextual information, along with the faces, lending criticism that the individuals with ASD may have been basing their emotional judgments on other contextual cues (e.g., body language or setting; Golan, Baron-Cohen, Hill, & Golan, 2006). Others have provided sketch drawings rather than true human photographs (Ashwin, Baron-Cohen, et al., 2006). The large scale implication of the

mixture of findings is that more study replications, with higher levels of control, should be pursued.

The ability to distinguish between these angry and fearful emotions can have large-scale effects; particularly in a person's ability to accurately detect threatening people or situations. In addition to studies finding that individuals with ASD attend to faces at a reduced rate in comparison to their typical peers, a number of studies have also indicated that individuals with ASD show even further reductions in attention toward a face when the caretaker or examiner exhibits a negative facial expression, such as anger, fear or distress (Corona, Dissanayake, Arbelle, Wellington, & Sigman, 1998; Dawson et al., 2004; Sigman, Kasari, Kwon, & Yirmiya, 1992).

Despite this reduction in attention toward negative emotions, studies have shown evidence for an anger superiority effect in individuals with ASD (Ashwin, Baron-Cohen, et al., 2006; Ashwin, Chapman, Colle, & Baron-Cohen, 2006; Ashwin, Wheelwright et al., 2006; Krysko & Rutherford, 2009). While these studies supported the presence of threat detection, it is important to note that the effect was flattened in the ASD participants. In other words, the participants attended to the angry face faster than the happy face, but lacked significant corresponding levels of identification accuracy for labeling and distinguishing types of negative faces (particularly angry faces) that is seen in participants with typical development.

Anxiety

While it is important to thoroughly examine the implications of attention and perceptual deficits in ASD, it is equally important to address the presence of social anxiety in the disorder, as well. A proposal by Ashwin, Baron-Cohen and colleagues (2006) has hypothesized that negative facial stimuli may differentially increase anxiety in individuals with ASD compared to

individuals with typical development. As a result, this increased anxiety could promote a slower response to the emotional stimuli and therefore interfere with the correct emotional interpretation due to the lengthened exposure to the anxiety. Still, if emotion recognition is impaired in ASD, why would there be an increase in anxiety in response to negative social stimuli? Further indication of anxiety being prompted by negative facial stimuli was found in a 2010 fMRI-based study showing increased activation of the right amygdala and left middle temporal gyrus upon the presentation of emotional stimuli in individuals with ASD who also reported social anxiety (Kleinhans et al., 2010). This increase in anxiety-related activations is not observed in typical individuals who are presented with the same stimuli. What is unclear, however, is the directional relation between the anxiety and the social learning. For example, while the 2010 study by Kleinhans and colleagues would suggest that anxiety occurs upon the presentation of the social stimuli, it is unclear whether the lack of accurate emotion learning and processing occurs as an effect of the already-present social anxiety or if the social anxiety is a result of a lack of understanding regarding the meaning of the emotional information. In either of the explanations, the larger clinical implication of these findings is the significant impact social anxiety may have on social processing in ASD, given the general maladaptive relation between anxiety and cognitive performance (Eysenck, Derakshan, Santos, & Calvo, 2007).

Impact of Social Attention and Perception on Learning

Taken together, the literature suggests that from early in life individuals with ASD show atypical attention to faces. It is likely that this atypical attention, particularly the tendency to focus on the mouth rather than the eyes, leads to difficulties understanding and appropriately perceiving emotional expressions. Given these early developing social attention difficulties, it might be logical to assume that individuals would develop adaptive or compensatory strategies to

effectively learn emotion recognition skills. Indeed, it has been suggested that individuals with typical development and individuals with ASD continue to improve in their ability to recognize subtle, configurable discriminatory characteristics of specific facial expressions well into adulthood (Rump et al., 2009). This finding is in contrast to previous research suggesting a possible ceiling effect of this improvement around age 10 for children with ASD (Bruce et al., 2000; Mondloch, Geldart, Maurer, & Le Grand, 2003). The Rump et al. (2009) study also suggests that while those with ASD continue to improve, they never fully catch up to their typically developing peers in regards to accuracy of recognition. It is possible that an early developing tendency to avoid looking at other people's faces causes children with ASD to be delayed in their understanding of emotional expressions. With experience, children with ASD may learn to attend to faces due to social pressure (e.g., it is necessary to interact with others in some capacity) but may not be as accurate as those individuals who have attended to faces from infancy onwards; decreased attention and exposure to facial stimuli leads to less learning opportunities.

Learning Theories

The literature on early developing impairments in emotion perception in ASD is consistent with the hypotheses that individuals with ASD have poor implicit or automatic learning and instead rely on explicit or effortful learning skills (Klinger, Klinger, & Pohlig, 2006). Implicit learning centers on what may be viewed as "accidental learning," or learning without intent (Reber, 1989). It is hypothesized that implicit learning develops early in life and is important for the development of social and language skills, including emotion understanding (Baron-Cohen, Golan, & Ashwin, 2009; Gomez and Gerken, 1999; Lieberman, 2000; Saffran, Newport, Aslin, Tunick, & Battueco, 1997). Klinger et al. (2006) hypothesized that individuals

with ASD were impaired in implicit learning and instead relied on explicit, rule-based strategies to learn skills that were typically learned implicitly. While preference for social stimuli is low, individuals with ASD may recognize that they need to learn to respond to others in a social manner to some degree and thereby go about more explicit manners of doing so. For example, it is common for therapists to utilize social stories and scripts in individuals with ASD as they are preparing for social interactions. These scripts are intentionally memorized and then applied in every day social settings to make the social interactions easier (Barry et al., 2003; Ruble, Willis, & Crabtree, 2008; Scattone, Tingstrom, & Wilczynski, 2006). These explicit-based social stories or scripts are not necessary for individuals with typical development, as they learn the social norms implicitly. While the explicit strategies may be useful to increase social understanding, individuals with ASD are still not learning to become as fluid in their understanding and execution of social norms as their typically developing peers, as supported in the Rump et al. (2009) study.

If explicit learning strategies may be used in place of implicit learning strategies, it would stand to reason that success across emotional discrimination tasks might improve if time exposure to stimuli were lengthened to allow for more opportunity for explicit processing to occur. In support of this, deficits have been reported in studies using rapid emotional processing conditions compared to slower emotional processing conditions in children with ASD (Clark, Winkielman, & McIntosh, 2008). These results indicate that when given longer periods of time to examine facial expressions, individuals with ASD were more accurate at detecting and thereby learning facially expressed emotions.

However, the theory of providing extended time of exposure to allow for compensatory explicit cognitive strategies has not been consistently supported in the literature. Other studies

have suggested that even with providing this extended time, compensatory strategies are not employed to accommodate for the processing deficits. (Ashwin, Wheelwright et al., 2006; Grossman & Tager-Flusberg, 2008; Lindner & Rosen, 2006). For example, Ashwin, Wheelwright et al. (2006) refer back to the anxiety literature and argue that emotion recognition difficulties may not result from impaired underlying learning processes but instead may be due to anxiety which therefore impedes learning. If true, then an extended amount of exposure may only heighten anxiety and increase the likelihood of an avoidance response in individuals with ASD (i.e., diminished attention toward facial stimuli as previously discussed in this document). One way to examine these conflicting explanations of emotion learning difficulties is to use a task that controls attention allocation such that any impairments in learning is indicative of perception atypicality and not due to lack of attention/exposure alone.

Learning Strategies to Pair Emotion with Context

Several investigators have used classical conditioning studies to examine emotion learning in children with typical development. These tasks have been developed to assess automatic or implicit learning and have controlled for attention/exposure. Thus, these tasks may be particularly useful in examining emotion learning in individuals with ASD. In a typical classical conditioning task, an unconditioned stimulus is paired with a conditioned stimulus, producing the same reaction across both stimuli after the pairing. A collection of studies on classical conditioning have explored a variation of this learning referred to as *evaluative conditioning*. Classical conditioning is distinct in that it pairs a more objective predictor (unconditioned stimuli) to the neutral stimuli (conditioned stimuli). In contrast, evaluative conditioning requires that an individual make an assessment of the qualitative value of the unconditioned stimuli. An *evaluative* judgment to the unconditioned stimulus is made and then

attributed to the paired neutral, conditioned stimulus. In doing this, the actual power of conditioning is open to individual evaluation or assessment of the original unconditioned stimulus (Field, 2000; Walther, Weil, Düsing, 2011). In the case of emotion research, this distinction is highly important if the initial unconditioned stimulus assessment is based on an emotive expression where the participant must first be able to aptly assess the displayed emotion.

An emerging body of research explores emotional perception in typical development through evaluative conditioning tasks (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, G., 2010). Field (2006a) examined the development of evaluative conditioning in children between 9 and 11 years of age. In this study, novel cartoon characters called “Futuremons” were associated with objects that were either commonly liked (e.g., ice cream) or commonly disliked (e.g., brussel sprouts). After the exposure phase during which these objects were paired with the Futuremon characters, more children had a preference for the characters associated with ice cream than characters associated with brussel sprouts (Field, 2006a). In a similar study, using an attention measure rather than a preference measure, Field (2006b) found that children showed a significant attention bias towards the cartoon character that had been associated with a negative stimulus (i.e., a scary vignette). Similar to the Hansen and Hansen (1988) studies on preference and biased attention toward fear using actual facial stimuli, the research by Field suggests that these same effects may be seen in learned associations and applied to nonsocial stimuli.

Few studies have examined evaluative conditioning in persons with ASD. Kamio et al (2006) conducted a priming study in which individuals with ASD were shown facial stimuli of happy, angry, and fearful facial expressions followed by cartoon stimuli at both a subliminal and supraliminal level. For the subliminal condition, faces were presented as primers for 16 ms, followed by the cartoon stimuli for 5000 ms. For the supraliminal condition, primers were

presented for 600 or 1000 ms, for adolescents and children respectively, followed by the cartoon stimuli for 5000 ms. Priming effects were seen in individuals with typical development, but not individuals with ASD. The authors of this study concluded that subliminal processing of emotions in ASD is impaired and that individuals with ASD were not responsive to affective priming due to amygdala dysfunction.

One important methodological aspect to consider in the Kamio et al. (2006) study is the order in which the stimuli were presented. In its design, the emotional expressions were presented first whereas in a typical evaluative conditioning paradigm the emotional expressions are presented second. This is an important distinction because Ashwin et al (2006) suggested that individuals with ASD may show an avoidance or anxiety response to emotional faces. If this is the case, regardless of the type of facial stimuli presented, an avoidance response may have been occurring in the Kamio et al. (2006) study thereby interfering with the conditioning task and producing a negative contingency. The importance of contingency presence between unconditioned and conditioned stimuli is a basic part of classical conditioning (Rescorla, 1968). If the presented stimulus induces a negative emotion, the contingency will possibly be for a negative attribution to be applied toward all paired conditioned stimuli resulting in poor priming or conditioning effects, as was seen in the Kamio et al. (2006) findings. By utilizing the same concept of pairing cartoon characters with facial stimuli, but first presenting the cartoon characters before the facial stimuli, the negative contingency effects may be reduced and therefore may result in a different rate of conditioned pairing of emotions in persons with ASD. Indeed, studies have lent support to the idea of cartoon characters being utilized in social learning interventions for those with ASD as the characters are often more motivating and activate sections of the brain (i.e. fusiform gyrus) necessary for emotion processing whereby

facial stimuli do not (Grelotti et al., 2004; Klin, 2008). Further, the reversal of the stimuli (e.g., presenting the character before the emotion-laced stimuli) is not a novel concept, as it has shown to be a successful design in individuals with typical development (Baccus, Baldwin, & Packer, 2004; Field 2006a, 2006b).

Proposed Study

The proposed study sought to apply the methodology of evaluative conditioning to examine whether individual with ASD show impaired implicit or automatic learning of emotional expressions. Within the Field studies, multiple stimuli were presented at once or in different positions on the screen, demanding a shift of attention and eye gaze from participants. The shifting of attention, particularly across social stimuli, has been indicated as a significant impairment for individuals with ASD (Swettenham et al., 1998). To control for gaze shift impairments, the task utilized a paradigm used in previous studies targeting the classical conditioning of positive self esteem. In this paradigm, all stimuli were presented one at a time and in a manner that required the shifting of attention for the task to continue (Baccus et al., 2004). If attention was not shifted, the task would not proceed with the next trial thereby insuring that for all participants to complete the task, their attention was adequately shifted and attained throughout the trials.

An additional consideration was made in regards to the measurement of learning effects. While priming effects were not seen in participants with ASD in the Kamio et al. (2006) study, liking assessments were taken immediately after each exposure. This task was not so much of a repeated exposure-based, learning task, as it was simply a measure of immediate associations. In contrast to taking liking assessments after each exposure, as in the study by Kamio et al. (2006), the current study presented all stimuli in succession. After providing repeated exposures to each

conditioned and unconditioned stimuli, an assessment of liking ratings was taken at one time for all stimuli after the entire exposure task was completed. In this way, while it's possible that impairment in emotional perception may be indicated by a lack of preference, the results of a higher liking for one emotion over another would be indicative of a learned association, not immediate association, making the results more salient in regards to assessing impaired or intact implicit learning of emotional information.

Based on previous studies, it was predicted that a cartoon character (conditioned stimulus) would be conditioned to a presented emotional expression (unconditioned stimulus) across participants with typical development (Field 2006a, 2006b; Kamio et al., 2006; Krysko & Rutherford, 2008). As a reflection of successful conditioning, participants with typical development were predicted to show higher preference ratings for the cartoon character associated with the happy face and lower preference ratings for the cartoon character associated with the angry face, with preference rating as the dependent variable. However, based on the implication of previous literature suggesting impaired implicit learning and impaired emotion perception in individuals with ASD, it was hypothesized that conditioning would not occur in participants with ASD (Ashwin, Chapman et al., 2006; Ashwin, Wheelwright et al., 2006; Field 2006a, 2006b; Kamio et al., 2006; Krysko & Rutherford, 2008). The preference data of the ASD participants were not expected to be correlated with positively expressed emotions, implying a lack of successful conditioning across the sample.

Chapter 2: Pilot Study Methods

The methodology of combining evaluative conditioning and priming techniques has not been used prior to the present study, making it necessary to conduct several rounds of pilot testing to insure that the task was operating correctly. The final successful round of pilot testing, including its methods and results, will be discussed in this document prior to the discussion of experimental methods and results. *Pilot study* will refer to this final round of pilot testing.

Design

The pilot study examined evaluative conditioning using two types of emotions: happy faces and angry faces. To control for possible bias based on picture characteristics, the Futuremons were counterbalanced into three character groups (A, B, & C; see Figure 1) with each group assigned to either the happy, angry, or neutral condition depending on task version (see Table 1). Participants were assigned to a different condition in a counterbalanced manner. For all facial stimuli, each face displayed either a happy or angry expression or was replaced by a gray square for a neutral condition. To assess overall learning effects, the dependent variable was preference for happy characters. Preference was assessed by calculating how frequently each participant preferred the happy-conditioned Futuremon to the angry-conditioned Futuremon.

Participants

A total of five rounds of pilot data, with approximately 15 individuals per group, were collected through volunteer participants to refine programming aspects of the computer task in an effort to ensure that successful learning was occurring in typically developing individuals.

The fifth and final round of pilot testing involved 17 typically developing individuals who were recruited from the community through IRB-approved flyers and electronic communication. Demographic data for this group of participants were not collected as they were not intended for later analysis relative to the experimental group. However, volunteers for the study were limited to those individuals with a developmental history free of any potentially interfering confounds involving a learning disability, intellectual disability, or attention difficulties/ADHD.

Apparatus

The stimuli were presented using *Inquisit 2.0* software and were run on a Dell Inspiron laptop computer with a 12.1” diagonal display.

Materials

For the conditioned stimuli, this study used sixteen distinct cartoon characters called “Futuremons” that were originally used by Field (2006a, 2006b; see Figure 2). Twelve neutral Futuremons were selected from the original eighteen characters and separated into three groups (see Figure 1). These twelve stimuli were chosen through a separate pilot study in which 45 participants enrolled in Psychology 101 were recruited through the University of Alabama Psychology Subject Pool. Participants were asked to rank the eighteen Futuremons on a slider bar scale. This scale was partitioned from 0 to 100, as presented in Figure 3, with 0 indicating a Futuremon that was rated as extremely unfriendly and 100 indicating a Futuremon that was rated as extremely friendly. The means and standard deviations of these ratings for each Futuremon were obtained and the twelve Futuremons possessing the most neutral and consistent ratings were used as the conditioned stimuli in this study. See Table 2 for selection task data.

The unconditioned stimuli in the pilot study were a set of eight photographed faces (4 faces displaying a happy face and 4 faces displaying an angry face) and 4 identical neutral

stimuli (a gray square). Therefore, there were three groups or conditions of emotion to be paired with the three groups of Futuremons. Of the four faces representing each emotion, two were male and two were female, in an effort to control for possible gender effects of emotional expression (see Figure 4; Dandeneau & Baldwin, 2004).

Procedure

Participants were tested at The University of Alabama Autism Spectrum Disorders Clinic. Following a description of the goals of the study and the measures to be taken, participants were asked to provide written consent. Following the collection of consent, participants were then administered the computer task. Once the task was completed, participants were asked if they had any questions regarding study procedures and were provided with contact information, should they desire to know the final results of the study. In sum, the entire procedure lasted approximately 30 minutes for participants.

Evaluative Conditioning Task. Based on a previous study utilizing a similar procedure (Baccus et al., 2004), participants were presented with 5 blocks of conditioning exposures, with each block consisting of 63 randomly displayed trials of stimuli pairings producing a total of 315 trials. The participant was instructed by the computer program that a set of animals known as Futuremons would be appearing in different corners of the computer screen. After appearing on the screen, a red square would appear on top of the Futuremon. Upon the presentation of each red square, participants directed the mouse at the Futuremon and clicked once, prompting the brief display of the unconditioned stimulus, followed by the presentation of a neutral crosshair in the center of the screen that was soon followed by the next Futuremon in a different quadrant of the screen. The conditioned stimulus would again disappear upon the clicking of the mouse. The unconditioned stimulus displayed for 400 ms and was then followed immediately by the

next randomly selected conditioned stimulus. See Figure 5 for a diagram of screenshots from the computer task.

After each block, participants were praised for their speed and encouraged to try to click through the trials even faster on the next set. By breaking the presentations up into separate blocks, it allowed the participant to rest momentarily to control for fatigue effects, as well as provided an opportunity for praise and encouragement to reduce the effects of boredom. This task typically lasted approximately 25 minutes.

Forced Choice Task. Following the conditioning tasks, one of the Futuremons that had been paired with a happy expression was presented next to another Futuremon that had been paired with an angry expression. Participants were then asked to select the Futuremon that they believed to be the friendliest. Following this selection, a second pair of Futuremons was presented with the same instructions. This process was repeated 16 times, allowing each of the 4 Futuremons paired with the happy emotion to be matched against each of the 4 Futuremons paired with angry emotion. This task typically lasted less than 2 minutes. A depiction of the presentation of this task is presented in Figure 6.

It should be noted that, prior to data analysis, forced choice selections that were made at intervals below 500 ms and above 5,000 ms were trimmed from the dataset as selections faster than 500 ms were considered too fast to have accurately perceived the stimuli and selections that took longer than 5,000 ms were considered to be relying more on explicit memory (e.g., actively thinking about the selection to make). As this was designed to be an implicit memory task, these selections that were likely based on explicit memory were deemed not informative.

Slider Bar Task. Next, each participant was presented with a 100 point slider bar scale along with one of the 12 Futuremons used as a conditioned stimulus. Identical to the task used to

select the 12 experimental Futuremons, participants were asked to rank how friendly they believed each Futuremon to be. This task typically lasted less than 2 minutes. A depiction of this presentation is presented in Figure 3.

Explicit Memory Task. Finally, each participant was given a recognition task to probe their explicit knowledge of the association. During the recognition task, participants were asked to identify whether each Futuremon was followed by a happy face, an angry face, or the grey square stimulus. This task was presented by displaying one of the twelve Futuremons at the top of the screen, with a previously unseen happy face, unseen angry face, and the grey square. The participant was asked to click on the image that immediately followed each of the Futuremons. A pictorial representation of this task is presented in Figure 7. The purpose of presenting previously unseen faces was to specify the type of expression that had been presented with each Futuremon, not the specific person. In other words, this is to ensure that any learning that is shown to have occurred explicitly was due to the emotion displayed and not a memory of specific facial characteristics (e.g., remembering that the green Futuremon was followed by a woman with the curly hair vs. followed by a person with an angry scowl). This task typically lasted less than 2 minutes.

Chapter 3: Pilot Study Results and Discussion

A one-tailed alpha of .05 was considered statistically significant for all of the following analyses. As studies examining social learning have used both forced choice and slider bar paradigms with success to assess learning and preferences, both tasks were used and counterbalanced during pilot testing to assess for order effects and the saliency of results. Earlier rounds of pilot testing indicated that the results of the forced-choice task were equivalent when presented prior to ($M = .40, SD = .49$) or following ($M = .45, SD = .50$) the slider bar task, $t(286) = -.95, p = .34$. Therefore, task order was not counterbalanced for the experimental task.

For the forced choice task, participants chose the Futuremon that was paired with the happy face (as opposed to the negative face) 71% of the time, ($M = .71, SD = .30$). A one-sample t-test revealed that this was significantly greater than the chance performance of 50%, $t(16) = 2.88, p = .01, d = 0.70$. Due to the difficult task of identifying twelve truly neutral Futuremons, all characters were counterbalanced, as described previously. If done correctly, there should be no significant differences between groups A, B, and C in slider bar ratings. A rating of 50 on the 100 point scale is indicative of a completely neutral rating. A one-way between groups analysis of variance was conducted to confirm this assumption in the pilot study. Analysis did not reveal significant differences on ratings among characters assigned to each grouping condition of A ($M = 61.60, SD = 24.27$), B ($M = 55.52, SD = 24.77$), or C ($M = 57.17, SD = 26.93$), $F(2, 201) = 1.04, p = .35$. This indicates that the Futuremons were both neutral and well balanced across groups.

Given these results, it was felt that the task was working effectively to demonstrate evaluative conditioning. Specifically, on the slider bard task, participants preferred the characters associated with the happy face over the characters associated with the negative face. Next, a study comparing individuals with ASD to individuals with typical development was conducted.

Chapter 4: Methods

Design

The experimental study used a 2 x 2 mixed design with diagnostic groups (ASD vs. Typical) a between subjects variable and types of emotions (happy vs. angry) a within subject variable. To control for possible bias based on picture characteristics, the Futuremons were counterbalanced into three character groups (A, B, & C; Figure 1) with each group assigned to either the happy, angry, or neutral condition depending on task version (see Table 1).

Participants were assigned to a different condition in a counterbalanced manner. For all facial stimuli, each face displayed either a happy or angry expression or was replaced by a gray square for a neutral condition. To assess overall learning effects, the dependent variable was preference for happy characters. Preference was assessed by calculating how frequently each participant preferred the happy-conditioned Futuremon to the angry-conditioned Futuremon.

Participants

Due to the nature of this study not having previous literature providing pilot data, a statistical power analysis based on group comparison is not provided. However, 15 participants is sufficient for a large effect size (Cohen's $d = 0.80$) based on a 1-tailed test with a significance of 0.10 for any 2 groups. This study compared the learning of emotional expressions in adolescents and young adults diagnosed with an autism spectrum disorder to a control group of adolescents and young adults with a history of typical development. To ensure that the differing learning effects observed between groups was due to the diagnostic difference based on ASD and

not those related to intellectual disability, individuals with *high functioning ASD* were recruited. As approximately 40 to 60% of individuals with ASD have an additional diagnosis of an intellectual disability, any significant statistical differences observed in the results should be as closely linked to the ASD diagnosis as possible and not intensified by other possible co-morbid impairments, such as intellectual disability (Baird et al., 2000; Chakrabarti & Fombonne, 2001). High functioning ASD was defined as an overall IQ score greater than or equal to 85 according to the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999).

Sixteen of the seventeen recruited individuals with ASD were selected for analysis, with one being excluded due to a low VIQ. The final sample of individuals with ASD ranged in age from 16.67 years to 25.20 years ($M = 21.18$, $SD = 2.70$). Please refer to Table 3 for complete demographic and descriptive information. Participants diagnosed with ASD were recruited from a database of previous clients from the University of Alabama Autism Spectrum Disorders Clinic who had expressed interest in participating in future research studies. ASD diagnoses were confirmed using the Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 2000).

Participants with typical development were included in the sample provided that their developmental history was free of any potentially interfering confounds involving a learning disability, intellectual disability, or attention difficulties/ADHD. This information was gathered through the use of a demographic questionnaire assessing information such as previous psychiatric history, medications, and educational information. Additionally, participants with reported typical development were excluded from the analysis if there were significant concerns of possible underlying ASD symptomology based on the results of the Brief Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007). Of the sixteen individuals with typical development that were recruited, fifteen were selected for data analysis.

One participant was excluded due to a high BAPQ score that exceeded two standard deviations from the rest of the typical sample's mean value, indicating significant underlying ASD symptomology. The final sample of typically developing individuals were aged 18.60 years to 22.67 years ($M = 20.32$, $SD = 1.42$). Participants with typical development were recruited from a pool of students enrolled in Psychology 101 at the University of Alabama, along with flyers distributed to the community. Prospective participants viewed a description of the study either on a flier or on a subject pool website administered by the University of Alabama. If interested, the participants were able to electronically schedule a time for participation or personally contacted the researchers directly by phone or email.

To ensure a proper matching of participants across diagnostic groups, all participants were administered the WASI to obtain a verbal IQ and were additionally matched on chronological age. Independent samples t-tests revealed that, with regards to chronological age in years, the ASD, ($M = 21.18$, $SD = 2.70$), and typically developing groups, ($M = 20.32$, $SD = 1.42$), were well matched, $t(29) = 1.06$, $p = .29$, $d = 0.40$. Similarly no differences were found with regards to Verbal IQ comparing groups with ASD ($M = 107.06$, $SD = 9.83$) and typical development ($M = 107.00$, $SD = 8.38$), $t(29) = 0.02$, $p = .98$, $d = 0.01$.

Apparatus

The stimuli were presented using *Inquisit 2.0* software and were run on a Dell Inspiron laptop computer with a 12.1" diagonal display.

Materials

Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). All participants were administered the WASI to match participants with ASD participants to participants with typical development on the basis of cognitive functioning, specifically on g the subscale

measuring verbal IQ. The WASI is comprised of four subtests: vocabulary, similarities, block design, and matrix reasoning. Based on these subtests, a verbal IQ, performance IQ, and full scale IQ can be derived. The WASI has good validity and reliability, with reliability coefficients for adults ranging from 0.84 to 0.98. The WASI is a screening instrument that can be completed in 20 to 30 minutes.

Brief Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007). The BAPQ is a 36-item questionnaire that assesses the three symptom domains associated with ASD: aloof personality (social), pragmatic language difficulties (communication), and rigid personality (repetitive behaviors). There are two versions of the BAPQ available: a parent report and a self-report. As this measure was only used as a screening tool for adolescents and young adults who were already ascertained as intellectually high functioning in conjunction with the ADOS-G, only the self-report version of the BAPQ was used. This measure takes approximately 10-15 minutes to complete and has generally high sensitivity and specificity for individuals with an ASD (67% and 63%, respectively), along with inter-item reliability coefficients ranging from .85 to .95 for parent and self informants.

Autism Diagnostic Observation Schedule - Generic (ADOS-G; Lord et al., 2000). The ADOS-G is a semi-structured assessment of the specific triad of deficits for autism (i.e., social interaction, communication, and symbolic play), diagnostically specified to aid in the identification of autism, ASD, PDD-NOS, but not other forms of delay. It consists of 4 modules, ranging from 1 to 4, with each module based on the language acquisition and development of the individual. For the participants recruited for the present study, modules 3 and 4 were the most appropriate. Regarding validity, modules 3 and 4 possess a mean weighted kappa of 0.65 and 0.66, respectively. Interrater reliability is reported at 88.2% for module 3 and 88.25% for

module 4, (Lord et al., 2000). A standard ADOS-G administration takes approximately 30 to 45 minutes to complete.

Stimuli. For the conditioned stimuli, this study used twelve distinct cartoon characters called “Futuremons” that were originally used by Field (2006a, 2006b; see Figure 2) and that were successfully used in the pilot study. As with the pilot study, the unconditioned stimuli in the experimental study were a set of eight photographed faces (4 faces displaying a happy face and 4 faces displaying an angry face) and 4 identical neutral stimuli (a gray square). Therefore, there were three groups or conditions of emotion to be paired with the three groups of Futuremons. Of the four faces representing each emotion, two were male and two were female, in an effort to control for possible gender effects of emotional expression (see Figure 4; Dandeneau & Baldwin, 2004).

Procedure

Participants were tested at The University of Alabama Autism Spectrum Disorders Clinic and also at the homes of participants. Following a description of the goals of the study and the measures to be taken, parents of child/adolescent participants were asked to provide assent. Adult participants were asked to provide their own written consent. Children/adolescents were asked for assent. Following the collection of consent/assent, participants or their parents were asked to complete a brief demographic form and BAPQ to collect additional profile information, including information regarding previous medical and or psychological diagnosis or pertinent educational or living history. The collection of this information was necessary to ensure proper participant matching for data analysis. Following the experimental tasks, each participant was administered the WASI to assess intellectual functioning and an ADOS-G evaluation, when necessary, on a separate day. Once all measures were completed, participants were asked if they

had any questions regarding study procedures and were provided with contact information, should they desire to know the final results of the study. In sum, the entire procedure lasted approximately 60 minutes for participants with typical development to complete the experimental tasks, followed by the WASI and BAPQ, and approximately 100 minutes for participants with ASD to complete the experimental tasks, followed by the WASI, BAPQ and, if needed, ADOS-G.

Evaluative Conditioning Task. The task was identical to the one used in the pilot study. Participants were presented with 5 blocks of conditioning exposures, with each block consisting of 63 randomly displayed trials of stimuli pairings producing a total of 315 trials. The participant was instructed by the computer program that a set of animals known as Futuremons would be appearing in different corners of the computer screen. After appearing on the screen, a red square would appear on top of the Futuremon. Upon the presentation of each red square, participants directed the mouse at the Futuremon and clicked once, prompting the brief display of the unconditioned stimulus, followed by the presentation of a neutral crosshair in the center of the screen that was soon followed by the next Futuremon in a different quadrant of the screen. The conditioned stimulus would again disappear upon the clicking of the mouse. The unconditioned stimulus displayed for 400 ms and was then followed immediately by the next randomly selected conditioned stimulus. A pictorial presentation of each screenshot of this task is presented in Figure 5.

After each block, participants were praised for their speed and encouraged to try to click through even faster on the next set. By breaking the presentations up into separate blocks, it allowed the participant to rest momentarily to control for fatigue effects, as well as provided an opportunity for praise and encouragement to reduce the effects of boredom. This task typically

lasted approximately 25 minutes.

Forced Choice Task. Following the conditioning tasks, one of the Futuremons that had been paired with a happy expression was presented next to another Futuremon that had been paired with an angry expression. Participants were then asked to select the Futuremon that they believed to be the friendliest. Following this selection, a second pair of Futuremons was presented with the same instructions. This process was repeated 16 times, allowing each of the 4 Futuremons paired with the happy emotion to be matched against each of the 4 Futuremons paired with angry emotion. This task typically lasted less than 2 minutes. A depiction of the presentation of this task is presented in Figure 6.

It should be noted that, prior to data analysis, forced choice selections that were made at intervals below 500 ms and above 5,000 ms were trimmed from the dataset as selections faster than 500 ms were considered too fast to have accurately perceived the stimuli and selections that took longer than 5,000 ms were considered to be relying more on explicit memory (e.g., actively thinking about the selection to make). As this was designed to be an implicit memory task, these selections that were likely based on explicit memory were deemed not informative.

Slider Bar Task. Next, each participant was presented with a 100 point slider bar scale along with one of the 12 Futuremons used as a conditioned stimulus. Identical to the task used to select the 12 experimental Futuremons, participants were asked to rank how friendly they believed each Futuremon to be. This task typically lasted less than 2 minutes. A depiction of this presentation is presented in Figure 3.

Explicit Memory Task. Finally, each participant was given a recognition task to probe their explicit knowledge of the association. During the recognition task, participants were asked to identify whether each Futuremon was followed by a happy face, an angry face, or the grey

square stimulus. This task was presented by displaying one of the twelve Futuremons at the top of the screen, with a previously unseen happy face, unseen angry face, and the grey square. The participant was asked to click on the image that immediately followed each of the Futuremons. A pictorial representation of this task is presented in Figure 7. The purpose of presenting previously unseen faces was to specify the type of expression that had been presented with each Futuremon, not the specific person. In other words, this is to ensure that any learning that is shown to have occurred explicitly was due to the emotion displayed and not a memory of specific facial characteristics (e.g., remembering that the green Futuremon was followed by a woman with the curly hair vs. followed by a person with an angry scowl). This task typically lasted less than 2 minutes.

Chapter 5: Results

Forced-Choice Task

An examination of the means showed little evidence of preference for the Futuremon characters that were paired with happy faces in either the participants with typical development ($M = .51, SD = .31$) or the ASD group ($M = .52, SD = .25$), with .50 representing chance performance. An independent samples t -test revealed no significant difference between diagnostic groups on the forced-choice task, $t(30) = .06, p = .95, d = -0.03$. A follow-up one-sample t -test indicated that children with typical development did not perform above chance levels, $t(14) = 0.19, p = .85, d = 0.05$. Similarly, children with ASD did not perform above chance levels, $t(15) = 0.34, p = .73, d = 0.17$.

Performance on the forced choice task within the typically developing sample of the experimental study was then compared to the performance of individuals from the pilot study, as the analysis of the pilot responses indicated successful learning of the associations. Participants in the pilot study more consistently selected the Futuremon paired with the happy face ($M = .71, SD = .30$) than did participants with typical development in the experimental group ($M = .51, SD = .31$), $t(30) = 1.79, p = .08, d = 0.63$. The Cohen's d statistic of 0.62 indicates a medium effect for these differences. It is important to note that the participants of the experimental sample and pilot sample were not matched on any demographic criteria, as this information was not collected on pilot participants. However, anecdotal evidence suggests possible cohort differences as most within the pilot sample were above the age of 22 and enrolled in a graduate education program,

as opposed to the participants of experimental sample whose ages in years ranged from 18.50 to 22.67 and enrolled in an undergraduate education program.

Slider Bar Task

The means for slider bar ratings are presented in Table 4. A 3(emotion pairing: Happy, Angry, Neutral) by 3 (task version: A, B, C) by 2 (diagnosis: ASD, typical) repeated measures analysis of variance was used to examine whether emotion pairing differentially affected slider bar ratings for individuals with ASD and individuals with typical development. There was no main effect of emotion pairing, $F(1, 25) = 0.56, p = .46, \eta_p^2 = .02$. Additionally, the two diagnostic samples were not differently affected by emotion pairing and no interaction effect was found, $F(1, 25) = 0.31, p = .58, \eta_p^2 = .01$. Finally, there were no significant main effects or interaction effects for version with all p 's $> .22$.

Explicit Memory Task

Next, an independent samples t -test was used to analyze the differences between diagnostic groups on the explicit memory task. It was expected that, if all participants were using implicit memory strategies in the forced choice and slider bar tasks, that these same participants would then perform poorly on an explicit memory test. There were no significant differences found between the ASD sample ($M = .46, SD = .24$) and the typically developing sample ($M = .51, SD = .27$), $t(29) = .65, p = .65, d = 0.20$. However, both the typically developing sample and the ASD sample were shown to be performing at levels significantly higher than chance on this task, with chance resting at .33; $t(15) = 2.49, p = .03, d = 0.62$, and $t(16) = 2.20, p = .04, d = 0.53$, respectively. Both sets of t -tests produced medium effect sizes, indicating that these results are reliable and that some aspects of explicit learning strategies were used in both diagnostic groups.

Further analyses revealed a significant positive correlation for the ASD sample between performance on the explicit memory task and performance on the forced choice task, $r(16) = .68$, $p = .004$, but these same effects were not present for the typically developing group, $r(15) = .15$, $p = .59$, See Figure 8. Hierarchical multiple regression analysis did not reveal a significant interaction effect for forced choice and explicit memory task performance based on diagnosis, $F(1, 27) = 1.54$, $p = .22$. The lack of a significant difference between groups, despite the presence of differing correlation values, is expected based on the lack of difference between diagnostic groups on the explicit memory and forced choice tasks.

Consistency of Performance

An additional indication of learning, aside from the explicit memory task, was found through assessing the unique response patterns across both groups. A significant portion of participants reversed the pattern of Futuremon pairing. For example, when participants were instructed to select the most likeable Futuremon on the forced choice task, some would routinely select the negative Futuremon instead. Further, 94% of the participants maintained either their accurate positive or *negative reversal* associations with those characters as they were rated in the slider bar task, with the distribution dispersed evenly across both ASD (Positive = 9, Negative = 7) and typically developing samples (Positive = 8, Negative = 7). A one-sample *t*-test found the number of negative reversals to be significant, $t(30) = 4.97$, $p < .001$, $d = 1.81$, indicating that a pattern exists for some aspect of learning to be occurring in both groups whereby the participants are more attracted to the negatively-paired character.

When looking more closely at the preference data of the forced-choice task, Pearson correlations revealed significant positive correlations between forced choice preference and responses given on the slider bar task for both those Futuremons paired with happy faces and

those paired with negative faces for both typically developing samples and ASD samples respectively, $r(15) = .88, p < .001$ and $r(16) = .80, p < .001$. In other words, if a participant preferred the Futuremon that was paired to a negative face, this Futuremon was also rated more negatively on the slider bar relative to the other Futuremons.

Social and Nonsocial Learning Effects

Given the lack of preference for characters associated with happy faces compared to characters associated with angry faces, we wondered whether participants might be showing an overall preference for characters associated with faces compared to the neutral (i.e., gray square) stimulus. Thus, the next set of analyses examined whether there was a difference between those with ASD and those with typical development related to how they discriminated between faces and neutral stimuli. Ratings for Futuremons associated with angry faces and happy faces were averaged together to create a *social* average (typical, $M = 59.55, SD = 11.68$; ASD, $M = 57.48, SD = 13.81$). This average was compared to the *nonsocial* or neutral average of the Futuremons associated with the grey square (typical, $M = 50.17, SD = 23.69$; ASD, $M = 67.81, SD = 17.28$). A 2 (pairing: Social, Neutral) by 2 (diagnosis: ASD, typical) between-subject ANOVA revealed a significant interaction between diagnosis and pairing, $F(1, 29) = 4.12, p = .05, \eta_p^2 = .12$, with the partial eta-squared indicating a medium effect size. Paired *t*-test analysis showed a trend for individuals with ASD to prefer characters associated with a neutral square to characters associated with an emotional face, $t(14) = 1.74, p = .10, d = 0.66$, with no significant differences present in the typically developing participants, $t(14) = -1.21, p = .24, d = 0.50$.

Autism Symptomatology

Although significant differences were not found between diagnostic categories as predicted on the forced-choice task through analysis of variance, Pearson correlations were used

to examine possible differences in learning based on ASD symptomatology for the larger sample as a whole, as represented through subscales of the BAPQ. It was expected that ASD symptomatology would be negatively correlated with task performance on the forced-choice task; meaning that greater ASD symptomatology would lead to more “incorrect” preferences for Futuremons across all participants, regardless of diagnostic grouping. Incorrect simply refers to not having a strong preference for the positively-paired Futuremon, as predicted in the study hypothesis. All correlations ranged between -0.32 and 0.23, with all p -values greater than .07 and were not found to be significant at the alpha .05 level. That is, ASD symptoms as represented by the BAPQ did not appear to be related to preference for the characters associated with the happy faces on the forced-choice task when examined in the group sample as a whole, not accounting for diagnostic samples.

When analyzing correlations for each diagnostic sample individual of the other sample, significant correlations were found within both the diagnostic samples. Within the ASD sample, a significant negative correlation resulted between forced choice accuracy and aloof personality traits, $r(16) = -.55, p = .02$, that individuals with ASD who had fewer aloof traits showed an increased preference for characters associated with the happy face (see Figure 9). This correlation was not found to be significant in the typically developing sample, indicating that aloof traits did not result in a significant effect for negative reversals, $r(15) = .28, p = .30$. Next, we examined whether the relationship between aloof personality traits, as measured by the BAPQ, and forced choice task performance differed between the ASD sample ($M = .52, SD = .25$) and typically developing sample ($M = .51, SD = .31$). An analysis of covariance was used, revealing a significant interaction effect between aloof personality traits and diagnosis on participants’ performance on the forced choice task, $F(1, 27) = 5.48, p = .02, \eta_p^2 = .16$. This

result indicates that the effect of aloof traits on forced choice averages was different for the two diagnostic groups. As can be seen in Figure 9, typically developing participants with higher aloof scores on the BAPQ were associated with greater preference for Futuremon paired with happy faces. However, ASD participants with lower BAPQ scores were associated with greater preference for Futuremon paired with happy faces. This interaction is difficult to interpret in that it is difficult to explain why BAPQ aloof traits would have opposite direction effects on participants with ASD and typical development. However, these results do indicate a significant relation between ASD symptoms and task learning.

Pearson correlations also revealed a significant negative correlation between BAPQ aloof traits and the measures of slider bar distinction (i.e., happy/angry difference) in the ASD sample, $r(16) = -.55, p = .02$, but not the typically developing sample, $r(15) = .19, p = .49$, for. In other words, individuals with ASD rated the happy Futuremons differently than the angry Futuremons significantly more when their aloof personality trait scores were lower, but this similar pattern was not observed in the sample with typical development. This is the same pattern of results seen above in the forced choice task. Taken together across the forced choice and slider bar tasks, individuals with ASD who had fewer aloof personality traits showed increased evaluative conditioning. A further moderate correlation was found in the ASD group, $r(16) = -.49, p = .05$, but not the typically developing group $r(15) = -.16, p = .56$, between aloof personality traits and the performance on the explicit memory task, indicating that greater symptoms of aloof traits was correlated with a lower rate of correct answers on the explicit memory task. Further, a significant correlation between aloof personality traits and difference between social/neutral ratings was not found for the typically developing group, $r(15) = .22, p = .44$, or ASD group,

$r(16) = .14, p = .60$. An overview of all correlations between BAPQ subscales and task results is presented in Tables 5 and 6 for each diagnostic group.

Chapter 6: Discussion

The use of emotion-based cues to respond to others in the environment is an integral part of navigating throughout the social world and is one that has also been identified as a key difficulty for individuals diagnosed with ASD (Osterling & Dawson, 1994; Werner et al., 2000). A wealth of research exists documenting the different manners in which those with ASD attend to social stimuli when compared to their typical peers, with the method of examining faces being particularly unique. For example, the specific attention paid to the mouth region of another person has been shown to interfere with the accurate perception of emotions due to larger proportion of social information being transmitted through the eye region of that other person (Klin et al., 2002; Pelphrey et al., 2002). Studies such as these would suggest that if the attention of those with ASD could be redirected to the eye-region that emotion recognition might improve. Still, other studies have documented difficulties with the accurate perception of emotions in ASD, indicating that when attention is not a problem, the perception still is. A variety of theories attempt to explain these difficulties, including differences in the styles of learning and processing emotional information, but these studies have repeatedly produced a mixture of results (Ashwin et al., 2006; Ashwin, Wheelwright et al., 2006; Grossman & Tager-Flusberg, 2008; Kamio et al., 2006; Lindner & Rosen, 2006; Rump et al., 2009). The present study sought to examine the ramifications of potentially impaired implicit learning on the ability to pair emotional information with novel contextual cues through the control of both attention and length of exposure to emotional cues. It was predicted that those with typical development would reflect

successful implicit learning of the emotion-based pairing through correctly or consistently preferring the character associated with the happy emotion on the forced-choice and slider-bar tasks, while those diagnosed with ASD would show a greater number of incorrect or more inconsistent pairings on these tasks.

Learning of Distinct Emotion-based Associations

The results of the current study provide no evidence for evaluative condition on either the forced choice task or on the slider bar task, as both diagnostic groups performed at chance on the forced choice task, indicating that the accuracy of their responses was within the realm of guessing. Similarly, no significant differences were found among emotion-paired Futuremons within the slider-bar tasks. As revealed through later analyses, a reason for the lack of learning in the ASD group may relate to a lack of preference for social information. Indeed, the typically developing group appeared to prefer faces significantly more than the ASD group, as the ASD group showed significant preference effects for the nonsocial grey box over any of the faces. In sum, these results suggest that individuals with ASD likely will not learn the value of a happy or angry face in the presence of other nonsocial stimuli due to their lack of interest or preference for such socially-based stimuli.

While the results of the forced choice task would fit with the predictions for the ASD group, it does not fit for the predictions of the typically developing group. If the typically developing group does not demonstrate successful learning, then accurate conclusions cannot be drawn regarding learning differences between groups and the analysis of the ASD group becomes limited in scope. Despite successful testing of the experimental forced choice task on a set of pilot participants with typical development, a significant effect for implicit learning was not observed within the typically developing group. Reasons for these differences between pilot

and experimental typically developing groups include participant characteristics along with contingency differences.

As reflected in Table 3, the group of typical individuals recruited for the experimental task was comprised primarily of subjects who were male, enrolled in an undergraduate-level introduction to psychology course, and typically under the age of 22. While extensive demographic information was not collected for pilot participants, most were between the ages of 22 and 30 and were recruited from the general population. All pilot participants were either enrolled in or had completed graduate-level education. The demographic information here is significant in that the importance of contingency would be different, with performance being directly related to social demands; in other words, *demand characteristics*. For the pilot participants, most were individuals known to the researcher through mutual contacts and would therefore be more susceptible to the effects of these demand characteristics. While not direct friends with the researcher, the completion of the task was often propositioned as a favor implying more salient social demands and possibly providing a positive effect on motivation. In contrast, the completion of the task for experimental subjects was predominantly related to course requirements, in that they were provided the option to either participate in university-based research or complete a separate assignment; thereby eliminating the demand characteristics.

Fatigue

A further consideration relates to fatigue effects. While the conditioning portion of the task was simple in execution, fatigue effects were likely in the typical sample as the task was designed to maximize positive motivational factors for those with ASD and not for those with typical development. For those with ASD, the nonsocial, computer-based task would be far

more appealing than a true social-based task (Heimann, Nelson, Tjus, & Gillberg, 1995). For those with typical development, however, it may have been more likely to induce boredom. However, the pilot participants did not appear to show fatigue effects and, in fact, showed stronger performance than earlier pilot versions using fewer trials. Further, the task used in the present study involves the same number of trials as the program used in the Baccus et al., study (2004), indicating that fatigue based on program length should not have been a concern for those with typical development.

Still, fatigue may have played a larger role in participant performance in the experimental condition versus the pilot condition for other reasons besides length of program time. The pilot participants may have been more protected from fatigue effects due to the demand characteristics as previously described. Due to the friendship-based request, there was an affiliation-based motivation to encourage participation in learning and completion of the task (Tremayne, Martin, & Dowson, 2007; Klein & Pridemore, 1992). This affiliation-based motivation was not present for those within the experimental group; they simply had to show up for the task to complete a course requirement. Any attention paid beyond that was extra and there was no motivational reason to do so. If the task was particularly lacking in stimulation, their attention may have been more significantly impacted than the pilot group. As fatigue is often counteracted by motivation, the motivation to complete a favor for a friend as observed in demand characteristics is often more salient and positive than the motivation to complete a requirement for a class (Boksem, Meijman, & Lorist, 2005).

Explicit Memory & Supraliminal Processing

An additional consideration to be made regarding the lack of evidence for implicit learning is found in the results of the explicit memory test. While the diagnostic groups were not

significantly different from each other on implicit learning, nor did they exhibit independent effects of implicit learning, there is evidence of explicit learning occurring at a rate higher than chance. When asked to explicitly identify which character was followed by which expression, a significant positive correlation was identified between performance on the explicit memory test and accurate performance on the forced choice and slider bar distinction tasks within the ASD group but not the typically developing group. Again, these results support the prediction that individuals with ASD have difficulty with implicit learning and rely on more explicit or effortful learning strategies for information typically learned implicitly.

What is not explained within these results is why the typically developing group also performed relatively well on the explicit memory task and also why this was not correlated with forced choice accuracy. In other words, despite a lack of predicted responding on the forced choice task, perhaps due largely in part to negative reversals, typically developing individuals still responded at a rate above chance on their accuracy for the explicit memory test. This could be due in part to length of exposure of the facial stimuli.

As extended time of exposure is related to the use of supraliminal perception and thereby explicit memory, it is possible that the number of exposures and length of time the stimuli were displayed may have been so extensive that the typically developing subjects began to clearly (i.e., explicitly) identify the pairings in the conditioning task itself. The current study attempted to expose stimuli for a slightly shorter amount of time than the 600 ms of the Kamio et al. study to approach the subliminal processes, but not as short as the subliminal condition within the Kamio et al. study (i.e., 16 ms); therefore, 400 ms was used. The use of 400 ms for successful conditioning was accomplished in the Baccus et al. study (2004). Still, despite its successful previous use, it is possible that the length of exposure of the current stimuli was long enough that

participants were able to recognize the faces with relative ease. The lack of follow-up questioning regarding the amount of recognition for the presented stimuli leaves the amount of supraliminal processing up for debate. This could have been easily addressed through more thorough follow-up questioning during the debriefing procedures, as in the Kamio et al. study.

Additional considerations for supraliminal processing relates to the type of facial stimuli used. Black and white photographs of faces were used in the Kamio et al. (2006) study, as opposed to the color photographs used in the current study. As the photographs in this study were both a different set of stimuli and in color, it is possible that these were more salient and therefore could have required a shorter length of exposure time to avoid being processed on the supraliminal level. A preliminary study examining the amount of exposure necessary for subliminal and supraliminal processing should have been conducted prior to the use of the facial stimuli used in this study, similar to what was used in the 2006 study by Kamio and colleagues.

Personality Characteristics

A contributing factor to consider regarding learning across both samples focuses on the forced choice accuracy as it relates to personality characteristics. A common pattern across both diagnostic groups indicated that a significant number of participants preferred the negatively-paired Futuremon and also rated these same characters more negatively than the other characters. When the presence of this pairing reversal is considered in conjunction with the accuracy percentages on the forced choice task (i.e., a range from 0 to 100%, with the lower percentages representing negative reversals) it is clear why the resulting average of forced choice accuracy would not be far from a chance of 50%; higher averages and lower averages would result in an approximate 50% average. This at-chance average would then give the false impression of no emotion-based learning occurring.

It may be inferred that an aspect of learning is occurring within these negative reversals due to the preference and memory of the negative emotional valence observed in the responses of the participants. This could be related to aspects of personality that were not adequately controlled for. For instance, there was a negative correlation related to aloof symptoms in the ASD sample with task performance, as would be expected given the theories on impaired social learning in ASD; this effect was not present in the typically developing sample. However, measures assessing more general psychopathological traits might be useful in assessing personality differences in learning across the typically developing sample. The BAPQ only assessed symptoms of aloof personality as they relate specifically to ASD; perhaps another personality measure more tailored to general psychopathology might assess other forms of aloof or antisocial behavior that would interfere with the learning of emotions. It is unclear, however, why this pattern did not emerge in the pilot data.

Learning of Social and Nonsocial Associations

While learning of distinctive emotional associations was not observed in the current data set, preferential learning of nonsocial information was evident through the significantly higher rated characters associated with the grey square, as opposed to the faces, in the ASD sample. The preference for nonsocial stimuli over social stimuli is well documented in the early developmental literature for children with ASD (Dawson et al., 1998; Osterling & Dawson, 1994; Swettenham et al., 1998; Werner et al., 2000). While it has been theorized that the fixation of attention early in development might produce increased learning opportunities and, thereby, increased discrimination abilities of emotion (Klin et al., 2002; Pelphrey et al., 2002; Mundy & Neal, 2001; Wetherby et al., 2007), the current studies demonstrates that even in a state of fixed attention and with indications of successful explicit learning, preference for

nonsocial stimuli is still present into young adulthood for those with ASD. Therefore, the fixation of attention and increased learning opportunities for these emotions early in life appear to continue across development. Indeed, the presence of continued atypical social and nonsocial processing has been documented in recent studies of adults with ASD (Fletcher-Watson, Leekam, Benson, Frank, & Findlay, 2008; Kleinhans, et al., 2007; Schultz, 2005).

Future Directions

If this task were to be repeated, a number of significant changes should be made. Aside from the removal of the red square, fatigue effects should be more stringently controlled and accounted for. An examination of typically developing individuals should be conducted comparing the current procedural set with a shortened version to examine possible improvements in accuracy in a shorter version. In addition to controlling for fatigue effects, an evaluative conditioning task replicating the precise experimental conditions used in the 2006 study of priming effects (Kamio et al.) should be attempted. As the researchers in this study were able to produce significant distinguishing results within their typically developing group for specific emotions, their procedures should not be altered to accurately assess the effects of evaluative conditioning. Finally, the current study did not adequately assess for symptoms of psychopathology in the typically developing sample; therefore, based on the unusual number of negative reversals, a measure of personality attributions should be made in future studies. While purely speculative in the patterns of responding, the current study present data indicating that when individuals preferred the angry-paired Futuremon, they also rated this Futuremon as negative on the slider bar ratings, as well. This preference for negative stimuli may be explained by either a heightened threat-detection response in some individuals or differing personality traits.

Threat detection theory would suggest that the negative stimuli would be more salient to subjects and may lead to the Futuremon being more salient in their memory. An incorporation of a sea-of-faces task using the Futuremon characters might show support for this theory. Also, this explanation still implies that the implicit learning of the associations is still occurring. With regards to personality traits, the present data show that social aloofness was a measure in ASD that correlated to performance on the implicit memory tasks. Perhaps personality measures such as the Minnesota Multiphasic Personality Inventory (Ben-Porath & Tellegen, 2008) or a shorter questionnaire such as the Behavior Assessment System for Children (Reynolds & Kamphaus 2004) might indicate personality or behavior traits that might be of significant importance to emotion-based implicit learning success in this style of task. Personality traits could have a significant effect not only on learning styles, but more importantly on the contingency of the faces relative to a diagnostically typical sample. This study assumed that angry faces would have a negative impact on participants, thereby pairing that negative emotion onto the conditioned stimulus. However, this will only be effective if the subjects are attuned to interpret negative or angry faces. While various cognitive and developmental disabilities were addressed within the demographic questionnaire, personality disorders were not. For those possessing callous-unemotional traits or other subclinical traits psychopathology, the negative valence of angry emotions may not resonate in a task that requires the subliminal processing of negative emotions as these are often not cognitively arousing within these populations (Dadds & Rhodes, 2008; Guyer et al., 2007). For this reason, future studies examining the learning of emotion perception should rule out the presence of these subclinical personality traits to ensure that their typically developing sample is accurately identifying the emotions as negative.

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Table 1

Character and Emotion Counterbalancing across Participant Versions

Group	Version A	Version B	Version C
A	Angry	Neutral	Happy
B	Happy	Angry	Neutral
C	Neutral	Happy	Angry

Note: Group refers to the groups of characters presented in Figure 1.

Table 2

Pilot Ratings of Futuremons

Futuremon	<i>M</i> (<i>SD</i>) N = 45	Group	<i>p</i>
a	63.16 (23.43)		
b	59.711 (23.34)	C	
c	42.00 (20.82)		
d	58.13 (22.42)	B	
e	68.40 (16.76)	A	
f	53.02 (22.28)	A	
g	62.87 (23.97)	C	
h	46.82 (21.35)	C	
i	62.31 (17.75)		
j	41.733 (22.68)	B	
k	60.98 (24.01)	A	
l	62.22 (19.85)	B	
m	21.07 (19.78)		
n	67.44 (21.86)	B	
o	53.51 (23.17)	C	
p	30.98 (20.48)	A	
q	22.29 (16.75)		
r	54.73 (24.61)		
Group A	53.34 (16.18)		
Group B	57.38 (11.11)		.89
Group C	55.73 (7.10)		

Note. Futuremon letter identifications correspond to those presented in Figure 2. For the twelve Futuremons selected for the experimental conditions, their corresponding group in Figure 1 is identified. The *p* value indicates that there is not a significant difference among the three group means. It should be noted that all means and standard deviations presented in this table are representative of the first round of pilot testing and not the fifth and final round. Following the first round of pilot testing, only those Futuremons assigned to groups A, B, and C were used for later testing.

Table 3

Participant Characteristics: Mean and (Standard Deviation) of and Significance Levels of T-test Comparing the Groups (p)

	Typical (<i>n</i> = 15)	ASD (<i>n</i> = 16)	p
Chronological Age (years)	20.33 (1.40)	21.16 (2.69)	.29
Gender			
Male	13	14	
Female	2	2	
WASI			
Verbal IQ	107.00 (8.38)	107.06 (9.83)	.98
Performance IQ	107.73 (9.43)	108.88 (11.94)	.77
Full Scale IQ	108.33 (6.53)	108.75 (8.61)	.88
BAPQ			
Total Score	96.00 (17.79)	123.17 (18.60)	<.001*
ADOS			
Module 3			
Raw Score	--	9.00 (1.00)	
Module 4			
Raw Score	--	10.15 (3.69)	

Note. BAPQ Total Score = Aloof, Language, and Rigidity Subscales; ADOS Raw Score = Communicative Language and Social Affect using ADOS-G revised algorithms. Diagnostic cutoffs for revised algorithms are as follows: Module 3 *Autism* = 10, *Autism Spectrum* = 7; and Module 4 *Autism* = 10, *Autism Spectrum* = 7.

Table 4

Slider Bar Means

	Typical <i>M(SD)</i>	ASD <i>M(SD)</i>
Happy	62.73 (21.28)	58.38 (18.20)
Angry	56.37 (11.47)	56.59 (19.58)
Neutral	50.17 (23.69)	67.81 (17.28)
Social	59.55 (11.68)	57.48 (13.81)

Note. Social refers to an average of the means for Happy and Angry Faces.

Table 5

Correlations for Autism Symptomology for Participants in ASD Condition

Measure	Slider Bar Difference	Forced Choice Accuracy	Explicit Memory Accuracy	Aloof	Language	Rigidity	Total
Slider Bar Difference							
Forced Choice Accuracy	.79**						
Explicit Memory Accuracy	.60*	.68**					
Aloof	-.55*	-.55*	-.49				
Language	.03	-.27	-.04	.38			
Rigidity	-.15	-.20	-.37	.68**	.13		
BAPQ Total	-.26	-.43	-.41	.86**	.65**	.76**	
Negative	-.72**	-.83**	-.49	-.38	-.06	.21	.17

Note. * $p < .01$, ** $p < .001$; Slider Bar Difference represents the difference between ratings of Happy-associated Futuremons and Angry-associated Futuremons. Forced Choice Accuracy represents the participants' selection of the Happy-associated Futuremons over the Angry-associated Futuremons. Explicit Memory Accuracy represents the participants' selection of the appropriate emotion matched with its respective Futuremon. The measures of Aloof, Language, Rigidity, and Total represent subscales from the BAPQ, representative of ASD symptomatology. Negative refers to negative reversals on the forced choice task.

Table 6

Correlations for Autism Symptomology of Participants in Typical Development Condition

Measure	Slider Bar Difference	Forced Choice Accuracy	Explicit Memory Accuracy	Aloof	Language	Rigidity	Total
Slider Bar Difference							
Forced Choice Accuracy	.88**						
Explicit Memory Accuracy	.19	.15					
Aloof	.19	.28	-.16				
Language	-.13	-.09	.25	.29			
Rigidity	-.15	-.21	-.01	.27	.49		
BAPQ Total	-.01	.03	-.01	.76**	.71**	.77**	
Negative	-.72**	-.83**	-.02	-.11	.08	.30	.11

Note. * $p < .01$, ** $p < .001$; Slider Bar Difference represents the difference between ratings of Happy-associated Futuremons and Angry-associated Futuremons. Forced Choice Accuracy represents the participants' selection of the Happy-associated Futuremons over the Angry-associated Futuremons. Explicit Memory Accuracy represents the participants' selection of the appropriate emotion matched with its respective Futuremon. The measures of Aloof, Language, Rigidity, and Total represent subscales from the BAPQ, representative of ASD symptomatology. Negative refers to negative reversals on the forced choice task.

Group A:



Group B:



Group C:

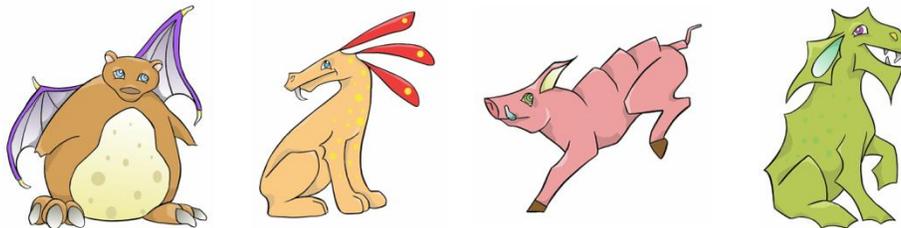


Figure 1. Twelve characters used in the experimental task (2006a). Each group of characters was paired with either the happy, angry, or neutral stimuli across all participants.



Figure 2. Eighteen characters originally used to select the 12 most neutral characters for use in the experimental tasks (Field, 2006a).

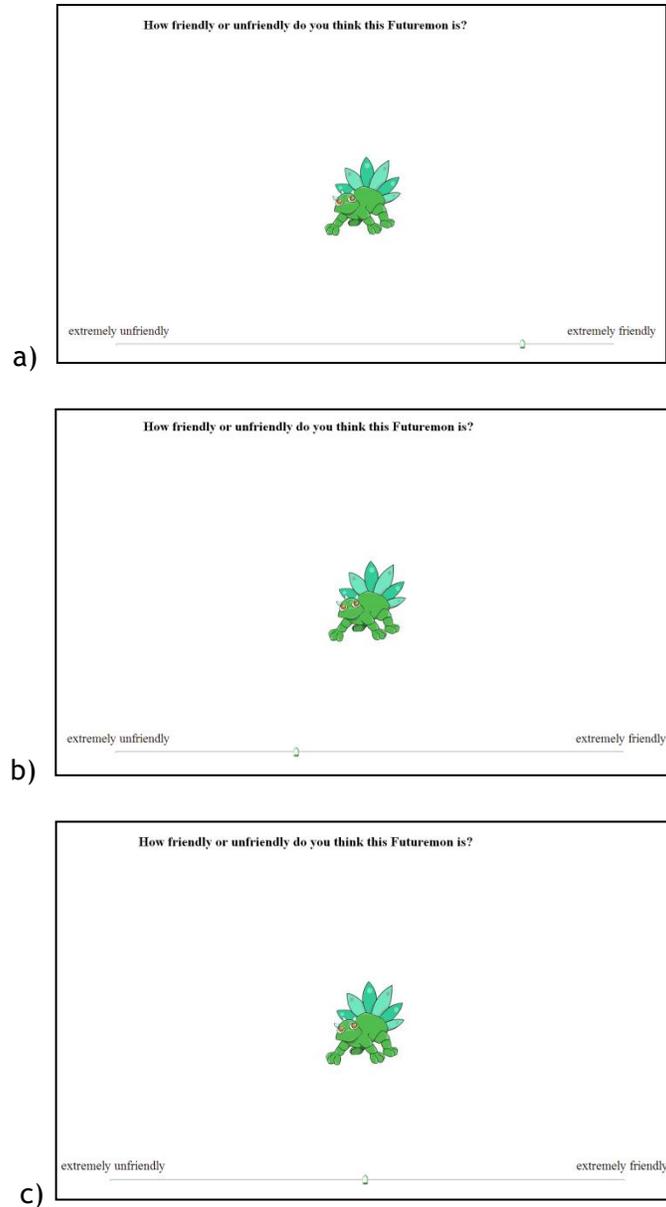
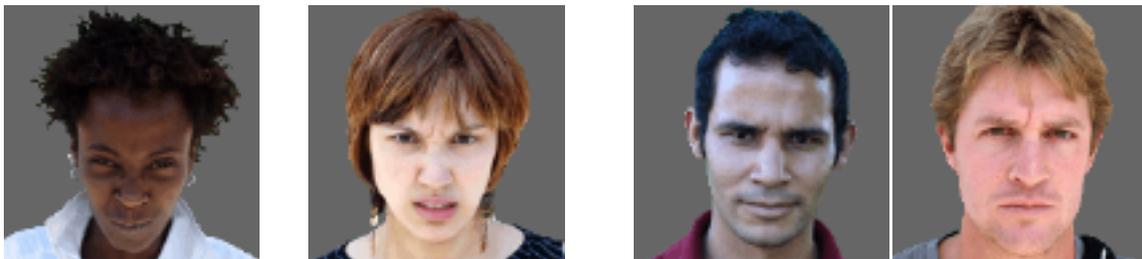


Figure 3. Screenshot images of slider bar task used in both the preliminary pilot study for all eighteen Futuremons and the experimental task for the twelve Futuremons used. If the participant thought the character was very friendly, they would slide the bar far to the right (a). If they thought the character was a little unfriendly, they would slide the bar far to the left (b). Each trial began with the bar placed in the very center (c).

Group A:



Group B:



Group C:



Figure 4. Group A represents the happy stimuli, group B the angry stimuli, and group C the neutral stimuli (Dandeneau & Baldwin, 2004). Each group was paired with one of the Futuremon groups presented in Figure 1.

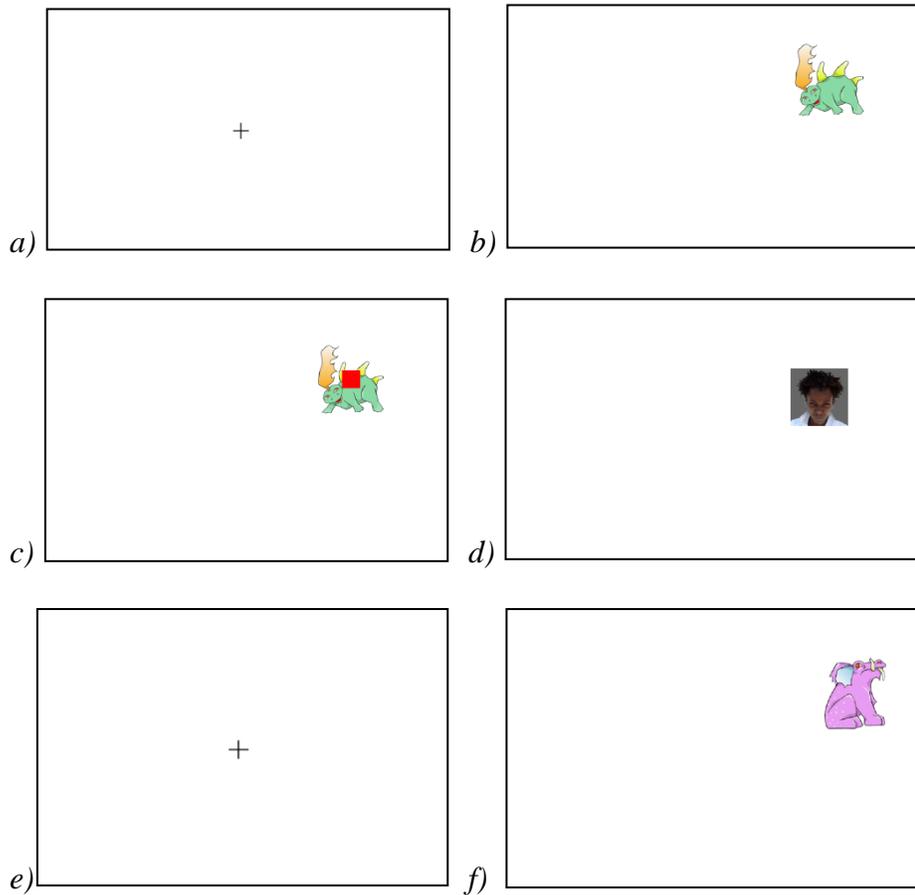


Figure 5. Pictorial representations of conditioning task beginning with a) screenshot image of computer prior to Futuremon presentation, followed by (b) screenshot image of computer with Futuremon displayed for 4000 ms. Image (b) is followed by (c) screenshot image of red square appearing. After the red square appears, the participant is instructed to click on the square to prompt screen (d), which is displayed for 400 ms then the computer automatically proceeds to next crosshair presentation (e) and sequence repeats with next Futuremon (f).



Figure 6. Screenshot image of forced choice task. Each participant was presented with sixteen sets of paired Futuremons, such as the ones above, and asked to click on the character they liked best.



Figure 7. Screenshot image of the explicit memory task. Each participant was presented with each of the twelve Futuremons, such as the one above, and asked to try and remember what kind of face followed the Futuremon during the learning trials and to click on that face.

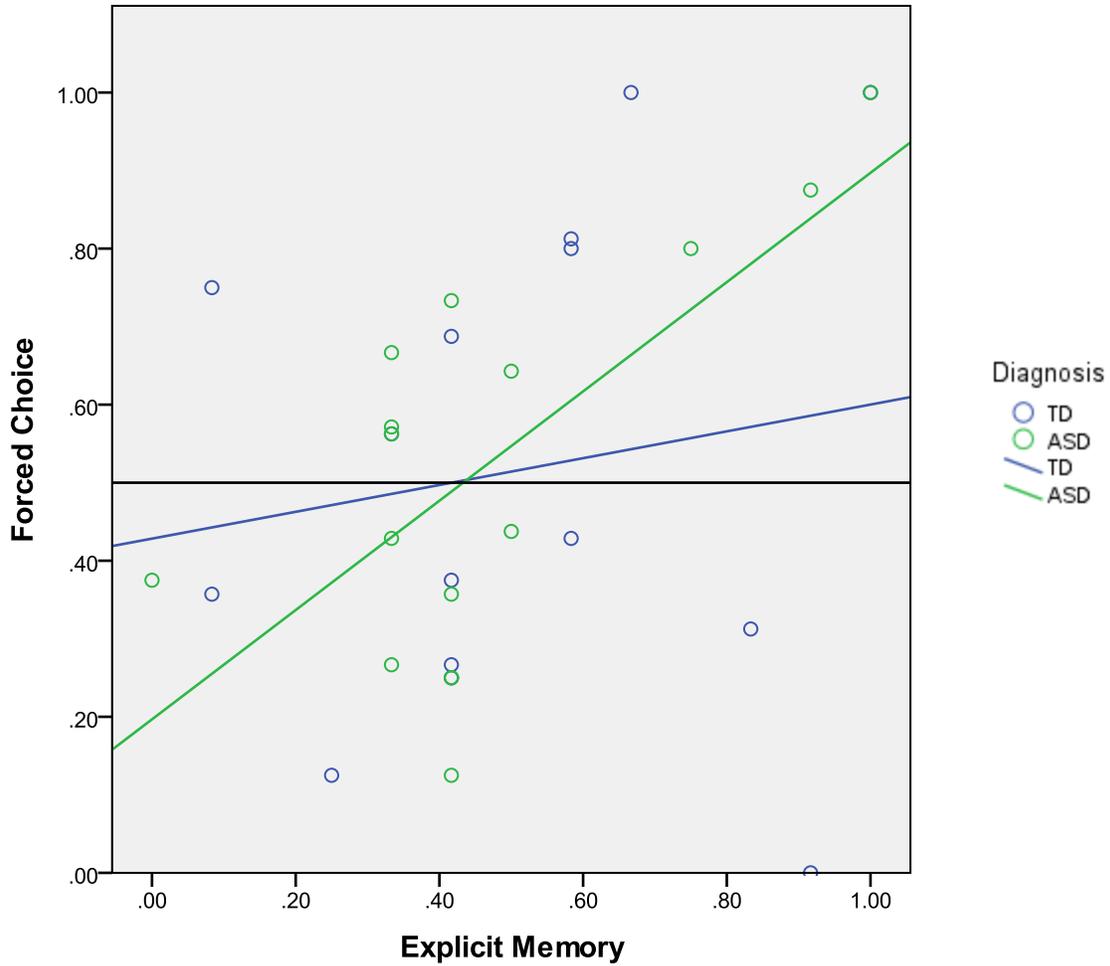


Figure 8. Responses for forced choice indicate a preference for happy-associated Futuremons; these were found to positively correlate with responses on the explicit memory task for those in the ASD sample, $r(16) = .68, p = .004$, but not within the typically developing sample, $r(15) = .15, p = .59$. The interaction was not significant, $F(3, 27) = 1.54, p = .22$.

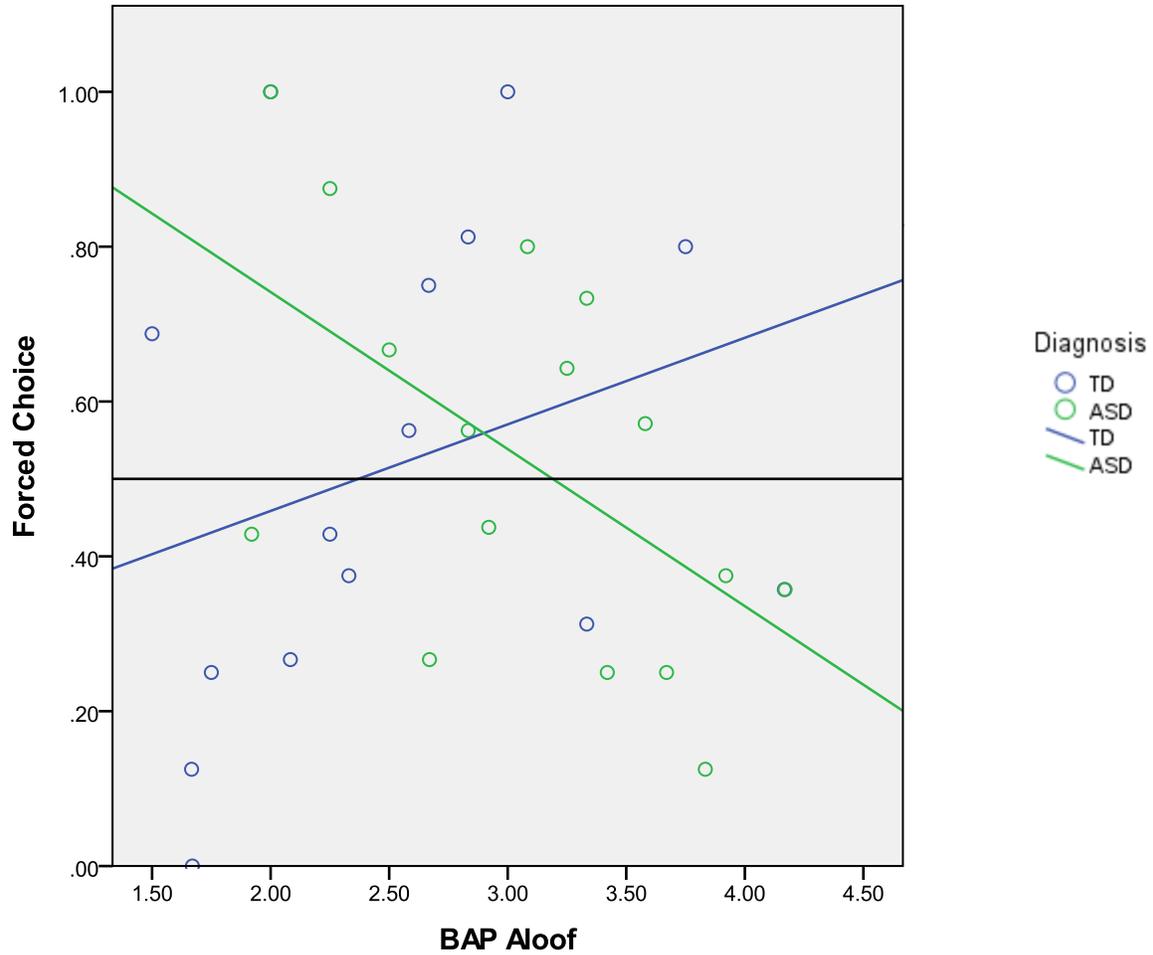


Figure 9. Responses for behavioral symptoms endorsing aloof personality traits were negatively correlated with performance on the forced choice task for those with ASD, $r(16) = -.55, p = .02$, but not for those with typical development, $r(15) = .28, p = .30$.