Running Head: PEOPLE OR VIDEO

People or Video? What Do Children with and without Autism Spectrum Disorders Choose?

Honors Psychology Thesis

Lauren K. Deisenroth

Vanderbilt University

Abstract

Autism is a pervasive developmental disorder characterized by social, communication and behavioral challenges. This research follows up on reports that children with autism spectrum disorders (ASD) learn important skills better from a person on video compared to a person who is present and interacts with the child. The purpose of this study with children with ASD and typically developing (TD) controls is to examine visual preferences to two sights: a video of a person and a real person who is present. Children were simultaneously shown a short video of a person singing songs and playing games and an identical "live" presentation by the same person. Previous studies that examined visual preferences did not compare children's preference for videotaped *and* live human behavior. This research may have implications both for theory regarding social deficits in autism, and practical applications for early detection and intervention.

People or Video? What Do Children with and without Autism Spectrum Disorders Choose?

Autism spectrum disorders are the second most common developmental disorder (CDC, 2008). Although researchers are able to identify the causes of other developmental disabilities, such as cerebral palsy and Down's syndrome, the cause of ASD is still unclear. What we do know, however, is that autism is a pervasive developmental disorder that occurs on a spectrum. This means that individuals with ASD have symptoms that range in severity. Five disorders fall under the umbrella of autism spectrum disorder (ASD): Autistic disorder (AD), Aspergers syndrome (AS), Rett's syndrome, childhood disintegrative disorder and pervasive developmental disorder-not otherwise specified (PDD-NOS). PDD-NOS is the most prevalent of the five disorders, while AS is considered by many researchers to be the mildest disorder on the spectrum. Additionally, ASD is four times more prevalent in boys than girls (CDC, 2008). ASD is present in 1 out of every 110 live births and is growing at an annual rate of 10-17% (CDC, 2009). ASD co-occurs with intellectual impairment in 1/4 to 1/3 of individuals with these disorders. It is evident that ASD presents somewhat of a public health crisis.

ASD primarily produces impairments in three main areas: social skills, communication and behavior. In general, people with ASD exhibit deficits in social skills that include; difficulty making eye contact, trouble empathizing, an unusual manner of speaking, an inability to see someone else's perspective and they do not understand humor or irony (Charlop & Milstein, 1989). In terms of behavior impairments, people with ASD may also engage in behavior that is viewed as 'odd' by others because it revolves around a singular obsession. For example, the results of a parent survey distributed by the National Autistic Society in 2001 show that children with ASD often tend to perseverate and fixate on the television character *Thomas the Tank*

Engine. In addition to restricted interests, some individuals may also make repetitive, stereotypic movements such as hand flapping and rocking back and forth. The degree of impairment in communication for people with ASD is highly variable. Some people may be completely nonverbal. Other people with ASD, however, may have strong expressive language skills, but struggle with the social conventions of small talk and conversations. Given all of these social, communication and behavioral challenges, it is clear that people with ASD have significant difficulty with human social interactions.

Visual Responses to Social Stimuli

When presented with social stimuli, people with ASD have atypical visual response patterns. Speer, Cook, McMahon and Clark (2007) examined this phenomenon using a head-mounted eye tracker to determine where children with ASD looked when they viewed photos and movies. When children with ASD viewed a videotape of multiple individuals interacting, they spent more time looking at body regions and less time looking at eye regions. Furthermore, the more time a child spent looking at body regions, the more likely he or she was to score poorly on a measure of social responsiveness.

Pelphrey et al. (2002) also examined the looking patterns of people with ASD. The researchers asked individuals with and without ASD to view photographs of human faces and identify the emotion that each face displayed. The scientists used a stationary eye tracking device to determine the specific locations on each photograph where each participant looked. Pelphrey et al. (2002) found that the individuals with ASD spent more time viewing features of the face that did not bear emotion, such as an ear or the hairline, than the control group of typical individuals did. The individuals with ASD also spent less time viewing important core features of the face, such as the eyes, nose and mouth. Their results furthered the argument made by others (Hobson et al., 1988; Langdell, 1978) that people with ASD look at individual facial features when identifying emotions. This contrasts with the processing strategy used by typically developing people, who identify emotions by examining the spatial configuration of the face as a whole (Diamond & Carey, 1986; Farah et al., 1998; Gauthier & Tarr, 1997). While this study provided evidence that adult men with ASD use atypical face processing strategies, it did not address how younger children with ASD process faces.

Klin, Jones, Schultz, Volkmar and Cohen (2002b) used eye-tracking technology to evaluate the location and amount of time that fifteen male adolescents with ASD spent looking at the human actors in a black and white movie clip. When compared to age and IQ-matched typically developing (TD) individuals, the participants with ASD focused twice as much on the mouths of the actors in the movie, 2 ½ times less on the eyes and 2 ½ times more on the body and inanimate objects. This study provided additional support for the argument that people with ASD do not have typical visual responses to social stimuli.

In addition, Klin et al. (2002b) found that level of social adjustment was correlated with the amount of time teenagers with ASD spent viewing mouths and objects. Teens who demonstrated increased attention to mouths were more likely to exhibit better social functioning. Increased attention to objects, however, predicted the opposite relationship. Interestingly, the researchers found that the amount of time spent viewing eyes was not predictive of social functioning. Strong expressive language is positively associated with an improved outcome for children with ASD, which explain why children who are more socially adept attended more to the source of speech, the mouth (Lord & Paul, 1997; in Klin et al. 2002). The results of eye-tracking studies showed that people with ASD used a variety of different face processing strategies, each of which differed from that used by typically developing people.

Differences in patterns of viewing are supported by neurological research findings. Children with ASD showed brain-based (ERP) response differences to familiar versus unfamiliar objects (like their TD peers), but they did not show such differences to familiar versus unfamiliar faces (Dawson, Carver, Meltzoff, Panagiotides, McPartland, & Webb, 2002). These atypical visual preferences may result in a lack of expertise in face processing and therefore in atypical cortical responses to faces (Grelotti, Gauthier, & Schultz, 2002; Pierce, Muller, Ambrose, Allen, & Courchesne, 2001). For instance, Hall and colleagues (2003, in Speer, Cook, McMahon & Clark, 2007) reported that individuals with ASD processed faces in the same brain region that is typically used to process objects.

Autism, Cartoons and Face Processing

Rosset et al. (2008) took a different approach to examining how children with ASD process faces. The researchers investigated the children's strategies for looking at cartoon faces versus photos of human faces. Since recent studies and clinical reports indicated that children with ASD express more interest in cartoon faces than human faces (Grelotti et al. 2005; Miyahara et al. 2007), the authors hypothesized that the children would use typical strategies to process cartoon faces, but not photos of human faces. They measured the presence of typical strategies by using an upright/upside-down face task to determine if the inversion effect occurs. Generally, when photos of faces are presented upside down, it takes typically developing people more time to process and identify the emotion on the face than when a face is presented upright. According to Rosset et al. (2008), this delay is called the inversion effect.

The authors found that the children with ASD only exhibited the inversion effect when viewing the cartoons. Thus, children with ASD processed cartoons using the same strategy that typically developing children did. The researchers suggested that their results occurred because children with ASD found cartoons to be a less socially threatening stimulus. Cartoons are not a social partner so children are not expected to interact with them, whereas they are expected to interact with humans. This study makes it evident that the social deficit of children with ASD does not interfere with at least one typical face processing strategy when children are viewing cartoons. According to the authors, this idea needs to be explored more fully since interaction is not possible with a photo of a human face either.

In another study, the eye fixations of children with ASD to cartoons of scenes with human figures versus neutral objects did not differ (and their look patterns were the same as those for TD children) (van der Geest, Kemner, Camfferman, Verbaten, & van Engeland, 2002). The authors state that they found no support for the idea that children with autism have, "a specific problem processing socially loaded visual stimuli" and suggest that "*social interaction* may play a decisive role" in gaze aversion in real life (van der Geest, Kemner, Camfferman, Verbaten, & van Engeland, 2002, p. 69, italics added). Talking as if children's responses to pictures and people would be identical is an example of what Siegel (1978) called the "pictorial assumption". In this context, we are referring to the assumption that a cartoon of a human would have the same impact as a real person attempting to engage in face-to-face interaction.

Learning in Video and Live Conditions

Aversion to interacting with human faces (or relatively little interest in them) may make it difficult for young children with ASD to learn survival skills, such as communication and self-care, by watching others. Unlike their TD peers, children with ASD may avoid attending to important social stimuli in their surroundings (Prior & Ozonoff, 1998; in Corbett & Abdullah, 2005). This makes learning social skills by observing others a challenging task.

However, older children with ASD have been shown to learn life skills better from videos of a person than from a person who is present in their environment (Charlop & Milstein, 1989; Charlop-Christy et al., 2000). Video modeling is one of the ways that researchers used to teach children with ASD to learn skills using observation. Charlop-Christy and her colleagues used video modeling to teach conversation skills to three boys with ASD. Video modeling involves a person, “observing a videotape of a model engaging in a target behavior and subsequently imitating” (Charlop-Christy, Lee & Freeman, 2000, p. 537). Haring, Kennedy, Adams, and Pitts-Conway (1987, in Charlop & Milstein, 1989) found that modeling purchasing skills for adolescents with ASD via a videotaped interaction was successful. Based on these findings, Charlop and Milstein (1989) hypothesized that videotape modeling would be useful in teaching social skills to children with ASD.

In their study, Charlop and Milstein (1989) showed participants videotaped conversations between an adult and a child about a toy. The researchers found that the children’s skills increased rapidly, generalized to other topics, and across settings. Additionally, the participants maintained all of these gains after a 15-month follow-up. This pattern is just the opposite of that found with young typically developing children, who learn much better from people they see face-to-face than the same people on video (Troseth & DeLoache, 1998; Troseth, Saylor, & Archer, 2006). Surprisingly, the children with ASD also increased the spontaneous variation in their speech. This is an especially significant finding because individuals with ASD often have trouble producing unrehearsed responses to questions and speak in a formulaic manner (Corbett & Abdullah, 2005).

Charlop-Christy et al. (2000) built upon their previous findings, which only examined video modeling, by comparing the effectiveness of video modeling with in vivo (live) modeling.

The authors chose two similar tasks, such as learning to brush one's teach and wash one's face, for each child with ASD and then randomly assigned the tasks to a live and video condition. The researchers found that the children learned the task in the video condition faster than the task presented by live modeling. Additionally, the children generalized the skills in the video to different stimuli, settings and people. Generalization did not occur in the live condition. The researchers presented two explanations for this outcome. First, the authors proposed that since the video zoomed in on relevant cues, the children were better able to follow along with the task (Dowrick, 1991, in Charlop-Christy et al., 2000). According to Charlop-Christy et al. (2000), individuals with ASD are more likely to pay too much attention to irrelevant cues in their environment. Video modeling helped direct children's attentions to the relevant social stimuli on the screen (Charlop-Christy & Daneshvar, 2002). Therefore, zooming in and editing out extraneous environmental information helped the children compensate for their over-attention.

The authors' also proposed a second explanation for their results. They thought that the non-social nature of video may have been less aversive to children with ASD. This allowed the children to better attend to the video. The researchers stated that when the children viewed the videos they, "[did] not expect any social interactions, as they would with in vivo modeling, and they [did] not have any added pressures, such as requirements of eye contact, that may [have] distract[ed] them from the observation." Therefore, video modeling helped children overcome part of their social deficit in order to learn the skills. This makes sense considering Rimland's (1968, in Charlop-Christy et al., 2000) finding that people with ASD relate better to objects than they do to people. This is once again the opposite pattern of what is seen in typically developing people. Typically developing children can in fact learn as well from socially-responsive media partners, such as interacting with a person via closed circuit TV, as they do from a person who is actually present in their environment (Troseth et al., 2006). For children with autism, however, the *non-responsiveness* of television and videos may actually help learning. The findings of Charlop-Christy et al. (2000) clearly support this idea.

As a first step in examining responses to a videotaped person versus real person, we examined whether young children diagnosed with ASD and typically developing controls preferred to look at a person on video, compared to a view of the same person who was actually present and visible through a TV-sized window. Children viewed a person on video singing songs and playing games. The activities were similar to those that typically occur on children's educational television show, like *Dora the Explorer*. At the same time, the person appeared live and carried out the same activities as the video. During the second and third trial, we presented the two events alone.

We had two aims in conducting our study. First, we wanted to look at the visual preferences and social behaviors exhibited by children with ASD as compared to TD controls when they viewed live and videotaped events. Note that in all the research surveyed above, children viewed videos or photographs, not real people. This study therefore was different in comparing a real person attempting to engage the child in social interaction, versus a pre-taped video of the person (similar to a television program).

Second, we wanted to look at whether or not visual preferences developed in very young TD children. We picked two ages that we hoped would be similar to the children with ASD in adaptive behavior level and receptive language (used as a proxy for IQ). We looked for whether very young children exhibited a preference for live social stimuli over videotaped stimuli (in line with TD toddlers' better learning from live events than video), and whether age differences in responding occurred. We also examined any social behaviors that the children directed toward the person who was present or on the TV.

We predicted that the children with ASD would spend a greater percentage of time looking at the videotaped person rather than the person present in their environment. In contrast, we expected the typically developing control groups to divide their attention between the two, looking back and forth between the person and her image. Because the scenes were identical, any differences in looking would not be attributable to the ability of video to “focus in” on the relevant events, but only to the real-versus-video distinction. We hypothesized that children with ASD would exhibit significantly fewer social behaviors during the “Live Only” trial than in the “Video Only” trial. Moreover, we expected that children with ASD would exhibit fewer social behaviors than both TD control groups. This study will provide the basis for future research into using video as a tool to teach children with ASD.

Methods

Participants

We recruited 12 children (9 boys and 3 girls) with ASD between the ages of 2 and 10 years old (*M* = 65 months). This unintentional ratio of boys to girls is relatively similar to the distribution of ASD diagnoses nationally. We primarily recruited these participants with the assistance of Dr. Wendy Stone; she shared information about the study with individuals in her database of previous Treatment and Research Institute for Autism Spectrum Disorders (TRIAD) research subjects and clinical contacts. We dropped two participants with ASD from the study due to child noncompliance.

For our typically-developing (TD) controls, we recruited 2 groups of children. The *TD-1.5-year-old* group of 12 children (5 boys and 7 girls) ranged in age from 18 to 20 months. The second group of 14 children (*TD-2.5-year-old*) ranged in age from 29 to 31 months and was comprised of 8 boys and 6 girls. We dropped seven TD participants due to experimenter error and one due to parental noncompliance.

We recruited the TD participants by accessing publicly available state birth records. We telephoned the parents of the appropriate age children living in Nashville and invited them to participate. For both the experimental and control groups, we posted an advertisement for our study on the Vanderbilt University Kennedy Center's online StudyFinder. Additionally, we put up flyers in relevant places around the Vanderbilt campus and medical center.

Apparatus

Children sat in front of a puppet stage (5 feet long, 6 feet high and 4 feet deep) that had two TV-sized cutouts with a small hole for a video camera in between them. They viewed a TV in one cutout and an open cutout that a person could appear in it (see Figure 1). We constructed the frame of the stage out of PVC pipe and attached black fabric tautly between the pipes. Children sat in a Stokke "Tripp-Trapp" chair two feet from the front of the stage, with their parents in an armchair next to them, facing away from the stage. We conducted a pilot test to ensure that a child's head and eye movements were clearly visible on camera at this distance. A six foot long panel made out of black fabric and PVC pipe extended from the front of the stage on either side of child and parent. This formed a three-sided room which helped eliminate environmental distractions, thus increasing the likelihood that children focused their attention on the stage.

The children viewed videotapes modeled after popular children's TV shows, in which the main character asked questions and then left pauses so that children could respond. In the videos, the first experimenter played games and sang songs with the help of her sock puppet named

"Joe". We filmed two similar "episodes" of the video; the topic of one was animals and the topic of the other was colors (see the Appendix A for episode scripts).

Measures

ASD diagnosis. To participate in the study, children with ASD needed to have a diagnosis provided by a Vanderbilt University clinician or an experienced community psychologist. This ensured that participants had a reliable diagnosis using rigorous criteria, including the Autism Diagnostic Observation Schedule (ADOS) (Lord, Rutter, DiLavore & Risi, 1999). If a participant with ASD did not have a current, research reliable ADOS in his or her medical file, then we asked the parents if they were willing for an ADOS to be completed. Dr. Cassandra Newsom, a Vanderbilt psychologist, administered the ADOS to provide a confirmation of the ASD diagnosis and additional information about the child's level of functioning.

Adaptive behavior scale. We also asked the parents to complete the Parent/Caregiver form of the Vineland Adaptive Behavior Scales (Sparrow, Cicchetti & Balla, 2005) while their child was watching the performances. This approximately 40-minute-long questionnaire assessed the child's level of adaptive functioning. The Vineland scores allowed us to determine the heterogeneity of severity among the participants with ASD. Moreover, this tool provided a measure by which we could compare the receptive language levels of the TD children and children with ASD. We matched the control group with the experimental group with ASD using Vineland receptive language scores as a proxy for mental age, a common matching technique (Dawson, Meltzoff, Osterling, Rinaldi & Brown, 1998).

Looking preferences. In our study, we considered looking time to be an indication of visual preference. For all three trials, we compared the difference in looking time and visual preferences of the group with ASD and typically developing controls. When children simultaneously viewed the in-person and videotaped presentations, two independent coders viewed the videotapes of children's sessions frame by frame and coded for the amount of time that children spent looking at each presentation. Using an intraclass correlation, we found that the reliability between the two coders ranged from 0.961 to 0.997. We then calculated a preference score for each child by subtracting the percentage of time he or she looked at the video from the percentage he or she viewed the real person. A positive number indicated a preference for viewing the real person, whereas a negative number indicated a preference for video. In order to prepare our data for analysis, we calculated the average preference score for each of the three participant groups.

The simultaneous videotaped and in-person presentations were difficult to implement. Sometimes the person’s “live” presentation of a particular sentence or behavior lagged slightly behind the videotaped version. To estimate the frequency of auditory asynchronies between the two presentations, coders examined the videotapes for 10% of participants from each of the three groups. Asynchronies caused the participant to switch from viewing one stimulus to the other in only a portion of cases. Cases where asynchronies did affect participant looking behavior occurred equally in all three groups. The total amount of time involved was relatively small: approximately 20 seconds across a 6-minute trial, which was only 6% of the total presentation time. We concluded that asynchronies would not significantly affect our analysis of the data.

When children viewed the videotaped and in-person presentations separately, two independent coders viewed the children’s videotapes and coded for the duration of time each child viewed the stimuli. For the “Video Only” trial, we used an intraclass correlation and determined that the reliability between the two coders ranged from 0.991 to 0.999. For the “Live

Only” trial, we used the same method and found that the reliability between the two coders ranged from 0.982 to 0.992. We calculated an attention score for these two trials for each child by dividing the number of seconds he or she looked at the stimuli (live or videotaped) by the total presentation length.

Social behaviors. Viewing the videotapes of children's sessions, other coders noted social behaviors that the children directed at the person in the presentations, such as verbal and nonverbal interactions in response to her questions, imitation, and pointing. We designed a coding scheme based on one used previously by Anderson and colleagues (2000) that allowed us to classify and quantify the behavior that our participants exhibited. We identified eight distinct behaviors, three of which were exclusively social in nature: verbal answers to questions (“answer- verbal”), nonverbal answers to questions (“answer- nonverbal”) and imitating when asked by the actor (“prompted imitation”) (see Appendix B for the full coding scheme). The average number of social behaviors exhibited by each group was analyzed. Two independent coders, trained to be proficient with the behavior coding scheme, viewed children’s videotapes and identified when children performed behaviors. Inter-rater reliability will be calculated this summer once our second coder analyzes 25% of the participants. Using Microsoft Excel, we calculated the number of social behaviors exhibited by each child in each presentation type (e.g. “Video Only”, “Both”, “Live Only”). We then found the mean number of social behaviors exhibited by each participant group during the three trials.

Media questionnaire. We asked the parents to complete a 15-minute questionnaire about their child’s experience with media (see Appendix B). The questionnaire included questions about the average weekly amount of time that the child spent using the internet, webcams, television, videotapes/DVD’s and digital cameras. Additionally, the questionnaire incorporated questions about the child's favorite TV shows and videos along with standard demographic information. Most parents completed this media questionnaire on-line before the experimental session using the RedCap secure survey technology. Ten parents did not complete the survey on-line so they completed a pencil and paper version in our lab during the experimental session.

We have not yet analyzed the data from the media questionnaires. This summer, we plan to use the media questionnaire data to determine if chronological age, and thus years of media experience, is predictive of visual preferences and social behaviors. Moreover, the media questionnaire will allow us to confirm that our TD-5-year-old group matches the group with ASD in terms of quantity and type of media exposure.

Design

During the first trial, we presented the videotaped and in-person presentations simultaneously and counterbalanced the side of the presentation (left or right window for each presentation type) across children. On the second and third trials, children viewed a new episode of the video or live presentation in isolation. We counterbalanced the order of presentation (viewing video vs. a real person first) and the side of presentation across participants. Children always viewed the "animals" episode in the first trial and the "colors" episode during the second and third trials.

Procedure

We chose these two typically developing age groups because we predicted that one of them would be an approximate "mental age" match of our group with ASD. When the participants and their parents arrived at the lab, an experimenter and an assistant greeted them. The experimenter invited the parents to ask questions and obtained written consent before collecting data. Next, the experimenter explained the Parent/Caregiver form of the Vineland Adaptive Behavior Scales to the parent and helped them begin the checklist. Parents then completed the media questionnaire, had they not done so ahead of time online.

While the experimenter explained the paperwork to the parent, the child played with some toys with the assistant, becoming comfortable with the lab setting. After this warm up period, the parent helped the assistant to place the child in the Tripp-Trapp chair facing the apparatus. The parent then sat near their child, but faced away from the apparatus. The experimenter instructed the parent not to provide any direction or encouragement to their child and to remain occupied with the questionnaires. If the child refused to sit in the chair, the child was allowed to sit on his or her parent’s lap, and the parent was instructed to close his or her eyes to prevent the child from using the parent’s gaze as a clue of where to look.

Once the child was buckled into the chair, he or she faced the apparatus for Trial 1. For six minutes, the child watched the experimenter, who simultaneously appeared on TV and in the window. The experimenter carried out the same exact activities (e.g., singing songs, playing games, asking questions, etc.) at the same time as she did them on the TV. After a five minute break, children participated in Trial 2: they watched the experimenter on TV or "in person" performing different actions (e.g., singing different songs, playing new games) for six minutes, followed by another five minute break. Finally, on Trial 3, children saw the experimenter perform these actions again during the opposite presentation type (video or live) for another six minutes.

The experimental sessions lasted approximately an hour and fifteen minutes. After the experimental portion of the session ended, the experimenter reviewed the parent’s answers to the questionnaires. At the end of each session, each child received a book, regardless of whether he or she completed the session or not. We determined the possible break activities through parental input about their child's preferences. Possible activities included; playing with puzzles, a coloring book, snacks, or reading a book with a parent or researcher.

Results

We conducted our study with two primary objectives in mind. First, we looked for differences between children with ASD and matched TD controls in terms of visual preferences and social behaviors. Second, we looked for age differences in TD children's preferences for viewing a person live or on video and their social behaviors towards the two stimuli.

ASD Diagnosis and Demographics

Of the 12 children with ASD in our study, six had a current, research reliable ADOS on file and we administered an ADOS to six as a part of this study. All children had been previously diagnosed by a reliable community or Vanderbilt psychologist. The ADOS results will be analyzed this summer in order to determine the range of impairment within our group with ASD. In the meantime, we utilized the age equivalents for the socialization and communication subscales of the Vineland as a measure of each child's adaptive functioning (see Table 1).

Adaptive Behaviors

We used the Vineland Adaptive Behavior Scales to assess adaptive functioning levels and compare across groups. Children's scores on the receptive language subscale were applied as a measure of cognitive functioning. The average age equivalent of the younger TD group was similar to that of the group with ASD but different from the older TD group (see Table 2). We performed an independent samples t-test and found that the mean receptive language age equivalent for the TD-1.5-year-old group and the group with ASD were not significantly different, $t(22) = .000$, $p = 1.00$. Our analysis showed that the TD-2.5-year-old group differed significantly from the TD-1.5-year-old group, $t(24) = 4.24$, $p < .001$, as well as with the ASD group, $t(24) = 2.92$, $p = .007$, two-tailed. Therefore, when we compared children's looking preferences between groups, we were especially interested in the comparison between the group with ASD and the TD-1.5-year-old group.

We also compared the mean age equivalent from the three socialization subscales of the Vineland across the groups (see Table 3). Using an independent samples t-test, we found that the mean age equivalent for the TD-1.5-year-old group and the group with ASD did not differ significantly, $t(13.55) = .81$, $p = .43$. Our analysis showed the TD-2.5-year-old group differed significantly from the TD-1.5-year-old group, $t(16.23) = 4.15$, $p = .001$, as well as with the ASD group, $t(24) = 2.42$, $p = .023$. For this reason, when we compared the social behaviors of the children toward the video and real person, we were especially interested in the comparison for the group with ASD and the *younger* TD group.

Visual preference

Simultaneous presentation. We examined whether children with ASD and typically developing children differ in their preferences for videotaped or in-person presentations of human behavior. Of particular interest were the between-group comparisons of visual preference during the "Both" trial, in which children simultaneously viewed a videotaped and an in-person presentation of human behavior.

We predicted that children with ASD would spend more time looking at the video of the person than the actual person present in their environment. In contrast, we expected the typically developing controls to divide their attention equally between the two presentations. A one-way analysis of variance (ANOVA) was calculated using the attention score (difference score:

percentage of time that each child spent viewing the “live” presentation minus percentage spent viewing the “video” presentation or looking away from both presentations). The analysis was significant, $F(2, 35) = 6.48$, $p = .004$, indicating that the three groups demonstrated different preferences. TD-2.5-year-old children and TD-1.5-year-old children spent a greater percentage of time viewing the real actor (*M* = .38, *SD* = .19, and *M* = .32, *SD* = .18, respectively). In contrast, the children with ASD looked at the videotaped person and real person for an equal amount of time (*M* = .05, *SD* = .33). Therefore, although our results did not match our hypothesis, the difference that we found was in the predicted direction.

Bonferroni post hoc tests indicated that the percentage of looking time for the group with ASD was significantly different from that of both the TD-2.5-year-old group ($p = .005$) and the TD-1.5-year-old group ($p = .03$). Moreover, the visual preferences of the TD-2.5-year-old group and the TD-1.5-year-old group were not significantly different from each other ($p = 1$).

Live only presentation. After examining children’s preference for human behavior during the “Both” trial, we investigated whether children with ASD and TD children differed in terms of their preference for human behavior presented in-vivo and alone. We predicted that TD children would be more attentive to the “Live Only” presentation that the ASD group would.

Our data supports our initial prediction. A one-way analysis of variance (ANOVA) comparing the percentage of time that children in the three groups spent viewing the “Live Only” presentation was significant, $F(2, 34) = 18.28$, $p < .001$. The typically developing children spent a much larger percentage of time viewing the live human actor than the ASD group did (see Table 4).

Bonferroni post hoc tests indicated that the ASD group’s percentage of looking time was significantly different from both the TD-2.5-year-old group’s ($p < .001$) and the TD-1.5-year-old group's ($p < .001$). However, the visual preferences of TD-2.5-year-old group and TD-1.5-year-old group were not significantly different from each other ($p = 1$).

Video only. As the counterpart to the "Live Only" trial, we created a "Video Only" trial in which we investigated whether the TD and ASD groups would differ in visual preference when presented solely with videotaped human behavior. We expected that the group with ASD would spend a greater percentage of time viewing the video presentation than the TD groups would.

We calculated a one-way analysis of variance (ANOVA) using the percentage of time that each child spent viewing the video presentation in the "Video only" trial. The analysis was significant, $F(2, 34) = 7.53$, $p = .002$, indicating that the both groups of TD children spent a greater percentage of time viewing the person on video than the ASD group did (see Table 4).

Bonferroni post hoc tests revealed that the ASD group's percentage of looking time was significantly different from both the TD-2.5-year-old group's ($p < .001$) and the TD-1.5-year-old group's ($p < .001$). Moreover, the visual preferences of TD-2.5-year old group and TD-1.5-year-old group were not significantly different from each other ($p = 1$).

Individual Differences in Attention in the "Both Presentations" Trial

One factor that might affect children's attention to a live, interacting person is the social functioning of each child. We examined whether children's mean socialization age in months, as measured by performance on the Vineland, was related to the percentage preference for viewing in-person human behavior. For each participant, we calculated the mean mental socialization age by averaging the mental age given for the three sub-domains of the Vineland "Socialization" domain. The mean socialization age for the TD-1.5-year-old group ($M = 22.08$, $SD = 6.03$) and ASD group ($M = 26.63$, $SD = 18.39$) were close, as were their receptive language scores ($M =$

23.67 and *M* = 23.67). Therefore, we used the younger TD group as the comparison group in this analysis rather than the TD-2.5-year-old group (socialization: *M* = 44.48, *SD* = 19.02; receptive language: *M* = 36.5, *SD* = 8.34). Across the two groups, mean socialization age was significantly correlated with children's attention difference score (percentage preference for live human behavior over video), $r(21) = .45$, $p = .033$ (See Figure 2).

Next we examined whether socialization age was a predictive covariant of visual preference when participant group (TD-1.5-year-old or ASD) was a fixed factor. Using a one-way analysis of covariance, we found that there was a significant main effect for group, $F(1, 20) = 10.16$, $p = .05$, and for socialization $F(1, 20) = 10.45$, $p = .04$. When the variance accounted for by mean socialization age was removed, participant group still predicted children's visual preferences, $F(2, 20) = 8.85$, $p = .002$. Looking at individual cases (see Figure 2), every TD child preferred to watch the person who was present in the room to a greater or lesser degree; in contrast, the children with ASD showed a less-marked preference for the real person; half of the children either actually preferred to watch the person on video (5 children) or demonstrated no preference (1 child).

Analysis of Social Behaviors

In addition to analyzing children's viewing preferences, we also examined the average number of social behaviors (e.g. verbal and nonverbal answers to questions) and interactions with the people in the stimuli that children produced during each of the three presentations (e.g. "Video Only", "Both", "Live Only").

We hypothesized that the ASD group would perform significantly fewer social behaviors on average than the older TD group (the 2.5-year-olds) during the "Both" trial. The group with ASD was expected to exhibit more social behaviors on the "Video Only" trial than on the "Live

Only” trial. We also predicted that the TD-1.5-year-old group would exhibit fewer social behaviors than the TD-2.5-year-old group across all three trials.

The mean number of social behaviors of the children is shown in Table 2. The overall number of social behaviors was assessed in 3 (group: ASD, TD-1.5-year-old, TD-2.5-year-old) x 3 (presentation trial: “Both”, “Live Only”, “Video Only") repeated measures mixed analysis of variance with presentation trial as a within-subject variable. There was a main effect of presentation type, $F(2, 34) = 4.20$, $p = .023$, $\eta = .20$, with the three groups showing different patterns of behaviors across the three presentations. There was no significant main effect of participant group, suggesting no group difference in total behaviors performed, $F(2,35) = 1.55$, $p = .226$, $\eta = .08$, and no interaction, $F(4, 68) = 1.62$, $p = .179$, $\eta = .087$. Although the raw group mean data appeared to suggest that the ASD group performed more behaviors on average than the TD groups (see Table 5), the results of our analysis indicated that number of behaviors performed by each group was not significantly different.

Discussion

Our results suggest that young children diagnosed with an autism spectrum disorder, compared to typically developing children, exhibit different preferences for videotaped or in-person presentations of human behavior. When children with ASD simultaneously viewed an in-person and videotaped presentation of a person, they demonstrated equal attention to the two presentations. Typically developing children, however, paid more attention to the presentation of the person who was present. Although these results do not match our hypothesis, they are in the general direction that we predicted.

When we showed the videotaped and in-person presentations one at a time, children with ASD paid less attention to both presentations than the typically developing children. Our original hypothesis that children with ASD would be *more* attentive to video than to a real person was not confirmed. Rather, the results indicated that children with ASD are less attentive than TD children both to a person who is present and to a person who appears on video.

An examination of the attention data from the “Both” trial revealed that the children with ASD demonstrated a broader range of preferences (*SD* = .33) for either of the two stimuli than TD-1.5-year-old children (*SD* = .19) and TD-2.5-year-old children (*SD* = .18) did. This led us to consider whether certain individual differences in children with ASD impacted their visual preferences.

We hypothesized that a child’s level of social functioning, as measured by the socialization domain of the Vineland Adaptive Behavior Scales, might be related to his or her preference for viewing a person who was present or on video. Because the typically developing one and a half year-old children were both a mental and socialization age match for the children with ASD, we examined the relationship between these children. Our analyses revealed a significant positive correlation between socialization age and visual preference for watching the person who was present across the two groups. Moreover, we found that both socialization age and group predicted how strongly children preferred viewing the in-person presentation. For both groups of children, more advanced social functioning was related to spending a greater percentage of time viewing the in-person presentation. However, the preference of children with ASD for the real person was weaker, and half of the children either preferred to watch the video or exhibited no preference.

Explaining the relation between social functioning and visual preference

We propose that intrinsic and extrinsic motivation may explain the relationship that we found between social functioning and visual preference. Typically developing children possess a drive to develop social skills and form interpersonal relationships (Baldwin, 2000; Tomasello, 1999). This might lead typically developing children to find viewing an actual human more useful for acquiring skills than viewing a videotaped person. Thus, they are more motivated to view the in-person presentation, which is reflected in their general preference for the real person over the video. All of the typically developing one and a half year-old children preferred viewing the in-person presentation. This preference lines up with the general advantage very young children show in learning from a real person rather than from a video in many previous studies (e.g., Troseth & DeLoache, 1998; Troseth et al., 2006). In contrast, the children with ASD may not possess this same strong motivation toward interpersonal relationships. Impairments in social interaction are considered essential diagnostic criteria for an ASD diagnosis (American Psychiatric Association, 2000).

There were substantial individual differences in the degree to which the children with ASD preferred to watch the real person or the video of the person, with approximately half preferring to view each. We found that as social functioning increased (as measured by parental report using the Vineland checklist), so did the children's preference for viewing the in-person presentation. One possibility is that children with ASD who had more or better social skills *training* preferred viewing the real human behavior over the video. Perhaps children with ASD who received social skills interventions were praised for engaging in social behaviors through the therapist's establishment of an external reward system, such as a token economy. To explore this possibility, we are currently re-contacting parents to inquire about the kinds of therapies that the participants with ASD have received.

Social Behavior

Experience with interactive-style television shows may also help explain the number of social behaviors exhibited by each group across the three presentations. The pattern in the raw data appeared to indicate that children with ASD performed many more behaviors (e.g., pointing, responding vocally) on average than both of the TD groups across all presentations. Our analysis, however, did not reveal that the children exhibited significantly different numbers of behaviors. The results go against our hypothesis that children with ASD would perform fewer social behaviors than both TD groups.

We think that this surprising result may be accounted for by differences in the chronological age and media exposure of the groups. We intentionally recruited TD children younger (M= 19 months and 30 months) than the ASD group's mean chronological age (M = 60 months) to match the groups on mental age. However, for this reason, our participants with ASD had many more years of television viewing experience than the TD children.

The video presentation was designed to be similar to an interactive-style television program for toddlers, such as *Blue's Clues* or *Dora the Explorer*. In previous research, children have become more interested in watching and more interactive with a character on video with repeated experience with the program (Anderson, Bryant, Wilder, Santomero, Williams, & Crawley, 2000). One possibility is that children who have watched more "interactive" television programs at home may have been more interested in watching and interacting with the video presentation in the lab. On the media questionnaire, we asked parents to report the programs that their child watched. We intend to explore potential relations between media exposure and children's interest in watching and responding to the video, in all of the groups. Additionally, we are currently recruiting a chronological age-matched group of TD children to participate in the research. It is important to compare how TD children with more exposure to interactive television respond to our stimuli, and to compare their behaviors to those of children with autism. Also, there may be other factors involved, such as the amount or kind of therapy involving social skills training encountered by children with autism. It will be important to look for relations between individual differences in social responsiveness and experiences such as training.

Implications

The results of our study may have practical applications. Researchers may be able to build upon the results of our study and use them to design early intervention techniques. For example, the groundwork laid by this study could lead to the development of a curriculum of videos that teach very young children with ASD important life skills. Studies demonstrating the value of video modeling (Charlop-Christy et al., 2000; Charlop-Christy & Daneshvar, 2002) have typically involved older children with autism than the current participants. The current study shows that young children with autism respond to a person on video. A substantial number of our participants preferred to watch a person on video rather than a person who was present. Since video interventions are less expensive than traditional interventions implemented by clinical psychologists, video modeling could be especially useful for low-income families for whom barriers exist to accessing traditional services.

The results of the current study suggest that video modeling interventions, like those used in Charlop-Christy et al. (2000), may be most effective for children with ASD who start out with more severe impairments in social functioning. Since children with lower levels of social functioning tended to prefer viewing the videotaped human presentation, video modeling may be the best intervention for these children. A pre-test, such as the Vineland, could be administered and scores in the socialization domain might be used to determine the most appropriate course of treatment. Social skills training using video could capitalize on some children's current visual preference for watching a video of a person rather than a real person.

The "Both presentations" trial might also be used as a simple screening tool for ASD in the at-risk younger siblings of children with ASD. More specifically, younger siblings who look at the video longer than the actual person could be identified and provided with early intervention. Early detection is important because early intervention can have a significant impact on long-term outcomes for people with ASD (Zwaigenbaum et al., 2007; Osterling et al., 2002).

Limitations

Our study had three main limitations. The majority of the families of typically developing children who volunteered to participate were Caucasian, suburban and of high socioeconomic status. This study illustrates the reality that only stay-at-home parents usually are able to participate in a study that takes place during weekday work hours. The lack of diversity among our TD population may restrict the extension of our results to more urban and diverse populations.

Second, our sample size was limited. We found it difficult to recruit participants with ASD. Unlike our (very young) TD children, children with autism in our age range attend school during the day as well as therapies in the afternoon. This made scheduling participants with ASD a challenge. While our sample size is small, we managed to recruit participants with ASD from diverse backgrounds and with different levels of impairment. To increase the size of our sample with ASD, data collection will continue until August 2010.

The third limitation of our study involved an aspect of the apparatus. Children with ASD would occasionally get distracted from the presentations by their reflection in the TV screen, especially during the “Live Only” trial. We considered covering the TV during this trial. But this solution would have caused the reflection problem to occur unequally across all three trials. However reflection from a TV is part of a naturalistic TV-viewing experience, at least with many older televisions. Modern flat-screen TVs may be less reflective, and therefore less distracting, to children with ASD.

Future Directions

The results of our study are guiding our future analysis of visual preferences in an interesting direction. We did not expect to find that children with ASD would attend equally to the “Video Only” and “Live Only” presentations. One interpretation of this result is that children with ASD are not highly motivated to look at people, even when a person is presented in a non-aversive manner, such as on a video. We would like to carry out another preferential looking studying presenting the same video of the real person paired with a cartoon of the person—which would be less “human” and possibly less aversive. This additional study would help us determine if children with ASD learn better from cartoons than from people, knowledge which would have implications for social skills training.

Our findings from the analysis of social behaviors (that our group with ASD and both TD groups did not significantly differ in the number of behaviors that they directed at the TV or person) prompted us to examine what factors other than ASD diagnosis may be involved in the production of social behaviors. We think that once we recruit more participants with ASD, we will find that these children perform significantly more behaviors than the much younger TD children. As mentioned above, we are currently recruiting a group of 5-year-old, TD children to create a “years of media exposure” match for the ASD group. This will allow us to test our hypothesis that prior experience with interactive television shows impacts how children interact with our videotaped stimuli. By comparing the number of social behaviors performed by the ASD group to the TD-5-year-old group's mean number of behaviors, we will be able to determine whether the ASD group's behavior is a function of their chronological age or their diagnosis. Moreover, we would like to incorporate the data from the on-line media questionnaire into this analysis as well. We intend to obtain data from 16 TD-5-year-old children before August 2010.

We will also conduct analyses using the reliable ADOS protocol scores for each of our participants this summer. We will perform a within-group analysis to examine whether severity of impairment (specifically, social functioning and communication) predicts visual preference or the number of social behaviors performed. We predict that this analysis will support our findings that social functioning is positively correlated with a preference for in-person human behavior. The broad range of functioning among our participants with ASD makes within-group analyses an interesting area to explore. We think that the results of our study provide a jumping-off point for future examinations of the social behaviors and visual preferences of children with ASD.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders*: *DSM-IV-TR* (*fourth edition, text revision*). Washington DC: American Psychiatric Association.

Anderson, D. R., Bryant, J., Wilder, A., Santomero, A., Williams, M., & Crawley, A. M. (2000). Researching Blue's Clues: Viewing behavior and impact. *Media Psychology*, *2*(2), 179-194.

Ayres, K., & Langone, J. (2005). Intervention and instruction with video for students with autism: A review of the literature. *Education and Training in Developmental Disabilities, 40,* 183-196.

Baldwin, D. A. (2000). Interpersonal understanding fuels knowledge acquisition. *Current Directions in Psychological Science, 9*(2), 40-45.

Center for Disease Control and Prevention. (2009). *Autism information center: Frequently asked questions- Prevalence.* Retrieved February 7, 2010, from http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5810a1.htm

Charlop, M. H., & Milstein, J. P. (1989). Teaching autistic children conversational speech using video modeling. *Journal of Applied Behavior Analysis, 22*, 275-285.

Charlop-Christy, M., Le, L. & Freeman, K. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of Autism and Developmental Disorders, 30,* 537-552.

Charlop-Christy, M. & Daneshvar, S. (2002). Using video modeling to teach perspective taking to children with autism. *Journal of Positive Behavior Interventions, 5,* 12-21.

Corbett, B. & Abdullah, M. (2005). Video modeling: Why does it work for children with autism? *Journal of Early and Intensive Behavior Intervention, 2*(1), 2-8.

Dawson, G., Carver, L., Meltzoff, A., Panagiotides, H., McPartland, J., & Webb, S. J. (2002). Neural correlates of face and object recognition in young children with autism spectrum disorder, developmental delay, and typical development. *Child Development, 73,* 700-717.

Dawson, G., Meltzoff, A., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with autism fail to orient to naturally occurring social stimuli. *Journal of Autism and Developmental Disorders, 8*(6).

Diamond, R., & Carey, S. (1986). Why faces are and are not special: an effect of expertise. *Journal of Experimental Psychology, 115,* 107–117.

Farah M., Wilson, K., Drain M., & Tanaka, J. (1998). What is special about face perception? *Psychological Review, 105,* 482–498.

Gauthier, I., & Tarr, M. (1997). Becoming a “Greeble” expert: exploring mechanisms for face recognition. *Vision Research, 37,* 1673–1681.

Grelotti, D., Gauthier, I., & Schultz, R. T. (2002). Social interest and the development of cortical face specialization: What autism teaches us about face processing. *Developmental Psychobiology, 40,* 213-225.

Hobson, R., Ouston, J., & Lee, A. (1988). Emotion recognition in autism: coordinating faces and voices. *Psychological Medicine, 18,* 911–923.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002). Defining and quantifying the social phenotype in autism, *The American Journal of Psychiatry, 159*, 895-908.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002b*).* Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry, 59,* 809–816.

Langdell, T. (1978). Recognition of faces: an approach to the study of autism. *Journal of Child Psychology and Psychiatry*, *19,* 255– 268.

Lord, C., Rutter, M., DiLavore, P.C., & Risi, S. (1999). *Autism Diagnostic Observation Schedule*. Los Angeles, CA: Western Psychological Services.

Miyahara, M., Bray, A., Tsujii, M., Fujita, C., & Sugiyama, S. (2007). Reaction time of facial affect recognition in Asperger's disorder for cartoon and real, static and moving faces. *Child Psychiatry and Human Development*, *38*, 121–134.

National Autistic Society. (2002). *Children with Autism and Thomas the Tank Engine*. Retrieved December 7, 2008, from http://www.nas.org.uk/nas/jsp/polopoly.jsp?d=368&a=2683.

Pelphrey, K., Sasson, N., Reznick, J., Paul, G., Goldman, B., & Piven, J. (2002). Visual scanning of faces in autism, *Journal of Autism and Developmental Disorders, 32*, 249-261.

Prior, M., & Ozonoff, S. (1998). Psychological factors in autism. In Fred R. Volkmar (Ed.) *Autism and developmental disorders* (pp. 64-108): Cambridge University Press: Cambridge, United Kingdom.

Rosset, D., Rondan, C., Da Fonseca, D., Santos, A., Assouline, B., & Deruelle, C. (2008). Typical emotion processing for cartoon but not for real face in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38,* 919-925.

Siegel, I. (1978). The development of pictorial comprehension. In S. Bikkar, B. S. Randhawa, & W. E. Coffman (Eds.), *Visual learning, thinking, and communication.* (pp. 93-111). New York: Academic Press.

Sparrow, S., Cicchetti, D., & Balla, D. (2005). *Vineland-II Adaptive Behavior Scales: Survey Forms Manual*. Circle Pines, MN: AGS Publishing.

Speer, L., Cook, A., McMahon, W., & Clark, E. (2007). Face processing in children with autism:

Effects of stimulus contents and type, *Autism, 11*, 265-277

Subiaul, F., Lurie, H., Romansky, K., Klein, T., Holmes, D., & Terrace, H. (2006). Cognitive imitation in autism. *Cognitive Development, 257,* 1-13.

Tomasello, M. (1999). *The cultural origins of human cognition.* Cambridge, MA: Harvard University Press.

Troseth, G. L., & DeLoache, J. S. (1998). The medium can obscure the message: Young children's understanding of video. *Child Development, 69*, 950-965.

Troseth, G. L., Saylor, M. M., & Archer, A. H. (2006). Young children's use of video as a source of socially relevant information. *Child Development*, *77,* 786-799.

van der Geest, J. N., Kemner, C., Camfferman, G., Verbaten, M. N., & van Engeland, H. (2002). Looking at images with human figures: Comparison between autistic and normal children. *Journal of Autism and Developmental Disorders, 32*, 69-75.

Zwaigenbaum et al., (2007). Studying the emergence of autism spectrum disorders in high-risk infants: Methodological and practical issues. *Journal of Autism and Developmental Disorders, 37,* 466-480.

Table 1

Vineland Adaptive Behavior Scales: Subscale Age Equivalents (in months) for Individual Participants with Autism Spectrum Disorders (ASD)

Participant	Receptive Language	Expressive Language	Interpersonal Relationships	Play and Leisure	Coping Skills	Mean Socialization
1	47	52	65	70	41	58.67
2	21	64	59	38	71	56.00
3	26	30	19	26	34	26.33
4	3	12	3	2	4	3.00
5	29	30	30	29	43	34.00
6	11	9	10	10	13	11.00
7	19	29	18	19	23	20.00
8	47	58	31	33	30	31.33
9	18	18	6	11	10	9.00
10	13	8	9	16	23	16.00
11	15	9	5	7	21	11.00
12	35	42	35	37	56	42.67

Table 2

Vineland Adaptive Behavior Scales: Receptive Language Subscale Mean Age Equivalents (in months)

Group	*M*	*SD*
TD-2.5-year-old	36.5	8.34
TD-1.5-year-old	23.67	6.88
ASD	23.67	13.78

Table 3

Vineland Adaptive Behavior Scales: Socialization Subdomain Mean Age Equivalents (in months)

Group	Interpersonal Relationships	Play and Leisure	Coping Skills	Overall Socialization
TD-2.5-year-old	42.79	36.64	54.00	44.48
TD-1.5-year-old	22.17	19.75	24.25	22.06
ASD	25.45	24.83	30.75	26.63

Table 4

Percent Attention to Stimuli in "Live Only" and "Video Only" Trials

	"Live Only" trial		"Video Only" trial	
Group	*M*	*SD*	*M*	*SD*
TD-2.5-year-old	0.90	0.08	0.92	0.08
TD-1.5-year-old	0.91	0.07	0.91	0.10
ASD	0.67	0.15	0.69	0.27

Table 5

Mean Number of Social Behaviors Exhibited by Group per Trial

	"Both" Trial		"Live Only" Trial		"Video Only" Trial	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*
TD-2.5-year-old	4.43	6.98	4.93	7.25	5.21	8.25
TD-1.5-year-old	5.17	7.46	11.00	12.14	6.17	7.36
ASD	12.17	16.22	14.50	16.94	9.08	13.32

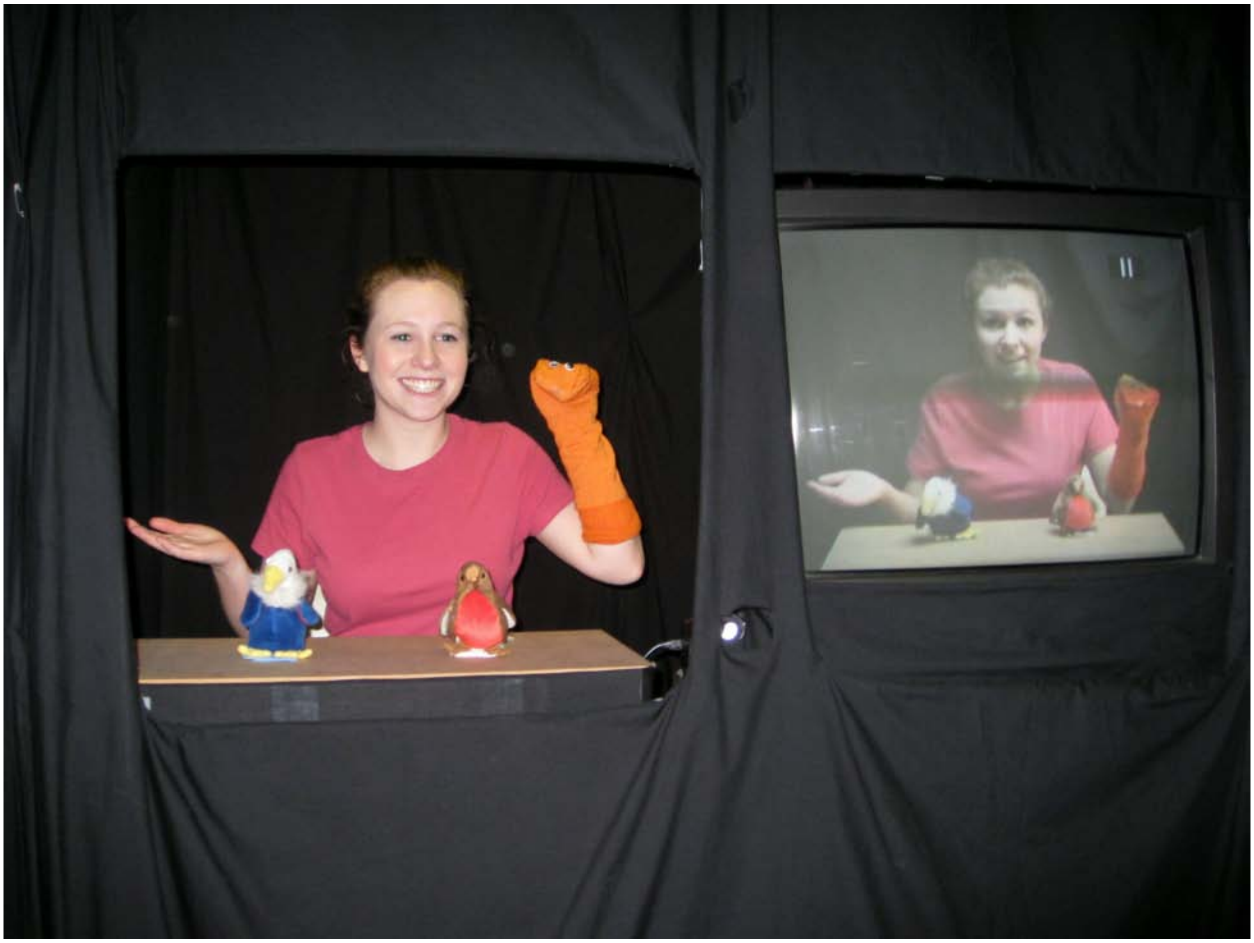

Figure 1. “Both” Presentation Trial Set-Up. The participant sits two feet in front of the simultaneous “live”and “video” presentations.

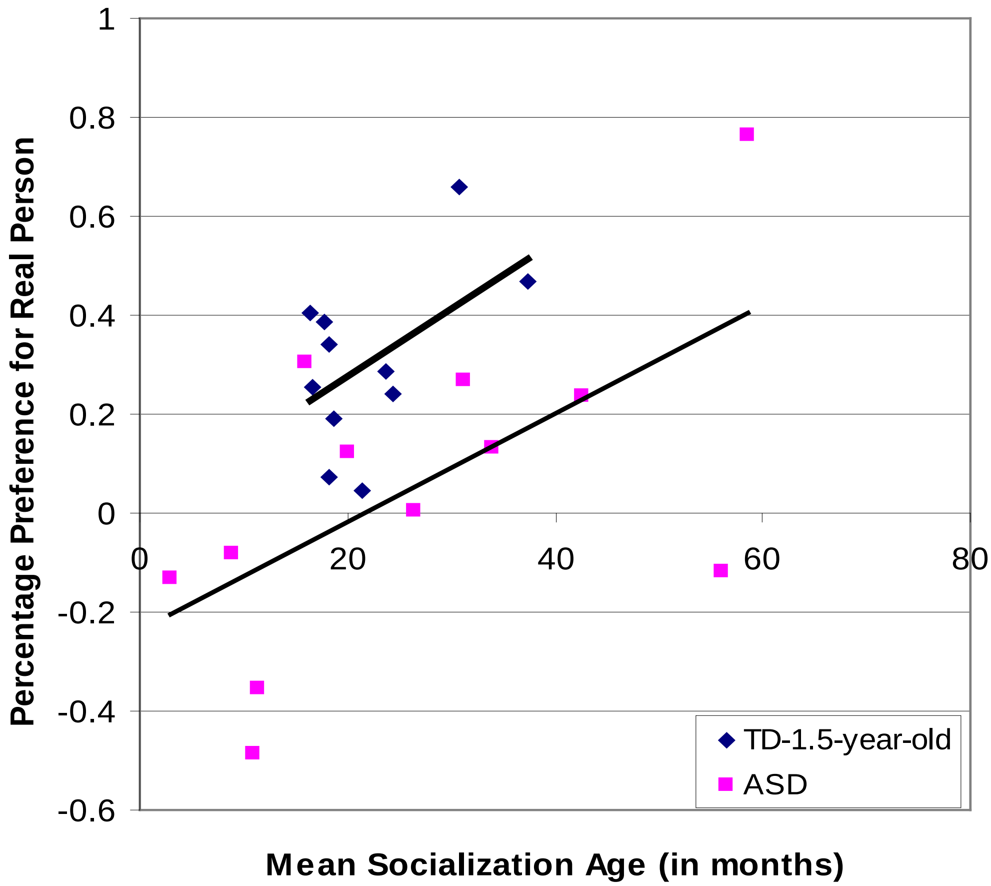

Figure 2. Percentage Preference for "Live" Presentation. When children were shown the simultaneous "live" and "video" presentations, their percentage preference for the "live" performance correlated with their mean socialization age, as determined by the Vineland Adaptive Behavior Scales.

.

Appendix A.

Video Script for "Both Presentations" Trial: Greta's Animals

Props:

-2 fish cut out of foam (one white, one green) with magnetic tape strips on the back

-1 foam fish bowl that has a magnetic tape strip for each fish to attach

-2 plush birds (one red, one blue)

-1 orange sock puppet, "Joe"

Intro Song- "Greata's Games"

(Greta's games, Greta's games, everyone wants to play Greta's games!)

Lauren: Hi, my name's Greta. Can you say Greta? [pause] Great! Today we're going to play some games. Are you ready to play? [pause] Great! First I want you to meet my friend. His name is "Joe". He's going to play with us and help us with our games. To get him to come out, we have to call for him. Can you say "Joe" with me? Say Joe! Say Joe! [pause] Oh, here he comes. Hi Joe! Are you ready to play with us?

(Joe nods his head "yes")

Lauren: Today we're going to learn about animals. Do you know what kind of animal Joe is? [pause] That's right. He's a worm. That's right, isn't it Joe?

(Joe nods his head "yes")

Lauren: Do you know what worms do? [pause] Worms like to wiggle. Can you wiggle like a worm? [pause] Hey Joe, can you show us how to wiggle like a worm? I can do that too. Wiggle with us. (Lauren and Joe wiggle) C'mon! [pause] Great job! Let's meet some other animals. But right now, the other animals are hiding. Could you please go find them Joe?

(Joe nods his head "yes")

Lauren: Great!

(Joe goes below puppet stage, waits 2 seconds, comes back up without the fish).

Lauren: Uh-oh! It looks like we'll have to call for the fish to get them to come out. You have to say "Fishies!" Can you say "fishies" with me? Fishies! Fishies! Do you see them? [pause] (Joe shakes head no) They must still be hiding. We have to call louder for them. Fishies! Fishies!

(Joe goes below stage again, brings back the fish, places them on stage)

Lauren: Hi fishies, it's great to see both you today. One fish is green and the other one is white. Which one is the white fish? Can you point to the white fish? [pause] Good job! You found the white fish!

Lauren: Did you know that fish like to swim? [short pause] That's right, fish like to swim in the water. Can you pretend to swim like a fish with us? [pause] (Lauren picks up yellow fish and moves it up and down in swimming motion) C'mon! Pretend to swim with us! Good job! It's time for the fish to go home because we have two more animals to meet. Could you please take the fish home, Joe?

(Joe nods yes, picks up fish and places them beneath stage)

Lauren: Thanks! O.K., let's meet the other animals. Joe, could you please go get the other animals?

(Joe nods, goes below puppet stage, waits 2 seconds, comes back up with out the birds)

Lauren: Uh-oh! It looks like we'll have to call for the birds to get them to come out. You have to say "Birdies!" Can you say "birdies" with me? Birdies! Birdies! Do you see them? [pause] (Joe shakes head no) They must still be hiding. We have to call louder for them. Birdies! Birdies!

(Joe goes below stage again, brings back red bird, places it on stage)

Lauren: Hi bird, I'm so glad you came to play today.

(Joe goes below stages again, brings back blue bird, places it on stage)

Lauren: Oh hello! I'm glad to see you too. Joe brought us two birds to play with. One of them is red and the other one is blue. Can you show me the red bird? Which one's the red bird? Point to the red bird! [Pause] (Lauren points to the red bird) That's right. This one's the red bird and this one's the blue bird (Lauren points to blue bird). Good job!

Lauren: Do you know what birds like to do? [short pause] Birds like to fly. Where do you think birds like to fly? [short pause] That's right, they like to fly in way up in the sky. Can you pretend to fly like a bird with me? C'mon, let's pretend to fly! (Lauren picks up bird and makes wing flapping motion with arms) Good work!

Lauren: Do you know what else? [short pause] Birds like to make noises. Do you know what sounds birds make? [short pause] Do birds say "cheep cheep"? Can you make the bird sound? [pause] "Cheep cheep!" Great job! Let's do it again! "Cheep, cheep!" Great!

Lauren: Now it's time to sing a song. Can you sing with me? [short pause] Old McDonald had a farm, E-I-E-I-O, and on his farm he had some birds, E-I-E-I-O. With a, "cheep, cheep," here and a, "cheep, cheep," there. Here a, "cheep," there a, "cheep," everywhere a, "cheep, cheep". Old McDonald had a farm, E-I-E-I-O. I liked that song, but now it's time for Joe to take the birds to go home. Can you say "bye bye" to the birds with me? [short pause] Bye bye!

(Joe takes birds under stage)

Lauren: Joe and I've had so much fun playing with you today. I hope you had fun too! Now it's time to say good-bye. Let's wave good bye. (Lauren waves bye) Bye!

Video Script for "Live Only" and "Video Only" Trials: Greta's Colors

Props:

-Play dough lids taped in a ring shape in the lid of a shoebox

-Plastic Orange fruit

-Green plastic toy shovel

-Green plastic bowl

-Blue plastic boat

-Yellow rubber duck

-Red plastic ring

-Red plastic ring hammer

-Orange sock puppet, "Joe"

Intro Song: "Greta's Games"

(Greta's games, Greta's games, everyone wants to play Greta's games!)

Lauren: Hi, my name's Greta. Can you say Greta? [pause] Great! Today we're going to play some games. Are you ready to play? [pause] Great! First I want you to meet my friend. His name is "Joe". He's going to play with us and help us with our games. To get him to come out, we have to call for him. Can you say "Joe" with me? Say Joe! Say Joe! [pause] Oh, here he comes. Hi Joe! Are you ready to play with us?

Joe nods his head.

Lauren: Today we're going to learn about colors. Do you know what color Joe is? [pause] That's right. He's orange. Can you tell me something else that is orange? Do you think this fruit is orange? [pause] That's right, it is orange. Today we're going to learn about some other colors too. Joe, could you please go find our toys?

Joe nods head “yes”.

Lauren: Great!

(Joe goes below puppet stage, waits 2 seconds, comes back up without the toys)

Lauren: Uh-oh! Joe didn’t get our toys. Can you help me tell Joe what we want? We have to tell him that we want “toys!” Can you say “toys” with me? Toys! Toys! Did Joe get our toys? [pause] Oh-no! He didn’t! We have to tell him what we want again. Say, Toys! Toys!

(Joe goes below stage again, brings back the toys, places them on stage)

Lauren: Oh hi Joe, you did a great job finding the toys. Two of these toys are green and one of them is blue. Can you show me the blue one? Point to the blue one! [Pause] Good job! You found the blue one. (Joe takes the blue boat below stage) We still have two more toys, the two green things. Which one these is the shovel? Can you point to the shovel? Is it this one (Lauren points to shovel)? Or is it this one (Lauren points to bowl)? It’s this one. That’s right. This one is the shovel (Lauren points to shovel) and this one is the bowl (Lauren points to bowl).

(Joe takes boat below stage)

Lauren: I have a question for you. What do we use shovels to do? [Pause] That’s right, we use shovels to dig. Can you help me pretend to dig? Let’s pretend to dig! (Lauren does digging motion) Good job! It’s time to put the toys away because we have more toys to play with. Could you please put the toys away, Joe? (Joe nods yes, picks up toys in mouth and places them beneath stage) Thanks!

Lauren: Now we can play with some different toys. Joe, could you please go get the other toys?

(Joe nods, goes below puppet stage, waits 2 seconds, comes back up without toys)

Lauren: Uh-oh! Joe didn't get the toys. We have to tell Joe that we want toys. Can you say "toys" with me? Toys! Toys! Do you see them? [Pause] Oh-no! He didn't get them! We have to tell Joe what we want again. Say Toys! Toys!

(Joe goes below stage again, brings back ring and places it on stage, then rubber duck, then hammer)

Lauren: Thanks! Joe brought us three toys to play with. Two of them are red. One of them is not, it's yellow. Which one is the yellow one? Point to the yellow one! [Pause] Great! You found the yellow one. (Joe takes yellow duck below stage). We still have two more toys, the red ones. Which one of these is the hammer? Can you point to the hammer? Is it this one (Lauren points to ring)? [Pause] Or is it this one (Lauren points to hammer)? [Pause] That's right, it's this one (Lauren points at hammer). This one is the hammer (Lauren points to hammer) and this one is the ring (Lauren points to ring).

Lauren: Hammers are really fun to play on. Can you pretend to hammer with me? [Pause] Great! Look at me, I'm hammering, I'm hammering! (Lauren makes pretends to hammer with toy). Pretend to hammer with me! I'm hammering, I'm hamming (Lauren makes hammering motions with toy again). Great job! It's time to put the toys away so we can sing a song. Joe, could you please put the toys away? (Joe nods head yes). Thanks!

(Joe takes slide under stage, bring back lid with play dough lids in it)

Lauren: Alright, now its time to sing a song. Look at all these colors. Sing with me! Red and yellow, green and blue, orange, pink and purple too (to the tune of "Now I know my ABC's). Did you like that song Joe? (Joe nods head yes). Great! Let's sing it again. Help me sing! Red and yellow, green and blue, orange, pink and purple too. Great job!

Lauren: Joe and I had so much fun playing with you today. I hope you had fun too! We're going to say good-bye now. Let's wave good bye. (Lauren waves bye) Bye!

Appendix B

Full Behavior Coding Scheme

1) “Answer- Verbal”- A verbalization that a child makes as an answer to a question asked to the child by the experimenter during the presentation. For example, the experimenter said, “Can you say Joe with me?” The then child responded by saying, “Yes!”

2) “Answer- Nonverbal”- A nonverbal answer, such as head nodding or pointing, provided by the child as an answer to a question posed by the experimenter during the presentation. For example, the experimenter said, “Do you know what birds like to do?” The child then nodded his head up and down.

3) “Prompted Imitation”- A verbal or nonverbal imitation that the child performed when asked to do so by the experimenter during the presentation. For example, a child, “wiggled like a worm” when asked by the experimenter to imitate how she wiggled like a worm.

4) “Pointing- Not an Answer”- A child points at the presentation, but not in response to a request made by the experimenter during the presentation. For example, a child pointed at Joe on the screen without being asked to do so by the experimenter.

5) “Social Smiling”- A child smiles back at the experimenter when she makes eye contact and smiles at the child during certain points in the presentation.

6) “Unprompted Verbal Imitation”- A child verbally imitates the experimenter without being prompted by the experimenter. For example, a child said, “His name is Joe” immediately after the experimenter said, “His name is Joe.”

7) “Unprompted Nonverbal Imitation”- A child nonverbally imitates behavior made by the experimenter without being asked to do so. For example, a child nods his head right after the experimenter nods her head.

8) “Comment- Verbal”- Verbalizations that the child makes that are directed at the presentation, but are not in response to a question posed by the experimenter. We did not include verbalizations made towards the parent in this behavior category. For example, a child looked at the “live” presentation and said to the experimenter, “Look over there, you’re on TV!”