

The Effect of Teaching Attending to a Face on Joint Attention Skills
in Children with an Autism Spectrum Disorder

by

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Abstract

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By

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Autism spectrum disorders are characterized in terms of behavioral deficits in areas of social behavior and language development. A failure to attend to the faces of others is the single best discriminator between 1-year-old children later diagnosed with an autism spectrum disorder (ASD) and those with typical development. Attending to the face of another provides the opportunity for episodes of attention sharing and is important to the development of communication, joint attention, and social behavior. A more advanced form of attending to a face is joint attention which has been defined as the ability to coordinate attention between an object and a person in a social context and is often regarded as an important developmental milestone. Since children with an ASD typically do not attend to the faces of others, they do not obtain social information provided by the faces of others, as in for example joint attention. Impairments in joint attention are also among the earliest signs of an ASD and, as such, play a crucial role in understanding the deficits in the area of social behavior that accompany the disorder. The current study examined the effects of teaching attending to a face to three children with an ASD aged 26 to 30 months. Results indicated that all three participants demonstrated an increase in attending-to-a-face and following gaze/head-turn behavior during treatment. This increase was also evident in generalization measures, which took place with novel stimuli, after treatment demonstrating that the program implemented for generalization across stimuli was effective.

Dedication

This work is dedicated to my father, Aldo Rovito, who allowed me to pursue my dreams because he was always only a phone call away. Thanks Dad, I miss you every day.

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The human face is considered to be a special object as it represents a crucial window into a person's identity, beliefs, and feelings (Hauser, 2000). The first exposure that typically developing infants have into the world of human communication and relatedness consists of whatever their caregiver does with his or her face, as well as his/her voice and/or body (Stern, 1977). Attending to the face of another provides the opportunity for episodes of attention sharing, which is crucial for the development of communication and social behavior and is said to be the cornerstone of social intelligence (Triesch, Teuscher, Deák, & Carlson, 2006). Face-to-face attention and social referencing in young typically developing children occur mainly during interactions with their caregiver (Naber et al., 2007). It is during this initial period of infant-caregiver interaction where the infant experiences the conditions of attention sharing in which they learn to initiate, maintain, modulate, terminate and avoid a social situation (Stern, 1977). It can also be said that at this point in typical development, the basic propensity for social behavior begins.

Problems with these interactive social behaviors are found in children diagnosed with ASDs. In fact, the classification of the greatest number of infants later diagnosed with an ASD has been predicted by how often a child looked at the face of another person (Osterling & Dawson, 1994). According to Rogers (2001), infants who were later diagnosed with an ASD showed an absence or low rate of looking at faces and/or visual attending to a communicative partner. Further, when examining videos of 8-10 month old infants who were later diagnosed

with Autistic Disorder, it was established that these infants were less likely than their typically developing peers to look at the face of another (Werner, Dawson, Munson, & Osterling, 2005). Other studies (Adrien et al., 1993; Dawson et al., 2004) have also produced this finding.

Considering the problems and deficits in individuals diagnosed with autism spectrum disorders (ASD's), many studies have been conducted and have shown the effectiveness of early intensive behavior intervention (EIBI) on improving the behavioral outcome of children with an ASD (e.g., Lovaas, 1987; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Boyd & Corley, 2001; Ben-Itzhak & Zachor, 2007; Reichow & Wolery, 2009). Indeed, the evidence suggests that early intervention programs are beneficial for children with autism, often improving developmental functioning, and decreasing maladaptive behaviors and symptom severity (Rogers & Vismara, 2008). In fact, as of 1996, intensive behavioral intervention is the only treatment recommended by the New York State Department of Health for young children diagnosed with an ASD aged 0-3 years (NYDOH, 1999). Nevertheless, few studies have investigated the implications of teaching attending to a face to young children with ASDs.

As mentioned earlier, research on the development of typical young children has established that attending to a face is an extremely important aspect of human communication and important to the development of understanding social cues. If typically developing infants are socially responsive and attend to the faces of others very soon following birth (DeCasper & Fifer, 1980), then in autism there may be a deprivation of the necessary experience for the development of social behavior beginning very early in life because of a failure to attend to the faces of others. Therefore, the present study proposes to examine the effects of teaching young children with an ASD to attend to the face of another using intensive behavior intervention because attending to the face of another is present very early in the typically developing

trajectory of social behavior. It is hypothesized that teaching very young children with an ASD to increase their attention to faces should result in an increase in social communication behavior, as evidenced in typical development.

I The importance of attending to faces in typical development

a) The impact of attending to faces on social behavior

Processing facial information, such as affect and gaze, is likely to be one of the earliest facilitators of social communication (Bushnell, Sai, & Mullin, 1989). In typical development at birth, and during the first six weeks of postnatal life, infants exhibit a remarkable sensitivity to social stimuli (Rochat & Striano, 1999). At around six weeks, the infant is capable of visually fixating on caregiver eyes (Stern, 1977). Furthermore, at as early as five months of age, infants begin to demonstrate sensitivity to very small deviations in gaze during social interactions with adults and demonstrate the ability to follow a visual line of reference (Symons, Hains, & Muir, 1998) suggesting the ability to engage in social eye gaze. Social eye gaze is defined as mutual gaze that involves an interpersonal exchange. In addition, all typically developing infants respond to social cues, such as affect and body gestures, potentially providing information about communicative intent. Communicative intent requires the ability to understand signals exhibited in social exchanges, for example, facial affect and gestures produced by others such as pointing or using eye gaze to demonstrate interest, thereby engaging in a socially communicative exchange between two or more individuals that may or may not involve spoken language. At approximately 9 months, gestures are used communicatively along with facial expressions when sharing attention with another person (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). Either way the importance of attending to the face of another is a necessary and critical part in the development of social communication.

There are many early studies that have indicated the importance of faces in the typical development of early human relatedness, for example, social communication. Attention to the face has been described as a foundation for attachment in typically developing infants, which becomes a reference and source of information necessary for the development social of communication (Rose et al., 2007). In a seminal study by Spitz (1946), 251 children varying in age from birth to 6 months served as subjects. Three-month-old infants demonstrated more interest in drawings of faces than in drawings of other objects. Human quality was defined as a configuration which consisted of certain elements within the human face that were combined with motion, such as that of the eyes and mouth. Results indicated that it was not the human face, rather, its human quality that acted as a stimulus for a smiling response. In addition, there is general agreement in the literature that in typically developing individuals, the ability to discriminate faces depends in a large part on configural and holistic processes as opposed to more feature-based strategies seen in the processing of non-face objects (Rose et al., 2007). For example, inverting a face disrupts the ability to consider the expected configuration of a face, which is typically a holistic process, for example, using where the eye, nose, or mouth is located to identify the stimulus as a face. When a face stimulus is inverted, a feature based process is generally used, for example, the presence or absence of an eye, nose, or mouth on a stimulus is considered when identifying the stimulus as a face.

Research has also suggested that the development of face recognition is an experience expectant process, which refers to a process whereupon the development of skills and abilities depends on exposure to certain experiences occurring over a particular period of time (Greenough & Black, 1992). Face recognition appears to reflect an experience expectant process that is, exposure to faces during a sensitive period (Nelson, 2001). Dawson, Webb, and

McPartland (2005) also discussed the experience expectant process but as a developmental progression involving a period of readiness where the brain accepts specific kinds of information from the environment during sensitive periods when the brain is ready to accept this reliably available information. An argument can be made here for an experience expectant period of development specific to face processing in infants. Typically developing infants gain experience and expertise with repeated contact with common stimuli, for example, social stimuli such as the faces of caregivers. In addition, shared attention or looking where another is looking by attending to the caregiver's face and following eye gaze and/or head turn, provides the opportunity for very young children to learn to attend to what is important in the environment and allows for the opportunity to learn social behavior.

b) *The impact attending to faces on joint attention behavior*

Research in the 1960s (e.g., Bell, 1968) on parent-child interaction, particularly in attention to the face, indicated that bidirectionality and reciprocity characterized the parent-child relationship and that both the parent and the child continually influence this relationship, which is critical in the development of joint attention behavior. More current research indicates that most typically developing infants can monitor and follow another person's attention in order to share an experience (joint attention) by their first birthday (Deák, Walden, Kaiser, & Lewis, 2008). Joint attention is a more advanced form of attending beyond attention to a face and refers to the ability to coordinate attention between interactive social partners with respect to objects or events in order to share awareness of objects or events (Mundy, Sigman, Ungerer, & Sherman, 1986). Its origins in the literature appear to be generally identified in an early study by Scaife and Bruner (1975). Joint attention emerges in typically developing infants at nine to twelve months of age when infants begin to systemically coordinate attention between people and

objects. At five months, infants develop an interest in objects; therefore, communication at this point can involve the coordination of the child and the caregiver's attention with respect to a third object or event (Paparella & Kasari, 2004).

In a noteworthy study conducted by Bakeman and Adamson (1984), joint attention was defined as the emergence of the ability to coordinate attention toward a social partner and an object of mutual interest and is often regarded as an important developmental milestone that also plays a pivotal role in language development. Many definitions for joint attention exist in the literature, perhaps best defined for the proposed study by Holth (2005). Holth provided an operant analysis of joint attention, as "a synchronizing of the attention" (involving the faces) of two or more persons sharing attention with a common object. It is behavior that is used in a social context to direct attention to an object or event, thus establishing a common focus of attention between a child, another individual, and an object of interest (Whalen & Schreibman, 2003; Mundy, Sigman, & Kasari, 1990). These pre-linguistic, triadic exchanges that occur when the attention is initially focused on the face of another, characterize communication in typical development between 6 and 18 months of age (Bakeman & Adamson, 1984).

c) The impact of attending to faces on language

Looking at the face of another is an important component in the early development of language in typically developing children. Increasing evidence suggests that prelinguistic joint attention abilities are associated with early language skills in typically developing children (Carpenter, Nagell, & Tomasello, 1998). Non-verbal communication begins as early as three months when infants engage in reciprocal vocal games by engaging in "taking turns" with their caregivers when making sounds. It is in these dyadic face-to-face interactions, that the foundation for communication skills is developed (Kaye, 1982). Attending to the face of another

allows one to reference where another is looking and gather information to map words to named objects based on the close temporal association between hearing the label and looking at the object (word-object pairing). Following the attentional focus of another is a common strategy evidenced in typically developing infants during language development. Typically developing children are able to learn a novel word by thirteen months using word-object pairing (Woodward, Markman, & Fitzsimmons, 1994). In fact, typically developing children learn many words by following the attentional focus of another i.e., looking where the person is looking, by the age of nineteen months (Tomasello & Barton, 1994). This particular strategy for learning language is disrupted in very young children with ASDs, for example, the absence of looking at the faces of others severely limits the opportunity to utilize this strategy.

II *Face processing in typical development*

Recognition of faces has played an important role in human development, and therefore to science, which was noted as far back as Darwin (1872/1965) who suggested that faces provide nonverbal information important for communication and survival. Indeed, the swift and precise processing of faces has survival value as a warning of imminent danger or threat to be quickly determined. In fact, studies (e.g., Bushnell, 2001; Bushnell et al., 1989) have established that newborn infants show recognition of their mother's face within hours of birth. Equally important is the ability to discriminate between a friend and stranger or attend to the facial expressions and eye gaze (where the eyes are looking) of others in social situations.

Researchers in the field of psychology have been studying "where the eyes are looking" since the 1950's. When investigating sensory systems in newborns, researchers at that time were interested in when particular systems developed over time, for example, sense of touch develops faster than visual acuity. That line of research led to the method that developmental

psychologists currently use to evaluate sensory processing in infant development which is to present a stimulus to the infant, such as a tone or flash of light, and then observe how the infant behaves in response to the stimulus, for example, a tone is presented and the turn of an infant's head is observed.

Furthermore, another technique currently used by developmental psychologists, to assess sensory capacity, is to present two stimuli simultaneously and observe if the infant exhibits a preference by looking at one stimulus longer than another. A researcher can also repeatedly present a preferred stimulus that the infant attends to until an infant "gets bored" and stops attending (habituation) and then change the stimulus in some way, for example, change a character on the visual presentation, and the infant demonstrates renewed interest in the stimulus by attending to it again (dishabituation). This method allows the researcher to investigate systems of development in the infant that would not otherwise be possible to examine because the infant cannot make their experiences known through coordinated movement or speech. Findings based on observations using this technique by McCall (1994) indicated that individual differences in the ability of infants to inhibit attention to, or disengage from, less salient stimuli, including the familiar stimulus, may be crucial to the prediction of later intellectual functioning as assessed by IQ testing. Nevertheless, infants clearly undergo dramatic changes in their first year of life and attending to relevant stimuli is an important part.

Early empirical evidence for the presence of preferential looking was demonstrated in a study conducted by Fantz (1961) with chimpanzees and again with human infants (Fantz, 1963; Fantz, 1964). Other early studies, such as Caron and Caron (1968; 1969), have also indicated that infant visual fixation gradually decreases with repeated presentations of the same stimulus (habituation) and then increases with the presentation of a different stimulus (dishabituation). In 1964, Fantz discovered that infants' attention declined with repeated presentations of visual

stimuli in his study with 2-6 month old infants. The stimuli, variable patterns vs. one constant pattern, were presented to the infants in pairs, for ten, 1-minute periods where one stimulus (constant) was always the same and the other always different (variable). Findings suggested that infants older than 2 months of age reliably decreased their attention to the repeatedly presented constant stimulus than at the stimulus that was always varied; therefore, they looked less at the constant or familiar stimulus than at the variable stimulus. This is an early example of the habituation paradigm, which continues to be used in current research studies.

In fact, Fantz's earlier study (1963) using habituation remains one of the earliest studies on infant visual preference for the face. Eighteen infants, aged ten hours to five days were presented with target stimuli divided into two categories, i.e., a pattern stimulus, which included a schematic face, and a non-pattern stimulus. Findings indicated that visual attention (fixation time) was two times longer for pattern than non-pattern with an unexpected finding of longest fixation time to the face stimulus over the other stimuli, across ages. Fantz suggested that the longer fixation time to the face stimulus indicated attention to a pattern that has certain similarities to social objects and has considerable "intrinsic" interest or stimulating value. Fantz (1963) further suggested that the underlying mechanism for this intrinsic interest should facilitate the development of social responsiveness because "what is responded to must first be attended to." This early finding has great relevance to the current research project and will be discussed in detail later in this paper.

The habituation paradigm, involving the measurement of visual fixation, is still used in research today as a routine measure of stimulus discrimination in infants and is utilized when studying an infant's ability to discriminate faces. Studies have also been conducted using the habituation paradigm to determine whether infants can discriminate among facial expressions

(e.g., Barrera & Maurer, 1981; Young-Browne, Rosenfeld, & Horowitz, 1977). In the Young-Browne et al. study (1977), infants aged 12-14 weeks were presented with images of three facial expressions, sad, happy, and surprised, which were produced by a male model. Each slide containing the male model imitating a particular facial expression was presented until a habituation criterion was met, for example, two consecutive looks of less than 50% (fixation time) of the mean of the first two looks, which was determined through trained observers. Results indicated that 3-month-old infants were capable of discriminating between happy and surprise faces and under certain circumstances between sad and surprise faces; however, discrimination between happy and sad faces was not established. In addition, results indicated the importance of the eyes and mouth as facial features, signifying the possible importance of these indicators of facial expressions displayed by caregivers as discriminative stimuli when acquiring appropriate emotional responses in infants very early in development. For example, an infant might observe a new stimulus, for example, a stranger in the environment, and then look at the face of the caregiver to determine the presence or absence of danger. If the parent indicates by facial expression, for example, smiling, then the infant looks back (joint attention) at the stimulus (stranger) and can comfortably interact.

The importance of facial expressions displayed by parents was investigated by Barrera & Maurer (1981) who used the faces of infants' mothers as stimuli compared to faces of female stranger as stimuli in order to determine whether 3-month-old infants could discriminate between smiles and frowns. Once again, the habituation paradigm was used and results indicated that unlike the findings in the Young-Browne et al. (1977) study, infants were able to discriminate between the smiling and frowning faces when their mother's face was the stimulus as well as when the female strangers served as stimuli for smiling and frowning faces. In the Young-

Browne et al. (1977) study, a male model was used; however, in the Barrera and Maurer (1981) study only female faces were used; therefore, it is possible that the infants generalized across the female faces (the mother's face with which they are very familiar, to the female face of the stranger), which may account for the difference in findings in the studies.

A considerable amount of research has been conducted since the 1980s on the cognitive, developmental, and most recently, neurological systems involved in the processing of faces in human development. Much of the research conducted in the 1980's and 1990's focused on theoretical models involving face processing, for example, whether or not the processing of faces was unique in comparison to other visual processing such as that of objects. Research from cognitive psychologists provided information on how the face is perceived differently from other objects and how it may represent a special class of stimuli. Developmental psychologists provided studies on face recognition during infant and caretaker interactions and the importance of the face on the development of communication before the onset of language. Studies in neuroscience on face processing provided information on specific neural activity, suggesting an area of the brain that is specialized for face processing and recognition. In addition, researchers have since obtained a better grasp on the functions involved in 1) infant recognition of the face, 2) infant recognition of emotion of the face, and 3) infant recognition of the face from various configurations, for example, whole face (configural) and detailed (featural) or parts of a face.

More recently, neuroimaging studies, for example, event-related potentials, positron emission tomography, and functional magnetic imaging techniques, have provided researchers with information on neural activation specifically related to face processing. The inferior temporal lobes and fusiform gyrus, more specifically the middle part of the right fusiform gyrus also known as the "Fusiform Face Area" (FFA), were discovered to be paramount in the

processing of faces (Kanwisher, McDermott, & Chun, 1997; Kanwisher, 2006). This specialized area has been examined through studies in prosopagnosia because it is an explicit brain impairment or selective deficit in visual face learning and an inability to recognize familiar faces, which is typically associated with damage to the fusiform gyrus (Grüter, Grüter, & Carbon, 2008). Typically developing individuals demonstrate the proficiency of discriminating the face as a “special” stimulus and are able to do so between faces and objects and amongst different faces (Peelen, Glaser, Vuilleumier, Eliez, 2009). Researchers have attributed this special status to faces due to the significant response of the fusiform face area when viewing faces as opposed to common objects, i.e., individuals discriminate faces faster and more efficiently than objects and concluded that the way in which typically developing individuals recognize and process faces is “special” (see Farah, Wilson, Drain, & Tanaka, 1998 for a review).

Research on infant recognition of the face has been conducted through studies on infants' preference for a mother's face over stranger's face. In a study conducted by Walton, Armstrong, and Bower (1998), infants ranging from 7 to 54 hours old were presented with an image of their mother's face or an image of a stranger's face using an operant procedure with face stimuli presented contingent upon infant sucking. Findings indicated a primacy effect with this procedure because infants quickly learned that sucking produced the image (of face) so that the first image that is presented is looked at the most often as the infant sucks more during this presentation presumably because the infant is exploring this contingency. However, this may explain why infants prefer the mother's face. The infant benefits from the primacy effect because the mother's face is generally the first face an infant pairs with reinforcement. This may also be an example of what Fantz referred to as the development of social responsiveness as the infant is attending to the mother's face and responding to the contingency of sucking, contact

comfort, and food (reinforcement), which becomes paired with the face of the caregiver.

Another important behavior, in addition to attending to the faces of others that occurs in social situations is the sharing of attention between two or more individuals i.e., joint attention. The ability to share attention with another is the foundation of social behavior and plays a critical role in the infant-caregiver relationship. It is within this relationship that typically developing infants learn the importance of attending to the faces of others. Infants participate in face-to-face interactions with their caregivers from birth during dynamic events that involve feeding, changing, and play. These interactions provide the early experience that infants require in order to develop social interaction behavior. Many of these interactions involve facial expressions from the caregiver, which communicate various expressions to the infant, for example smiling encourages behavior whereas a caregiver repeatedly not reciprocating an infant's smile may extinguish it.

III *Face processing in autism*

It is specifically with these types of behaviors, for example, looking at the faces of others and sharing attention, that individuals on the autism spectrum have a great deal of difficulty. Early studies have indicated deficits in the understanding and/or use of facial information in individuals with ASDs (e.g., Volkmar, Sparrow, Rende, & Cohen, 1989). In fact, a definitive impairment in social interactions, specifically an inattentiveness toward the faces of others, has been considered to be a core deficit in pervasive developmental disorders, such as autism, from as early as 1943 (Kanner, 1943). In addition, there is much evidence to suggest that individuals with pervasive developmental disorders (also known as autism spectrum disorders) process information regarding faces differently than their typically developing counterparts. Impairments in face processing in ASDs are exhibited in problems with the recognition of facial

affect, comprehension of facial affect, visual scanning of faces, memory for faces, visual processing of faces, as well as a failure to develop a cortical face specialization in the brain (see Sasson, 2006; Golarai, Grill-Spector, & Reiss, 2006 for reviews).

While the most recent diagnostic manual, revised in 2000, for the standard classification of mental disorders, the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition , Text Revision (American Psychiatric Association, 2000), does yet not list abnormal face processing as an essential component in the criteria for a pervasive developmental disorder, it does include problems with eye-to-eye gaze and understanding facial expressions. It remains an empirical question as to whether individuals with this disorder have problems with face processing because they are not attending to the faces of others and missing experiential information required to process faces or they are not attending to the faces of others because they have impairments in face processing to begin with. Impairments in face processing in the former might be due to a lack of experience with faces as predictors of social information or as “special stimuli,” which is relevant to the present paper. It is important that investigations in this area continue because the human face is so significant to the development of appropriate social behavior.

IV Autism and the lack of attending to the faces of others

In 1943 in his seminal article, Kanner noted that children with autistic disturbances of affective contact exhibited a definitive disturbance in attending toward the faces of others. Kanner (1943) observed the deficit in attending to faces in those diagnosed with autism very early on; in fact in his account of childhood autism, Kanner considered the children in his study to have an “inability to relate themselves in the ordinary way to people and situations from the beginning of life.” Interestingly, Kanner referred to his work as a preliminary report;

nevertheless, the paper produced a definitive prototype for what would later become Autistic Disorder.

According to the DSM-IV-TR (2000), Autistic Disorder, or autism, is a neurodevelopmental disorder of childhood development and one of five Pervasive Developmental Disorders (PDDs) or autism spectrum disorders (ASDs) as they are informally referred to in the field of research. Pervasive Developmental Disorders are characterized by qualitative impairments in social interaction and communication, as well as the presence of repetitive or stereotyped behaviors and/or restricted interests. Genetic factors are strongly implicated in many cases (Abrahams & Geschwind, 2008). Autistic Disorder is the most common and classical form of the PDDs as well as the most severe form, as opposed to Pervasive Developmental Disorder, Not Otherwise Specified, or Asperger's Disorder where the symptomatology is less severe. Difficulties with reciprocal social interaction are present across all PDDs. However, behavior deficits in areas of social behavior and language development are not typically diagnosed until after age two or later. Nevertheless, subtle behavioral signs appear before 18 months of age in the majority of cases of individuals diagnosed with Autistic Disorder. A meta-analysis of the prevalence rates of PDDs conducted by Fombonne (2005) established that approximately 37 individuals in 10,000 are affected with one of the ASDs.

There are several hallmark features evident when identifying very young children with Pervasive Developmental Disorders or autism spectrum disorders. A study by Osterling and Dawson (1994) demonstrated that differences between infants with ASDs and typically developing infants could be identified by one year of age. In children diagnosed with an ASD at age three, deficiencies appeared in developmentally appropriate behavior and consisted of an absence or low rate of an expected behavior, for example, looking at faces or responding to name

by head turning when one's name is called generally emerges at 5-7 months of age in typical infants (Dawson et al. 2004). This was also consistent with findings by Osterling and Dawson (1994) who conducted retrospective observations of home-videotapes, which indicated that children diagnosed with an ASD responded less to their name being called than typical children and also indicated the absence of developmentally appropriate behavior which distinguished infants later diagnosed with an ASD. In addition, the study determined that the failure to attend to the faces of others was the single best discriminator between 1-year-old children with an ASD and those with typical development.

a) *The absence of attending to faces in autism*

Determining why individuals with ASDs do not attend to the faces of others and therefore perhaps do not process information provided by faces is an important question posited in the current paper and remains important in the unraveling of problems that these individuals experience with social interactions. An early study investigating gaze behavior in autism by Volkmar and Mayes (1990) established that subjects with an ASD were more likely to look less at staff members and engaged in more looking away from staff members than matched non-ASD controls during one-to-one interactions. The ability to obtain, perhaps by attending to a face, and process relevant information from the faces and gestures of others is imperative for the development of appropriate interpersonal communication and interactive social skills. Researchers have investigated several areas in which problems with attending to the faces of others and processing information about faces exist in individuals with ASDs. Some of the earliest studies on face processing in autism (Hutt & Ounsted, 1966; Hutt & Hutt, 1970) investigated gaze avoidance behavior in children with autism and hypothesized that gaze avoidance occurred in these children because they found it "too arousing" and therefore aversive

in some way. However, Hermelin and O'Connor (1970) hypothesized that if eye contact in children with autism was avoided simply because it was too arousing, then these individuals would spend less time looking at a face with its eyes open than closed; however, their findings were not indicative of this hypothesis (Hermelin & O'Connor, 1970).

Langdell (1977) initiated the earliest study involving preferred features of a face. Langdell's study investigated whether particular features of the human face were more relevant than other features, to a child with autism. In this study eight groups were employed as such; two Autistic groups, that is, two groups of ten subjects, 4 female and 16 male, diagnosed with Autistic disorder based on Rutter's (1970) criteria divided according to age: one "younger" group ages 8 to 9 years old (Group 1) and one "older" group ages 13 to 57 years old (Group 2); two "Subnormal" (IQ below 62) control groups of ten subjects: one matched on mental age of autistic group (Group 3) and one matched on calculated age of the autistic group (Group 4); two normal control groups of ten subjects each matched on mental age of the autistic group (Groups 5 & 6); and two normal control groups of ten subjects each matched on calculated age of the autistic group (Groups 7 & 8).

During the procedure, 10 black and white photographs (9 peers plus the subject, in each group of 10) of natural pose, "fairly expressionless" with mouth closed, eyes open, and matched on tone, sharpness, and contrast were presented. The subject was instructed to inform the examiner of whose picture they were viewing or to "have a guess." Subjects were instructed to respond even if they were unable to identify the face. The order of presentation for each of the 10 photos was as such: 1) inverted, 2) only the nose visible, and 3) only the eyes visible. The subject was then given the view of mouth and chin only and following the "guess," the nose area on the same photo was revealed. Following the "guess" of the photo with the mouth, chin, and

nose area exposed, the eyes were then revealed. It should be noted that the subject was informed that he or she did not have to change his or her mind as more of the photo was revealed. This procedure of progressively revealing the photo of a face was implemented with each of the 10 photos randomized for each subject (total of 80) in the study. No feedback on errors was provided to the subjects. Response times were also collected.

Results indicated no significant differences between mean percentage of errors between normal and “subnormal” groups. The upper half of the face was found to be generally easier to recognize than the lower half in both the normal and “subnormal” groups. However, subjects in the young autistic group and the older autistic group performed significantly better on the lower half than the upper half suggesting that individuals with autism attended to the mouth region of the face whereas individuals without autism attended to the eye region. This finding was also indicated in more recent studies (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Trepagnier, Sebrechts & Peterson, 2002) which also found that individuals with autism use abnormal strategies when processing faces in that they exhibit reduced attention to the core features of the face, for example, eyes, as opposed to their typically developing peers. Interestingly, in the Langdell study, the young autistic group did not differ from the control groups on the inverted face presentation yet the older autistic group demonstrated significantly less errors than the young autistic and control groups when faces were inverted. The older autistic group performed significantly better than all other groups on the inverted face presentations suggesting that their scanning strategies were not disrupted in this condition as they would be in the typically developing population. This is especially important given that the perception of the human face is influenced by its orientation and that a failure to recognize a familiar face that has been inverted is a well- known phenomenon (Diamond & Carey, 1986).

The superior performance on inverted face presentations evidenced in the Langdell (1977) study in the older autistic group has been found in several recent studies as well. Arnstein (2004) found that children with autism responded significantly more quickly to photographs of inverted faces than children without autism. This effect was also demonstrated during a more current functional neuroimaging study that used functional Magnetic Resonance Imaging (fMRI) to investigate face processing deficits using upright versus inverted face stimuli in individuals with autism (Bookheimer, Wang, Scott, Sigman, & Dapretto, 2008). Studies using fMRI to investigate face processing in ASDs as well as in typically developing individuals generally examine areas of the fusiform gyrus (fusiform face area, FFA). It should be noted here that prosopagnosia, which is a brain impairment that involves the inability to recognize faces, is also a disorder in which the fusiform gyrus is examined. Nevertheless, individuals with ASDs do not typically exhibit the striking behavior deficits that might be expected to result from fusiform gyrus damage, such as those seen in prosopagnosia, and individuals with ASD's have deficits that appear to extend well beyond face identification and include a wide range of impairments in social perceptual processing (Hadjikhani et al., 2004). In addition, overt prosopagnosia seems to be a rare neuropsychological symptom in persons with ASDs (Pietz, Ebinger, & Rating, 2003).

Using fMRI during a face processing task, Bookheimer and her colleagues (2008) established that typically developing children demonstrated a classic behavioral inversion effect (see Valentine, 1988 for a review) i.e., increased reaction time for inverted face stimuli, while this effect was significantly reduced in subjects with an ASD. However, both groups demonstrated activation in the same brain area i.e., fusiform face area, but differed in other areas of the brain particularly the prefrontal cortex, which is an area important to social cognition further suggesting that behavioral differences in processing upright versus inverted faces for

typically developing children were related not to visual information processing but to the social significance of the stimulus. A study by Speer, Cook, McMahon, and Clark (2007) found the same results when using an eye-tracking device to examine gaze behavior patterns in children with and without ASDs. Findings indicated that subjects with an ASD demonstrated normal recognition for non-socially significant stimuli, for example, objects, as compared to their typically developing peers without autism.

In an earlier study conducted by Hadjikhani et al. (2004), the question as to whether individuals with an ASD have abnormal fusiform gyrus activation to faces was assessed also using fMRI. Face perception in 11 adult individuals with an ASD was compared to 10 normal controls using face stimuli, object stimuli, and sensory control stimuli (scrambled versions of the face and object stimuli) containing an initial fixation point in the center of the stimulus to ensure that participants were looking at and attending to the images as the stimuli were presented. The fusiform face area (FFA) and other brain areas normally involved in face processing was activated in the individuals with an ASD when they viewed faces as did their typical counterparts. This finding suggests the importance of the strategy used in the Hadjikhani et al. study (2004) because it was successful in maintaining the attention of the ASD subjects with the fixation point on the face stimuli thus indicating through their data that subjects with an ASD also had activation in the FFA as did their typical counterparts when their attention was maintained and focused on the stimulus. The finding that the FFA was activated in subjects with an ASD when attending to face stimuli has not been typically found in the literature. Hadjikhani and her colleagues suggested that the abundant evidence found in previous experimental paradigms that children with ASD's are deficient in recognizing faces may be due to an abnormality in attention to or interest in faces, particularly the eye area, rather than a

primary deficit in facial recognition or a simple dysfunction of the fusiform face area as demonstrated in her research (Hadjikhani et al., 2004). These findings are in agreement with the later findings of Dalton et al. (2005) who used an eye tracking device that simultaneously measured functional brain activity during a face discrimination task in individuals with an ASD and their typically developing controls. Results indicated that activation in the fusiform gyrus was strongly correlated with time spent fixating on the eyes on a face stimulus in the subjects with ASD as compared to typically developing controls.

In addition to the use of fMRI, event-related potentials (ERPs), which refers to the average electrical signal recorded in relation to a timed event, have also been used to address fundamental questions, such as those pertaining to face processing. ERP's have been used with both typical and atypical populations because they are noninvasive in that they only require the participant to tolerate a damp sensor net or an electrode hat for relatively short periods of time and do not require the participant to follow explicit directions or produce motor or verbal responses which might limit research that could be conducted with individuals with ASD's (Dawson et al., 2005). Based on the results of electrophysiological studies, face processing impairments are present in individuals with ASDs by 3 years of age. ERP studies of young children with ASDs (Dawson et al 2005; Webb, Dawson, Bernier, & Panagiotides, 2006) have found slower speed of processing of faces as well as a failure to show the expected speed advantage of processing faces versus nonface stimuli. Perceptual performance of individuals with ASDs has also demonstrated that when face processing ability is compared between adult individuals with ASDs and typically developing controls, individuals with ASDs were slow in their speed when discriminating between faces and were slower than the control group in discriminating between objects (Behrmann et al., 2006).

Results of a study by McPartland, Dawson, Webb, Panagiotides, and Carver (2004) that also examined ERPs were similar to Behrman et al. (2006), and indicated that individuals with an ASD demonstrated a slower response to faces and a larger response to objects when compared to individuals with typical development. These findings suggest that individuals with an ASD respond differently to faces and objects than their typically developing peers. Perhaps this is so because in addition to problems with processing social stimuli, there is a lack of social significance attributed to faces in those with an ASD. In addition, the aforementioned study by Klin et al. (2002) indicated that individuals with an ASD fixated more on the mouth or body regions of individuals and less on the eye region than their typically developing counterparts, possibly because of an inability to process the social information that is presented during the typical face to face interactions in human social behavior because of lack of experience with the face. It should be noted that this particular impairment has not been shown to be related to issues with visual discrimination; rather, several studies have indicated that areas of the brain that process objects are utilized to process faces in individuals with ASDs (Hall, Szechtman, & Nahmias, 2003).

When three- to four-year-old children with an ASD (Dawson et al., 2002) were compared to children with developmental disabilities and typically developing children on a face processing task that presented pictures of their mother's face and an unfamiliar face; and their favorite object and an unfamiliar object (one that they had not experienced previously), the children with an ASD demonstrated differential brain activity (ERP latency of P400) only to objects (both familiar and unfamiliar) not faces (familiar or unfamiliar) while the children with developmental disabilities and typically developing children demonstrated differential brain activity to familiar vs. unfamiliar faces and objects. This is particularly interesting given the

evidence that this brain activity (increased P400 latency to faces) has been associated with greater impairment in joint attention, a social behavior, which suggests the possibility that joint attention may be related to a failure to adequately process information regarding significant social information, including the importance of faces and the essential information they contain, for example attending to a face and following a gaze shift or head turn.

To summarize, face processing is an emergent and developmental skill that is heavily mediated by early experience with faces and not simply maturational (Sasson, 2006).

Abnormalities in face processing in ASDs have been described as the result of reduced response to social stimuli (e.g., Bookheimer et al., 2008; Speer et al., 2007). It has been hypothesized that individuals with ASDs fail to attribute special status to faces, for example, social significance, which restricts the visual input required for the development of neural regions specialized for face processing. Both neuroimaging and behavior studies have demonstrated that children and adults with ASDs exhibit both impaired face processing and face recognition. Results of behavior studies investigating early symptoms of autism based upon family home movies (Adrien, Perot, Hameury, & Martineau, 1991; Adrien, Perrot, Sauvage, & Leddet, 1992; Adrien et al. 1993; Osterling & Dawson, 1994; Clifford, Young, & Williamson, 2007) indicated that individuals later diagnosed with an ASD exhibit reduced social responsiveness, a failure to look at others, and use atypical strategies for processing faces characterized by reduced attention to the eyes. Taken together these findings suggest that the failure to process faces in a typical manner as well as attend to faces, as opposed to objects, in order to gather social information, might be one of the earliest measurable symptoms of an ASD emerging by 1 year of age or possibly earlier (Dawson et al, 2005).

b) *The impact of not attending to faces on the development of social behavior in autism*

Individuals diagnosed with ASDs have difficulty with demonstrating and interpreting social communication behavior, for example, following the gaze of another. Klin and Jones (2008) conducted a case study with a 15-month-old child, which provided further evidence that abnormalities of social engagement in children with an ASD are present even during infancy. The case study indicated the possibility that mechanisms of social development, which rely on preferential engagement with socially contingent conspecifics, and that emerge in the very first weeks of life in typically developing infants, are developmentally derailed in children with an ASD. Perhaps this is due to the lack of experience children with an ASD encounter because of their failure to attribute reinforcing properties to the faces of others. Hobson and Hobson (2007) investigated the relation between a component of joint attention and a specific form of imitation using children with an ASD and age-matched controls. Subjects were tested for their propensity to imitate “self-other” aspects of another person's actions to evaluate their propensity to identify with other people as, according to the authors, this is an important factor in the ability to imitate and to share experiences with others. Findings were as predicted by the authors and as such: (a) participants with an ASD spent more time looking at the objects and less time looking at the tester as well as exhibiting fewer "sharing" looks toward the tester than controls and (b) although participants with an ASD showed fewer "checking" and "orientating" looks, they were specifically less likely to show any sharing looks. Hence, the child with an ASD will not be aware of a spatial objective in a change in the gaze of the caregiver if he/she is not attending to the face of his/her caregiver.

It is evident that individuals with ASDs exhibit deficiencies in the area of social skills. This may begin very early in development if they are not attending to the relevant social cues that provide important information by, for example, the face of their caregiver. The face,

ultimately, is a complex stimulus (Falck-Ytter, 2008). If this dyad with a caregiver is not rewarding to the young child with an ASD as it is for the typically developing child, then social, and other important information that is available at that time is not placed in their repertoire of social behavior to be called upon later in life when needed. The ability to share experiences with another is developed from a very young age and begins with attending to the face of another. However, the social behavior that expands over time and development becomes much more complex from joint attention to engaging in a conversation with another. In fact, social engagement directly affects other important behavior like language (Rogers, 2000). If social behavior were merely contingent upon looking at the face another and not the attribution of reinforcing properties to the faces of others, which is a pivotal behavior in human social repertoires, we would expect individuals who are blind to lack social skills as well or perhaps exhibit behavior that would qualify as autistic. Studies suggest that this is not the case because a lack of vision is not a necessary or a sufficient cause for the autistic-like features in children who are blind (Pérez-Pereira & Conti-Ramsden, 2005).

In a study conducted by Hobson, Lee, and Brown (1999), a group of nine congenitally blind children aged 3 to 8 years of age with autistic tendencies, for example, perseveration, motor stereotypies, indifference to people, matched on chronological age and verbal mental age (in the mildly delayed range) with nine sighted autistic children were observed for twenty minute sessions, in three environments. Findings indicated that the blind subjects displayed social isolation, marked impairment in use of body (gestures), and stereotyped play with objects; however, the sighted, autistic subjects were more severely impaired in their relationships with others as well as in their emotional expression, for example, the variety, depth and modulation of affect. In addition, the majority of blind children in the study demonstrated pretend play where

the majority of sighted children with autism did not. The authors also indicated anecdotally that children who were congenitally blind might have been “predisposed” to possible problem areas in social relatedness and use of gestures, but not to the degree seen in those with ASDs. A later study by Hobson and Bishop (2003) found that the more disabled the child who was blind, the more their qualities of social impairment were similar to those in sighted children with autism. In addition, Pérez-Pereira and Conti-Ramsden (2005) also established that some blind children who demonstrated autistic-like features also exhibited significant cognitive delays or additional handicaps. Nevertheless, the “autistic features” in those with ASDs are not particular to cognitive delays or abilities. The qualitative social impairments in individuals with ASD’s are a core deficit across the autism spectrum and particular to the disorder irrespective of cognitive delay. However, the degree to which social impairment impacts the individual on the spectrum can vary i.e., the less impaired the cognitive ability of the individual, the better the individual is at learning skills to adapt to his or her environment, yet the core qualitative impairment typically remains throughout the lifespan. For example, in a study by Shattuck et al. (2007) symptoms of autism in 241 subjects between the ages of 10-52 years were prospectively examined over a 4.5 year period. Although most individuals’ symptoms remained stable, individuals with mental retardation had more severe symptoms of autism than those without mental retardation and improved less over time as compared to those without mental retardation (Shattuck et al., 2007).

Imitation is critical in the development of language and social communication in both blind and sighted children. Individuals with ASDs are often impaired in the development of imitation abilities with regard to both body movements (gestures) and actions on objects (Charman et al., 2003). Indeed, in many individuals with ASDs, who may eventually possess the ability to speak, the capacity to comprehend and utilize communicative gestures is seriously

impaired whereas in children who are blind it is not. In a study by Iverson, Tencer, Lany, and Goldin-Meadow (2000), 5 congenitally blind and 5 sighted toddlers were videotaped longitudinally between the ages of 14 and 28 months. Findings suggested that gesture production was relatively low in the blind toddlers as compared to their sighted peers; however, all of the blind toddlers were found to produce some gestures during the one-word stage of language development indicating that gesture is a robust phenomenon even in the absence of experience with a visual model. A more recent study conducted by Bruce, Mann, Jones, & Gavin (2007) found that gestures expressed by children aged 4 to 8 years, who were congenitally deaf-blind, were used most often for the functions of requesting an object or requesting an action; however, they also directed the attention of others through touch i.e., the children in their study called and directed the attention of others (joint attention) through touch, indicating that a form of joint attention is present in those who are blind whereas the lack of joint attention abilities is a defining characteristic in ASDs.

Stone and Yoder (2001) reported that imitation of body movements but not actions on objects was associated with later expressive language skills in children with an ASD (excluding Autistic Disorder indicating milder symptoms in the subjects) who were followed longitudinally from age 2 to 4 years. The study established that imitation, joint attention, and play abilities measured at the first time point were associated with expressive language ability at four years. Similar findings were also demonstrated by Charman et al. (2003) in that the imitation of actions on objects at 20 months in typically developing children was associated with language ability in the fourth year of life. However, McDonough, Stahmer, Thompson, & Schreibman (1997) evaluated imitation of familiar actions in children with autism compared to typically developing controls. Findings indicated no problems with imitation of causal/means-ends actions on objects

in low functioning children with autism with the caveat that results were obtained in highly structured test situations and sharply contrast with the impairments seen in children with ASDs who are observed in naturalistic settings as in the longitudinal studies.

c) The impact of not attending to faces on the development of joint attention in autism

A deficit in the development of joint attention skills is a defining feature of children diagnosed with ASDs and is clearly unique to autism (Sigman, 1999). Many of the early social impairments in autism such as deficits in joint attention and social communication involve the ability (or inability) to attend to and process information from faces (Dawson et al., 2005). Studies that have demonstrated the deficit of behavior related to joint attention in children diagnosed with an ASD may also indicate problems with attending to the face of another. When differentiating the definitions of the impairments in joint attention in individuals with ASDs, studies have indicated that the essential distinction is not whether the deficit is at the imperative level (engaging in gestures to obtain something tangible) versus the declarative level (engaging in gestures to obtain social attention), it is the degree to which the child is monitoring the attention of the other person in relation to objects and events (Mundy, Sigman, & Kasari, 1994; Philips, Gomez, Baron-Cohen, Laa, & Riviere, 1995; Charman, 1998). Nevertheless, joint attention plays a pivotal role in the psychopathology of autism as the absence of joint attention is considered to be one of the core deficits in ASDs (Sigman, Dijamco, Gratier, & Rozga, 2004).

As Kanner found in 1943, children with autism typically do not attend to the faces of others; therefore, they do not obtain social information provided by the faces of others, as in for example joint attention, and cannot follow the attentional focus of their caregivers which in turn restricts the possibility of learning words by looking where another is looking, a common strategy for learning new words employed by typically developing toddlers. Impairment in

language is one of the criteria for a diagnosis of an ASD. In fact, the failure to acquire language at the expected age is the most frequent presenting complaint for preschool children diagnosed with Autistic Disorder (Rapin, 1991). According to Tager-Flusberg (2000), to acquire language, children must understand the link between words and objects, and must be able to interpret the communicative gestures of others; therefore, they must attend to the faces of others to do so. Preissler and Carey (2005) found that during a labeling-objects component of their study, 95% of typically developing toddlers looked at the experimenter's eyes as compared to 17% of toddlers with an ASD. In addition, language in children with this disorder often does not have the same flexibility as in those with typical development in that their spoken language is commonly infrequent, inflexible, and imitative rather than spontaneous. Language, when present in individuals with this disorder, is often repetitive or idiosyncratic.

The current approaches to teaching language to children with ASDs are not satisfactory because social precursors are typically not considered. Many research studies have been conducted on the treatment of language impairment in ASDs and have frequently focused on teaching expressive language skills with very little consideration of the social precursors, for example, attending to the face of another, that make language a meaningful, communicative tool. Not surprisingly, teaching language to these individuals has been met with varying degrees of success. Typically when teaching language to young children with an ASD, the target outcome excludes teaching social precursors, for example, attending to the face of another or responding to a gesture. Language in many individuals with an ASD often contains rigid, inflexible word use that does not capture the range of the social or semantic aspects of typical language users. In addition, some children with an ASD who have age-appropriate scores on standardized tests, have significant impairments in many aspects of pragmatics and discourse (Luyster, Kadlec,

Carter & Tager-Flusberg, 2008).

As evidenced in the literature, individuals with ASDs benefit from behavior-analytic procedures that seek to increase social skills (e.g., Pierce & Schreibman, 1995; Whalen & Schreibman, 2003; Taylor & Hoch, 2008). In addition, multiple studies indicate that treatment based on applied behavior analysis may facilitate clinically significant gains in intellectual, social, emotional and adaptive functioning (e.g., Eikeseth, Smith, Jahr, & Eldevik, 2007; McEachin, Smith, & Lovaas, 1993).

Most recently, Taylor and Hoch (2008) implemented a multiple baseline design across participants to teach joint attention behavior to children with an ASD using techniques in applied behavior analysis. Results indicated limited success in an increase in the three dependent variables, which were 1) looking at a target stimulus, 2) making a verbal comment about the target stimulus, and 3) looking back at the experimenter after looking at the target stimulus (initiation of joint attention). The aforementioned results could have been due to the difficulty that the participants had in shifting their gaze i.e., looking from the target stimulus and then back to the experimenter as pointed out by the authors when highlighting the observation that gaze shifting should have been taught and observed to be mastered before the initiation of their teaching protocol for joint attention. Furthermore, in typical development, children attend to the faces of others and engage in gaze shifting very soon following birth. It is likely that this behavior is a precursor to joint attention in typical development and therefore, a prerequisite to joint attention behavior in children with ASDs as well. The authors suggested that future research studies teach the gaze shifting response to a mastery criterion before the introduction of teaching joint attention.

Another suggestion for future research, not employed by Taylor and Hoch (2008), is the

use of target stimuli that are previously demonstrated as preferred stimuli, as will be implemented in the proposed study, to elicit the initiation of joint attention when teaching the response rather than employing stimuli deemed visually enticing or merely novel. In addition, future research might attempt to shape behavior that is already present in the repertoire of the participant, as will also be implemented in the proposed study, rather than the administration of punishing consequences as in the Taylor and Hoch (2008) study. That study attempted to decrease the initiation of joint attention behavior when the participant demonstrated the joint attention response not in reference to a target stimuli, for example, if a participant initiated a joint attention bid toward a non-target stimulus (book on a shelf) rather than a target stimulus previously placed in the room by the experimenter, the experimenter corrected the bid made by the participant toward a target stimulus, by saying to the participant following the incorrect response, “We see books all the time, it’s not necessary to talk about books” in the assumption that the statement was aversive and would therefore reduce future initiations of joint attention toward a non-target stimulus hence the use of a punishment.

V Proposed study

It is widely accepted that individuals with ASDs do not demonstrate the same appropriate recognition for social stimuli (faces) as their typically developing peers. There may be a fundamental impairment in the processing of social stimuli in ASDs, which has not been found to be due to a difficulty with visual discrimination when individuals are matched on cognitive functioning. Therefore, in consideration of the aforementioned research, one may conclude that the profound disability in social motivation found in ASDs is evident first in a failure to attend to faces. In addition, neural systems that mediate face recognition and are present very early in typical development could possibly be one of the earliest indicators of abnormal brain

development in autism (Dawson et al., 2002). Beginning very early in life, there may be a deprivation of critical experience-driven input that is present in the typically developing trajectory and necessary for the development of social communication, which occurs in autism and results from a failure to attend to the faces of others. There is evidence for this in face recognition research and could explain the face processing deficits that appear in ASDs. There is also evidence for this hypothesis in the research of congenitally blind children in that those children are not able to look at the faces of others and have deficits in gestures and social communication but not to the extent that individuals with ASDs exhibit even though they are able but typically do not attend to the faces of others.

The social motivation hypothesis proposed by Dawson et al. (2002) suggests that face processing deficits are secondary to a primary impairment in social motivation and or attention to socially relevant stimuli. According to this hypothesis, reduced social motivation results in less time spent paying attention to the faces of others as well as to other social stimuli, such as the human voice and gestures (Dawson et al. 2005). Face recognition impairments found in individuals with ASDs might be the result of the reduced reward value of faces (Dawson et al., 2005). For example, if very young children with an ASD are not attending to the faces of others (their caregivers) because the initial motivation to look at the face is lacking, they will be missing the opportunity to engage in behavior that will increase the frequency of occasions to build a reinforcement repertoire (gain reward value) with those faces further complicating the problem as the young child with an ASD develops. This will then decrease attention to socially relevant stimuli (faces and the information they provide) and limit the opportunity to engage in behavior that is socially creating a developmental spiral ending in an inability to engage in social behavior. Simply put, if these individuals are not attending to faces early on because faces lack

reinforcing value, faces will not subsequently be paired with primary reinforcers (basic needs such as food etc.); therefore, these individuals will not be motivated to look at faces, which then cannot become secondary reinforcers (face is rewarding in and of itself), that is, faces will continue to have reduced, or no reward value. If individuals with ASDs do not find social stimuli (faces) motivating, there might be a window of opportunity to increase the occasions in which the face is paired with reinforcing stimuli in order to increase its reward value. When the face of another becomes effective as a secondary reinforcer, the individual with autism will attend to the face of another more frequently; thus the opportunities to obtain information from the face of another increases. Should the face of another then become a signal that certain responses will be reinforced following certain specific consequences, and because faces provide so much information related to social communication, further complex pivotal social behavior is more likely to occur as a result of the increased opportunities for reinforcement when attending to the face of another. Therefore, providing the environment that will significantly increase opportunities of positive experiences with faces for young children with an ASD should be considered.

The purpose of the proposed study is to examine the effects of teaching attending to a face to children with an ASD who do not do so. As mentioned earlier, individuals with ASDs demonstrate marked abnormalities in the processing of faces when not attending directly and because children with ASDs often exhibit deficits in social relatedness, social communication and language, it is hypothesized that increasing attending to face behavior in very young children with an ASD will result in an increase in joint attention behavior in these children. Because a deficit in joint attention skills is a defining feature of children diagnosed with ASDs and is clearly unique to autism, it remains an important pivotal behavior to be targeted for intervention

in individuals with ASD's.

The present study seeks to evaluate a technique designed to use a reinforcer as the object that the experimenter uses to engage the subject to attend to her face, rather than a verbal or physical prompt followed by a reinforcer, as was implemented in the Whalen and Schreibman study (2003). Methodologies based upon the principles of applied behavior analysis were implemented to teach subjects behavior not reliably present in their repertoire.

Following the training proposed in the present study, when the face of another became effective as a secondary or conditioned reinforcer, the individual with an ASD attended to the face of another more frequently; thus the opportunities to obtain information from the face of another will increase. Should the face of another then become a signal that certain responses will be reinforced following certain specific consequences, and because faces provide so much information related to social communication, more complex social behavior, for example, joint attention, is predicted to be more likely to occur as a result of the increased opportunities for reinforcement. The present study proposes to utilize behavior intervention, i.e. techniques in applied behavior analysis, to teach attending to a face to very young children with an ASD. Studies have shown that behavior intervention implemented early in development can be effective for children with ASDs presumably because of the plasticity of neural systems during that period of time (Dawson & Zanolli, 2003). As mentioned earlier, there may be a deprivation of critical experience-driven input in autism very early in life that results from a failure to attend to the faces of others. Therefore very early intervention, which increases attention to faces and social interaction by making faces more rewarding, may be optimal for best outcome in increasing social communication behavior in ASDs (Dawson & Zanolli, 2003).

Method

Participants

Three children between the ages of two and three, had been diagnosed with an ASD, and were in the process of receiving Early Intervention (EI) specifically designed for children with an ASD participated in this study. Participants were required to have a behavior deficit exhibited as an absence of looking at the faces of others for example, the faces of their parents, and reported as such by parents. In addition, participants were required to have a behavior deficit in the area of responding to a joint attention bid which was defined as the failure to follow the gaze of the experimenter toward a target object.

Agencies that provide Early Intervention services where participants could be recruited were contacted by the principal investigator (experimenter). All children in the aforementioned age group who had a diagnosis on the autism spectrum were eligible to participate in this study via information flyer (Appendix A) provided to families by the Early Intervention agencies. Three participants were selected based on a “first come, first served” basis when a parent contacted the experimenter to express interest in the study. The experimenter then explained the study parameters to the parent who then, upon agreeing to have their child participate, signed a consent form. The parents received a copy of the signed consent form before the beginning of the study. In addition to obtaining parental consent, the participant’s level of comfort was monitored at all times. If a participant seemed uncomfortable or distressed, for example, crying, an attempt to alleviate the discomfort was implemented and when not easily rectified, for example, crying no longer occurring, the session was immediately terminated.

Assessments

Joint attention behavior, both in terms of response to and initiation of a joint attention

bid, was determined through a structured observation made by the experimenter based on specific criteria for coding during the Autism Diagnostic Observation Schedule-Generic (ADOS-G) diagnostic test (Lord et al, 2000). The ADOS-G was conducted when a participant was accepted into the study and when the study was completed. The ADOS-G was videotaped and interobserver agreement was obtained with another qualified rater. It should be noted that there is no specific measure for attending-to-face on the ADOS-G; therefore, the presence or absence of the attending-to-face response was determined by a baseline measure prior to implementation of the intervention.

Responding to a joint attention bid is item number B-11 on the ADOS-G Module 1, which is a specific item that codes for a child's response to the experimenter's use of gaze or pointing (bid) in order to direct the child's attention to a distant object. The spontaneous initiation of joint attention behavior is item number B-10, which is also a specific item but codes for a child's attempts to draw another person's attention to objects that neither of them is touching by using clearly integrated eye contact to reference an object out of reach by looking at the object, at another person, then back to the object and may also be coordinated with pointing. Both ADOS-G measures indicated a deficit in attending to a face for a participant to qualify for the present study. In addition, an informal interview was conducted by the experimenter with the parents and the in-home service providers (interventionists) for the participants who reported if they observed the presence of an attending-to-face response and appropriate responding to joint attention cues in the natural environment. For example, a caregiver is asked if their child shares interests by pointing things out (e.g., a dog or airplane) in their environment and then looks back at their caregiver. Another example is the caregiver or interventionist is asked if the child looks at their face when they are sharing a toy. This anecdotal information indicated that these

behaviors were not present in the repertoires of any of the three participants before the initiation of the present study. All measurements, observations, and reports were in agreement amongst observers, that is, in agreement that an attending-to-face response was not present in the behavior repertoires of the participants and that there was an absence of appropriate responding to joint attention cues, for the participant to qualify for the present study.

Pre- and post- treatment measurements of the severity of autism in each participant were also obtained through the implementation of the PDD Behavior Inventory (Cohen & Sudhalter, 2005), an assessment tool with high levels of reliability and validity that evaluates responsiveness to intervention in children with an ASD. Pre- and post-measurements of adaptive functioning were obtained with the Vineland Adaptive Behavior Scales II (Sparrow et al. 2005) and pre- and post-measurements of language ability of each participant with the Preschool Language Scale-3 (PLS-3; Zimmerman et al. 1992). These measures, listed in Table 1, were selected because of their excellent reliability and validity. In addition, pre- and post-measurements of the initiation of joint attention were obtained with the ADOS-G.

Table 1 Participant Information

Pre- and post-measurements for: Preschool Language Scale-3 (PLS-3; Zimmerman et al. 1992), ADOS-G for response to and initiation of joint attention, PDD Behavior Inventory (PDDBI; Cohen & Sudhalter, 2005) for severity of autism score with a Confidence Interval of 90% for all participants; Vineland Adaptive Behavior Scales II (VABS II; Sparrow et al. 2005) for adaptive functioning. All participants were Non-Verbal for pre and post measurements.

Pre- and Post- Experiment Measures	DANNY		CARLOS		JERRY	
	Pre- 2/08	Post- 10/08	Pre- 2/08	Post- 10/08	Pre- 2/08	Post- 10/08
Chronological Age	2:6	3:2	2:2	2:10	2:2	2:10
PLS-3: Expressive Communication Age Equivalent	1 month	1 yr, 3mos	1 month	1 year	2 months	1 year
ADOS-G: Response to joint attention bid	No	Yes	No	Yes	No	Yes
ADOS-G: Initiation of a joint attention bid	No	No	No	Yes	No	No
PDDBI: Severity of autism composite score (50 = average autism)	58	49	40	44	56	52
PDDBI: Receptive/Expressive Social Communication Abilities Composite Score (↑50 = better competence in areas)	46	51	57	50	45	52
VABS II Adaptive Behavior Composite Standard Score	66 Mildly delayed	62 Mildly delayed	74 Borderline	73 Borderline	66 Mildly delayed	69 Mildly delayed

Setting

The study was conducted in the home of each participant. The sessions took place in the bedroom of the respective participant, which contained two child-sized chairs, one table and various stimuli appropriate to an environment of a young child. During each session, a video camera on a tripod was present behind the chair of the experimenter facing the participant. All sessions were videotaped for inter-observer agreement coding and for coding of response to intervention. The experimenter sat approximately 60 cm across from the participant to the side of a child-sized table during baseline, treatment, and generalization measurements. Anonymity and ethical principles were in accordance with the APA regulations followed by the Early Intervention (EI) providers. This project was also reviewed and approved by the Brooklyn College (CUNY) Institutional Review Board (IRB) for the Protection of Human subjects in Research and Research Related Activities prior to the initiation of data collection.

Selection of Stimuli

Target objects composed of toys and objects specifically designed to elicit the interest of a very young child, such as preferred DVDs or toys, for example, mini-computer toys and lighted toys, are listed in Appendix B. Those listed were potential reinforcers that were offered as visual stimuli and, depending on the participant's choice during the preference assessment, those selected from that list were used during baseline, treatment and generalization trials. A preferred stimulus (potential reinforcer) was selected by the participant (see procedure below) from the array of toys and was then used by the experimenter as the target object for the select number of trials during a session. Reinforcer determination was empirically based on the preferences particular to the participants as described below.

Before initiation of each session, reinforcers for all participants were determined using a

method of reinforcer assessment for each participant consisting of a multiple stimulus preference procedure without replacement (DeLeon & Iwata, 1996). Reinforcers were those that were top ranked stimuli identified in the reinforcer preference assessment conducted prior to each session by the experimenter. For example, six items or potential reinforcers from the list in Appendix B were placed in a straight line on the floor, sequenced randomly approximately 5 cm apart, in front of the participant and the item that the participant reached for was used as one of the reinforcers (preferred stimuli) during that session (see procedure section for a full account). Efficacy of the preferred stimuli as reinforcers was assessed by their ability to increase the frequency of the occurrence of the dependent variable during treatment conditions.

Sessions

Three sessions of ten trials each (30 trials in total) were conducted two days per week, over a six-month period. Sessions were conducted in the homes of the participants. Each session, or thirty trials, lasted approximately sixty minutes and divided into the following segments: fifteen minutes each for set up and clean up, fifteen minutes to conduct preference assessment to choose preferred items, and thirty minutes to conduct baseline or treatment sessions. The total of sixty minutes per day occurred two times per week, for each of the three participants in each of their homes.

Dependent Measures

Attending-to-face behavior was defined as the participant looking directly at the eyes of the experimenter (the person conducting the sessions) for a minimum of 1 second. Following gaze/head turn was defined as the following: the experimenter initiated a joint attention cue by obtaining eye contact with the participant and then turned her head and eyes toward a referent or target object. The participant then responded to that joint attention cue by using the orientation

of the eyes or head of the experimenter and immediately turning his head and eyes toward the target object to which the experimenter was referencing.

Procedure

There were eight conditions: pre-baseline, baseline, and treatment conditions 1, 2, 3, 4, 5 and post treatment. The experimenter conducted all conditions with all three participants. Post-treatment measures were obtained to measure generalization to novel stimuli (details in generalization section). Many different stimuli (listed in Appendix B) were used during sessions in order to plan for generalization of the target behavior (Stokes & Baer, 1977) across stimuli. In addition, two novel interventionists, one male and one female, also conducted one session for each participant during one of the five treatment conditions (details in results section). One of these interventionists (male) also conducted one post-treatment session for each participant.

During all conditions, the participant was brought to the child-sized chair and prompted to sit approximately 60 cm in front of the experimenter, who sat on the floor, at eye-level with the participant. Experimenter and participant were seated on either side of a corner of a child-sized table.

Pre-baseline: Assessment of spontaneous looking at the face of another

Because the present study is based upon the theory that attending to the faces of others is an extremely important aspect in the development of social communication, and because it is not typically frequent in the behavior repertoire of a child with an ASD but present in typically developing children, a pre-baseline condition was conducted with the participants to determine the frequency of spontaneous, non-contingently reinforced looking at the face of another, during a semi-structured free play period. The procedure used was loosely based on the Object Spectacle Task in the Early Social Communication Scales (ESCS) structured observation

(Mundy et al., 2003) which structures the environment to observe for several responses including initiating joint attention. The rationale for choosing this particular task was to employ a task in which the participant was most likely to look at the face of the experimenter. During this particular task, it is necessary for the participant to look at the face of the experimenter in order to initiate a joint attention bid which was the behavior of interest for the pre-baseline measure. It was also important to implement a tool that had been conducted with typically developing children in order to compare the frequency of looking at the face of another (initiating joint attention measure in the ESCS) in a similar, semi-structured environment to the frequency of looking at the face of another in the participants in the present study during the pre-baseline condition. Further, the pre-baseline condition was conducted to observe the frequency, if any, of the attending-to-face behavior of each participant in a spontaneous, untrained condition in addition to the experimental condition that was implemented during the baseline condition prior to teaching the behavior.

In a study by Mundy et al., (2007), the ESCS was administered with 63 typically developing 18-month-old infants sitting face-to-face with an unfamiliar tester while the tester presented a series of hand-operated toys. The frequency of initiation of joint attention was measured during a 20 to 25 minute period and defined as the participant making eye contact with the tester while manipulating a toy or alternating eye contact between an active mechanical toy and the tester. By comparison, in the present study the experimenter engaged in a semi-structured interaction with each participant for a total of fifteen, five minute sessions per participant. Engaging in an interaction was defined as the experimenter manipulating different toys or objects (listed in Appendix B), one at a time, with or in close proximity to the participant while intermittently saying for example, “This is a nice toy” or “I like this one.” The frequency

or number of times the participant attends (looked) at the face of the experimenter during that time was recorded.

Another interventionist was also included in this condition to rule out the possibility that the interaction between the experimenter and the participant were unique to the experimenter and could not be demonstrated with another person. Therefore a familiar interventionist who was currently working with the participant, conducted two, five minute sessions, with each participant during pre-baseline only, in the same method as the experimenter with data obtained.

Item Selection

During all conditions, a multiple stimulus without replacement procedure was conducted upon the initiation of each session (Deleon & Iwata, 1996). On the floor were six items (Appendix B) sequenced randomly, in a straight line on the floor, approximately 5cm apart. The participant was approximately 30 cm from the stimulus array on the floor and the experimenter instructed the participant to choose, for example, by presenting a Discriminative Stimulus (S^D). The S^D is similar to a signal in that when it is presented, there is a greater probability that a specific response will be reinforced in its presence rather than its absence. For example, an interventionist says, "Touch your nose," when teaching a child; if the child touches his nose when the interventionist says "Touch your nose," he will receive a reinforcer; however, if the child touches his nose when the interventionist has *not* said "touch your nose," he will not receive a reinforcer. An S^D is different than a prompt, which would be, for example, when an interventionist says, "Touch your nose," and the child does not touch his nose, the interventionist would then prompt the child to perform the behavior by physically taking the child's hand and touching the child's nose with the child's hand.

The S^D in the present study is presented by the experimenter who says, "Find the one

you want,” or “Choose one,” while gesturing to the objects on the floor. The participant indicated a choice by touching, pointing or reaching for the stimulus of choice. After the choice was made by the participant, the experimenter removed the chosen stimulus from the array which remained on the floor, in order to give the participant access to the chosen stimulus during sessions, and proceeded with the first 5 trials using that item as a reinforcer for half a session of ten trials. However, if the participant demonstrated continued interest with the preselected, preferred stimulus by continuing to touch, look at, or manipulate it in any way, trials continued with that item until the participant turned away from the stimulus or looked toward, touched, pointed toward or reached for another stimulus from the array which remained on the floor nearby. After the five trials were completed, the participant was prompted toward the remaining five stimuli from the preference array that remained on the floor. The previous five items or potential reinforcers were rotated by taking the item that was at the left of the array and moving it to the right end, followed by shifting the other items so that they are again equally spaced on the floor. The next stimulus that was chosen from the array by the participant was used for the next five trials if no continued interest was demonstrated. This continued until all items were selected or no selection was made by the participant within 30 s of the beginning of the trial. If the participant did not demonstrate any choice-making behavior, for example, not attempting to obtain one of the objects within 3 s of the experimenter-initiated instruction to choose a preferred item from the array, the experimenter took two of the objects from the floor and held them up in front of the participant and repeated the instruction to the participant to choose, for example, by saying, “Find the one you want,” or “Choose one.” The above procedure was also conducted with six DVDs for use in the DVD player.

Baseline: Assessment of response to a bid for joint attention

During the baseline condition, a trial consisted of the following: the experimenter looked at the participant when the participant was not looking at the experimenter and said “LOOK!” in order to give the participant the opportunity to look at the eyes and face of the experimenter. The experimenter then simultaneously turned her head and eyes toward the target object, while simultaneously and peripherally looking to see if the participant was looking at the target object, which was placed on the floor, approximately 60 cm from the participant. The target object (toy car) that was used during baseline was the same for all three participants for each session. The same target object was also used for the post-treatment session for each participant. The participant was given access to a chosen preferred stimulus from the array after the completion of ten trials which was followed by 112 s of non-contingent access to a preferred stimulus, in most cases a preselected DVD. Three sets of ten trials occurred for a total of thirty trials per session per day along with 448 s (3 x 112 plus 112 at beginning of each session) of non-contingent reinforcement.

In this condition, the trial occurred with no prompting (e.g., experimenter physically turns the participant’s head toward the preferred stimulus) or consequence (access to reinforcer) regardless of correct or incorrect responding from the participant. If the participant did not look at the eyes and face of the experimenter, the experimenter continued to turn her head and eyes, toward the preferred stimulus. The order of events was: 1) before beginning the session, the target object, toy car, was placed on the floor approximately 60 cm from the left or right of the experimenter and the participant; 2) the experimenter looked at the participant to ensure the participant was not looking at the experimenter 3) the experimenter attempted to gain attention the attention of the participant by presenting the S^D and saying, “LOOK!” and then directing the participant’s attention by turning her head and eyes, toward the target object; and finally 4)

checking to see if the participant was looking at the target object. If the participant looked at the eyes/face of the experimenter and followed the head turn/eye gaze of the experimenter toward the preferred stimulus within 1 s of the experimenter's attempt at getting the participant's attention by saying, "LOOK!" the experimenter indicated a correct response on a data sheet. If the participant did not look at the eyes/face of the experimenter within 1 s of the experimenter's attempt at getting the participant's attention, the experimenter indicated an incorrect response on a data sheet. No consequences occurred during trials in the baseline condition. Correct or incorrect responding data were recorded for each trial. In addition, intermittent contingent reinforcement in the form of food (raisins or cookies) was provided to the participant for sitting and remaining in his chair. Reinforcement in this case was not provided following a teaching or probe trial during any of the conditions.

Treatment

Treatment Condition 1: Attending-to-face training

a) Teaching Trials

During sessions, after the participant had selected a preferred item, the participant was seated approximately 60cm in front of the experimenter (or interventionist as described earlier) in a child-sized chair with experimenter on the floor in front of the participant at eye-to-eye level as in all conditions in this study. The type of trial (teaching or probe) was indicated on a data sheet. Four teaching trials were followed by a probe trial (to be described below) for a total of thirty trials per session, per day. Correct or incorrect responding data were recorded for each trial of teaching and probe data. Recording data on prompted trials was for tracking purposes only as these were teaching trials; and therefore prompted. Furthermore, data that were graphed were probe trials only as these trials did not involve prompting or contingent reinforcement.

During teaching trials, the experimenter would have the preselected item, which was the preferred stimulus that was selected by the participant from the array, in her hand (usually in lap), who would then put her face within 10 cm of the participant and present the Discriminative Stimulus (S^D) which was the verbal instruction, “LOOK!” These steps were conducted as simultaneously as possible to ensure an errorless trial is presented by the experimenter to the participant, meaning no error is allowed to occur between presentation of the S^D and the response of the participant. The experimenter prompts the correct response almost immediately (1 s) after the presentation of the S^D and before an error can occur, during the teaching trial. When the participant looked at the eyes/face of the experimenter within 1 s of S^D , the experimenter would provide behavior specific feedback by saying for example, “That is good looking,” along with immediate access to the preferred stimulus provided for 5 s.

If the participant did not look at the eyes/face of the experimenter within 1 s of the S^D , during the teaching trial, the experimenter implemented a prompt and used the preferred stimulus to track eye gaze to the experimenter’s eyes. This was done by holding the preferred stimulus close to participant’s eyes and pulling it back to the experimenter’s eyes and down toward her chin, or holding the preferred stimulus above the experimenter’s head and placing experimenter’s face within eight to ten centimeters of participant’s eyes. When the participant looked into eyes/face of experimenter, the experimenter would provide behavior specific feedback by saying for example, “That is good looking,” along with immediate access to the preferred stimulus which was provided for 5 s. The S^D (“Look”) was not repeated during correction procedures on any trials to ensure that the correct response follows the presentation of one S^D .

b) Probe trials

After each set of four teaching trials with prompting, one probe trial with no prompting was implemented. During probe trials no prompting or consequence occurred. The experimenter looked at the participant when the participant was not looking at the experimenter and presented the S^D “LOOK!” If participant looked at the eyes/face of experimenter within 1 s of S^D , the experimenter recorded a correct response on the data sheet. If the participant did not look at the eyes/face of the experimenter within 1 s of S^D , the experimenter recorded an incorrect response on the data sheet. No consequences occurred during probe trials. The participant was required to respond correctly on 5 of 6 probe trials for two consecutive sessions of 6 probe trials within 24 teaching trials to obtain mastery before being moved to the next condition.

Treatment Condition 2: Attending-to-face of the experimenter and then following her gaze/head turn to the preferred stimulus held next to the face of the experimenter.

a) Teaching Trials

During the teaching trials, the experimenter had the preferred stimulus in hand (usually in lap and out of immediate view), and looked at the participant when the participant was not looking at the experimenter and presented the S^D “LOOK!” with no prompting or consequence. No prompting or consequence occurred following the presentation of the S^D in this condition (Treatment Condition 2) because the participant was required to master the behavior of attending-to-face before moving to Treatment Condition 2. Therefore, during teaching trials in this condition, after presenting the S^D “LOOK!” the experimenter would hold the preferred stimulus next to her face. The randomly selected right or left side of the experimenter’s face and hand that held the preferred stimulus was indicated on a data sheet. In this condition, the participant was required to look at the experimenter’s face/eyes *and then* at the preferred stimulus. If the participant looked at the face or eyes of experimenter and then looked at the

preferred stimulus within 1 s of S^D , immediate access to the preferred stimulus for 5 s was provided while the experimenter provided behavior specific feedback by saying, for example, “That is good looking.” The teaching trials were recorded as correct or incorrect responses. Only probe trial data that were graphed.

If the participant did not look at the preferred stimulus after looking at the face of the experimenter, the experimenter implemented a prompt as in Treatment Condition 1. The experimenter would then follow the steps as in Treatment Condition 1 and simultaneously turn her head and eyes toward the preferred stimulus (while simultaneously and peripherally looking to see if the participant was looking at the preferred stimulus), which was still held next to the experimenter’s face. If the participant looked at the face or eyes of experimenter and then looked at the preferred stimulus within 1 s of S^D , immediate access to the preferred stimulus was provided for 5 s while the experimenter provided behavior specific feedback by saying, “That is good looking.” The attention-to-face response was recorded as incorrect on the data sheet. If participant demonstrated a failure to attend to the face of the experimenter, which was mastered in Treatment Condition 1, for a minimum of 3 of 30 trials, the participant was to receive booster training in attending-to-face responding before continuing to the next treatment condition. A failure to maintain mastery of attending to the face of the experimenter behavior was defined as obtaining at least 3 of 30 incorrect attending-to-face responses, as per data collection teaching trials on a data sheet.

Following the procedure in step a, if the participant still did not look at the face/eyes of the experimenter, the experimenter applied a more restrictive prompt to the participant by touching the participant lightly on the cheek and if participant looked at the eyes/face of the experimenter, the experimenter would then immediately hold up the preferred stimulus within 10

cm of the participant and track it back to the preferred stimulus still held in experimenter's hand but then next to the experimenter's face. The experimenter would then simultaneously turn her head and eyes toward the preferred stimulus (while simultaneously and peripherally looking to see if participant was looking at the preferred stimulus), which was held next to the experimenter's face. If the participant looked at the face or eyes of the experimenter and then looked at the preferred stimulus within 1 s of S^D , "LOOK!" immediate access to the preferred stimulus for 5 s was provided while the experimenter provided behavior specific feedback by saying, "That is good looking."

b) Probe trials

As in Treatment Condition 1, after each set of four teaching trials with prompting, one probe trial with no prompting was implemented. During probe trials in Treatment Condition 2 however, the experimenter looked at the participant when the participant was not looking at the experimenter and presented the S^D "LOOK!" *and then* turned her head and eyes, toward the preferred stimulus (while simultaneously and peripherally looking to see if the participant was looking at the preferred stimulus or target object), which was held next to the experimenter's face in this condition. No prompting or consequence occurred regardless of correct or incorrect responding from the participant. If the participant looked at the eyes and face of the experimenter *and then* followed the head turn/eye gaze of the experimenter toward preferred stimulus within 1 s of S^D , the experimenter recorded a correct response on the data sheet. If the participant did not look at the eyes and face of the experimenter and instead followed the head turn/eye gaze of the experimenter toward preferred stimulus within 1 s of S^D , the experimenter indicated an incorrect response on the data sheet. No consequences occurred during probe trials.

Treatment Condition 3: Attending-to-face of the experimenter and then following her gaze/head

turn to the preferred stimulus held at elbow length to the face of the experimenter.

This condition was implemented with a similar procedure as in Treatment Condition 2; however, in this condition, the preferred stimulus was held to the side of the experimenter's face at elbow's length about 30 cm from her face. As in previous conditions, the session began with the participant choosing the preferred stimulus from an array.

a) Teaching Trials

During the teaching trials, the experimenter followed the same procedure as in Treatment Condition 2 only in this condition, the preferred stimulus was held in the hand of the experimenter with her arm at elbow length (approximately 30 cm) from her face. The randomly selected right or left side of the experimenter's face and hand that held the preferred stimulus was indicated on a data sheet. In this condition, as in Treatment Condition 2, the participant was required to look at the experimenter's face/eyes *and then* at the preferred stimulus. The same prompting as in Treatment Condition 1 was implemented as necessary as well.

b) Probe trials

After each set of four teaching trials with prompting, one probe trial with no prompting was implemented as in Treatment Conditions 1 and 2. During probe trials in Treatment Condition 3, the experimenter looked at the participant when the participant was not looking at the experimenter and presented the S^D "LOOK!" *and then* turned her head and eyes, toward the preferred stimulus, which was held in the experimenter's hand with arm bent at elbow distance (about 30 cm) from the experimenter's face. No prompting or consequence occurred regardless of correct or incorrect responding from the participant occurred during probe trials.

Treatment Condition 4: Attending-to-face of the experimenter and then following her gaze/head turn to the preferred stimulus in the experimenter's hand with arm held straight out from the face

of the experimenter.

This condition was implemented with a similar procedure as in Treatment Conditions 2 and 3; however, in this condition, the preferred stimulus was not held next to the experimenter's face but at arm's length out straight at about 60 cm from the face of the experimenter. As in previous conditions, the session began with the participant choosing the preferred stimulus from an array.

a) Teaching Trials

The teaching trials were conducted as in Treatment Conditions 2 and 3, but in this condition the experimenter held the preferred stimulus with arm out straight at a distance of approximately 60 cm from her face. In this condition, as in Treatment Conditions 2 and 3, the participant was required to look at the experimenter's face/eyes *and then* at the preferred stimulus. The same prompting procedure as in the previous conditions was implemented if necessary.

b) Probe trials

As in the previous conditions, after each set of four teaching trials with prompting, one probe trial with no prompting was implemented.

Treatment Condition 5: Attending-to-face of the experimenter and then following her gaze/head turn to the preferred stimulus, on the floor, (not in experimenter's hand) approximately 2 feet from the face of the experimenter.

This condition was implemented with a similar procedure as in Treatment Condition 4; however, in this condition, the preferred stimulus was not held by the experimenter, rather it was placed on the floor approximately 60 cm from the experimenter and the participant on either side of the experimenter as per data sheet. As in previous conditions, the session began with the participant choosing the preferred stimulus from an array.

a) Teaching Trials

During the teaching trials in Treatment Condition 5, the teaching trials began similarly to Treatment Conditions 1 through 4; however, during teaching trials in this condition, after presenting the S^D “LOOK!” the experimenter was not holding the preferred stimulus rather, the preferred stimulus was quickly put on the floor by the experimenter, making no contact with her hand and approximately 60 cm (arms length) from the participant and experimenter. The randomly selected right or left side of the experimenter’s face and hand that held the preferred stimulus was indicated on a data sheet.

As in previous conditions during teaching trials and correction procedure, if the participant did not look at the preferred stimulus after looking at the face of the experimenter, the experimenter used a prompting procedure during which she placed the preferred stimulus within 10 cm of the participant’s eyes and tracked it back to her face, which was initially held in the experimenter’s hand with arm held out straight at a distance of approximately 60 cm from her face. Nevertheless, in this condition, the experimenter then had to quickly put the preferred stimulus on the floor so that it had no contact with experimenter’s hand and was approximately 60 cm from the participant and experimenter when the experimenter turned her head toward it.

b) Probe trials

As in previous conditions, after each set of four teaching trials with prompting, one probe trial with no prompting was implemented. During probe trials in Treatment Condition 5, the preferred stimulus was *not* held in the experimenter’s hand; rather it was on the floor approximately 60 cm from the experimenter and the participant. No consequences occurred during probe trials. Table 2 below indicates the procedure for each condition.

Table 2 Criteria for Baseline and Treatment Conditions in Probe Trials

	<u>Experimenter Behavior</u>	<u>Participant Behavior (Correct)</u>	<u>Participant Behavior (Incorrect)</u>
<u>Baseline</u> Before treatment (no training)	Experimenter says "LOOK!" and turns her head and eyes, toward the preferred stimulus, which is <i>on the floor at arm's length</i> from the face of the experimenter	Participant looks at the eyes/face of the experimenter <i>and then</i> turns his head and looks toward the preferred stimulus within 1s of the experimenter saying, "LOOK!"	Participant does not look at the eyes/face of experimenter within 1s of the experimenter saying "LOOK!" <i>--because participant cannot follow gaze/head turn without looking at experimenter first</i>
<u>Treatment Condition 1</u> Attending-to-face training	Experimenter places her face within 3 to 4 inches of the participant and says "LOOK!"	Participant looks at the eyes/face of the experimenter within 1s of the experimenter saying, "LOOK!" (not turning head yet)	Participant does not look at the eyes/face of experimenter within 1s of the experimenter saying "LOOK!" (not turning head yet)
<u>Treatment Condition 2</u> Attending-to-face <i>and</i> follow gaze & head turn to the preferred stimulus held <i>next to</i> the face of the experimenter	Experimenter says "LOOK!" and turns her head and eyes, toward the preferred stimulus, which is placed <i>next to her face</i>	Participant looks at the face or eyes of experimenter <i>and then</i> looks at the preferred stimulus within 1s of the experimenter saying "LOOK!"	Participant does not look at the face or eyes of experimenter <i>and therefore cannot</i> follow the gaze/head turn of the experimenter to the preferred stimulus
<u>Treatment Condition 3</u> Attending-to-face <i>and</i> follow gaze & head turn to the preferred stimulus held <i>elbow length</i> from the face of the experimenter	Experimenter says "LOOK!" and turns her head and eyes, toward the preferred stimulus, which is <i>held in the hand</i> of the experimenter with her <i>arm bent at the elbow</i>	Same as Condition 2	Same as Condition 2
<u>Treatment Condition 4</u> Attending-to-face <i>and</i> follow gaze & head turn to the preferred stimulus held <i>arm's length</i> from the face of the experimenter	Experimenter says "LOOK!" and turns her head and eyes, toward the preferred stimulus, which is <i>held in the hand</i> of the experimenter with her <i>arm held straight out</i>	Same as Condition 2	Same as Condition 2
<u>Treatment Condition 5</u> Attending-to-face <i>and</i> follow gaze & head turn to the preferred stimulus at <i>arm's length</i> from the face of the experimenter but <i>NOT held</i> by the experimenter	Experimenter says "LOOK!" and turns her head and eyes, toward the preferred stimulus, which is <i>on the floor at arm's length</i> from the face of the experimenter	Same as Baseline	Same as Baseline

Post-Treatment: Assessment of response to a bid for joint attention with a novel experimenter

One post-treatment session was conducted with each participant following mastery of criteria in Treatment Condition 5. The session was conducted with the same (male, novel) interventionist who conducted one session for each participant during treatment. As in the Baseline Condition but now with the interventionist, a trial consisted of the following: the interventionist looked at the participant when the participant was not looking at the interventionist and said “LOOK!” in order to give the participant the opportunity to look at the eyes and face of the interventionist. The interventionist then simultaneously turned his head and eyes toward the target object, while simultaneously and peripherally looking to see if the participant was looking at the target object, which was placed on the floor, approximately 60 cm from the participant. The target object (toy car, same as the Baseline Condition) was the same for all three participants for each session. The participant was given access to a chosen preferred stimulus from the array after the completion of ten trials which was followed by 112 s of non-contingent access to a preferred stimulus, in most cases a preselected DVD. Three sets of ten trials occurred for a total of thirty trials for the one session conducted in post-treatment, along with 448 s (3 x 112 plus 112 at beginning of the session) of non-contingent reinforcement.

Generalization

During the baseline and post-treatment conditions, the target object used was not the same as those used during the pre-baseline and all treatment sessions to test for generalization across stimuli. In addition, although generalization across people was not planned for in the treatment protocol, an assessment of generalization across people was measured during one post-treatment session, which was conducted with the male interventionist that conducted the probe session (not teaching session) during one of the treatment conditions for each participant.

Interobserver Agreement

Each session was video recorded for inter-observer agreement (IOA). Experimenter and interventionists (during post generalization probes) recorded correct or incorrect responses on paper with pens during the sessions. Two observers (other than the experimenter) independently scored from videotaped recordings of the previously defined target responses to assess inter-observer reliability. The experimenter collected IOA data for 25% of sessions of all three participants. An agreement was scored when all observers recorded that a defined behavior had occurred during the trial. Point by point agreement was determined by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100 percent. The average interobserver agreement was 90% during baseline and treatment.

Results

All three participants demonstrated an increase in attending-to-a-face and following gaze/head-turn behavior during treatment. This increase was also evident in generalization measures, which took place with novel stimuli, after treatment demonstrating that the program implemented for generalization across stimuli was effective. In addition, the data demonstrated that attending-to-a-face and following gaze/head turn behavior also occurred with the novel interventionist. The post treatment session conducted with a novel interventionist indicated a higher rate of correct responding (following gaze/head turn) than in the baseline condition with the experimenter.

Statistical analysis of data

A repeated measures, one-way ANOVA, which tests the equality of means, was conducted on the data on the subjects as a group, across conditions to investigate the possibility of differences among number of sessions required to meet criteria for each Treatment Condition (Table 3). A repeated measures, one-way ANOVA was also conducted to analyze differences among the number of responses required to meet criteria for each Treatment Condition (Table 4). In addition, a repeated measures, one-way ANOVA was conducted to analyze differences among the number of responses required to meet criteria for Baseline, Treatment Condition 5, and Post-Treatment (Table 5).

Table 3 Repeated Measures ANOVA Subject X Treatment Session (Probe) Data

	Treatment Condition 1	Treatment Condition 2	Treatment Condition 3	Treatment Condition 4	Treatment Condition 5
	Total number of Sessions to Criterion	Total number of Sessions to Criterion	Total number of Sessions to Criterion	Total number of Sessions to Criterion	Total number of Sessions to Criterion
Danny	4	8	2	2	8
Carlos	12	3	2	2	5
Joseph	6	8	2	2	3
Group mean number of Sessions to Criterion	7.3	6.3	2	2	5.3
Standard Deviation (SD) for group	SD for Treatment Condition 1	SD for Treatment Condition 2	SD for Treatment Condition 3	SD for Treatment Condition 4	SD for Treatment Condition 5
3.03	3.4	2.4	0	0	2.1
Standard Error of the Mean (SEM) for group	SEM for Treatment Condition 1	SEM for Treatment Condition 2	SEM for Treatment Condition 3	SEM for Treatment Condition 4	SEM for Treatment Condition 5
1.75	2	1.4	0	0	1.2
ONE WAY REPEATED MEASURES ANOVA (SESSIONS ACROSS TREATMENT CONDITIONS)					
Source of Variability	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	Error Term (F ratio)	Critical Value (CV)
Treatment	72.56	4	18.14	2.11 not significant	F.95 (4,8) = 3.84
Subject x Treatment	68.84	8	8.60		

Table 4 Repeated Measures ANOVA Subject X Treatment Responses (Probe) Data

	Treatment Condition 1	Treatment Condition 2	Treatment Condition 3	Treatment Condition 4	Treatment Condition 5
	Total number of Responses to Criterion	Total number of Responses to Criterion	Total number of Responses to Criterion	Total number of Responses to Criterion	Total number of Responses to Criterion
Danny	17	32	12	12	28
Carlos	24	16	11	11	19
Joseph	22	33	11	11	13
Group mean number of responses to Criterion	21	27	11	11	20
Standard Deviation (SD) for group	SD for Treatment Condition 1	SD for Treatment Condition 2	SD for Treatment Condition 3	SD for Treatment Condition 4	SD for Treatment Condition 5
3.39	2.9	7.8	.47	.47	6.2
Standard Error of the Mean (SEM) for group	SEM for Treatment Condition 1	SEM for Treatment Condition 2	SEM for Treatment Condition 3	SEM for Treatment Condition 4	SEM for Treatment Condition 5
1.96	1.7	4.6	.28	.28	3.7
ONE WAY REPEATED MEASURES ANOVA (RESPONSES ACROSS CONDITIONS)					
Source of Variability	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	Error Term (F ratio)	Critical Value (CV)
Treatment	548.7	4	137.18	3.88 significant	F.95 (4,8) = 3.84
Subject x Treatment	282.91	8	35.36		

Table 5 Repeated Measures ANOVA Subject X Treatment Responses (Probe) Data for Baseline, Treatment Condition 5, and Post-Treatment

	Baseline	Treatment Condition 5	Post-Treatment		
	Total number of Responses to Criterion	Total number of Responses to Criterion	Total number of Responses to Criterion		
Danny	3	28	4		
Carlos	6	19	4		
Joseph	5	13	3		
Group mean number of responses to Criterion	4.7	20	3.7		
Standard Deviation (SD) for group	SD for Baseline	SD for Treatment Condition 5	SD for Post-Treatment		
8.49	1.25	6.16	.47		
Standard Error of the Mean (SEM) for group	SEM for Baseline	SEM for Treatment Condition 5	SEM for Post-Treatment		
4.91	.59	3.63	.28		
ONE WAY REPEATED MEASURES ANOVA (RESPONSES ACROSS CONDITIONS)					
Source of Variability	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	Error Term (F ratio)	Critical Value (CV)
Treatment	500.79	2	250.40	11.37 significant	F.95 (2,4) = 6.94
Subject x Treatment	88.07	4	22.02		

The ANOVA conducted to search for differences among the number of sessions required for the subjects (group) to meet criteria for each condition revealed that there were no significant differences in the number of sessions required to meet criteria for each condition among the four times of measurement, $\underline{F}(4,8) = 2.11, p > .05$. However, the ANOVA conducted to evaluate for differences in the number of responses required to meet criteria indicated that there were significant differences in the number of responses between conditions amongst the four periods of measurement, $\underline{F}(4,8) = 3.88, p < .05$. In addition, the ANOVA conducted to search for differences among the number of responses required to meet criteria in the Baseline, Treatment Condition 5 and Post-Treatment conditions indicated that there were significant differences in the number of responses required to meet criteria between conditions amongst the three periods of measurement, $\underline{F}(2,4) = 6.94, p < .05$. Therefore, the full null hypothesis could be rejected as the calculated \underline{F} at 6.94 exceeded the critical value of 11.37.

A Tukey's Honestly Significant Difference (HSD) procedure was then conducted to determine which means were significantly different from one another in the data for responses required to meet criteria (Table 6). When the means of the responses of the groups are

Table 6 Tukey's Honestly Significant Difference (HSD) Responses (Probe) Data

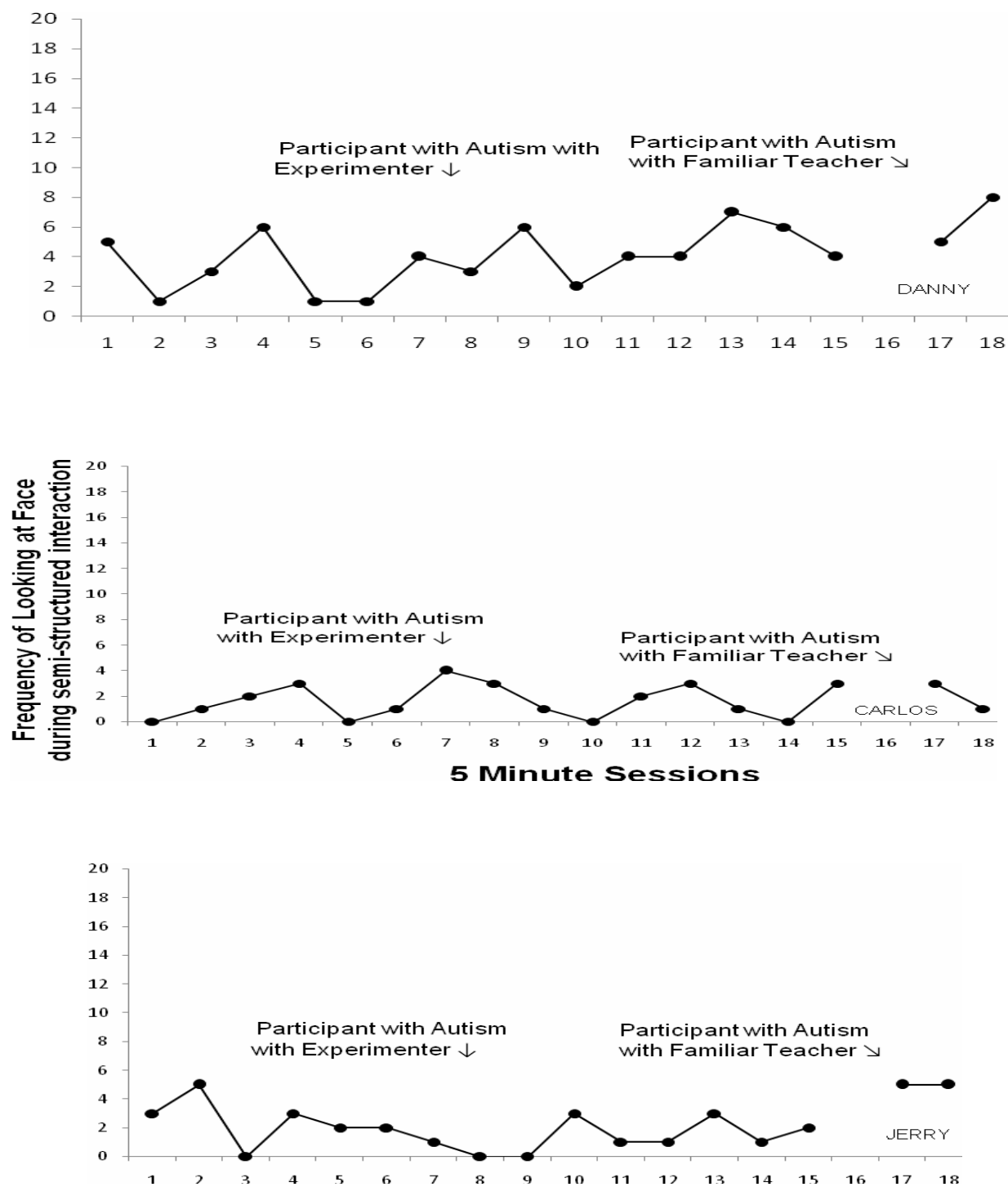
Tukey's Honestly Significant Difference (HSD) for Responses Across Treatment Conditions					
$MS_E = 40.42/3(N) = 3.67 \times 4.89 = CD$ CD = 17.95	$X_1 = 21$	$X_2 = 182$	$X_3 = .67$	$X_4 = .67$	$X_5 = 114$
$X_1 = 21$	—	161*	—	—	93*
$X_2 = 182$	—	—	—	—	—
$X_3 = .67$	20.33*	181.33*	—	—	113.33*
$X_4 = .67$	20.33*	181.33*	—	—	113.33*
$X_5 = 114$	—	68*	—	—	—
* p < .05					

examined, there is a significant difference between the largest mean in Treatment Condition 2 and the smallest means in Treatment Condition 3 and Treatment Condition 4. There was also a significant difference between the means of Treatment Condition 2 and Treatment Condition 1 as well as Treatment Condition 2 and Treatment Condition 5. More responses were required to meet criteria in Treatment Conditions 2 and 5 than in Treatment Conditions 1, 3, and 4 suggesting that the change in criteria in fading in distance between the face of the experimenter and the preferred stimulus resulted in more learning opportunities (responses) required to master criteria. There was also a significant difference between the means of Treatment Condition 5 and Treatment Conditions 3 and 4. In addition, there was also a small but significant difference between the means of Treatment Condition 1 and Treatment Condition 3 as well as Treatment Condition 1 and Condition 4 suggesting that the change in criteria for mastery of looking at the face of the experimenter to looking at the face and then following the gaze and head turn of the experimenter required more responses.

Pre-baseline and Baseline conditions

Figure 1 demonstrates the pre-baseline data frequency count of attending-to face-behavior, when measured during spontaneous, untrained five-minute periods of free play. Each

Figure 1 Pre-baseline data for attending to the face of the experimenter and attending to the face of the familiar teacher. Each data point is a five minute session of a semi-structured interaction.



data point is the frequency of looking at the face of the experimenter or teacher during a five minute session of a semi-structured interaction. When the participant Danny had access to a chosen item and the experimenter attempted to engage in an interaction with him and the toy, Danny looked at the face of the experimenter five times during the first session of five minutes, one time during the second session of five minutes and three times during the third session of five minutes on the first day of pre-baseline. On the second day, Danny looked at the face of the experimenter six times during the fourth session of five minutes, one time during the fifth session and one time during the sixth session on the second day of pre-baseline. On the third day of pre-baseline data collection, Danny looked at the face of the experimenter four times during the seventh session, three times during the eighth session and six times during the ninth session. On day four of pre-baseline data collection, Danny looked at the face of the experimenter two times during session ten, four times during session eleven, and four times during session twelve. On the fifth day of pre-baseline data collection, Danny looked at the face of the experimenter seven times during session thirteen, six times during session fourteen, and four times during session fifteen. When the familiar teacher conducted a pre-baseline session, Danny looked at the face of the familiar teacher five times during the first session, or sixteenth session as it followed the sessions with the experimenter, and eight times during session seventeen. For comparison, an 18-month-old typically developing child looks at the face of an unfamiliar person 19 times in a 20-minute session of semi-structured play similar to that in the pre-baseline condition (Mundy et al., 2007).

For pre-baseline for the participant Carlos, during session one he looked at the face of the experimenter zero times during the first session of five minutes, one time during the second session and two times during the third. For session four, Carlos looked at the face of the

experimenter three times, zero times in session five, and one time during session six. Carlos looked at the face of the experimenter four times during session seven, three times during session eight, and one time during session nine. During session ten, Carlos looked at the face of the experimenter zero times, two times during session eleven, and three times during session twelve. For session thirteen, Carlos looked at the face of the experimenter one time, zero times during session fourteen, and three times during session fifteen. When the familiar teacher conducted two pre-baseline sessions, during the first session (or session sixteen), Carlos looked at the face of the familiar teacher three times and one time during the second session (or session seventeen).

During pre-baseline for the participant Jerry, during session one he looked at the face of the experimenter three times, during session two he looked five times, and during session three Jerry looked at the face of the experimenter zero times. For session four, Jerry looked at the face of the experimenter three times, two times in session five, and two times during session six. Jerry looked at the face of the experimenter one time during session seven, zero times during session eight, and zero times during session nine. During session ten, Jerry looked at face of the experimenter three times, one time during session eleven, one time during session twelve, three times during session thirteen, one time in session fourteen, and two times in session fifteen. When the familiar teacher conducted two pre-baseline sessions for Carlos, he looked at the face of the familiar teacher five times during the first session (or session sixteen), and five times during the second session (or session seventeen).

Figure 2 indicates pre-baseline data for attending to the face of the experimenter and attending to the face of the familiar teacher for each participant with autism. However, unlike

Figure 2 Pre-baseline data consists of attending to the face of the experimenter and attending to the face of the familiar teacher for each participant with autism. Each data point for the experimenter is four, five minute sessions combined for a total of 20 minutes to compare to the 20 minute session of a typically developing child. The familiar teacher data point indicates two, five minute sessions combined for a total of 10 minutes. The dotted line indicates the frequency (19 times) of looking at the face of an unfamiliar person of a typically developing 18-month-old child (Mundy et al., 2007).

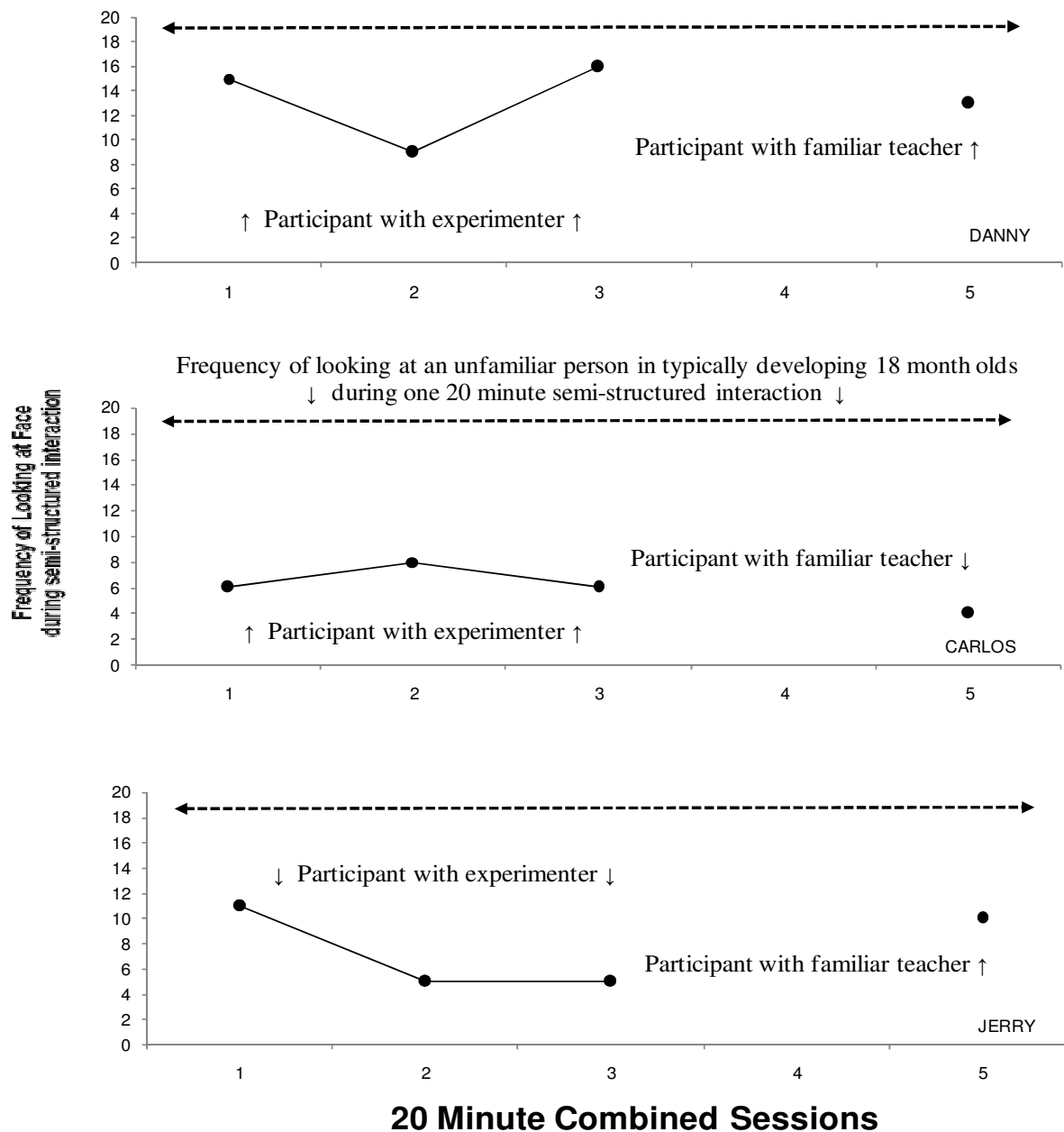
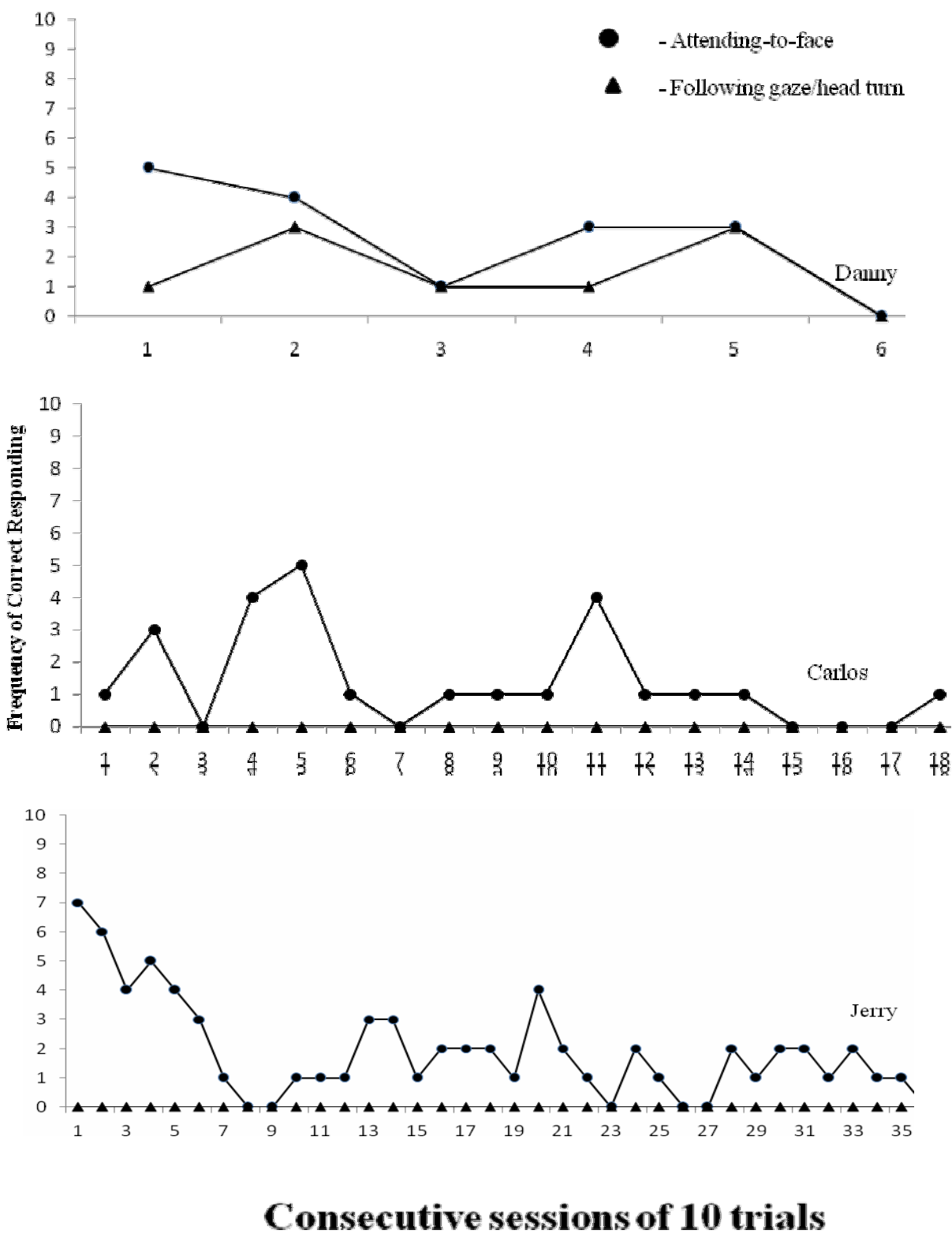


Figure 1, each data point in Figure 2 for the experimenter is four, five minute sessions combined for a total of 20 minutes to compare to a 20 minute session of a typically developing child interacting with an unfamiliar person. The familiar teacher data point indicates two, five minute sessions combined for a total of 10 minutes. This was because the familiar teacher was not available during the time allotted for pre-baseline and was only available for two five minute sessions. For comparison, the dotted line indicates the frequency, which was 19 times, of looking at the face of an unfamiliar person of a typically developing 18-month-old child during a semi-structured interaction period of twenty minutes similar to the one conducted with the participants with autism in the current study (Mundy et al., 2007). The data indicate that the attending-to-face behavior occurred at a low frequency when compared to typically developing children.

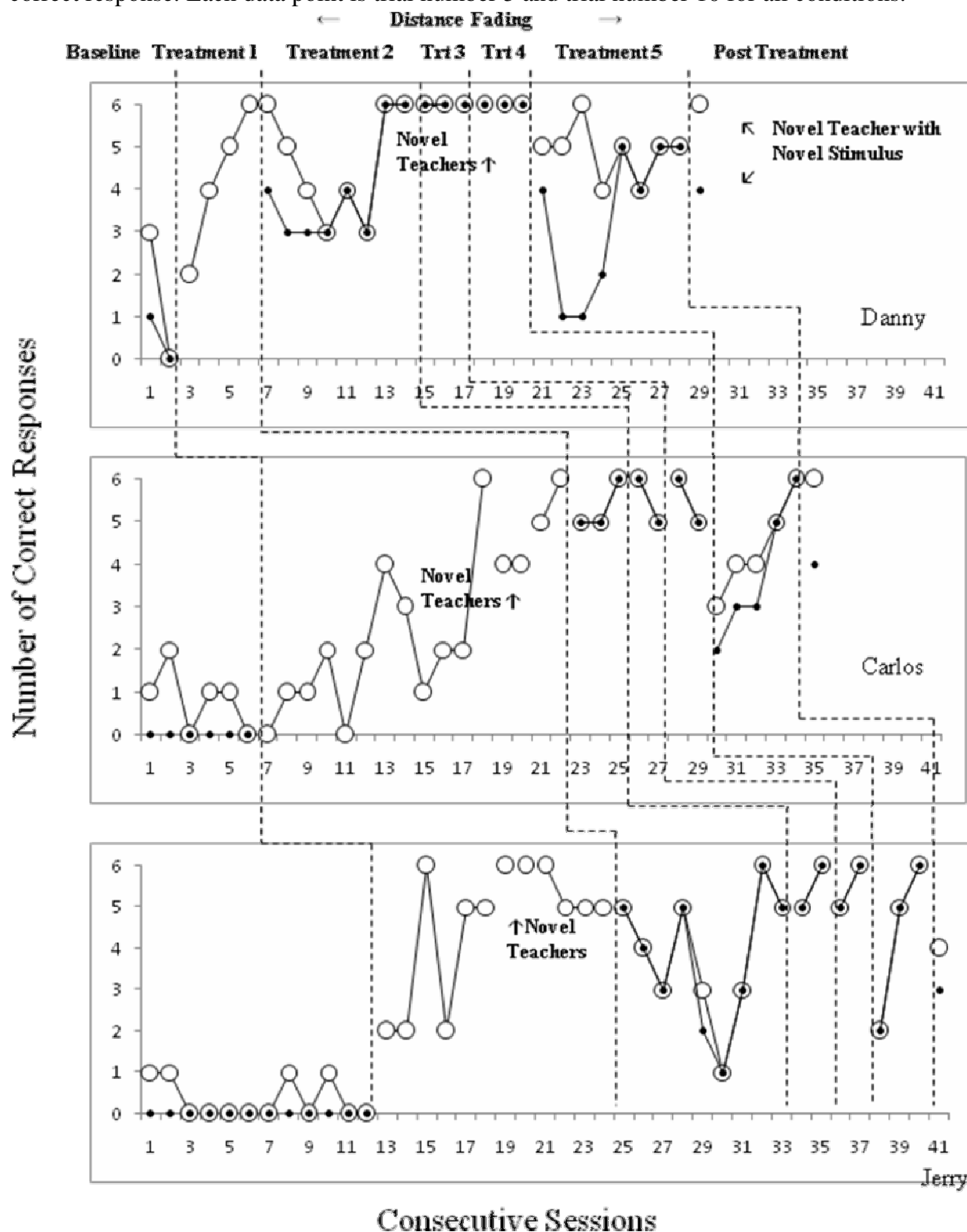
In Figure 3, the frequency of correct responding for attending-to-face and following gaze/head head toward the target object is demonstrated for each participant during the baseline condition. The graph in Figure 3 represents each data point in the baseline condition as opposed

Figure 3 Baseline of frequency of correct responding data for attending to the face and following gaze/head turn of the experimenter for each session of 10 trials per participant.



condition. The graph in Figure 3 represents each data point in the baseline condition as opposed to the data points on the graph in Figure 4 which correspond to the non-prompted probe (opportunities to demonstrate learning) trials only (trials 5 and 10) across three sessions in the treatment conditions for each participant by comparison. Data in Figure 4 were graphed in this

Figure 4 Baseline, treatment conditions 1, 2, 3, 4, 5, and post-treatment data for attending to the face (open circles) and following gaze/head turn (filled circles) of the experimenter and novel interventionists for each participant. Each data point is a probe or non-prompted trial that was a correct response. Each data point is trial number 5 and trial number 10 for all conditions.



way to correspond to the non-prompted probe trials (trials 5 and 10) in the treatment (and post treatment) conditions. Each data point in the baseline condition is trial 5 and 10 only, for each of three sessions, for a total of six opportunities per data point. Each data point in the treatment and post treatment conditions is trial 5 and 10 only, for each of three sessions for a total of six opportunities for correct responding per data point, per participant. The data in this condition indicate that the behavior was not already present in the repertoire of the participant. The other trials in the sessions of treatment are not graphed because they are trials that are prompted by the experimenter or the novel interventionist and do not demonstrate learning in the participants. Probe trials are not prompted and are therefore representative of the presence or absence of the behavior in the repertoire of the participant.

For participant Danny, during session one of baseline with all opportunities graphed, he attended to the face of the experimenter five times of ten opportunities in session one, four of ten in session two, one of ten in session three, three of ten in sessions four and five, and zero times in session six. He followed the gaze/head turn of the experimenter one time in sessions one, three and four, and followed the gaze/head turn of the experimenter three times in sessions two and five and zero times in session six.

Participant Carlos exhibited attending to the face of the experimenter responses zero times in sessions three, seven, fifteen, sixteen, and seventeen; one time in sessions one, six, eight, nine, ten, twelve, thirteen, fourteen, and eighteen; three times in session two; four times in sessions four and eleven; and five times in session five. Carlos did not follow the gaze/head turn during any of the sessions in the baseline condition. For the responding-to-joint attention response during the baseline sessions, when the experimenter turned her head to look at the target object, Carlos did not demonstrate the responding-to-joint attention response by following

the gaze/head turn toward the target object during any of the baseline sessions, even when he looked at the face of the experimenter during the baseline condition.

During his thirty-six sessions of baseline, Jerry exhibited attending to exhibited attending to the face of the experimenter responses zero times in sessions eight, nine, twenty-three, twenty-six, and thirty six; one time in sessions, seven, ten, eleven, twelve, fifteen, nineteen, twenty-two, twenty-five, twenty-seven, twenty-nine, thirty-two, thirty-four, and thirty-five; two times in sessions sixteen, seventeen, eighteen, twenty-one, twenty-four, twenty-eight, thirty, thirty-one, and thirty-three; three times in sessions six, thirteen, and fourteen; four times in sessions three, five and twenty; five times in session four; six times in session two; and seven times in session one. Jerry did not follow the gaze/head turn during any of the sessions in the baseline condition.

Treatment conditions

Figure 4 indicates the results of correct probe or opportunities to demonstrate learning (fifth and tenth trial) responses for attending-to-face, taught and mastered in Treatment Condition 1 and along with learned attending-to-face response) in Treatment Conditions 2 to 5, in all three participants in baseline, all five conditions, and post treatment sessions.

During Treatment Condition 1 in Figure 3, Danny demonstrated the attending-to-face response when the S^D “Look” was presented by the experimenter during two of the six probes (opportunities to demonstrate learning) in the first session, four of six during the second session, five of six during the third session, and six of six during the fourth session meeting criteria for mastery. Mastery consisted of two consecutive sessions of five of six or six of correct response trials as indicated in the method section. In Treatment Condition 2, following mastery of the attending-to-face response, he was then required to attend to the face of the experimenter and then follow the gaze and head turn of the experimenter in order to demonstrate the correct

responding-to-joint attention response. Danny demonstrated the responding-to-joint attention response during four of six probes in the first session, three of six in the second session, three of six in the third session, three of six in the fourth session, four of six in the fifth session, three of six in the sixth session, six of six probes in session seven, and six of six probes in session eight demonstrating mastery in the last two consecutive sessions.

In Treatment Condition 3, Danny demonstrated the responding-to-joint attention response during six of six probes in the first session and six of six in the second session indicating mastery for this condition. Following mastery in Treatment Condition 3, a novel (male) interventionist conducted session seventeen with Danny. During this session, Danny exhibited correct responding-to-joint attention responses during six of the six probe trials. During Treatment Condition 4, Danny also demonstrated the responding-to-joint attention response during six of six probes in the first session and six of six in the second session indicating mastery for this condition with the experimenter. Another different, novel (female) interventionist conducted session twenty in which Danny also demonstrated the responding-to-joint attention response during six of six probes. In Treatment Condition 5, Danny demonstrated the responding-to-joint attention response during five of six probes in the first session, one of six probes in the second, one of six in the third, two of six in the fourth session, five of six in the fifth, four of six in the sixth session, and five of six in the seventh and eighth sessions indicating mastery for this condition with the experimenter.

In Treatment Condition 1, Carlos demonstrated the attending-to-face response when the S^D “Look” was presented by the experimenter during four of the six probes in the thirteenth session followed by a decrease in correct responding during the four sessions that followed which were sessions fourteen, fifteen, sixteen, and seventeen. Carlos then demonstrated an

increase in correct responding in the sessions that followed as such; six correct attending-to-face responses (probes) in session eighteen and four of six correct attending-to-face responses in sessions nineteen which occurred with a novel interventionist (female) and twenty which also occurred with another novel interventionist (male). In sessions twenty one and twenty two, Carlos met criteria for mastery, that is, two consecutive sessions of five or more (six) correct attending-to-face responses, and was therefore advanced to the next or Treatment Condition 2.

In Treatment Condition 2, Carlos met criteria for responding to the experimenter's joint attention initiations in three sessions and was advanced to Treatment Condition 3 in session twenty-three. However, during session twenty-two the data indicated that Carlos did not meet criteria for the attending-to-face response, which was necessary in order to respond to the experimenter's joint attention initiation during the probe trials. Not attending to the experimenter's face during this session occurred only during the teaching trials and did not occur during the probe trials as indicated in the data meaning that he would require a booster session of attending to face only as per methodology. Consequently, Carlos was not advanced to the next condition following session twenty-two. During the teaching trials in Treatment Conditions 2 to 5, the attending-to-face response was not prompted as it was in Treatment Condition 1 because the participant would have mastered this response in Treatment Condition 1 as per criteria. However, during the teaching trials in Treatment Conditions 2, 3, 4, and 5, the following gaze and head turn of the experimenter (response to the joint attention cue by the experimenter) was prompted and data were recorded for both responses (please refer to methodology for details). Therefore, even though Carlos met criteria for responding to the joint attention cue made by the experimenter by following her gaze/head turn during session twenty-two, he did not attend to the face of the experimenter for 5 of the 30 teaching or prompted trials; he received one session of

booster training before the initiation of the next session as was the procedure indicated in the methodology of this paper. Following mastery of criteria during the booster training, session twenty-three took place and Carlos met criteria with six of six correct responding-to-joint attention responses and was advanced to Treatment Condition 3.

In Treatment Conditions 3 and 4, Carlos met criteria for responding to the experimenter's joint attention initiations in two sessions each and was advanced to Treatment Condition 5. During Treatment Condition 5, the first session, or session twenty-eight, Carlos achieved two of six correct probes and three of six correct probes in sessions twenty-nine and thirty. He then met criteria for mastery by responding correctly in five of six probes in session thirty-one and six of six correct probes in session thirty-two.

During Treatment Condition 1, Jerry exhibited two of six correct probe responses in sessions thirteen and fourteen, followed by six of six correct probe responses in session fifteen. Jerry did not achieve criteria in session sixteen and exhibited only two of six correct probe responses. Nevertheless, in sessions seventeen and eighteen, Jerry met criteria to advance to the next condition by demonstrating five of six correct probe responses in those two consecutive sessions. Before advancing to the next condition, at this time, a probe session was implemented with a novel interventionist for session nineteen where Jerry demonstrated six of six correct probe responses. Another probe session in session twenty was implemented with another novel interventionist and Jerry also demonstrated six of six correct probe responses as well. However, even though Jerry met criteria to advance to Treatment Condition 2, he was maintained in Treatment Condition 2 for four more sessions which were session twenty-one, twenty-two, twenty-three, and twenty-four. This occurred because it took more sessions for the second participant, Carlos, to meet criteria in Treatment Condition 1 in order to advance to Treatment

Condition 2; therefore, participant three, Jerry, had to be maintained in Treatment Condition 1 until Carlos met criteria according to the single-subject, multiple baseline across subjects design methodology. This methodology requires that, following baseline, each subject is systematically administered a treatment in order of how the treatment was initially dispensed; for example, first subject followed by second, followed by third as each subject serves as its own control. Once the second participant, Carlos, met criteria in session twenty-two, which corresponded with session twenty-four for Jerry, Jerry was advanced to Treatment Condition 2 as he met criteria to advance while he was maintained until Carlos met criteria.

During Treatment Condition 2, Jerry demonstrated five of six correct probe responses in session twenty-five, four of six in session twenty-six, four of six in session twenty-six, three of six in session twenty-seven, and then five of six in session twenty-eight. Jerry did not meet criteria to advance in session twenty-nine as he demonstrated only two of six correct probe responses and only three of six in session thirty. He went on to meet criteria to advance to the next condition following session thirty-two as he demonstrated six of six correct responses in session thirty-one and five of six correct probe responses in session thirty-two. In Treatment Condition 3 and Treatment Condition 4, Jerry met criteria for advancement to the next condition in two sessions as he exhibited correct probe responses in five of six sessions and six of six sessions in each condition. During Treatment Condition 5, Jerry demonstrated correct responding in two of six probes in session thirty-seven, and demonstrated five of six correct responses in session thirty-eight and six of six correct probe responses in session thirty-nine where he met criteria for mastery of this treatment condition.

Post-Treatment condition

For the post-treatment measures in all three participants, the novel interventionist that

conducted session seventeen with Danny in Treatment Condition 3, session twenty with Carlos in Treatment Condition 1, and session twenty with Jerry in Treatment Condition 1, conducted the post-treatment session for all three participants. All three participants maintained a higher rate than baseline of following gaze/head turn with the novel experimenter in the post-treatment session. In the post-treatment session with the novel experimenter, Danny demonstrated the responding-to-joint attention response by following the gaze/head turn of the novel experimenter after attending to the face of the novel experimenter during four of six probes. Carlos demonstrated correct responding-to-joint attention during four of six probes with the novel experimenter and Jerry demonstrated the responding-to-joint attention response during three of six probe trials during the post-treatment session with the novel experimenter.

Discussion

The purpose of the present study was to investigate the effects of implementing a distance fading technique used in applied behavior analysis while using a preferred stimulus as contingent reinforcement by using the preferred object to engage the participant to attend to a face and then respond to a joint attention cue by following the face and head turn of the experimenter. As suggested for future research by Taylor and Hoch (2008), the present study successfully used target stimuli that were previously demonstrated as preferred stimuli to elicit behavior when teaching the attending-to-face and responding to joint attention behavior rather than employing stimuli deemed visually enticing or merely novel. Results in Figure 4 indicated that after treatment, all three participants demonstrated an increase in attending to the face of the experimenter and responding to her joint attention cue by following her gaze and head turn toward a target object.

In addition, each participant demonstrated correct responding with a novel interventionist without having been explicitly trained to do so. Generalization across people was not programmed into the procedure as no other interventionists conducted teaching (or probe) trials during any of the conditions in the study; yet, generalization to novel people occurred. It is possible that this occurred because the participants were concurrently receiving intervention in the applied behavior analysis model via multiple interventionists (teachers) and response generalization across interventionists had occurred for other responses in their repertoire. The use of multiple interventionists is common because of the amount of hours typically assigned to a child receiving in-home early intervention. The use of multiple interventionists could also have affected the attending-to-face response as evidenced during the baseline condition for all three participants in that correct attending-to-face responding was present but at a low frequency

(below 50%) across all participants, except for Danny in Session 1 of baseline (Figure 3).

Interestingly, Danny exhibited a repetitive requesting behavior reported by the early interventionists and his mother (as well as observed by the experimenter) in that he preferred to hear a randomly selected, particular word in print repeated to him over and over. The interesting part is that he would look at a person's face when he wanted the word repeated to him but not at other times or to interact socially, as reported anecdotally.

Statistical analysis of data

The number of sessions required to meet criteria across participants was not obviously different and was therefore not statistically significant as demonstrated in the statistical analysis in Table 3. It is not unexpected that the differences across participants did not vary greatly as the procedure was implemented with each participant as uniformly as possible as required by the protocol in its design. However, when the number of responses (Table 4) required to meet criteria to advance to the next condition is considered, a significant difference was observed, which was expected as this indicated that the participants exhibited a positive response to the treatment protocol and demonstrated learning of the target behavior. This was also apparent upon visual inspection of the graphs in Figure 4.

Pre-Baseline and Baseline conditions

Before the initiation of baseline, which measured the presence of attending to the face of the experimenter and then following her gaze/head turn toward a target object in response to a joint attention cue in a structured environment, a measure of looking at the face of the experimenter in a semi-structured activity was conducted in the Pre-Baseline condition. This measure was implemented to compare the attention to a face in typically developing young children to the participants who have an ASD during a semi-structured activity. The data in

Figure 2 demonstrated that the frequency of attending-to face-behavior of the participants, when measured during spontaneous, untrained periods of free play, occurred at a lower frequency when compared to typically developing children. The finding was not unexpected and is consistent with the literature on this behavior (e.g., Werner et al, 2005; Dawson et al., 2004). In addition, upon further investigation of the behavior of the participants via video-tape of the sessions, if the participant looked at the face of the experimenter or the familiar teacher, it was to initiate (“request”) assistance with a toy from the experimenter or familiar teacher or to terminate the use of the object and to select another which is a behavior that is typically taught during Early Intervention programming.

Treatment conditions

The number of sessions required to advance in Treatment Condition 1 where the participants were taught to attend to the face of the experimenter only, was the smallest for Danny as compared to the other participants. However, the number of sessions that Danny required to meet criteria in the other treatment conditions was not significantly different than the other participants, except in Treatment Condition 5, where he required more sessions to meet criteria than Carlos and Jerry. It is possible that Jerry’s repetitive requesting behavior (looking at a person’s face when he wanted a word repeated to him) caused an inadvertent increase in his looking at the faces of others. This could be an example of the research findings of the Klin et al. study (2002) where individuals with autism attended to the mouth region of the face indicating that individuals with autism use abnormal strategies when processing faces in that they exhibit reduced attention to the core features of the face, for example, eyes, as opposed to their typically developing peers.

When Treatment Condition 2 was initiated, Carlos required less sessions to meet criteria

than either Danny or Jerry. This was an unexpected finding. In this condition, the participant was required to look at the face of the experimenter first, then follow her gaze/head turn toward a preferred stimulus which was next to her face. It was the first time the participants were taught to look at a face first, then follow gaze/head turn. All participants were expected to respond in a similar way since this was a behavior that was not in any of their repertoires' as demonstrated during baseline. Another unexpected finding, as mentioned earlier, was the high percentage of correct responding during the sessions that were conducted with two different, novel interventionists because generalization across people was not programmed into the teaching protocol which would have required multiple teaching sessions with a variety of interventionists.

All participants mastered Treatment Conditions 3 and 4 within two sessions. This was not surprising as the only change in behavior required by the participants was that they follow the gaze/head turn of the experimenter to the preferred object which was further from the face of the experimenter than it was in Treatment Condition 2 but still held in the hand of the experimenter. However, the change that occurred in Treatment Condition 5 where the experimenter turned her gaze/head toward an object that she was no longer touching produced an unexpected change in behavior across participants in that they did not continue to meet criteria in two sessions as they had in Treatment Conditions 3 and 4. All three participants required more sessions than they did in the previous two conditions to reach criterion. Responding was expected to continue as the same rate and not drop initially at the start of Treatment Condition 5. Nevertheless, contact with the preferred (target) stimulus and not merely distance from the object and the face of the experimenter was a critical aspect in terms of how the participants learned the target behavior.

Post-treatment session

The post-treatment session was conducted approximately three weeks following the last session in Treatment Condition 5 and conducted with the same “novel” teacher that conducted one session for each participant during the treatment protocol. All participants maintained a higher frequency compared to baseline levels, of both attending to the face of the experimenter and responding to joint attention cue made by the experimenter, or in this session the novel interventionist. This was not an unexpected finding in that the learned behavior that the participants demonstrated consistently remained in their repertoires’ following the completion of treatment.

Implications for clinical application

As evidenced in the literature, individuals with ASDs benefit from behavior-analytic procedures that seek to increase social skills as was evidenced in the current study. Teaching a child with an ASD to attend to the face of another increases the likelihood that the child will look at faces more often as do their typically developing peers. As mentioned previously, the current approaches to teaching language to children with ASDs are not satisfactory because social precursors are typically not considered early enough or at all in the teaching protocols. If the protocol in this study were to be implemented by interventionists when they begin working with a young child on the autism spectrum at the earliest possible time, and the social precursors to language, for example, attending to the face of another or responding to a gesture such as a head turn, were taught sequentially while teaching expressive and receptive language skills, it might make for a better outcome for social behavior. In addition, the pairing of preferred stimuli with the face of the interventionist who spends a significant amount of time teaching the young child with autism (typically 10 to 20 hours per week) might increase the likelihood that the face will become reinforcing and result in more time spent attending to the faces of others as well as to

other social stimuli, such as the human voice and gestures. This may mediate the problems proposed in the social motivation hypothesis which suggests that less time is spent looking at faces in individuals with ASDs because faces do not typically serve as reinforcers for individuals with ASDs (Dawson et al., 2005).

Limitations and ideas for future research

The probe sessions conducted with the novel interventionists for participants Carlos and Jerry were conducted during Treatment Condition 1 where the response was attending-to-face only should have been conducted in Treatment Condition 2, 3, 4, or 5 for comparison to Danny whose required behavior was attending-to-face and following gaze and head turn. Nevertheless, the post-treatment trial conducted was conducted with the same male “novel” interventionist for each of the three participants and each demonstrated correct responding of both attending-to-face and following gaze and head turn more than at baseline levels.

While single-subject design research yields scientifically valid research, the present study only utilized one teacher (the experimenter) to implement the protocol across all conditions. Future research might include a larger number of subjects receiving the treatment protocol as well as a larger number of interventionists implementing it. In addition, future research should also include probe trials to test for correct following gaze/head turn when the experimenter turns his/her head away from the target stimulus which was not included in the present study.

Why are we interested in teaching precursors to social behavior?

Interests

Typically developing children are naturally reinforced by social behavior. This is not typical in children with autism spectrum disorders. Why are children with autism spectrum disorders not overtly social? What role does social behavior have in the development of language?

In order to provide answers, we need to ask the following questions:

- Will attending to the faces of others increase social behavior in children with autism spectrum disorders?
- Will teaching a very early precursor to social behavior increase social behavior in children with autism spectrum disorders?
- Will attending to the faces of others increase language skills in children with autism spectrum disorders?

What happens during the studies?

- We will be using objects that individual children prefer to increase attending to face behavior. For example, if we hold your child's favorite book close to our face, will your child look at our face in order to obtain it?
- We will take several measures of social behavior and language to have measurements both before and after our study is conducted.

What are using to increase looking?

We will use preference assessments to make sure the objects we use to entice your child attend to our faces are reinforcing and fun for your child. We have extensive experience in working with children on the autism spectrum and are familiar with successful teaching techniques.

In addition to helping us further our research

- The results will be potentially useful for teaching other children with autism

More information

Location of study

In your home, where your child is comfortable and at a time convenient for you and your child. We are happy to make the necessary arrangements around your child's intervention services.

The Effect of Teaching Attending to a Face
on Joint Attention Skills in Children
with Autism Spectrum Disorders

Length of Study

Each session takes about 20- to 30-minutes. We would like to work with your child for a total of 12 to 16 weeks, with a session held twice per week when convenient.

We hope you will consider participating!

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Please contact Tina Rovito Gomez at 718-494-5355, or trovito1@excite.com to find out more about the study.

The Results

We request that you allow us to videotape your child during the administration of our intervention so we can code behavior at a later time. You may request that we make a copy of it for you. You may also request that we erase the videotape (parts or all of it) for any reason.

Mailing address:

Tina Rovito Gomez
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Department of Psychology
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The City University of New York Graduate Program and Brooklyn College

This study complies with federal guidelines and is supported by the Cognition, Brain and Behavior Program at Brooklyn College and the Graduate Center of the City

University of New York

Appendix B

List of the target objects used during teaching and probe trials

Baseline and Post-Treatment Stimuli:		
	RC Speed Racer Auto	Tough Roggz RC Car
Pre-baseline and Treatment Stimuli:		
Panasonic Portable DVD Player	Jensen Radio	Gazillion Bubbles
Swirling Gumball	Hokey Pokey Elmo	Diego Talking Radio
Bruin Light Sound Ball	Stack and Count Cups	Learning Piano
Fridge Phonic Magnet Letters	Kyn Phone	Barnyard Blocks
Farmer Diego	Aquadoodle Travel Mat	Discover Boombox
Laugh & Learn Phone	Rhyme & Discover Book	Fun2Imagine Bench
Diegos Laptop	Elmo Loves You	Noah's Ark Fleece
Alphabet Pal Leap	Giggle Driver Elmo	Elmo Laptop
Barney Pop up Piano	Push N Go Vehicles	Toby the Totbot
Toby the Totbot	Baby Learn Laptop	Explore Learn Copter
Fun 2 Learn Laptop	Chicken Chase Pop-Onz	Popin Pals Butterfly
Farmer Dora	LNL Keys	Littlest Pet
DVD'S:		
JJ Jetplane Sensational DVD	Baby Einstein DVD	Dora the Explorer DVD
Thomas the Train DVD	Thomas Sing Along DVD	Best of Elmo DVD
Teletubbies Altogether DVD	Sesame Street Count DVD	Sponge Bob DVD
DE Catch a Star Video	BC Alphabet Power DVD	Kiddy CD

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