EVALUATING THE EFFECTIVENESS OF A COMPUTER BASED INTERVENTION, THE TRANSPORTERS, ON BOTH RECOGNITION AND UNDERSTANDING OF EMOTIONS IN YOUNG CHILDREN WITH AUTISM

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Abstract

NERI L. ROMERO: Evaluating the effectiveness of a computer based intervention, *The Transporters*, on both recognition and understanding of emotions in young children with autism(Under the direction of Samuel Odom)

Social impairments may be the most striking deficit in individuals with autism spectrum disorder (ASD). A common social impairment in individuals with ASD is difficulty interpreting and or predicting emotions of others. This difficulty can affect an individual's ability to develop and maintain positive relationships with others. Two boys and one girl, 4-8 years in age, who are educated in self-contained classrooms for students with communication and social skills deficits, participated in this study. A multiple probe across participants design was utilized to assess the effects of using a computer based intervention designed to teach young children to recognize and understand emotions in others. Episodes from the software program, *The Transporters* were shown three times daily with a quiz immediately following the third viewing each school day for a period of roughly four weeks (based on attendance). In addition, participants were tested on emotion recognition skills in live settings pre and post-intervention. All participants showed marked improvements in measures assessing their recognition of both basic and complex emotions in faces following a four week computer-based intervention in the school setting. Specifically, gains in performance on emotion recognition tasks in both quizzes and live scenarios were observed in all participants during and following the intervention.

Dedication

This work is dedicated to my mother and father, Marjorie and Renato Romero, who have provided me with encouragement, support, and a couple swift kicks to get me back in gear when I needed it most. Thanks for always believing in me and pushing me to believe in myself.

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The inability to understand and recognize emotions in others affects one's social competence. Social competence refers to one's ability to successfully engage in social interactions, establish and maintain relationships, and get needs met across contexts (Merrell & Gimpel, 1998; Stichter, Randolph, Gage, & Schmidt, 2007). Social competence can have a positive effect on the overall quality of one's life (Hall, 2009). It is important in establishing and maintaining mutually satisfying relationships (Merrell & Gimpel, 1998), and leads to; increased self-esteem, self-confidence, and adaptability (Merrell & Gimpel, 1998). Social competence increases one's ability to; hold a job (Cotugno, 2009), and decreases the likelihood of; negative treatment or victimization from others (Hall, 2009). Limited social competence can result in negative responses and or evaluative judgments from others (Merrell & Gimpel, 1998), peer rejection, academic failure, and social dissatisfaction (Alwell & Cobb, 2009). The ability to connect with others through sharing thoughts, ideas, and feelings is central to being human (Hourcade, Pilotte, West, & Parette, 2004).

One of the most common observations about people with autism spectrum disorder (ASD) is their lack of social competence. In fact, their social impairments may be their most striking deficit (Koegel, Koegel, Hurley, & Frea, 1992; Roeyers, 1995). Individuals with ASD have difficulty interpreting and predicting the emotions, intent, and beliefs of others, which leads to social, communication, and behavioral challenges (Baron-Cohen, Leslie, & Frith, 1985). If left untreated these social skills deficits could have long-term negative

effects, such as isolation (Rogers, 2000), difficulty maintaining employment (Cotugno, 2009), and a lack of outside interests (Eaves & Ho, 1997; Stichter et al., 2007) all of which negatively impact quality of life (See Appendix A for definition of terms).

Although the social impairments in children with ASD are pervasive, appropriate and well-planned interventions can lead to significant improvements in social functioning (Rogers, 2000; Swaggart, Gagnon, Bock, & Earles, 1995). Elliot and Gresham (1993) identified four factors that contribute to social skills deficits in children with ASD: (1) lack of knowledge, (2) lack of cues/feedback/reinforcement, (3) lack of practice/opportunities, and (4) presence of interfering problem behaviors. Individuals with ASD demonstrate limited knowledge regarding basic social functioning, such as reading nonverbal cues or inferring thoughts and feelings of others (Baron-Cohen et al., 1985). The difficulties are exacerbated by the fact that individuals with ASD often withdraw from others, which preclude them from practicing social skills and receiving reinforcement. Finally, individuals with ASD may exhibit problem behaviors such as making inappropriate comments, or talking out of turn. One area of social functioning that has been the target of a range of investigations is the ability to recognize emotions in others. Ability to recognize emotions in others is a key skill in social interactions and in the development of empathy (Baron-Cohen, Wheelwright, Lawson, Griffin, & Hill, 2002; Clark, Winkielman, & McIntosh, 2008).

Face processing studies in individuals with ASD have demonstrated an impairment that is present from an early age (Dawson et al., 2002) affecting perception of affect in faces (Hobson, 1986a, 1986b; Hobson, Ouston, & Lee, 1988). Several studies have focused on emotion recognition by individuals with ASD of the six basic emotions: happiness, sadness, fear, anger, surprise, and disgust (Ekman, 1993; Ekman & Friesen, 1971). The findings have

been inconclusive, with some studies suggesting that individuals with ASD are impaired in their ability to recognize emotional states of others (Ashwin, Chapman, Colle, & Baron-Cohen, 2006; Braverman, Fein, Lucci, & Waterhouse, 1989; Celani, Battacchi, & Arcidiacono, 1999; Clark et al., 2008; Hobson, 1986a, 1986b; Loveland et al. 1995; Macdonald et al., 1989; Scambler, Hepburn, Rutherford, Wehner, & Rogers, 2007; Wallace, Coleman, & Bailey, 2008; Yirmiya, Sigman, Kasari, & Mundy, 1992), and other studies suggesting that individuals with ASD perform no differently than typical peers on basic emotion recognition tests (Buitelaar, Van der Wees, Swaab-Barnevald, & Van der Gaag, 1999; Baron-Cohen, Spitz, & Cross, 1993; Gepner, Deruelle, & Grynfeltt, 2001; Grossman, Klin, Carter, & Volkmar, 2000; Jones, et al., 2011; Tracy, Robins, Schriber, & Solomon, 2011).

In contrast, studies examining the recognition of complex emotions (e.g., embarrassment, friendliness, jealousy) have consistently found that individuals with ASD have greater difficulties than typical peers (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Capps, Yirmiya & Sigman, 1992; Golan, Baron-Cohen, Hill, & Rutherford, 2007; Yirmiya et al., 1992).

Currently, there are competing theories that seek to explain why individuals with ASD have difficulty recognizing and understanding facial expressions of others. One such theory, Theory of Mind describes the ability to understand mental states of others including thoughts, intentions, and beliefs, as well as their impact on behavior. Typically developing children acquire Theory of Mind rapidly during preschool years (Wellman, Cross, & Watson, 2001). However, individuals with ASD experience delays in acquiring Theory of Mind as evidenced on lack of success in inferential false belief tasks requiring prediction of thoughts,

speech, or behavior of an individual (Happe, 1995; Yirmiya, Erel, Shaked, & Solomonica-Levi, 1998). These delays might result from inattention to the social world. Klin, Jones, Schultz, Volkmar, and Cohen (2002) contend that individuals with ASD have atypical gaze and gaze following patterns; they are not attracted to the eye region when looking at faces. In contrast, neurotypical individuals are attracted to the eye region when looking at faces. Additionally, neurotypical individuals are constantly interpreting social meaning and are prone to attribute social meaning in even non-living things (Klin, Jones, Schultz, & Volkmar, 2003). Poor Theory of Mind abilities have been linked to difficulties interacting with others, especially in emotion recognition (Ashwin et al., 2006), social competence (Bosacki & Astington, 1999) and anxiety in social situations (Coupland, 2001). Theory of Mind deficits can lead to daily difficulties and negative long-term outcomes.

Ability to attribute mental states to others requires awareness and attention to facial expressions (Baron-Cohen, Wheelwright, & Jolliffe, 1997). Facial expressions provide important clues to an individual's mental state. Inattention to facial expressions combined with a lack of social adaptation may have a negative impact on ability to perceive faces in a configural manner (Behrmann et al., 2006). Behrmann et al. suggest that that face processing in individuals with ASD is under developed due to the fact that faces are both social and represent complex visual stimuli. As a result, they require configural rather than local processing. Possible difficulties with this combination of social and complex visual processing, leads to a second cognitive theory of autism: Weak Central Coherence.

Weak Central Coherence Theory seeks to explain difficulty understanding and recognizing facial expressions of others as a result of a local processing bias in individuals with ASD (Frith, 1989, 2003; Frith & Happe, 1994). According to this theory, individuals

with ASD process things in a piece-meal fashion rather than by looking at things as a whole or globally. Typical children process information by extracting overall meaning. In relation to processing facial expressions, typical children are generally able to extract emotions of others by looking at and processing facial expressions. If they possess Theory of Mind, then they are also able to use the information from other people's faces and make assumptions or predictions regarding future behavior. Individuals with ASD, on the other hand, have difficulty extracting overall meaning or emotion from facial expressions of others and thus have difficulty predicting behaviors.

Researchers have employed several different techniques to teach individuals with ASD to recognize facial expressions. These techniques have included applied behavior analysis (Grindle & Remington, 2005; Shaw, 2001; Stafford, 2000), social skills groups (Cotungo, 2009; Ryan & Charragain, 2010; Solomon, Goodlin -Jones, & Anders, 2004), direct instruction (Feng, Lo, Tsai, & Cartledge, 2008), and assistive technology incorporating virtual environments or computer technologies (Bölte et al., 2006; Golan & Baron-Cohen, 2006; Ryan & Charragain, 2010; Silver & Oakes, 2001; Swettenham, 1996; Tanaka et al., 2010). Conclusions from the research suggest that teaching emotion recognition (ER) is possible but that the results do not generalize to non-instructional contexts.

Currently some evidence supports the use of computer interventions to teach both basic and complex emotion recognition to individuals with ASD (Golan, Baron-Cohen, & Hill, 2006; Golan & Baron-Cohen, 2006; Lacava, Ranklin, Mahlios, Cook, & Simpson, 2010; LaCava, Golan, Baron-Cohen, & Smith- Myles, 2007; Silver & Oakes, 2001; Weinger & Depue, 2011). One computer intervention program, *The Transporters* (Golan et al., 2010), was created to teach 3-7 year old children with autism to understand and recognize facial

expressions. It was designed specifically for children with ASD and superimposes real actors' faces onto mechanical vehicles in an attempt to encourage children with ASD to look more at human faces. It differs from previous interventions, in that it seeks to teach relatively excluded individuals with ASD: those with significant learning disabilities, and preschoolers. It is unclear whether either group has an interest in using computers, but it was hypothesized that animated films depicting vehicles might interest and entice both groups.

According to one theory, individuals with ASD are strong systemizers (Baron-Cohen, 2002, 2006). They are drawn to predictable, rule-based systems and patterns of repetition. "At the core of autism is an ability to deal effortlessly with systems because they do not change and they are the same every time, and a disabling difficulty in dealing with the social world because it is always changing unpredictably and is different every time" (Baron-Cohen, Golan, Chapman, & Granader, 2007, p.76). According to the hyper-systemizing theory (Baron-Cohen, 2006), vehicles whose motion is predictable (such as vehicles that could only go backwards or forwards on a track) would be highly favored over vehicles whose motions are highly variable like planes or cars. *The Transporters*, therefore, based its animated series around eight characters that are all vehicles governed by rule-based motion. Each of the 15 episodes lasts five minutes and begins with the panning of a boy's bedroom, where he plays with his vehicles in the same predictable way in each episode. The characters are the real-life faces of actors grafted onto the vehicles. Each episode is narrated, and the characters do not talk in order to allow children with ASD to focus on the facial expression rather than watching the characters talking. *The Transporters* program aims to teach both basic emotions and more complex ones.

Although preliminary testing of *The Transporters* produced favorable results (Golan et al., 2010; Young & Posselt, 2012), more research is necessary to demonstrate efficacy. Previous research on ER in individuals with ASD has highlighted a need to assess generalization to natural settings with peers or family members. Given that generalization of skills is another deficit of individuals with ASD (Fein, Tinder, & Waterhouse, 1979; Frith, 2003; Koegel & Koegel, 1988), the current study was designed to investigate whether computer based instruction helps students improve ER ability in computer based assessments and if ER ability generalizes to a live model. The current study aims to replicate existing findings regarding the positive impact of *The Transporters* on facial recognition (Golan et al., 2010; Young & Posselt, 2012) and extend those findings by determining whether improvements in facial recognition will transfer to a live model in the classroom. Specifically, the current study will investigate the relationship between instruction with *The Transporters* DVD and student performance in ER tasks by addressing the following research questions:

1. Does participants' use of *The Transporters* improve performance on *The Transporters Quizzes* during the intervention?

2. Does participants' use of *The Transporters* improve performance on emotion recognition tasks involving a live model from pre- to post-intervention testing?

Significance

This study is significant because there has been an increase in the number of young children identified as having ASD and a call for scientifically proven interventions to address

their needs (Shavelson & Towne, 2002). Research reviews suggest that there is no single research-based practice that is appropriate for all individuals with ASD (Pelios & Lund, 2001; Heflin & Simpson, 1998); however, in reviewing key components of effective instructional practices for working with children with ASD, Powers (1992) identified the need for early intervention, programming for generalization, and an emphasis on increasing social and communication skills. In fact, early intervention programs for young children with ASD include a strong focus on social and communication skills (Dawson & Osterling, 1997) because the need to address these areas is so pervasive.

This study addresses key components of effective instructional practices by providing early intervention targeting social and communication skills with a focus on generalization. It was designed to improve participants' ability to pay attention to and process faces in a global manner, which is imperative in correctly interpreting the emotional states of others and is necessary for appropriate social interaction and developing social competence. Additionally, this study extends the research on ER in children with ASD by examining their capacity to process information from people's faces as well as situational cues. Situational context is vital to interpreting emotions of others, given that most facially expressed emotions do not occur in isolation. Ability to understand the context in which a given emotion is appropriate has been linked to positive psychological and behavioral outcomes (Denham, 1994). *The Transporters* does not attempt to teach ER in isolation. In each episode, a situation is presented and then the characters respond to the situation. Just as in real life, sometimes characters respond differently to the same situation. The two primary aims of this study were: (1) to establish whether *The Transporters* is effective in teaching young children with ASD to identify facial expressions, match similar facial expressions, and

determine a likely facial expression from situational cues, and (2) to determine whether use of *The Transporters* affects performance on ER tasks incorporating a live model.

Computer intervention was targeted because it has been successful as a teaching instrument for children with ASD across domains (Higgins & Boone, 1996; Panyan, 1984). In addition to providing multisensory interactions and individual feedback, computer instruction allows both individualized instruction and independent use for individuals with ASD.

Chapter Two: Review of the Literature

The purpose of this study was to investigate the impact of a computer-based intervention on the ability of young children with autism spectrum disorder (ASD) to recognize facial expressions and recognize emotion. To support this work, this chapter begins with a brief overview of ASD, followed by theoretical models of autism that serve as a structure for understanding emotion recognition (ER) in individuals with ASD. Subsequently, a brief historical review of ASD will be presented, succeeded by research on the development of emotion and ER, and finally the chapter concludes with a review of the research on teaching ER.

Autism Spectrum Disorder

ASD is a pervasive developmental disorder characterized by a triad of impairments: communication impairment; social interaction deficits; and unusual patterns of repetitive behavior and or narrow and restricted interests. It is considered a spectrum disorder because the impairments vary in severity from one individual to the next. ASD is one of five disability subtypes under the heading of pervasive developmental disorders (PDD) in the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV-TR (American Psychiatric Association, 2000). Recent studies reported prevalence rates of ASD rising from 4 to 5 cases in the 1960s (Lotter, 1967) to 5-31 cases per 10,000 children in the 1990s (Nordin & Gillberg, 1996; Webb, Lobo, Hervas, Scourfield, & Fraser, 1997). Recent estimates from the Center

for Disease Control and Prevention (CDC) report a prevalence rate of 1 in 110 or roughly 1% of the population. One in 70 boys and one in 310 girls have an ASD (CDC, 2009).

With the increase in prevalence rates, there has also been an increase in requests for autism-specific services (Hurth, Shaw, Izeman, Whaley, & Rogers, 1999). Literature regarding treatment of individuals with autism has exploded over the last 10-20 years (Heflin & Simpson, 1998). Parents are understandably overwhelmed in attempting to determine an appropriate, empirically supported, and efficacious methodology (Dunlap, 1999; Olley, 1999). An international review of best practices for children with ASD (Parsons et al., 2011) revealed that, although there has been a substantial amount of research on interventions for children with autism, there is insufficient evidence regarding the effectiveness of any one intervention or approach when compared to another one. Controversy over appropriate interventions exists among researchers, program developers, educators, parents, advocates, attorneys, and the media (Gresham, Beebe-Frankenberger, & Macmillan, 1999; Hurth et al., 1999). Factors which have contributed to current contentions include: increased prevalence of autism, increased litigations concerning appropriate practice, numerous publications touting various interventions, and a lack of guidance in determining appropriate interventions for individual children (Iovannone, Dunlap, Huber, Kincaid, 2003).

Whatever intervention provides the solution for an individual child it must address the social cognitive deficits that are a central defining feature of ASD. These social cognitive deficits are evidenced by the inability to communicate effectively, failure to develop age-appropriate peer relationships, and a lack of social reciprocity. (Hobson,1986a, 1986b ; Osterling & Dawson, 1994).

Understanding the importance of ER as a component of the social cognitive deficits in autism and the significance of the proposed investigation is supported by two theoretical frameworks: Theory of Mind and Weak Central Coherence Theory.

Theoretical models of ASD. One theory that attempts to explain the social deficits in individuals with ASD is Theory of Mind. This theory posits that individuals with ASD are unable to socially connect with others because they lack theory of mind, or the knowledge that others know, want, feel or possess beliefs. Specifically, individuals with ASD may experience difficulty relating socially to others because they have difficulty attributing thoughts and emotions in others as well as anticipating what others might say, feel, or do in any given situation. This model specifies a deficit in the ability to conceive of mental states of others; specifically having what Premack and Woodruff (1978) termed a 'theory of mind'. Baron-Cohen et al. (1985) contend that individuals with ASD have difficulty interpreting and predicting the emotions, intent, and beliefs of themselves and others, thus leading to social, communication, and behavioral challenges. This model is particularly salient to the current study because recognition of emotion in others can affect one's social competence. Specifically, possessing theory of mind can affect ability to respond pro-socially, share emotional states, and make predictions about behavior. The recognition of emotions in others appears to be the first step towards the development of theory of mind.

Another cognitive theory of ASD is that of Weak Central Coherence (Frith, 1989; Frith & Happe, 1994). This theory postulates that individuals with ASD make sense of things by looking at different parts. Typical people, on the other hand, usually examine incoming information in context and derive the overall gist (Frith & Happe, 1994). Specifically, this theory postulates that autism is characterized by a weak drive for global coherence. This

notion was first described by Kanner in 1943, who believed that the condition had two defining features: "autistic aloneness" and "obsessive desire for the preservation of sameness". He related the latter to fragmented processing. Individuals with autism process things by looking at pieces, but are unable to extract overall meaning from the global whole. Happe' and Frith (2006) reviewed research on central coherence and suggested modifications to Frith's original account. Their suggestions included addressing the independence of weak coherence and social-cognitive deficits in ASD. They suggest that weak coherence is a processing preference as opposed to deficit, and reduced global processing is the result of superior local processing rather than a global processing deficit per se. Additionally, Happe' and Booth (2008) have postulated that weak coherence could be the result of two separable factors: an increased tendency to process features and a decreased tendency to integrate information. In examining this theory in relation to the proposed study, individuals with ASD look at different features of the face, but are unable to coherently process the configuration of features or extract meaning or emotional information from the collective face (Deruelle et al. 2004). This theoretical model was chosen because it can be used to explain how individuals with autism differ from their neurotypical peers in their ability to process information from faces in order to extract overall meaning.

Face processing in individuals with ASD. Studies examining viewing patterns of individuals with ASD when looking at human faces have revealed that individuals with ASD focused on non-feature areas of the face significantly more often and at core feature areas of the face (eyes, nose, and mouth) less often than controls. These findings have been demonstrated both in a 15 month old infant (Klin & Jones, 2008) and in a high functioning adolescent and adult males (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Pelphrey, Morris,

& McCarthy, 2005; Rutherford, Clements, & Sekuler, 2007; Sasson et al., 2007). Individuals with ASD are less likely to attend to and process information from the eye region of the face (Riby & Doherty-Sneddon, 2009; Rutherford et al., 2007). Furthermore, throughout their lifespan, individuals with ASD also orient to faces significantly less than neurotypical controls (Sasson et al., 2007). In fact, reduced attention to faces and decreased eye contact are early indicators of possible ASD (Osterling & Dawson, 1994). Individuals with ASD process faces in an atypical fashion with reduced attention to eyes and using piecemeal rather than configural strategies (Dawson, Webb, & McPartland, 2005). The Weak Central Coherence Theory is presented as a lens for viewing ER difficulties in autism and as part of the conceptual framework for this study.

Historical perspective of ASD. Prior to the 19th century, it was widely believed that children were not susceptible to mental illness. In fact, prior to the 19th century, asylums did not admit children. As a result, psychiatrists were not provided with the opportunity to systematically observe them. In fact, children did not come under observation until the advent of the 19th century expansion of public and private schooling. Prior to this time, the children remained in the home and deviant behavior was largely unnoticed unless it interfered with daily life.

By the end of the 19th century, new ways of understanding childhood pathology led to new institutional forms and professions focused specifically on children. With the 19th century need to make clearer distinctions across categories of pathology, Eugene Bleuler a Swiss psychologist first coined the term autism, "living in self" in 1911 to describe self-absorption due to poor social relatedness in schizophrenia (Houston & Frith, 2000). Leo Kanner (1943), author of the first book on child psychiatry, used the term to describe a group

of children he saw at his clinic at Johns Hopkins University in Baltimore. He described eleven children who: had no speech or parroted speech, used idiosyncratic language, engaged in stereotyped movements, had limited spontaneous activity, engaged in perseveration, enjoyed spinning objects, were unable to play cooperatively, were uninterested in conversation, had difficulty with change, were prompt dependent, lined things up in long rows, lacked initiative, demonstrated a desire to keep things in a fixed order, and exhibited signs of a hidden intelligence. Kanner viewed their "…inability to form the usual, biologically provided affective contact with people," as a primary feature of the disorder (Kanner, 1943 p. 44). Kanner recognized that these children were emotionally disconnected from others from a very young age.

At about the same time, Hans Asperger, a pediatrician in Vienna, described a phenomenon he labeled 'autistic psychopathology in children,' in which he summarized features of similar children in 1944. He noted that his clients were intelligent, possibly gifted in mathematics or natural science, creative thinkers who demonstrated poor social and emotional relationships, were highly sensitive, often lacked empathy, demonstrated stereotypic behaviors, held pervasive special interests, were often clumsy, and used idiosyncratic language. Asperger held the belief that the condition could be identified in early childhood, that it was life long, and that it was an inherited personality variant. He wrote about seeing similar characteristics in the parents of the children he saw. In addition, Asperger believed his clients shared a principal characteristic, disturbed social interaction (Houston & Frith, 2000).

These impaired social interaction skills include an impairment in the ability to empathize. According to Baron-Cohen (2002), empathizing is "the drive to identify another

person's emotions and thoughts and to respond to these with an appropriate emotion" (p. 248). According to Smith (2009), empathy is a set of processes and outcomes that are central to human social behavior. Both Kanner and Asperger noted that their clients were incapable of emotionally connecting with others and lacked empathy from a very young age. Since the first step in empathy is recognition of how someone else is feeling, this ties directly to ER and Theory of Mind.

As soon as autism was established as a disorder, cause and cures were immediately presented. Bruno Bettelheim (1967) was the first to emphasize the importance of a child's social environment and the first to use the term "refrigerator mother". He believed that autism in children resulted from the emotional detachment of the mother. Specifically, the children withdrew socially, as a result of being reared by a cool, emotionally detached mother. On the other hand, Bernard Rimland (1964) argued that autism resulted from biology. Specifically, he noted high comorbidity in identical twins, and that siblings of children with ASD were neurotypical. Researchers have not yet come to consensus on either the etiology of autism or on specific interventions to reduce ASD features. Although Bettleheim's theory has been dismissed, current research supports the comorbidity observed by Rimland (Lichenstein, Carlstrom, Rastam, Gillberg, & Anckarsater, 2010; Losh, Sullivan, Trembath, & Piven, 2008).

In the 1970's a landmark study by Lorna Wing, a London-based epidemiologist who studied children with intellectual disabilities, found that a number of children with intellectual disabilities exhibited three core features of autism. Wing noted that social impairments were largely due to egocentric interactions. She felt that communication impairments were evident in children with fluid speech, in that they were still unable to take part in proper two-way

conversation. She also observed that the repetitive routines could be very simple or they could be highly abstract. These findings led to the notion of autism being a spectrum disorder characterized by a triad of impairments in social interaction, communication, and repetitive interests/behaviors (Wing, & Gould, 1979).

In the 1980's at the MRC Cognitive Development Unit in London, researchers hypothesized a mentalizing deficit in individuals with ASD that supported the view of deficits in Theory of Mind, or the ability to infer thoughts or feelings of others (Premack & Woodruff, 1978). This theory was intriguing in that it identified a critical point during which the interactions of children with ASD differ from typical social interactions (Houston & Frith, 2000). Specifically, Leslie (1987) proposed that typically developing children possess an innate mechanism that allows them to distinguish between things in the real world and things in the mind. He noted that pretend play should actually be highly confusing to a child and lead to incorrect learning; however, typical children don't often confuse their ideas about the physical world with their ideas about the world inside their own and other people's heads. Maybe a reason that many children with ASD do not engage in pretend play is due to the fact that their brains lack the crucial mechanism which distinguishes things in the world from things in the mind.

Deficits related to Theory of Mind result in an inability to infer thoughts or feelings of others. Specifically, these deficits make it difficult for one to acknowledge that other people are capable of possessing divergent thoughts or beliefs. Individuals with ASD have difficulty perspective taking and predicting behavior of others (Frith, 1989). Social interactions are dependent on successful perspective taking, which is determined by interpreting thoughts and

feelings of others in context and acting in accordance. Thus, Theory of Mind deficits lead to ineffective social interactions in individuals with ASD (Lacava et al., 2007).

Difficulty inferring thoughts, beliefs, and predicting actions in others may be a result of an inability to distinguish facial expressions in others. Weak central coherence could affect ability of individuals with ASD to process facial features in order to extract meaning. Emotion recognition requires the ability to understand various affective expressions and to interpret the social-contextual meaning of the expressions (Bauminger, 2002). Individuals with ASD are generally unable to identify/interpret contexts related to an emotional state. Theory of Mind deficits have recently been considered from a different perspective, that of empathizing. Whereas Theory of Mind has to do with the ability to infer the thoughts or intentions of others, empathizing includes the ability to both identify emotional states and respond accordingly (Baron-Cohen, 2003; Baron-Cohen et al., 2002). Theory of Mind and facial expression recognition are linked in that proficient emotion recognition requires attribution of a mental state to someone else. Difficulty with perspective taking, coupled with the inability to recognize and understand facial expressions of others compounds the social impact on individuals with ASD.

Research on Emotional Development and ER

Scientists have been interested in communication of emotion through expression since the 1800's. Charles Darwin's (1872/1998) *The expression of the emotions in man and animals* is the seminal examination of both the appearance and function of human expression.

Darwin sought to explain the connection between emotion and expression through three principles. The first, "principle of associated serviceable habits," asserted that facial movements originally served direct adaptive functions in specific situations. For instance, one could close one's eyes or avert gaze in order to avoid unpleasant visual stimuli. Darwin's "principle of antithesis" states that facial movements are mere side effects of previously relevant associations and counter-associations. "The principle of action of the nervous system" proposes that physiological changes such as facial flushing, muscle tension are side effects of emotional states. Regardless of the veracity of Darwin's explanation, facial expression conveys information to others regarding an individual's emotional state.

According to Darwin, facial expression/movements are the result of complex events in evolutionary history. For example, the "knit brow" is linked to the expression of sadness. When an infant screams, the eyes become gorged with blood and the muscles around the eyes contract. Over the course of many years, this contraction of the eye muscles became fixed. The screaming in older individuals has been repressed, but the muscles around the eyes still contract when distress is felt. The "knit brow" in adults is a remnant of a more primitive facial movement of screaming infants.

Thorndike (1932) was the first to study individual differences among humans in the ability to recognize facial expressions. He described three types of intelligence: verbal, mechanical, and social. He defined social intelligence as the ability to understand and manage others. Individuals with ASD lack the form of intelligence Thorndike called social.

Ability to recognize expression, one form of this social intelligence, is a basis for possessing theory of mind, being able to understand feelings and intentions of others. The

ability to recognize basic facial expressions may be universal (Darwin, 1872/1998; Ekman, 2003). In the late 1960's psychologist, Paul Ekman set out to the island of New Guinea in an attempt to prove that facial expressions do not mirror social convention, but are rather universal displays of human emotion. When he asked the participants who had very little contact with the outside worlds to point to a face that evoked a certain emotion such as anger, disgust, fear, joy, sadness, or surprise they made the same association as people in other parts of the world. This supports the understanding that the ability to recognize facial expressions is universally impaired in individuals with ASD rather than a result of the environment or culture in which children with ASD are raised.

Universally, human faces are highly salient. Newborn infants are able to direct their gaze at faces from birth (Farroni, Menon, & Johnson, 2006; Cassia, Turati, Simion, 2004). Young infants show preference for mother's faces (Burnham, 1993) and prefer faces with open eyes and direct gaze (Farroni et al., 2006; Hains & Muir, 1996). This marks the beginning of the development of the ability to recognize emotions and understand mental states. In fact, emotion discrimination and imitation has been reported in neonates. Specifically, Field, Woodsor, Greenberg, and Cohen (1982) had an adult model one of three facial expressions (happy, sad, and surprised) to 74 neonates with an average age of 36 hours. They found that the newborn infants visually fixated on the mouth region more than the eye region irrespective of the expression modeled. Furthermore, the infants demonstrated less visual fixation on faces over trials and renewed fixations to the presentation of a different facial expression. In addition, the facial movements of the infants mimicked the expression of the model.

Haviland and Lelwica (1987) studied similar responses to mothers' presentations of three basic emotions: anger, joy, and sadness to twelve 10-week-old infants. The data indicated that the infants responded differently to the three expressions, were able to match or mirror joy and anger expressions, and appeared to use the matching of responses to indicate meaningful affect states and possible self-regulation. It has been suggested that cortical circuits involved in face processing become localized and increasingly specialized over the first year of life. The learning that occurs during this time is critical to the normal development of face processing. In fact, regions of the brain become specialized for face recognition (de Haan, Belsky, Reid, Volein, & Johnson, 2004).

While it begins to develop at birth, emotion recognition continues to develop through childhood and adulthood as part of theory of mind development. Typically developing infants as young as four months of age appear to discriminate and respond in meaningful ways to the expressions of others in familiar naturalistic settings (Montague & Walker-Andrews, 2001). Whereas infants at nine months are able to view adults displaying a positive or negative emotion and make inferences about people's subsequent actions on objects (Barna & Legerstee, 2005), these are core social deficits of individuals with ASD (Baron-Cohen, 1995; Hobson, 1994).

Emotional development and emotion in ASD. Difficulties with social interactions, including emotion recognition and reciprocity as well as nonverbal communication (e.g., gestures, eye contact, and facial expression), are often considered the main deficit of individuals with ASD (American Psychiatric Association, 2000; Baron-Cohen, 1995); however, the ability to recognize facial expressions early in life is crucial to developing interpersonal connections. Facial expression recognition aids in understanding feelings and

intentions of others (Rump, Giovannelli, Minshew & Strauss, 2009). The difficulty individuals with ASD experience recognizing emotions, particularly more complex emotions such as jealousy and embarrassment that require mentalizing (Bauminger, 2004; Capps et al., 1992) appear to negatively impact their ability to make interpersonal connections.

Affect sharing and affect coordination between caregivers and infants in early development are the foundation for more complex types of communication. Children with autism, who demonstrate marked impairments in social emotional relatedness, may not develop the foundation necessary to develop more complex communication. Numerous studies indicate that individuals with ASD have difficulties relating to affective exchanges throughout childhood. In a retrospective study using videotapes of first birthday parties, the single best discriminator between infants who were later diagnosed with ASD versus typically developing children was the failure to look at others (Osterling & Dawson, 1994).

In addition, studies have shown that individuals with ASD exhibit less attention to negative emotional displays of others (Bacon, Fein, Morris, Waterhouse, & Allen, 1998; Dawson et al., 2004; Sigman, Kasari, Kwon, & Yirmiya, 1992), which may be the result of being innately less emotionally responsive to others or may result from the inability to interpret emotions shown by others (Sigman et al., 1992). Whatever the case, individuals with ASD exhibit limited affect expression in social interactions (Joseph & Tager-Flusberg, 1997) when compared with matched controls. This is noteworthy, because caregivers who perceive that their children are not responding emotionally may direct less direct emotional displays with children over time (Scambler et al., 2007).

In examining emotional experiences of high functioning children with ASD, Losh and Capps (2006) found that they demonstrated limited understanding of complex emotions such as pride, embarrassment, and shame. In addition, the participants had difficulty reflecting on personal emotional experiences and tended to report generalized accounts of experiences using alternative strategies for interpreting emotional experiences. Specifically, when asked to recall emotional experiences, they tended to describe visually salient elements of their memories and exclude any references to causes of emotions. The authors concluded that "our memories of emotional events comprise a complex knowledge base that guides and shapes world encounters as we continuously cull information on the causes, consequences, and subjective meaning of affectively charged happenings. Lacking such a repository could render autistic individuals seriously disadvantaged when engaging in emotional transactions" (p. 816).

This understanding of the importance of memories of emotional events is consistent with the developmental model of ASD posited by Mundy and Neal (2001). They suggested that early impairments in social attention deprive children with ASD from acquiring necessary social information during the formative years (infancy and preschool) and consequently disrupts typical brain and behavioral development. According to this model, if social impairments are identified early and interventions are employed, children with autism might be directed to a more typical pattern of development. If this is possible, then it is also possible that young children with ASD would then form more emotional memories that would support them in developing social competence over time.

It is clear that this difference in early social interaction distinguishes young children with ASD from other young children. For example, in an attempt to discern which

impairments best discriminated young children with ASD (3-4 years of age) from children with developmental delays and typically developing children, Dawson et al., (2004) found that children with ASD were significantly impaired in the domains of social orienting, joint attention, and attention to distress of others. Given that children with ASD are less likely to engage in communication acts to share experiences, they also have fewer opportunities to learn to attend to and make meaning of others' emotional expressions during communication exchanges. These early differences appear to be compounded over time.

Social referencing. In general, people use the emotional expression of others to guide them in ongoing interactions and to inform them about external events. Development of this skill, social referencing refers to the ability to discriminate expressions of others and connect them to environmental events. Beginning in infancy, children without disabilities reference a caregiver's emotional expression in determining their own response. For example, Klinnert (1984) presented 12- and 18-month-old neurotypical infants with a set of novel toys and directed the infants' mothers to express a look of happiness, or fear, or to remain neutral in their expression. At both ages, infants stayed closer to the mother when she posed a fearful expression and approached the toys when she posed a happy expression. In a later study, Sorce, Emde, Campos, and Klinnert (1985) placed infants on a visual cliff with a drop off. The infants' mothers posed either fearful or happy expressions when the infant was close to the drop off. Of the infants whose mothers presented a happy expression, 74% of the infants crossed over the cliff. On the other hand, none of the infants whose mothers posed fearful expressions crossed the cliff. In contrast with typical children, even as young as 12 months of age, who use social referencing to guide their behavior in unfamiliar or ambiguous situations,

children with ASD do not employ social referencing or looking toward an adult in similar situations regardless of cognitive level (Bacon et al., 1998; Dawson et al., 2004).

ER research in ASD. Akechi, Senju, Kikuchi, Tojo, Osanai, and Hasegawa (2009) examined gaze direction combined with decoding facial expressions in children with ASD compared to typically developing children. They employed face stimuli with averted or direct gaze to examine the effect of congruency between gaze direction and facial expression. In the typical development group, gaze direction accelerated speed of recognition of facial expressions. On the other hand, gaze direction did not affect the speed of recognition of expression in the ASD group. This suggests that children with ASD do not integrate motivational tendencies communicated via facial expression and gaze direction in the same way that typical development children do. This apparent lack of integration could be due to cognitive style such as weak central coherence or it could be due to atypical function and development of the social brain network.

Eye tracking studies have been implemented to determine whether individuals with ASD differ from typical peers in the way they view human faces. Klin et al. (2002) devised a study in which participants were shown videotape clips of complex social situations while wearing an eye tracking device. Individuals with ASD fixated two times more on the mouth, body, and object regions than did the controls, but fixated two times less on the eye region, relative to controls. The authors concluded that the best predictor of autism was reduced fixation time on the eye region. In addition, fixation on mouths and objects was positively correlated with social functioning: increased focus on the mouth region was indicative of improved social adjustment and fixation on objects predicted autistic social impairments.

Hernandez et al. (2009) also found that individuals with ASD spent less time fixating on the eye region of faces than controls. However, in contrast with Klin et al. (2002), the participants with ASD in the study conducted by Hernandez spent more time fixated on the eye region than on other regions of interest (nose and mouth). Another study investigated visual scanning and pupillary responses to face and non-face stimuli in children with ASD from ages 1 year to 6 years with age matched controls (Anderson, Colombo, & Shaddy, 2006). While the scanning of face stimuli did not differ significantly between groups, children with ASD displayed significant pupillary constriction in response to facial stimuli, whereas the control group showed pupillary dilation in response to the same stimuli (Anderson et al., 2006). Pupillary responses are associated with engagement and information processing (Hess, 1975). Riby and Doherty-Sneddon (2009) found that participants with ASD were unable to use configural facial cues to match unfamiliar faces and showed difficulty looking at and processing information from the eye region. They did not note any preferential processing of the mouth region. Riby and Hancock (2009) used eye-tracking techniques to explore attention to pictures of faces. They found that individuals with ASD exhibited reduced face gaze or looked at faces less, which they linked to a lack of interest in socially relevant information. These deficits suggest that face perception is generally atypical for individuals with ASD.

Golan and colleagues (2008) examined a new task, assessing the recognition of complex emotions and mental states in social context. Complex emotions generally involve attributing a cognitive state as well as an emotion and are generally more context dependent (Griffiths, 1997). To assess this recognition of complex emotions, children with ASD and matched (age, IQ, employment status and education) controls viewed the child version of the

'*Reading the Mind in Films*' task (RMF-C), which uses 22 short ecologically valid scenes from feature films including visual input, auditory input, and context. Results showed that high functioning children with ASD scored significantly lower than matched controls. This finding is consistent with the weak central coherence theory, which suggests that children with ASD would find this task very difficult, given their likelihood to focus on parts or details and their difficulty integrating parts into a whole.

In another study, twelve children with ASD and 24 controls were presented with emotional and non-emotional facial expressions on a computer screen under audio or silent conditions and under slow speed, very slow speed, normal speed, or static control (Tardif et al., 2007). Overall, the children with ASD performed significantly lower in expression recognition in all conditions of presentation. The participants with ASD performed significantly better in non-emotional than in emotional recognition tasks. Additionally, children with ASD performed the best when presented with the facial images at a very slow speed. Children with milder symptoms of ASD performed better than children with moderate to severe symptoms of ASD. These results suggest that there is a correlation between severity of the symptoms of ASD and the degree of visual processing impairment (Tardif et al., 2007).

Rump et al., (2009) examined the ability of children of a variety of ages and adults with and without ASD to make judgments based on briefly presented dynamic expressions. The participants without ASD became more proficient at recognizing subtle affect changes as they aged. From the child group to the adult group there was continuing improvement in the ability to recognize facial expressions. In contrast, children with ASD performed worse than age-matched controls in their ability to recognize expressions; however, these group differences were not seen with the older children. By adulthood, however, participants with

ASD were again performing worse than their matched controls. The evidence suggests that adults with ASD never attain the level of proficiency of age-matched peers without ASD to recognize emotions in others.

Boraston, Blakemore, Chilvers, and Skuse (2007) compared emotion recognition ability using a novel test incorporating computer animation and a more standard emotion recognition test using a standard set of pictures of facial affect (Ekman & Friesen, 1976). Adults with ASD and neurotypical controls were matched on age and verbal IQ. In both experiments, adults with ASD were significantly impaired in their perception of sadness in comparison with controls. Their findings indicate a deficit in ER of individuals with ASD that extends beyond facial recognition of emotions and could significantly impair social interaction skills. This supports evidence that the level of social impairment in ASD correlates with behavioral variables such as eye-gaze patterns (Klin, Jones, Schultz, Volkmar, & Cohen, 2002). These results extend to adults with high functioning ASD (Humphreys, Minshew, Leonard, & Behrmann, 2007).

Wolf et al., (2008) examined face-processing abilities in 85 children, adolescents, and young adults with ASD. Participants with ASD had significantly lower accuracy in matching identity across expressions, matching identity across masked features, and discriminating information in the eye region of the face. However, they displayed significantly better ability to discriminate information in the mouth region.

In summary, individuals with ASD have difficulty interacting appropriately with others. This is evident in lack of eye contact, gestures, and play (Kanner, 1943). One of the most striking differences in children with ASD is their lack of ability to share mental states

with others (Kanner, 1943). Children with ASD require support in order to learn how to communicate effectively and socialize properly with others. Without support, individuals with ASD will most likely withdraw from social situations and will certainly fail to form emotional memories. Lack of social ability, can influence a person's ability to form peer friendships (Merrell & Gimpel, 1998), acquire and maintain a job (Cotugno, 2009), and interact and be part of the community (Merrell & Gimpel, 1998). The ability to recognize emotional expression has implications on the understanding of emotion and mental states in others (Hobson, 1986a). Ability to process facial expression quickly and accurately is a highly adapted functional skill for survival in a social world. Even young infants are able to discriminate between basic facial expressions (Haviland & Lelwica, 1987). The ability to recognize the emotions of others is a key component to development of social interaction and theory of mind.

Biological differences in ASD. The social interaction differences noted in ASD are those that are typically highlighted as the core features of the disorder, but there are other biological differences that are also likely to impact social interactions. One such biological difference is found in the ability of chidren with ASD to imitate facial expressions. Several studies examining emotion recognition in children with ASD have found that some participants with ASD mimicked the presented facial expressions prior to labeling them (Gepner et al., 2001; Tardif, Laine, Rodriguez, & Gepner, 2007;Wright et al., 2008) An explanation for this deviation is that perhaps imitations give the child feedback on his or her own facial muscles, which might allow him or her to assess emotion by internal reference as opposed to putting him or herself in another person's shoes. From a neurological point of

view imitation in humans is related to the mirror neuron system, which has been found to be impaired in individuals with ASD (Oberman et al., 2005; Theoret et al., 2005).

Emotion recognition deficits in individuals with ASD may be a result of brain abnormalities. Comparisons of anatomical brain features in a group of adults with high functioning ASD and a group of sex, age, IQ, and handedness matched controls, revealed decreased gray matter in the ASD group in the mirror neuron system areas of the brain (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2006). This mirror neuron system area is believed to play a part in one's ability to empathize. Decreased gray matter in this area would logically influence an individuals' ability to recognize emotions in others. The comparisons also revealed cortical thinning of the mirror neuron system was positively correlated with severity of ASD symptoms. The researchers conclude, "Early dysfunction of the MNS [mirror neuron system] could generate abnormal development of other areas of the social brain and result in several of the clinical features that characterize autism, including the failure to develop reciprocal social and emotional abilities" (Hadjikhani, et al. 2006, p.1279). Perhaps typically developing children automatically activate their mirroring system and individuals with ASD engage it only in specific situations (Oberman, Winkielman, & Ramachandran, 2009). It has also been suggested that local bias in individuals with ASD results from abnormal neuronal connectivity, which is supported by functional imaging studies showing reduced connectivity (Bird, Catmur, Silani, Frith, & Frith, 2006; Just, Cherkassky, Keller, Kana, & Minshew, 2007).

Hubert, Wicker, Monfardini, and Deruelle (2009) examined electrodermal reactivity to emotion processing in adults with ASD. Individuals with ASD differed from matched controls in that they demonstrated altered autonomic processing. Specifically, individuals with ASD

failed to produce normal physiological reactions to emotional states of others. It is difficult to know if the failure to respond causes or results from an inability to recognize the emotions of others, but certainly this biological difference is related to the difficulties children with ASD have in recognizing the emotions of others.

Functional neuroimaging studies have shown decreased activation of the amygdala during expression recognition tasks when compared with matched controls (Baron-Cohen et al., 1999; Critchley et al., 2000). In addition, structural neuroimaging studies have demonstrated differences in the size of the amygdala in individuals with ASD (Abell et al., 1999; Schumann, Barnes, Lord, & Courchesne, 2009; Sparks et al., 2002). Hubl et al. (2003) measured blood oxygen levels while participants looked at faces and other complex objects. Individuals with ASD showed less activation in the fusiform gyrus but greater activation in areas associated with object recognition (medial occipital gyrus) and visual search (medial frontal gyrus). This suggests that individuals with ASD may be using an atypical visuospatial strategy to process faces.

In neurotypical subjects, facial processing relies more on holistic strategies and less on visuospatial processing. In the control group, there were significantly lower signal changes in the superior parietal lobule during face processing than during object processing in comparison with the ASD group (Hubl et al., 2003). Pelphrey et al., (2005) used event-related functional magnetic resonance imaging to show that in autism, brain regions associated with gaze processing and social cognition including the superior temporal sulcus region are not sensitive to intentions associated with gaze shifts. Specifically, brain regions did not differentiate congruent and incongruent gaze shifts. Individuals with autism failed to link shifts in eye gaze to a character's motives and desires in order to determine intent.

Additional processing in the superior temporal sulcus region did not occur in individuals with ASD. These findings suggest that gaze processing deficits in ASD are not based on gaze discrimination problems, but rather are linked to deficits in using information from eye gaze to make assumptions regarding the intentions of another person.

To summarize biological differences as compared to neurotypical controls, individuals with ASD: tend to mimic facial expressions prior to labeling them in ER tasks (Gepner et al., 2001; Tardif et al., 2007; Wright et al., 2008); have decreased gray matter in the mirror neuron system of the brain, which has been linked to both ER and empathy (Hadjikhani et al., 2006); demonstrate reduced neural connectivity during ER tasks which results in local bias (Bird et al., 2006; Just et al., 2007); do not respond with normal physiological reactions to emotional states of others (Hubert et al., 2009); demonstrate decreased activation of the amygdala during ER tasks (Baron-Cohen et al., 1999; Critchley at al., 2000); have enlarged amygdales (Schuman et al., 2009); show greater activation in brain regions associated with object recognition during ER tasks (Hubl et al., 2003) than with regions of the brain associated with gaze processing and social cognition (Pelphrey et al., 2005). These biological differences suggest a different cognitive style as well as an atypical function or development of the areas associated with the social brain.

Interventions to Teach Individuals with ASD to Recognize Emotions

Young children with ASD are likely to engage in problematic social behavior and become increasingly socially withdrawn with the absence of targeted interventions addressing social demands in naturally occurring contexts (Eaves & Ho, 1997). Educators, school administrators, parents, and support personnel contend that intervention for social skills

deficits must be a focus of instruction if students with ASD are to be successful and independent in life (Brown, Odom, & Conroy, 2001; US Department of Education, 2003). In response, researchers have developed a variety of interventions for teaching social skills to individuals with ASD (Hwang & Hughes, 2000; Rogers, 2000; Stichter et al., 2007). Emotional recognition is a component of these studies.

Solomon et al. (2004) developed a 20-week social adjustment enhancement curriculum for boys with ASD from 8-12 years of age. Three specific deficits were targeted: ER and understanding, theory of mind, and executive functions. Children's group sessions consisted of a welcome song, a check-in time for discussion of the last week's assignment, a snack time, a lesson time, motor activity, and a joke time. Sample activities from the curriculum included: drawing emotion thermometers with color coding for different emotional responses to various scenarios; playing facial expression and body language charades in response to a scenario; playing games that require problem solving, etc. Statistically significant improvements in facial expression recognition and executive functioning were reported for the intervention group compared to the control group children. In addition, there were significant reductions in the number of child problem behaviors that were reported.

Ryan and Charragain (2010) addressed weak central coherence theory in teaching children with ASD to recognize emotions in others. Small group social skills' training (4-7 children from 6-14 years of age) was utilized to teach children through a part-whole process, focusing on different elements of the face that make up an expression. Participants viewed photographs of the six basic emotions while the therapists highlighted key features that are inherent to a specific emotion. Participants were provided multiple opportunities to identify

emotional expressions from a range of photos. As part of the training, participants also engaged in role playing exercises, tracing and drawing emotional expressions, matching tasks with parts of faces, and completing workbooks at home which reinforced practice of each emotion. ER training took place in hour -long sessions, once a week for a total of four weeks. Improvements were significantly greater for the treatment group than the delayed treatment control group.

Social skills training targeting emotion recognition in others for individuals with ASD has been successful (Ryan & Charragain, 2010; Solomon et al., 2004). Another intervention targeting teaching emotion recognition to individuals with ASD involves the use of a computer.

Computer-based interventions. Assistive technology has also been used in an attempt to teach children with autism to recognize emotions. Lacava, Golan, Baron-Cohen, and Smith Myles (2007) reported on an intervention consisting of 10 weeks of using the computer software *Mind Reading*: *The Interactive Guide to Emotions* (Baron-Cohen, Golan, Wheelwright, & Hill, 2004) in either home or school settings. ER testing was conducted using a computer before and after intervention. The results indicated that participants improved in both face and voice ER for basic and complex emotions that were addressed by the software. Additionally, children with ASD performed well on ER tasks that were not included in the software, suggesting that they might generalize ER skills they acquired. *Mind Reading* was also utilized to teach adults with Asperger syndrome and high functioning ASD to recognize complex emotions in faces and voices. In a relatively short period of time, participants were able to recognize a variety of complex emotions and mental states, but were unable to generalize skills (Golan & Baron-Cohen, 2006). This same computer software

program, *Mind Reading*, was used to investigate whether boys with ASD who were exposed to the program for 7 to 10 weeks resulted in changes in ER and social behavior. All four boys experienced improved ER scores and social interactions with peers (Lacava et al., 2010). In an additional study by Weinger and Depue (2011), *The Mind Reading Computer Software* was used for five sessions over a three-week period with 6 children with ASD. The participants scored significantly higher in the ER tasks in the post-test when compared to pretest scores.

Silver and Oakes (2001) also studied the effects of a computer program, *Emotion Trainer*, designed to help people with autism learn to recognize and predict the emotions of other people. The research indicated that using the Emotion Trainer had positive effects on participants' performance both within the program and on the assessment tasks. Participants made significant gains on the sections focusing on predicting emotions generated by external stimuli and by mental states. A computer based program designed to teach and test the identification of basic facial expressions called the *Frankfurt Test* and *Training of Facial Affect Recognition* (FEFA) (Bölte et al., 2002) was examined in 10 adolescents and adults with high-functioning ASD. The participants exhibited considerable improvements in identifying basic emotions and mostly reached normative values on the FEFA eyes and face test post intervention; however, no significant changes were noted the activation in the fusiform gyrus pre and post intervention with functional magnetic resonance (Bölte, et al., 2006).

Tanaka et al. (2010) conducted a randomized clinical trial to assess whether a computer based intervention, the *Let's Face It!* program could teach face recognition skills to children with ASD. The computer program consists of seven interactive computer games that

target specific face impairments associated with ASD. Children assigned to the treatment group received 20 hours of face training using the *Let's Face It!* Program. Relative to the control group, the treatment group demonstrated reliable improvements in processing features holistically. Importantly, this is the first study in ER that shows evidence that a local processing bias can be altered through training and practice.

Another study (Hopkins et al., 2011) assessed the efficacy of *FaceSay,* a computer based social skills training program for children with ASD. This randomized controlled study examined both children with high functioning and low-functioning ASD. The computer intervention incorporates realistic avatar assistants to improve specific social skills. The children with low functioning ASD improved in two areas of the intervention: emotion recognition and social interactions. The children with high-functioning ASD demonstrated gains in all three areas: facial recognition, emotion recognition, and social interactions.

Golan et al. (2010) evaluated *The Transporters* with high functioning children with ASD between the ages of 4-7. The intervention took place over a period of four weeks and the participants were tested before (Time 1) and four weeks after (Time 2). Two control groups, one with ASD and the other typically developing, were matched to the intervention group for age, sex, verbal IQ, and time spent between the two assessments. The parents of participants in the intervention group were given the intervention series and user guide to use with their child at home. Children were asked to watch at least three episodes per day over the four-week period. Parents were asked to document the number of episodes watched per day (49-382 weekly). The number of episodes viewed by individual participants varied greatly. The intervention group improved significantly more than ASC group on all tasks and performed comparably to typical controls at Time 2. The authors conclude that use of *The*

Transporters can significantly improve recognition and understanding of young children with ASD.

Young and Posselt (2012) also evaluated *The Transporters* with children from 4-8 years of age who met the criteria for Pervasive Developmental Disorder. Participants were randomly allocated to two groups: an intervention group that watched *The Transporters* and a control group that watched a *Thomas the Tank Engine* DVD that was created for the study by selecting episodes from the series that draw attention to emotions. Participants in both conditions were asked to watch at least three episodes a day in their home. Both groups participated in viewing episodes for a period of three consecutive weeks. In addition, children in both groups were provided feedback if their responses were incorrect. Following the intervention, the ability of children with PDD to identify and label basic and complex emotions significantly improved when viewing *The Transporters* DVD, while participants in the control group who observed the alternate DVD showed no such improvement.

Computer intervention does appear to be a particularly appropriate tool for teaching individuals with ASD. Some of the reasons that computers appear to be appropriate include the fact that individuals with ASD often have difficulty screening out unnecessary information/stimuli. Focusing on a computer screen might minimize such difficulties. Furthermore, individuals with ASD can have difficulty with change and dealing with an unpredictable world. Computer programs can provide predictable and consistent responses free from any social demands, which can be repeated over and over again. Computer programs can also be designed to assist individuals of all cognitive levels in terms of the cognitive complexity of the information presented and the complexity of response. The fact that computers now allow realistic depictions (photographs or video) may also help

individuals generalize skills across settings. Computers also make it possible to repeat an individual lesson until mastery is achieved. Finally, individuals with ASD tend to enjoy working on computers, which means that computer programs can assist them in learning independently.

Summary

At the heart of ASD, is a lack of social competence. With the significant increase in the number of individuals diagnosed with ASD, comes a need for evidence-based programs to address their social deficits. Research addressing computer-based interventions aimed to improve social skills in individuals with ASD is limited but encouraging. The purpose of the study was to determine whether *The Transporters* software would lead to improvements in emotion recognition in both quizzes following the intervention and on in vivo emotion recognition tasks post intervention. Although *The Transporters* has already been linked to improvements on emotion recognition tasks in two small group randomized controlled studies (Golan et al., 2010; Young & Posselt, 2012), more research is needed to confirm its efficacy and to determine whether learned skills generalize to other people and other settings. It was hypothesized that participants would perform better on *The Transporters* quizzes during intervention in comparison with performance on *The Transporters* quizzes during the baseline phase. A second hypothesis was that participants would perform better on in vivo emotion recognition tasks post intervention when compared to pre-intervention performance.

Chapter 3: Methodology

This study investigated the use of *The Transporters* to teach emotion recognition and understanding to children with autism spectrum disorder (ASD) in a school setting. This chapter describes the methods used in the study. It begins with a description of the participants, followed by a description of the setting, materials and procedures. The chapter concludes with information on data analysis and research hypotheses.

Researcher

The primary researcher was a full time CSS teacher, during the time that the research was conducted at the research site. The school site had five classrooms designated as self-contained CSS rooms located in a separate wing of the campus. The primary researcher recruited participants from three CSS classrooms at the site; her classroom was excluded from participating due to the age of the students. The fact that the primary researcher was a teacher at the site made it ideal for conducting research. Specifically, the primary researcher had a good working relationship with the other teachers and students, as they participated in several shared activities such as: field trips, recess, lunch, and resources (P.E., Art, etc.)

Participants

Four students were recruited to participate in the study from a public school in Duval County, FL. Due to possible attrition, four students were recruited to increase the likelihood that complete data would be collected for at least three participants. One participant did transfer to another school midway through the intervention phase. As a result he did not complete the study and the available data from him has been excluded from this study.

The criteria for participating in the study were: (a) students served in self-contained Exceptional Student Education classrooms for children with communication and social skills deficits; (b) no prior experience with *The Transporters*; (c) attending a school in Duval County, FL; (d) aged between 4 and 8 years at the onset of study; (e) the ability to make choices by pointing with a finger; (f) parents consented to have their child participate in the study (See Appendix B); (g) enrolled in a class with a teacher who consents to participate in the study (See Appendix C); (h) an age equivalent of four years or greater on the Peabody Picture Vocabulary Test 4th edition (Dunn & Dunn, 2007); and (i) a pre-test score of 50% or less on the "Try a Mix of Questions" hard version created from *The Transporters* program.

The three participants who completed the study included two males and one female. One student was Caucasian and two were African American. All students were between 4-8 years of age at the start of the study. Complete descriptions of each participant appear below and in Table 1.

Table 1

Participant Characteristics

Participant	Age	Ethnicity	Diagnosis	PPVT- Age equivalent	General Education Participation	Grade
Bella	8,0	African American	Intellectually Disabled; Language Impaired	5.3	none	2nd
Angel	4,11	Caucasian	PDD-NOS; Communicatively Disordered	4.0	One hour each day	Pre-K
Darius	6,5	African American	Infantile Autism; Communication Disorder	4.4	none	1st

Participant 1: This participant was an 8- year old, zero-month African American female named Bella (hers and all other participant names are pseudonyms). According to school records, Bella's full scale intelligent quotient (FSIQ) was measured at 59 on the *Stanford –Binet Intelligence Scales (SB5) fifth edition*. She is identified as Intellectually Disabled and Language Impaired. She is served in a self-contained Communication Social Skills (CSS) Classroom for 2nd-3rd grade students with eight other students, a teacher, and two assistants. Her parents completed the Vineland when she was evaluated through the school district in 2009. Her adaptive behavior composite score was a 69. The researcher evaluated her receptive language using the *Peabody Picture Vocabulary Test 4th* edition (Dunn & Dunn, 2007), and her age equivalent was five years and three months.

In terms of her social functioning, Bella is very friendly and enjoys interacting with both peers and adults. She speaks in complete sentences, answers questions, initiates greetings and conversations with others, and verbalizes her wants, needs, and feelings. She prefers the company of others, either peers or adults for activities both in the classroom and outside of it. She does not seem to have a preference over interactions with peers or adults. She has difficulty interpreting social cues, and can upset her peers by close proximity or continued questioning. She demonstrates good eye contact. She does not use any gestures to supplement her verbal communication. In responding to questions, she typically responds with a few words but does not expand answers or ask questions in response. She demonstrates a range of appropriate facial expressions in conversations with others: happiness, surprise, etc.

Participant 2: This participant was a 4-year, 11-month old Caucasian male named Angel. According to school records, Angel was diagnosed by a neurologist with mild Pervasive Developmental Delay, not otherwise specified (PDD-NOS). Angel is also Communicatively Disordered. A diagnosis of Communicatively Disordered implies a significant discrepancy between his Visual-Spatial Problem Solving (VPS) age and his functional receptive language to result in some social engagement issues due to language avoidance. The *Batelle Developmental Inventory -2nd edition (BDI-2)* was administered in 2010 through a psychologist for the school district. Angel scored as follows: Adaptive Domain, 80; Personal-Social Domain: 78; Communication Domain: 81; Motor Domain: 80; Cognitive Domain: 61. The researcher evaluated his language using the *Peabody Picture Vocabulary Test 4th* edition (Dunn & Dunn, 2007), his age equivalent was four years and zero months. Angel speaks in complete sentences, expresses wants and needs verbally, but is

prone to stuttering. This student was also placed in a self-contained Communication Social Skills (CSS) Classroom for pre-kindergarten students with a teacher, two assistants, and eleven other students. In addition, Angel participated in a general education classroom setting for an hour every day without any additional support.

Angel responds to greetings from familiar people independently, but rarely initiates greetings. He prefers social interactions with adults over peers. During classroom center activities, he is prone to choose centers which allow him to work independently such as the computer or listening center. When he does choose to engage in activities with peers, he tends to direct others, telling them what to do or say. During recess, he prefers to play with older children with ASD, again directing play. Although he is included in a general education classroom for part of the day, he prefers staying in his CSS classroom and makes excuses on a daily basis as to why he should stay. He demonstrates good eye contact but limited range of expression. Like Bella, he does not use gestures to further communicate his speech. He is able to express wants and needs in full sentences, but does not talk about his feelings. He particularly enjoys conversations with adults and will expand on answers readily.

Participant 3: This participant was a 6 year, 5 month old male African American student. According to school records, Darius was diagnosed by a neurologist with Infantile Autism and Communication Disorder in 2008. In 2009, the school district completed independent testing using the Gilliam Autism Rating Scale- 2nd edition (GARS-2) and the Autism Diagnostic Observation Schedule- Module 1 (ADOS). The autism index for the GARS was 122, which indicates "very likely" probability of autism and the ADOS scores were as follows: Communication: 5; Reciprocal Social Interaction: 14. These scores on the ADOS meet the criterion for ASD. In addition, his mother served as respondent on the

Vineland Adaptive Behavior Scales, Second Edition (Vineland-II) in which his adaptive behavior score was a 59. The researcher evaluated his language using the *Peabody Picture Vocabulary Test* 4th edition (Dunn & Dunn, 2007); his age equivalent was four years and four months. Darius uses short phrases or one-word utterances or questions to convey his wants and needs. Darius is served in a self-contained Communication Social Skills (CSS) Classroom for 1st-2nd grade students for the entire school day with eight other students, a teacher, and one assistant.

Darius exhibits variable eye contact when engaging with others. He never uses gestures to supplement verbal communication. He has a very flat tone when talking with others. In addition, he does not employ a range of facial expressions. When responding to questions, he typically responds with a 1-2 word utterance or not at all. He does not initiate greetings or conversations with others and requires a prompt to do so about half the time. He has a special friend in the classroom, whom he prefers over all others. When playing together, Darius responds with compliance of demands made by his friend, smiles or laughter, and the occasional one to two word utterance. He rarely uses language in interactions with peers, including his special friend. He has the tendency to move around and fidget. When requesting a want or need, he generally uses a one word statement, such as "bathroom" or "lunch", etc. He is unable to explain his feelings, but does get upset frequently. When he is upset, he cries and or tantrums (yelling and repeatedly hitting or kicking the ground).

Setting

The study was completed in an elementary school in the Duval County, Florida School System. Pre-intervention and post-intervention assessments as well as both baseline and intervention data collection occurred in each students self-contained special education classroom or the therapy lab where the students received speech or language instruction and or occupational therapy.

Baseline Measures

The participants were introduced to *The Transporters* by repeatedly taking the "hard" version of the quiz "Try a Mix of Questions", which is embedded in the DVD and features randomly presented questions about different emotions from a variety of episodes. The "hard" quiz differs from the "easy" quiz by offering three possible answers, as opposed to two, for each question posed. Although the questions consist of material from all of episodes, the questions are posed in such a way that the participants would not require prior knowledge of the episodes in order to respond correctly to the emotion recognition tasks if they had emotional recognition skills.

The quiz was used to assess how well the participants performed on simple emotion recognition tasks such as matching faces with faces. For example, the quiz depicts one of the characters looking surprised while the narrator poses the following statement and questions "Barney is surprised. Who else is surprised? Is it Dan?" while depicting an image of Dan playing around "Or Nigel?" depicting an image of Nigel looking surprised "Or Jennie?" showing a third image of Jennie looking embarrassed. Another simple emotion recognition task used in the DVD requires the participant to match a face to an emotion. For example, a speaker would be shown and the narrator's voice would state the following "Who is sorry? Is

it Charlie?" and show Charlie looking proud "or Nigel?" showing Nigel looking angry "or Barney?" showing Barney looking sorry. Additionally, the quiz assessed how well the participants performed on more complex emotion recognition tasks that involve theory of mind, by identifying a facial expression that might be displayed in a given situation. For example, one question posed by the DVD asks, "Oliver was kind to Sally by taking her passengers when she was tired. (Oliver is shown with a blank featureless face, transporting Sally's passengers) How is Sally feeling? Is she afraid (while depicting a blown up version of Sally's face looking scared) or happy (again showing Sally's enlarged face looking happy) or sad (showing Sally's enlarged face looking sad)?" If the quizzes were used in the standard manner, after a participant chose the correct answer, he/she was rewarded with verbal praise, such as "you're doing great!" and presented with animation showing a moving wheel or wheels. When a participant chose an incorrect answer, the response from the DVD was "No, that's not right. Try again" and a picture of smelly fish was shown on screen. The scenario was then played out again and the same three choices were available. For this study, the participants were asked to point to their choice as opposed to clicking a mouse in order to eliminate feedback and prevent learning correct responses as a result of repeating the quizzes.

In an effort to promote attention to task and participation in baseline trials, prior to the start of each quiz, participants were presented with a choice of preferred items (stickers, small piece of candy, bubbles, time to play Wii, etc.) to work towards (See assent script, Appendix D). After responding to each question, a mark was made in a chart, so that the participant had a visual representation of the expectations and how many responses they had to give prior to being rewarded with the reinforcing item of their choice. No other feedback was given, with the exception of marking each box on the chart. Upon completion of the quiz, the participant

was given their self-nominated preferred item for participating regardless of his/her performance.

Procedures

Before initiating the multiple probe across participants design, all participants completed an in vivo pre-test assessment of their ability to recognize emotions in the faces of adults they know and work with regularly. In order to assess emotion recognition ability in live models pre-intervention, the circumscribed interests of the subjects were identified via observations of the child and parent questionnaires. The researcher created eight different scenarios incorporating one or more of the circumscribed interests of each participant and a corresponding emotion to be acted out or narrated by researcher, teachers, the Communication and Social Skills Site Coach, Occupational Therapist, and the Speech and Language Pathologist in front of the participant. The scenarios mimic the design of *The Transporters* quizzes in that two scenarios focus on matching two characters displaying the same emotion, two more focus on matching a face to an emotion, and four questions center on matching a face to a situation. The interest of the child was incorporated, in an effort to increase the likelihood that he/she would watch the scenario play out. The participant sat at a table with familiar adults acting out scripts. Each session was recorded for interobserver reliability. For example, in questions involving matching faces to faces, a narrator might state "Ms. Romero is worried" and Ms. Romero would make a worried face in response. Ms Romero would continue to display the emotion until the participant responded to the ensuing question. Then the narrator would pose the following question, "Who else is worried? Is it Ms. Jon (looking angry) or Mr. Al (looking happy) or Ms. Mia (looking worried)?" The actors would wait to demonstrate the emotion until the narrator stated their name. Again, they would continue to

display the emotion until the participant pointed to one of them, indicating their response to the question. The scripts for each participant can be found in Appendix E. For questions involving theory of mind, the actor would face away from the participant and engage in an activity that the participant enjoys while the narrator explains what is happening and asks how the actor feels. For example one of the scenarios used involved Barbies, the narrator stated the following "Ms Romero's friends are coming to play Barbies with her (Ms Romero stands in front of a dollhouse with Barbies in each hand, moving them through the house with her back to the participant so that her face is unseen). Ms Romero can't wait until they can play Barbies together. Ms Romero loves playing Barbies with her friends. How is Ms Romero feeling? is she excited ?(pointing to the first picture affixed to a board depicting a blown up picture of Ms Romero's face displaying an expression of excitement) or surprised? (Pointing to the second picture on the board which is a blown up shot of Ms Romero's face looking surprised) or afraid? (pointing to the last picture on the board which is a blown up picture of Ms Romero looking afraid). The actor faced away from the participant in order to ensure that theory of mind was assessed as opposed to assessing simple emotion recognition. The individually relevant scenarios serve as the pre-test and post-test measure for the in vivo condition.

A multiple baseline probe design across participants was used in order to assess changes in emotion recognition tasks as a result of using *The Transporters*. At the start of the study all four participants were presented with daily quizzes from the DVD to establish baseline. Once the intervention began for the first participant, the remaining participants were presented with quizzes every third day, rather than daily. However, prior to introducing the independent variable, the researcher conducted a short but continuous baseline measure (3

consecutive days) for each individual. The purpose for utilizing a probe design instead of the standard multiple baseline design was to minimize any possible negative reactions to repeatedly taking the "Try a Mix of Questions Quiz."

The baseline phase utilizing the "Try a Mix of Questions" hard quiz was presented in a familiar classroom (3^{rd}-5^{th} grade CSS classroom) and the researcher sat with the participant and recorded his/her answers. All baseline sessions were videotaped and every 5th session was shown to two independent reviewers who recorded the participants' answers in order to determine reliability. The quiz was given daily to all participants until a minimum of three stable baseline measures were obtained for the first participant. At this point, the first participant was presented with the pre-intervention in vivo assessment. Next, the intervention phase and episodes of *The Transporters* was introduced for the first participant, while baseline data collection continued for the other participants. In order to decrease possible negative reactions to taking a daily quiz for the other participants, a multiple probe design was used to periodically record baseline levels. Probes were conducted every 3^{rd} school day for the 2 participants who were in the baseline phase. After stable performance on the quizzes was obtained for the first participant, the intervention began for the second participant. Prior to beginning the intervention phase, the participant was presented with the "Try a Mix of Questions" hard quiz for at least three consecutive school days in order to assist in establishing a true representation of baseline level responding. Next, the participant was given the in vivo assessment and then the intervention phase began for her. Similarly, this format was repeated for the third participant.

After baseline was established with the first participant, and he completed the live pre-assessment he watched the first episode at three different times during the day but did not

participate in taking the quiz until immediately following the third viewing. The rationale for repeated viewings is to increase familiarity, predictability, and mastery of content. During the intervention phase, participants took the same "try a mix of questions" quizzes with the feedback eliminated instead of participating in the quizzes directly from the DVD that are based on specific episodes, in order to eliminate the possibility of learning the correct response. Distractions were identified and minimized so that the participant paid attention to the DVD. Data was recorded by the researcher and every 5th session was videotaped in order to check interobserver reliability. If a participant arrived late to school, every effort was made to conduct three viewing sessions within the school day. If this was not possible, then the episodes were shown three times the following day. The first participant watched the first episode three times at the start of the intervention phase, taking a quiz after the third viewing. His or her responses were recorded on the fidelity checklist (See Appendix F). The following day, the second episode was shown three times daily, followed by a quiz after the third viewing. The same pattern was followed for subsequent episodes. The second participant began watching the videos and taking the quizzes after the first participant had established stable performance following the introduction of the intervention. The second participant completed the live pre-assessment following the same guidelines described for the first participant. Prior to the introduction of the independent variable, the second participant took the "Try a Mix of Questions" quiz daily for at least three consecutive school days, (as opposed to every third day) data were recorded for question responses, and participation was videotaped. The third participant began watching the videos and taking the episode quizzes after following the same guidelines described for the first two participants.

Each participant watched episodes from *The Transporters* and was tested using the random quizzes after every 3rd viewing. After the first participant had watched and completed quizzes for all 15 episodes and had 5 days of choosing any episode to watch on three different times each day, followed by the "try a mix" quiz after the third time, the same in-vivo, live play scenarios used in the pre-assessment were reenacted. These play scenarios were again conducted by researchers and school staff and videotaped. Participant responses were recorded and independent blind research assistants viewed segments of the videotape to determine the participant's selection.

The multiple baseline design presents the opportunity to demonstrate experimental control over three different points in time (Horner et al, 2005; Kazdin, 1982), whereas the pretest posttest design allows comparison of emotion recognition tasks performance before and after the intervention was implemented. In this way, divergent information was collected in order to ascertain whether the computer program is an effective intervention in improving performance on emotion recognition tasks both in computer based assessments and in live conditions. The in vivo pre- and post- assessment took place in the child's school in a familiar classroom or the therapy lab/office. The researcher and familiar school staff role-played the participant-specific scenarios incorporating the child's circumscribed interests, and the participants' responses were recorded by the researcher who posed a question at the end of each scenario. These sessions were videotaped in order to ensure accuracy of recorded data and for reliability. Two independent blind reviewers watched segments of recordings in which the participant made a choice and recorded the response.

Materials and measures. Episodes from a children's animated series, called *The Transporters,* which was created specifically for children between the ages of 3-8 with ASD

to recognize and understand facial expressions, was shown repeatedly following the baseline. The series consists of fifteen, five-minute episodes that each focus on an emotion or mental state. The emotions depicted/taught in the series include: (a) the "basic" emotions of happiness, surprise, fear, anger, sadness, and disgust (Ekman, 1999); (b) developmentally significant emotions such as jealousy, pride, and shame; and (c) emotions and mental states such as kindness, unfriendliness, or joking, that are an integral part of everyday social functioning (Golan et al., 2010*).* The fifteen emotions addressed in *The Transporters* are happy, sad, angry, afraid, disgusted, surprised, excited, tired, unfriendly, kind, sorry, proud, jealous, joking, and ashamed. The series includes eight characters, all vehicles, which are part of a toy set in a boy's bedroom. All of the vehicles run on tracks, cables, or otherwise have limited degrees of freedom of motion that are predictable. In addition, the vehicles have real human faces grafted onto them of different ages, sex, and ethnicity. Incorporating diverse age, sex, and ethnicity was intentional in order to enhance generalizability of effects. The assumption was that children with ASD would look more often at faces attached to mechanical systems (vehicles) than they would under normal circumstances (Golan et al., 2010). Additionally, a narrator was utilized instead of talking characters, in order to allow children to focus on facial expression as a whole rather than trying to obtain affective information from the character's speech. The DVD includes a selection of quizzes that relate to each episode that can be accessed from the main menu. In each episode quiz and in the "Try a Mix of Questions" quiz, there are a maximum of eight questions. Three types of questions are utilized in each of the quizzes: (a) matching faces with faces (match the two characters that are feeling the same); (b) matching faces to an emotion (identify the face that portrays a specific emotion); (c) matching situations with faces (identify the correct emotion

that might be displayed in a given situation). Each "Try a Mix of Questions" and episode-based quiz has two questions each for matching faces with faces, and matching faces to an emotion. The final type question, matching situations with faces is asked four times in each episode-based quiz. Each quiz has two levels of difficulty, easy and hard; hard quizzes repeat the easy quizzes but offer three potential answers as opposed to two. The total number of questions in the Try a Mix of Question pool was 120 questions for the easy version and 120 for the hard version.

Dependent variables. There were six variables that were measured in order to assess any effects from watching episodes from the DVD. Three of these variables were measured through taking quizzes from *The Transporters* DVD. The other variables assessed performance in live conditions.

Ability to identify a person's facial expression from a DVD. In the "Try a Mix of Questions" from the DVD, two questions per quiz assess the participant's ability to identify, from a choice of three responses, which character is feeling a given emotion. For these questions a squawk box or speaker is shown followed by a narrator posing the question "Who is feeling _____?" and presenting close-ups of three different character' faces displaying different emotions. Responses to these types of questions were recorded and progress was monitored via graphs created through Microsoft Excel.

Ability to match face with a face from a DVD. A second type of question utilized in the Try a Mix of Questions Quiz from the DVD, asks the participants to match similar emotions in different characters. For example, the DVD might show a close-up of Barney, one of the characters looking angry. The narrator might then pose the following question:

Barney is feeling angry. Who else is feeling angry? Is it Jennie? Or William? Or Sallie? There are two of these types of questions in each quiz and they all follow the same format. Again, participant responses were recorded and tracked in Excel in order to determine improvements, patterns, or trends.

Ability to match a situation to a face from a DVD. The third question type used in the DVD requires theory of mind. These questions account for the other 4 questions in the Try a Mix of Questions Quiz. An example of this type of question from the DVD would begin with a close-up of William, the chain ferry, with his features blurred out; the narrator would then make the following statement and pose the following question: "William is trying to get to the harbor, but he's losing his strength. How is William feeling? Is he proud? (showing a close-up of William looking proud) Or happy? (showing a second close-up of William looking happy) Or tired?" (again showing a close-up of William looking tired). Next, the DVD shows a green screen with the three choices which consist of William's face showing three different emotions. The participant would point to their chosen response and the response was again recorded and graphed to assess changes with the introduction of the independent variable.

Ability to identify a person's facial expression from a live model. For the in vivo pre- and post-test, two of these types of questions were used in both assessments. The participant sat at a table with familiar adults, while the narrator read from a script. For example, the narrator might pose the following question: Who is surprised? Is it Ms Romero (Ms Romero would show a look of surprise until the participant made a choice by pointing to an adult or stating a response)? Or Ms. Mia (making an angry face when name is called and continuing

to look angry until the participant made a choice) or Ms Jon (making a disgusted face and holding it until a response was given). Responses were recorded and graphed in Excel.

Ability to match a face to a face in live models. Again, two of these types of questions were used in the pre-test and post-test. In the in vivo condition a narrator might pose the following question: Ms. Romero is feeling angry. (Ms. Romero would look angry upon hearing her name and continue to hold this expression until the participant responded to the question) Who else is feeling angry? Is it Ms. Jon (Ms. Jon would look happy upon hearing her name and continue to look happy until the participant responded) Or Mr. Al (Mr. Al would look tired and hold the expression until the participant responded) Or Ms. Mia (Ms. Mia would make an angry expression upon hearing her name and hold it until the participant responded to the question. Again, responses were recorded and graphed.

Ability to match a situation to a face in a live setting. These types of questions make up the remaining four questions for the in vivo assessments. For these questions, a familiar adult who served as narrator sat with the child at a table. Circumscribed interests of the child were taken into account and were used to create scripts in order to pique interest of the participants. An example used was "Ms. Romero's friend is coming to play Barbies with her. Ms. Romero can't wait until they can play Barbies together. Ms. Romero loves playing Barbies with her friend. How is Ms. Romero feeling? Is she excited? Or surprised? Or afraid?" Ms. Romero faced away from the participant and engaged in play with Barbies in a doll house. A picture board was presented with three blown-up photos of Ms. Romero looking excited, surprised, and afraid. The narrator pointed to each face as she asked each question. Performance was again recorded and graphed.

Follow-up. Additionally, in order to assess whether any treatment effects were maintained, a follow-up assessment was conducted one-month post intervention. In order to assess maintenance, the "Try a Mix of Questions" quiz was again shown and data on responses was recorded.

Social validity. Upon completion of the post-test, the parents and teachers were given a short questionnaire. The questionnaire asked these adults whether any changes were noted in the identification of facial expressions and or reaction to facial expressions (the intervention worked) outside of the intervention. It also asked about the accessibility of the intervention and whether or not the teacher or parents would continue to use *The Transporters* DVD upon completion of the study. Finally, the questionnaire probed whether either group would recommend the DVD to other parents and teachers of children with autism spectrum disorder. The questionnaires can be found in Appendix G and H.

Treatment fidelity. Treatment fidelity was maintained throughout the intervention by documenting when episodes were shown and recording target responses via checklist and videotape. Furthermore, sections of the recorded sessions were shown to two independent blind reviewers in order to insure fidelity of recording participant responses and determine inter-observer reliability. Teachers were also provided with explicit instructions for showing the episodes to each participant. In addition, teachers were provided with forms to document when the episodes were shown.

Interobserver reliability. Interobserver measures were calculated for 20% of baseline and intervention sessions for all participants. Two research assistants who were unfamiliar with the study watched portions of video recordings and recorded participant responses.

Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The mean agreement for recording of participant responses was 97%.

Data analysis. Data were graphed using line graphs from Microsoft Excel. Visual analysis of the data was used to assess patterns of experimental control and changes level and trend. In addition, simple descriptive statistics were calculated to assess differences in mean level of response across phases.

Chapter 4: Results

This study investigated the use of *The Transporters* computer software to teach emotion recognition to young children with autism spectrum disorder (ASD) being educated in Communication and Social Skills Classrooms and to assess whether improvements were evident in live sessions using adult models in the school setting**.** Specifically, the study investigated the relationship between instruction with *The Transporters* software and participant performance on emotion recognition (ER) tasks.

Participant Performance on ER Tasks during Intervention

It was hypothesized that participants' use of *The Transporters* would improve performance on The Transporters Quizzes during the intervention. Three dependent variables that were measured in this study included the ability of the participants to identify: (a) a person's facial expression from a video; and (b) matching facial expressions for different people from a video; identify an emotion that might occur as a result of a scenario in a video. Following the introduction of the intervention, the number of correct responses increased from a mean of 3.3 correct responses per session in the baseline (maximum score was 8) phase for all participants to a mean of 5.2 correct responses per session in the intervention and follow-up phase (+ 1.9). Figure 1 shows group data on performance during both intervention and intervention on the first

three dependent variables. Tables 2-7 provide information regarding individual performance in terms of level and trend changes.

Overall, in reviewing the data, Bella showed the most improvement with a mean score of 2.9 in baseline to a mean intervention score of 5.5 correct responses per session (+2.6). The series begins with episodes focused on more basic or simple emotions such as happiness, sadness, etc. After the 7th episode, the series centers around more complex emotions such as jealousy, being unkind, etc. An arrow was utilized in figure 1 to show when episodes involving more complex emotions were shown to the individual participants. Mean scores on ER tasks were calculated for performance after viewing the first 7 episodes and following viewing of the last 8 episodes in order to examine whether there were performance spikes following the viewing of episodes depicting the complex emotions. Angel scored an average of 4.6 correct responses in episodes involving simple emotions. His average number of correct responses during the phase of the intervention in which complex emotions were introduced was 6.1 (+1.5). Similarly, Bella scored an average of 4.4 correct responses on quizzes after viewing episodes focused solely on simple emotions. Her scores increased by 1.5 to 5.9 correct responses on the quizzes following viewing of episodes targeting complex emotions. Darius showed the least amount of difference with a score of 4.1 average of correct responses for the first 7 episodes to 4.5 (+.4) average of correct responses following viewing of episodes showing complex emotions.

After watching all episodes of *The Transporters*, one day for 15 school days, the participants were given a choice as to which episode he/she would like to watch for the final 5 days of the intervention. During this time the average numbers of correct responses from baseline to the last five days of the intervention were 4.3 to 6.6 (+ 2.3) for Angel, 2.9 to 6.8 (+ 3.9) for Bella, and 2.7 to 4.2 (+ 1.5) for Darius. Scores during these 5 days warrant closer

inspection because they reflect performance after participants had completed episodes focused on basic and more complex emotions.

The follow-up probe, conducted one month post-intervention, suggests that treatment effects were maintained for all participants in the absence of watching episodes from *The Transporters*. Specifically, both Angel and Bella responded correctly to 7 of 8 questions on the follow-up, which was consistent with their scores during the final weeks of the intervention phase, and Darius responded correctly to 5 of 8 questions, which was somewhat consistent with his intervention scores.

Figure 1.
Scores on Hard "Try a Mix of Questions" Quiz for Three Participants

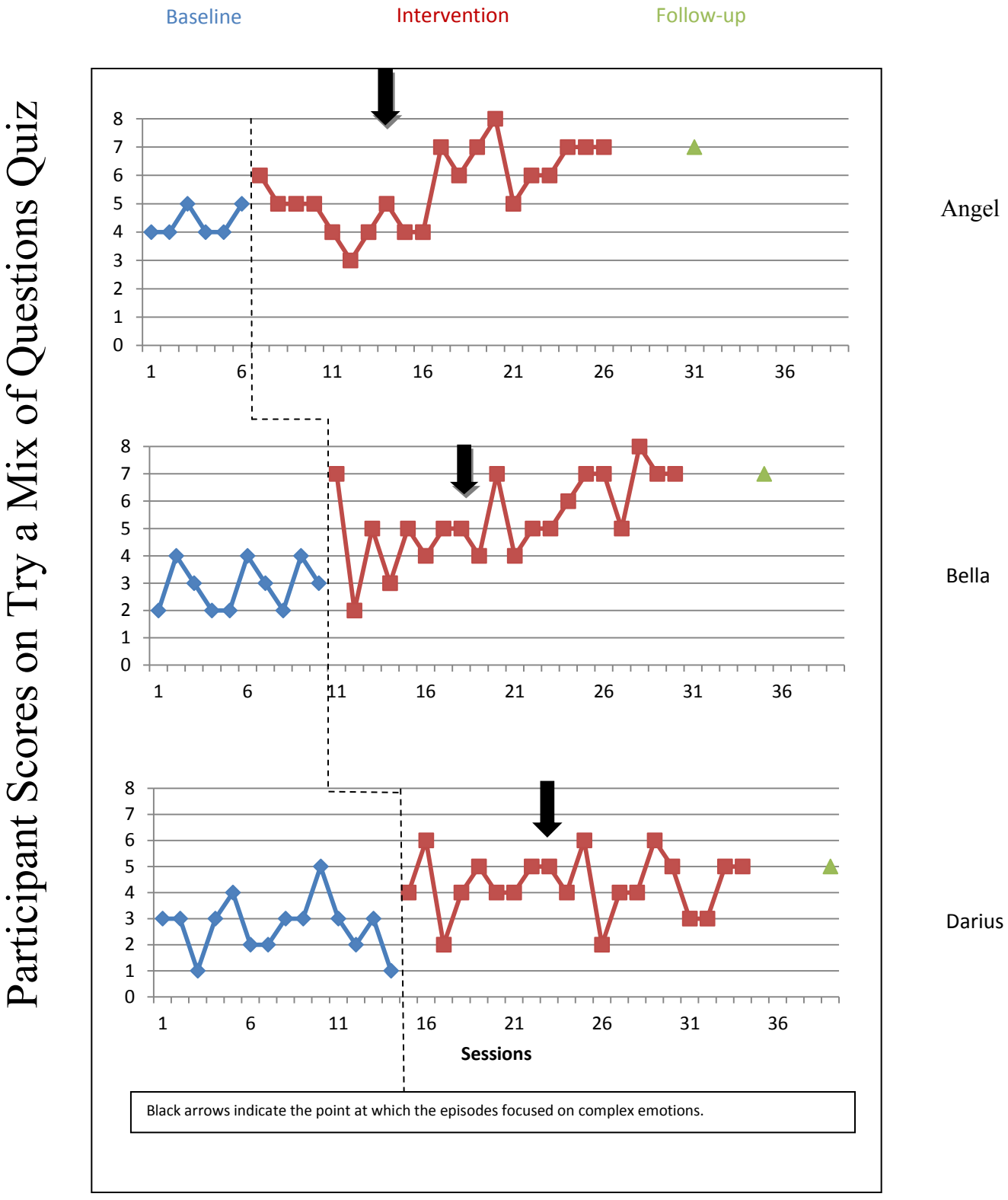
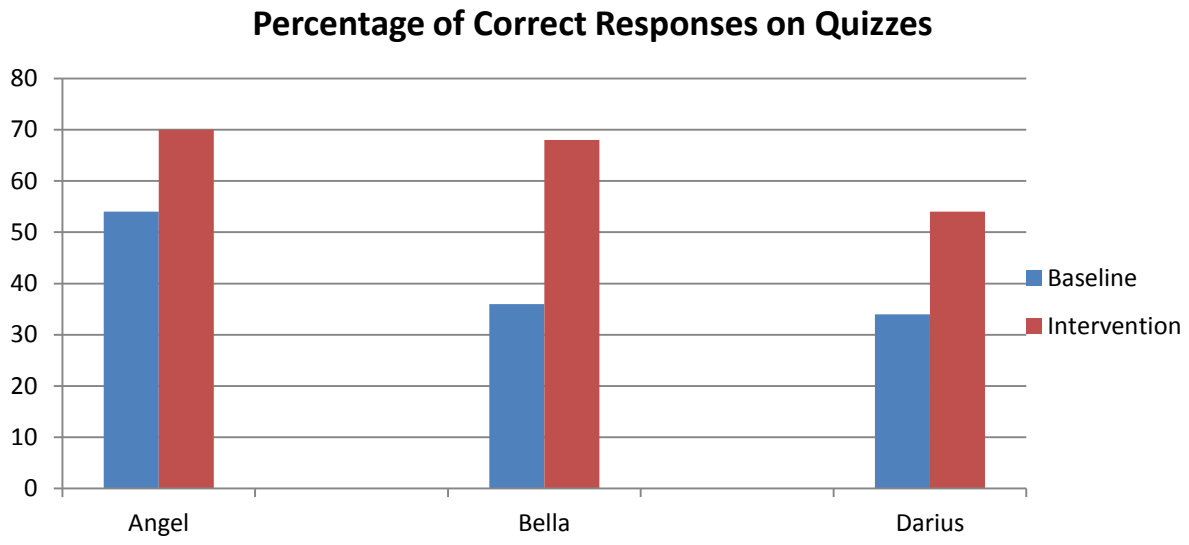


Figure 2 displays the data in percentages of correct responses to quizzes during the baseline and intervention phases. Angel increased his percentage of correct responses from 54% during baseline to 70% during the intervention and follow-up phases. In calculating the percent increase by subtracting one number from the other and multiplying by 100, Angel improved his quiz scores by 30% from baseline to the intervention phases. Bella scored an average of 36% correct responses during baseline to an average of 68% correct responses during the intervention phase and follow-up phase. In using the same calculations cited above, she increased her score by 89%. Darius increased his score by 62% with an average of 34% correct responses on quizzes during the baseline phase to an average of 54% correct responses during the intervention phase.

Figure 2:

Average participant scores on Try a Mix of Questions quizzes from baseline through intervention and follow-up.



Analysis of individual performance.

Table 2.

Angel's performance: level changes

	Baseline	Intervention
Median	4	6
Mean	4.3	6
Range	4-5	3-8
Relative Change	0 (no change)	+2.5 (improved)

In terms of Angel's level changes, his performance on quizzes went from a mean of 4.3 to a mean of 6 (+1.7) during the intervention phase. Level change calculations suggest that his scores were stable on ER quizzes in the baseline phase and improved by +2.5 in the intervention phase. Immediate change in level for phase change was +1, which suggests that the intervention has had some effect.

Table 3.

Angel's performance: trend changes

	Baseline	Intervention
Direction	Accelerated	accelerated
Stability	Stable	stable

The accelerated trend direction suggests that he was improving in ER tasks.

In terms of variability, data of both conditions is considered stable (80% of data points fall within 25% of the median values for each condition). The percentage of non-overlapping data is 55%.

Table 4.

Bella's performance: level changes

	Baseline	**Intervention**
Median	3	5
Mean	2.9	5.5
Range	2-4	2-8
Relative Change	(+1) improved	(+1.5) improved

Bella's performance on quizzes went from a mean of 2.9 to a mean of 5.5 (+2.6) during the intervention phase. Level change calculations suggest that her scores improved by +1 on ER quizzes in the baseline phase and by +1.5 in the intervention phase. Immediate change in level for phase change was +4, which suggests that the intervention has had some effect.

Table 5.

Bella's performance: trend changes

	Baseline	Intervention
Direction	**Accelerated**	**Accelerated**
Stability	**Stable**	**Variable**

In reviewing Bella's data, the accelerated trend direction suggests that she improved in ER tasks. In terms of stability, data of the baseline condition is considered stable (80% of data points fall within 25% of the median values for each condition). Data of the intervention condition is considered variable as only 55% of the data points fell within 25% of the median value. Percentage of non-overlapping data is 75%.

Table 6.

Darius' performance: level changes

	Baseline	Intervention
Median	**3**	**4**
Mean	**2.7**	**4.4**
Range	**1-5**	**2-6**
Relative Change	**(0) no change**	**(+.5) improved**

His performance on quizzes went from a mean of 2.7 to a mean of 4.4 (+1.7) during the intervention phase. Level change calculations suggest that his scores were stable on ER

quizzes in the baseline phase and increased by +.5 in the intervention phase. Immediate change in level for phase change was +3, which suggests that the intervention has had some effect.

Table 7.

Darius' performance: trend changes

	Baseline	**Intervention**
Direction	Decelerated	Accelerated
Stability	Variable	Variable

The accelerated trend direction suggests that he improved in ER tasks with the introduction of the IV. In examining stability, data of both the baseline condition and intervention condition are considered variable as only 71% of the data points fell within 25% of the median value in the baseline condition and only 75% fell within 25% of the median value in the intervention condition. The percentage of non-overlapping data is 15%.

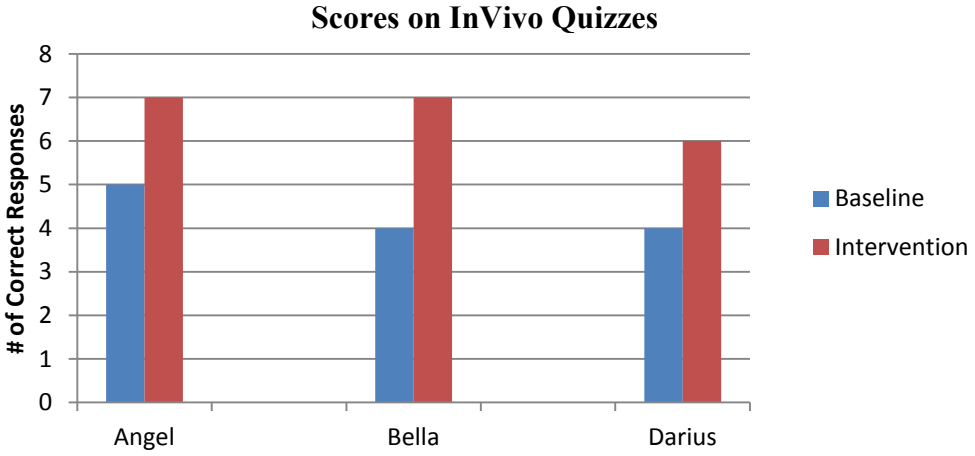
Participant Performance on ER Tasks Involving a Live Model from Pre- to Post-Intervention

It was also hypothesized that use of *The Transporters* would improve performance on emotion recognition tasks involving a live model from pre- to post-intervention. The other three dependent variables that were measured included the ability of participants to identify: (a) a person's facial expression from watching a live model; (b) matching faces to faces of live

models; (c) an emotion that might occur as a result of a live situation. Table 8 displays the results of performance on the in vivo quizzes both at baseline and post-intervention for all participants. All participants made gains from pre-intervention to post intervention, which suggests that the participants were able to generalize the information learned from watching *The Transporters* and were better able to recognize and understand emotions of familiar adults in live settings.

Table 8:

Participant scores on In vivo Quizzes



Figures 3, 4, and 5 display the results by question type in order to provide more specific information to determine whether participants were better able to respond to questions involving matching an emotion to a face, matching emotion to emotion, or scenarios involving theory of mind. In Figure 3, which depicts scores from 0-2 correct responses on the match facial expression to another facial expression questions (i.e. "Barney is feeling surprised? Who else is

surprised? Is it Sally? Or Jennie? Or Charlie?"), the only participant who demonstrated marked gains was Bella. The trend for correct responses was evident in her scores, which consisted of perfect responses from the 20th session through the rest of the intervention, as well as the follow-up. Both Angel and Darius showed more variability in their scores, and as such a trend was not evident. Darius particularly showed more variability in his responses by scoring 0-2 throughout the baseline and intervention phases.

Figure 3.

Scores on Matching Facial Expression to Facial Expression Questions

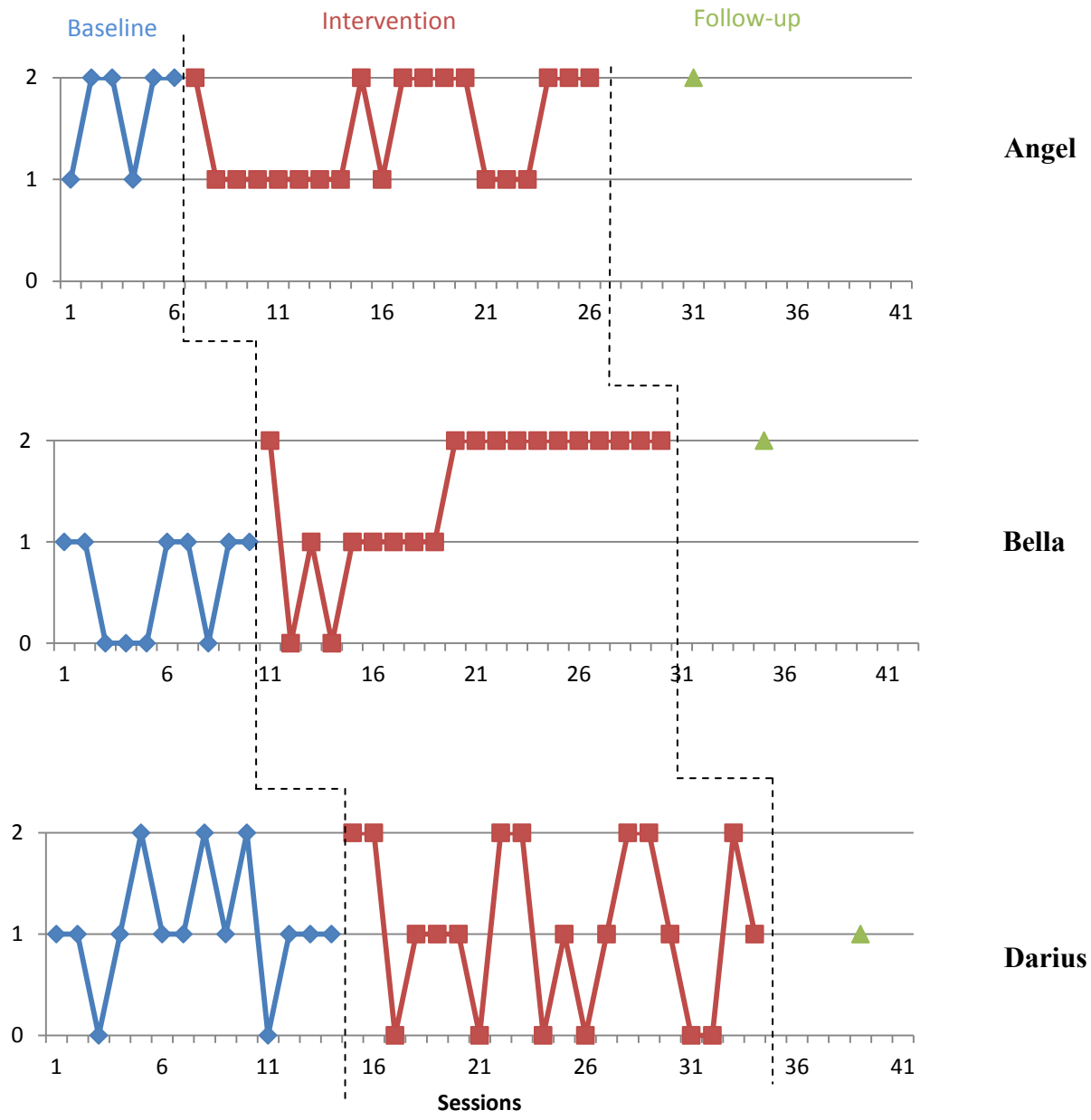


Figure 4.

Scores on Matching Emotion to Facial Expression Questions

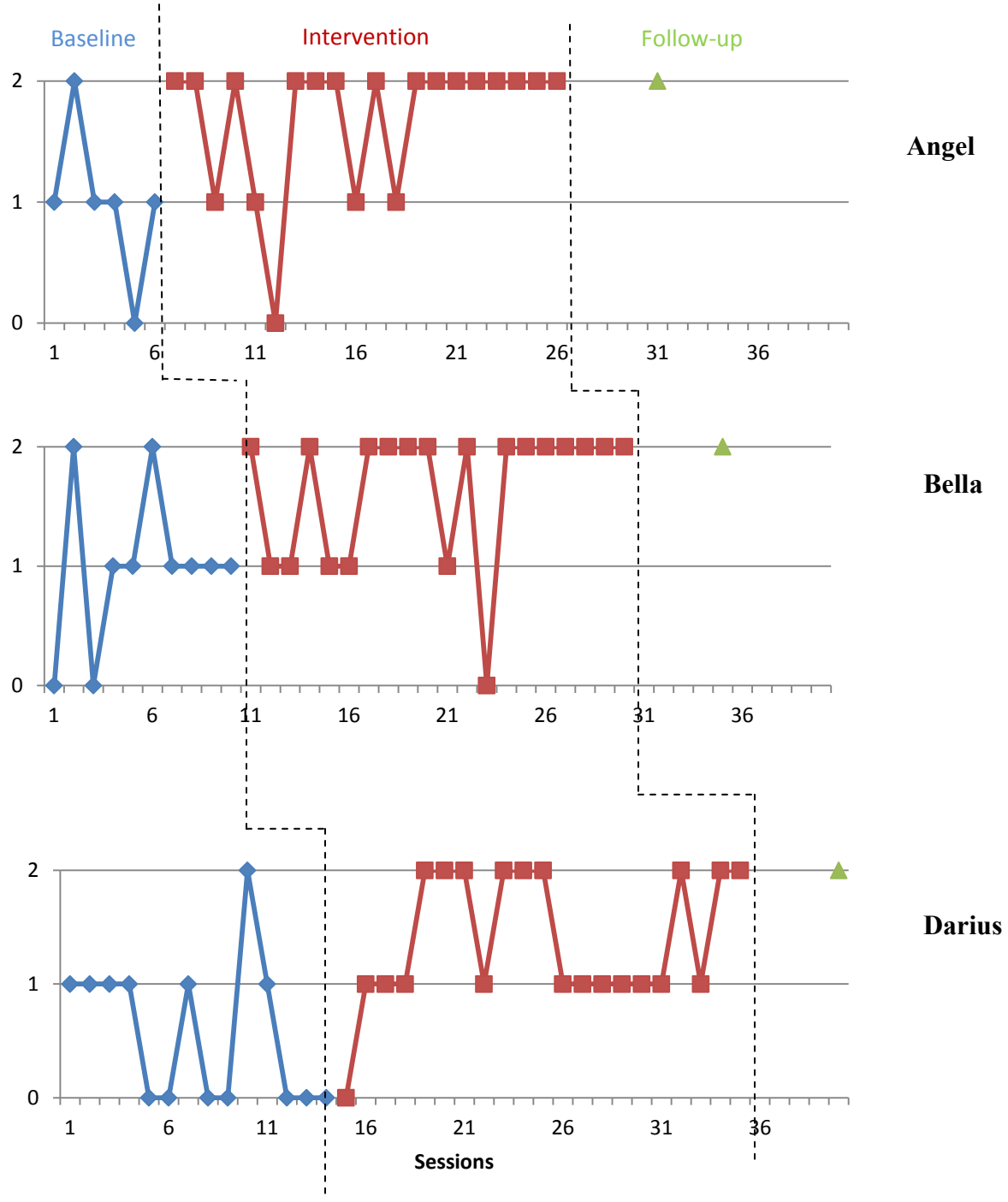
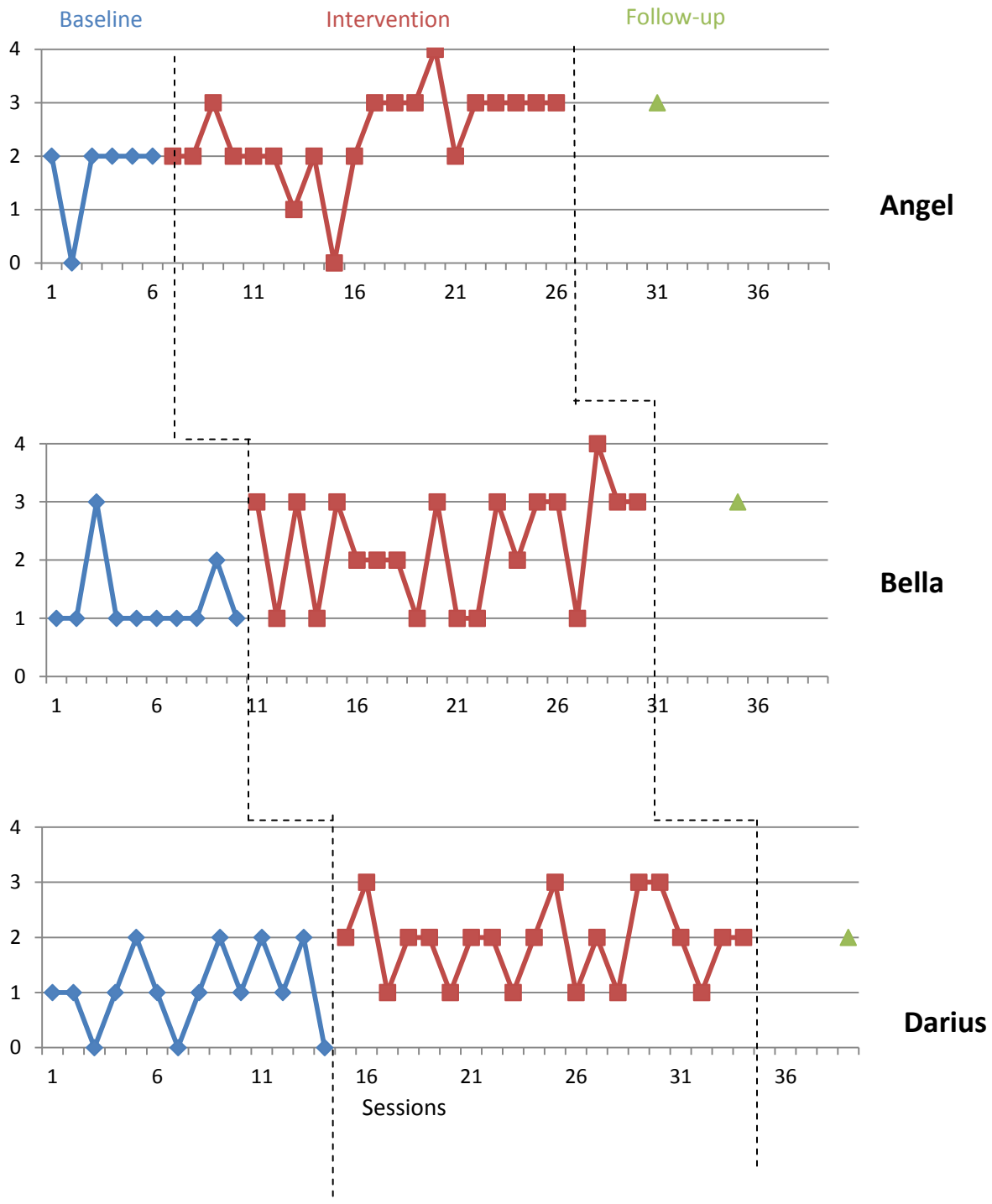


Figure 5.

Number of Correct Responses on Quiz Questions involving Theory of Mind



Social Validity Results

The results for the social validity survey for teachers and parents are shown in tables 9 and 10, respectively. All three teachers and two of the parent participants responded to the survey following the intervention phase and the In Vivo post-test. The third parent was sent the information three times, but failed to respond. Overall, teachers and parents who responded felt that the intervention benefitted the participants. These results suggest that the raters viewed the treatment as socially valid.

Table 9.

Teacher Survey Responses

Questionnaire Item			
1.Did you feel that *The Transporters* was easy to use?	Yes	Yes	Yes
2.Do you feel that your students enjoyed viewing episodes from *The Transporters*?	Frequently	Sometimes	Frequently
3.Do you feel that the students benefitted from using the software?	Yes	Yes	Yes
4.If so, in what way?	It taught them to recognize and understand facial expressions.	She is now more sensitive to facial expressions. No need for verbal	I noticed improved emotional control and less tantrums.

		prompts.	
5.If you had access to your own copy of *The Transporters*, would you use it with other students?	Yes	Yes	Yes
6.Would you recommend *The Transporters* to other parents and or teachers of children with autism?	Yes	Yes	Yes

Table 10.

Parent Survey Responses

Questionnaire Item		
1. Did your child talk about his feelings prior to this study taking place?	Yes	Yes
2. If yes, how often?	Sometimes	A Little
3. Did your child talk about other people's feelings prior to this study taking place?	Yes	No
4. If yes, how often?	A Little	N/A
5. Does your child talk about feelings now?	Yes	Yes

6. If yes, how often?	Frequently	Frequently
7. Would you consider purchasing your own copy of *The Transporters*?	Yes	Yes
8. Would you recommend *The Transporters* to other parents of children with autism?	Yes	Yes

Chapter 5: Discussion

The major rationale for the current study was to determine whether the use of *The Transporters* in a school setting led to an increase in scores on emotion recognition measures for young children with autism spectrum disorders (ASD). This is the first study using *The Transporters* in a school setting versus a home setting, and it is the first to assess the impact of the intervention on in vivo recognition of emotions. *The Transporters* is a relatively new intervention designed to teach emotion recognition to young children. The effectiveness of individual use of *The Transporters* was evaluated in a school setting over a four-week period with follow-up one month post-intervention. It was hypothesized that the viewing of episodes from *The Transporters* would increase emotion recognition ability in participants during intervention. Significant increases in emotion recognition tasks were evident from baseline to intervention phase for all 3 participants. Furthermore, the improvements in emotion recognition and understanding for all three participants were evident in the follow-up phase, which suggests that treatment effects were maintained. Overall, the results suggest that *The Transporters* could be an effective tool in teaching emotion recognition and understanding to young children with significant social deficits and impaired ability to recognize emotions in others. This finding supports previous research supporting the efficacy of utilizing *The Transporters* to teach emotion recognition in young children with ASD (Golan et al, 2010; Young & Powell, 2012).

Both previous investigations involving *The Transporters* consisted of group designs and were conducted in home settings. Generalization was minimally addressed. The current study sought to address some of these deficits in the research by focusing on a small number of children in the school setting and incorporating live models in assessment in order to address generalization.

It was hypothesized that the use of *The Transporters* would improve performance on emotion recognition (ER) tasks involving a live model from pre to post-intervention testing. Improvements were evident in all three participants. These improvements from the pre-intervention in vivo condition to post-intervention in vivo condition suggest that participants were also able to generalize the ER skills they acquired while using the software. This is significant because prior studies examining ER interventions for individuals with ASD have shown limited generalization of learned skills (Bölte et al., 2002; Silver & Oakes, 2001).

One of the aims of the study was to establish whether *The Transporters* is effective in teaching young children, served in self-contained, special education Communication Social Skills (CSS) classrooms, to identify facial expressions, match similar facial expressions, and determine a likely facial expression from situational cues. In each random quiz from *The Transporters*, two questions were posed to elicit a response regarding facial expression identification. A squawk box was shown and the narrator's voice would ask "Who is feeling _____?" Then three different characters from the series would be shown and the participant would select their choice. None of the participants scored highly on these types of questions during the baseline sessions, which supports previous findings that children with ASD have

difficulty identifying facial expressions in others (Ashwin et al., 2006; Braverman et al., 1989; Celani et al., 1999; Clark et al., 2008; Hobson, 1986a, 1986b; Loveland et al. 1995; Macdonald et al. 1989; Scambler et al., 2007; Wallace et al., 2008; Yirmiya et al., 1992). During the intervention phase, all three participants demonstrated gains in identifying facial expressions in these quizzes.

In addition to questions that required participants to identify an emotion, there were two questions in each random quiz that required participants to match similar facial expressions. This skill did not appear to be a deficit for Angel based on his performance during baseline. Due to his high scores during baseline, a trend or level change was not apparent during the intervention phase based on performance on these types of questions. Bella, on the other hand, performed relatively poorly in baseline and during the first half of the intervention phase on these types of questions. Mid-way through the intervention a level change and trend were apparent for Bella. Darius showed the most variability in his scores during both baseline and intervention sessions. There was no apparent level change or trend in his scores on these types of questions. This might be due to his attentional deficits while viewing episodes from *The Transporters* and in taking the quizzes.

The final types of questions featured in the quizzes were theory of mind questions, which made up the last four questions of the quiz. The theory of mind questions involved situational contexts, which made the questions more complex. These questions centered on how one might feel as a result of a particular situation. All three participants made gains in this area. Bella and Darius made the most improvements, while Angel showed modest improvements answering these types of questions. Similar improvements in theory of mind tasks were found by Silver and Oakes (2001) following a computer based intervention. These

findings are significant because very few studies have focused on using a computer to teach theory of mind to children with ASD (Beaumont & Sofronoff, 2008; Silver & Oakes, 2001; Solomon et al., 2004; Sweetenham, 1996). And even fewer studies support gains in theory of mind tasks following an intervention (Beaumont & Sofronoff, 2008; Silver & Oakes, 2001).

This theory posits that individuals with ASD have difficulty connecting socially with others because they lack theory of mind or knowledge that others know, want, feel, or believe. Data for all three participants at the onset of the study show that they had difficulty answering questions regarding predicting emotions in others in given situations. All participants made gains in ability to infer how someone might feel in a variety of scenarios. This is suggestive that as a result of participating in the intervention students gained theory of mind in that they were able to attribute thoughts and emotions to others as well as make predictions about emotions in given situations. In short, they learned to interpret and predict emotions in others. This is significant because theory of mind can affect one's social competence, which can impact overall quality of life.

Furthermore, predicting or inferring how another person might feel could lead to empathizing. Understanding how another person is feeling is crucial to developing empathy. Empathy can subdivided into two components: cognitive and affective empathy. Cognitive empathy is the drive to identify how another person is feeling. Affective empathy refers to the drive to respond appropriately to another person based on how he/she is feeling. Based on the data from this study, it appears that The Transporters has been successful in teaching cognitive empathy. However, more research is necessary in order to determine whether affective empathy is also affected.

Although autism is characterized by a weak drive for global coherence (Frith, 1989; Frith & Happe, 1994), results of this study suggest that use of *The Transporters* software can lead to improvements in extracting meaning or emotional information from faces in both videos and in real-life scenarios. Improved performance on ER tasks by all three participants suggests that a change occurred in their ability to process faces. At the onset of the study all three participants demonstrated poor performance on simple ER tasks such as identifying how someone is feeling or matching how one person is feeling with how another person is feeling. Over time, after watching episodes from the series, the participants became more adept at these skills. The findings suggest that in a relatively short amount of time individuals with ASD can learn to process different features of the faces of others in a more global manner. This apparent change from local processing to global processing might possibly be a result of increased focus on core feature areas of the face (eyes, nose, and mouth) as opposed to non-feature areas of the face. Another possible cause of processing changes could be a result of overall increased attention to faces of others as a result of watching episodes from *The Transporters*. After participating in several viewings of episodes from The Transporters series, all participants made gains in ER tasks which suggest that this can be an effective tool in teaching individuals with ASD to process faces in a more global manner in order to extract meaning.

Implications

The purpose of the current study was to examine the effects of a computer-based intervention on ER abilities in children served in CSS self-contained classrooms. This study indicates that viewing episodes from *The Transporters* enhances facial and emotion recognition abilities. These improvements in ER were evident in both quizzes from *The*

Transporters and in assessments using live models. These results are consistent with previous studies touting the effectiveness of computer-based interventions targeting social skills for children with ASD (Bölte et al., 2002, 2006; Golan et al., 2008; Lacava et al., 2007; Lacava et al., 2010; Simpson, Langone, & Ayres, 2004; Sweetenham, 1996; Tanaka et al., 2010), but extend most of those findings by also demonstrating that the positive results transfer to live contexts.

In a relatively short amount of time, 15 minutes per day over a four week period, all participants made gains in tasks involving both emotion recognition and understanding. The fact that all participants learned to extract overall meaning from different features of faces in the video and live conditions demonstrate marked gains in ability to process features globally. The data suggests that the participants, in a short amount of time, experienced changes in ability to process information from more local to global processing of faces. In addition, participants made gains in attributing mental states to others as a result of the intervention. These gains in theory of mind tasks could be a result of increased attention to faces as a result of watching *The Transporters* series.

In terms of practical implications, *The Transporters* could be used by teachers in classrooms to support social skills training in individuals with ASD throughout all English speaking countries. If future participants/students make similar gains, the potential impact on the social skills of children with ASD could be outstanding. *The Transporters* could be used independently by students in multiple settings (home, school, therapy lap, etc.) and it could be individualized to address students' needs. For example, the teacher might only show episodes that focus on a certain emotion that a particular student has difficulty recognizing. The fact that anecdotal data suggest that the participants enjoyed watching the series; it seems likely

that it would be enjoyed by other individuals with ASD as well. The fact that some individuals with ASD appear to enjoy watching the series and that they are able to access the DVD via computer independently frees the teacher up to instruct in other areas. For example, a teacher might allow three students in her classroom to access *The Transporters* through the classroom computers while she runs a social skills group with two or three other students.

Although it was not measured, anecdotal observations suggest that the participants enjoyed watching the series. Both Angel and Bella frequently asked if it was time to watch the episodes and or if it was time to go next door to watch the last episode and take the quiz. Both Angel and Bella would make comments regarding how the characters were feeling at frequent intervals through both viewing of the episodes and during the quizzes. They both also tended to mimic the facial expressions shown while watching the episodes. Darius, on the other hand would willingly come to the area to watch episodes and take the quizzes, but he was highly distractible. Based on anecdotal records, he did not comment on the episodes during viewing and spent more time looking around the room than watching the episodes. His limited engagement during the viewing could account for his variable performance and modest gains during the intervention.

Limitations

One of the limitations of this study is the small sample size. A second limitation is the variability of symptoms present in each individual child. Specifically, as autism is a spectrum disorder, there is a wide degree of variation in the way it affects people. The diverse presentation of symptoms in children with ASD may limit generalizability of results, as each child with ASD is unique.

Another limitation of this study was the variability of the assessments given as well as variability in who provided the assessments. With the exception of researcher obtained receptive language scores on the PPVT for all participants, the available assessments were different for each of the participants. The lack of common assessments limits both generalizability of results and future replication. Specifically, Bella's psychological report consisted of scores on the *Stanford –Binet Intelligence Scales (SB5) fifth edition* as well as parent completed Vineland Scores for adaptive behavior. Angel's psychological report consisted of ADOS test results and the *Batelle Developmental Inventory -2nd edition (BDI-2)*. Darius' testing information included the Gilliam Autism Rating Scale- 2nd edition (GARS-2), the Autism Diagnostic Observation Schedule- Module 1 (ADOS) and the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II). Consistency in types of tests used and or reported limits the generalizability of the results.

Another limitation of the study is lack of information regarding the psychometric properties of the assessments that are part of *The Transporters*. While the results of the current investigation suggest that they measure what is being taught, there is no available information regarding the reliability and validity of these quizzes. The same can be said for the researcher-created in vivo assessments.

Recommendations for Future Study

While the current research supports that use of *The Transporters* can assist children in learning to identify and recognize emotions in others, more research is needed to support the use of *The Transporters* as evidence-based practice. Further study of this program should

include group studies, longer intervention periods, diverse settings, and more careful control over the population under study.

Given the positive findings of this particular study and in light of the practical implications of using *The Transporters* in a school setting, further research is warranted to explore how it might be used in social skills training or other treatment groups for children with ASD in the school setting. Additional research might address how teachers can further assist students with ASD in recognizing and understanding emotions in others, particularly in natural contexts. Teachers could pose questions throughout the day asking students to either identify how a classmate, peer, adult is feeling and or attribute a mental state to another individual in a real situation (e.g. Mark missed the school bus. How is Mark feeling?).

In addition, future research might include using *The Transporters* along with the recently developed resource CD from Changing Media Development. The CD, which would lend itself well to classroom use, features individual games, group games, activity worksheets, emotions cards, and a user's guide.

Another area of research might include using The Transporters in conjunction with eye-tracking technology in order to assess changes in eye gaze patterns. This is significant because eye tracking studies have demonstrated that individuals with ASD differ from typical peers in the way that they view human faces (Anderson et al., 2006; Hernandez et al., 2009; Klin et al., 2002; Riby & Sneddon, 2009). Eye tracking studies while using *The Transporters* might document increased attention to faces, increased attention to the eyes, or pupilary dilation. Finally, although generalization was assessed through the in-vivo portion of the

intervention, more research is needed to study generalization of skills in natural settings and to determine whether the use of this software impacts other social skills.

Continuing this line of research is necessary as preliminary research has demonstrated that ER skills can be acquired through appropriate teaching methods. Recognizing and understanding emotions and mental states of others may allow individuals with ASD improved social integration in both school and community.

Appendix A:

Definition of Terms

Terms that are used in this dissertation will be defined in the following list.

Emotion: refers to a mental and physiological state associated with a wide variety of feelings, thoughts, and behavior.

Basic Emotions: There are six basic emotions identified by Ekman (1999) and found to be understood universally. They include: happiness, sadness, anger, fear, surprise, and disgust.

Complex Emotions: These emotions typically develop over time and require mentalizing in both self and others. This includes emotions such as embarrassment, jealousy, shame with the addition of mental states such as thinking and knowing. Basic emotions are typically situation based, whereas complex emotions involve specific social contexts in which an emotion is inferred and behavior is predicted.

Emotion Recognition: The ability to identify emotions in both oneself and others.

Joint Attention: the ability to "coordinate attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events" (Mundy, Sigman, Ungerer, & Sherman, 1986, p.657).

Social Competence: refers to the social, emotional, and cognitive skills and behavior that is required for successful social adaptation.

Social Orienting: to spontaneously orient to naturally occurring social stimuli in the environment.

Theory of Mind: the ability to infer the thoughts, feelings, or intentions of others.

Weak Central Coherence Theory: This theory postulates that individuals with ASD make sense of things by looking at different parts.

Appendix B

Parental Consent & Permission for a minor child to Participate in Research Form

University of North Carolina at Chapel Hill
Parental Consent & Permission for a Minor Child to Participate in a Research Study
Consent Form Version Date: 09/24/2011
IRB Study # 11-1558
Title of Study: Evaluating the effectiveness of a computer based intervention, The Transporters, on both recognition and understanding of emotions in young children with autism
Principal Investigator: Neri Romero
Principal Investigator Department: School of Education
Principal Investigator Phone number: 904-874-3519
Principal Investigator Email Address: rneri@heelmail.unc.edu
Faculty Advisor: Samuel Odom, Ph.D.
Faculty Advisor Contact Information: slodom@unc.edu

What are some general things you and your child should know about research studies?
You are being asked to allow your child to take part in a research study and to take part yourself. To join the study is voluntary.

You may refuse to give permission, or you may withdraw your permission for your child to be in the study, for any reason, without penalty. Even if you give your permission, your child can decide not to be in the study or to leave the study early. You may choose not to be in the study yourself, or to start but stop at any time.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You and your child may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you and your child understand this information so that you and your child can make an informed choice about being in this research study.
You have been given two copies of this consent/permission form, one to keep for your records, and one to turn in to the researchers. You and your child should ask the researcher named above any questions you have about this study at any time.

What is the purpose of this study?
The purpose of this research study is to learn whether a computer based intervention, *The Transporters* is effective in teaching young children with Autism Spectrum Disorder (ASD) to recognize and understand emotions. Children who participate will watch episodes from

The Transporters and take quizzes which look at their ability to match similar expressions, identify a named expression, and determine how someone might feel as a result of an action or consequence.

I am an educator who has worked with children with autism spectrum disorder (ASD) for the last thirteen years. I have worked with numerous children and service providers to promote the educational and social development of children with ASD. Presently, in Duval County, there is no adopted curriculum for teaching social skills to children with ASD. I want to contribute to the preliminary research on *The Transporters* in order to assess whether it is effective in teaching young children with ASD to recognize and understand emotions. If my research supports that of others, Duval County and other counties in NE Florida might consider purchasing the DVD's and using them in self-contained Communication Social Skills classrooms.

The Transporters was developed to accelerate understanding of emotions through entertainment and simple repetition. The DVD was created with funding from the UK government and developed by the Autism Research Centre in Cambridge University and a Manchester-based production company. The DVD is centered on eight animated vehicles with predictable patterns of movement (tram, cable car, train, chain ferry, etc.). Real human faces of various ages and ethnicities were grafted onto each of the animated vehicle characters in the DVD.

The characters are part of a toy set in a child's bedroom that comes to life when their owner leaves for school. A narrator helps the children focus attention on emotions displayed rather than watching characters talking. Each episode focuses on one key emotion, presented in different contexts throughout the story. This central emotion is expressed by more than one character, to allow children to explore the expressions on different faces.

There are 15 episodes that last five minutes each and present both basic (happy, sad, etc.) and complex emotions (jealous, ashamed, etc.). In addition, the DVD offers episode-based quizzes, as well one that presents questions from several different episodes. The Transporters DVD is commercially available through Changing Media.

Some preliminary research showed that using *The Transporters* significantly improved levels of emotion comprehension and recognition in four to seven year old children with high functioning ASD in only four weeks.

Your child is being asked to be in the study because your child is currently served in a classroom for children with ASD and is between the ages of four and nine years.

How many people will take part in this study?

Up to 20 children and their parents in several classrooms who are interested in the study are being invited to be in the initial part of the study, which helps to find children who meet specific study requirements. Four to eight parent +child pairs in up to four schools will be

involved in the second part of the study. The study will also include up to four classroom teachers.

How long will your part and your child's part in this study last?

If you decide to participate and allow your child to participate, we will be asking you to provide a very brief summary of items/characters/toys that are highly reinforcing for your child.In addition, you will be asked to complete a short (up to 15 minutes) questionnaire near the end of the study, regarding whether you feel that the intervention made an impact on/changed your child. Your child will take daily quizzes that should take between four and eight minutes to complete, and during intervention, watch a five minute episode from *The Transporters* three times daily. The overall length of time that your child will participate is five to eleven weeks. In addition, a follow-up quiz which will take between four and eight minutes to complete will be given one month post-intervention.

What will happen if both you and your child take part in the study?

As noted above, you would be asked to complete a brief questionnaire about how much your child talked about feelings prior to and at the completion of the study. The questionnaire should take five to fifteen minutes to complete.

Your child may be tested using the Peabody Picture Vocabulary Test and may take a quiz from *The Transporters* in order to determine if your child meets study requirements.

If your child meets eligibility requirements, he or she will be asked "Do you want to play with me?" If your child chooses not to participate in the second part of the study when first asked, your child will be asked again, and if necessary, will be asked a third time. Even if you agree to allow your child to participate, your child may choose not to participate. Next, he/she will be introduced to a live play scenario based on interests/characters/toys that you determined to be highly liked by your child, and asked questions regarding emotions of the actor/s involved.

Following the live scenario, your child will participate in taking quizzes of eight randomly selected questions for 4-16 times over several days. Your child will be videotaped every fifth viewing session to both monitor his engagement and his responses.

Next, your child will be shown the first five minute episode of *The Transporters* three times daily and then given a quiz. The following school day, he/she will watch the second episode of *The Transporters* three times daily followed by a quiz. This process will continue until your child has watched all 15 episodes of *The Transporters*.

Next, your child will have the opportunity to choose an episode to watch at three different times during the school day and will take a quiz following the third episode/viewing each day. Your child will follow this procedure of choosing episodes for a total of five school days.

After a total of twenty school days of watching episodes from *The Transporters*, your child

will be exposed to the same live play scenario. Afterwards, you will receive the parent survey to complete. Your child will no longer participate in watching videos or taking quizzes from *The Transporters*. One month later, however, in order to determine whether any acquired skills were maintained, your child will again take a quiz with questions selected from several episodes of *The Transporters*.

We are also asking your permission to obtain from the school and copy, for research purposes, any of your child's relevant educational and psychological testing scores.

What are the possible benefits from being in this study?
Research is designed to benefit society by gaining new knowledge. It is also possible that your child may benefit from being in this study. The benefits to your child from being in this study may be an increased awareness of how other people are feeling.

What are the possible risks or discomforts involved from being in this study?
The children involved might experience infrequent frustration from taking the Try a Mix of Questions quizzes repeatedly. A visual token economy will be provided to each child prior to the start of the quiz which will help clarify expectations and reinforcement in the form of a small self-nominated prize will be provided once the task/quiz has been completed.

We will monitor your child's behavior and do what we can to prevent your child from losing interest or getting frustrated. Even if you give permission for your child to be in the study, your child may still refuse to participate at any particular time, and we will respect that.

For parent participants, the questionnaire is very short, and does not contain any sensitive questions.

How will your privacy and your child's privacy be protected?
You and your child will not be identified in any report or publication about this study. Names will not be used by the research staff to identify your information or your child's information. Instead, a research ID code will be used. Only research staff will know which ID code refers to which parent and child. The list that links names and ID codes will be kept secure in a locked file.

Your signed parent consent/permission form will be stored in a locked cabinet. All information obtained from or about you or your child as part of this study, such as the educational assessments, will be stored securely. As noted above, they will not contain your child's name, only an ID code.

Video recordings will be used to monitor your child's engagement and to keep accurate records of your child's responses, for research purposes. We will keep them in a secure location, and only people involved in the study will be able to watch them. It is possible that we might want to share short clips at professional conferences. We ask you about that at the end of this form. Your child's name will not be revealed or linked to the recording.

Will your child receive anything for being in this study?

Neither you nor your child will receive anything for being in this study.

Will it cost you anything for your child to be in this study?
It will not cost anything to be in this study.

What if you or your child has questions about this study?
You and your child have the right to ask, and have answered, any questions you may have about this research. If there are questions about the study, complaints, concerns, contact the researcher listed on the first page of this form**.**

What if there are questions about your child's rights as a research participant?
All research on human volunteers is reviewed by a committee that works to protect your child's rights and welfare. If there are questions or concerns about your rights, or your child's rights as a research subject, or if you would like to obtain information or offer input, you may contact the University of North Carolina at Chapel Hill's Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Please note: We are asking many families to be in this study, so your child might not participate in this study, even if you give permission.

Parent's Agreement to participate:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

_____ _____
Printed Name of Research Participant (parent) Date

_____ _____
Signature of Parent Date

Parent's Agreement to allow child to participate:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily give permission for my child to participate in this research study.

_____
Printed Name of Research Participant (child)

_____ _____

Signature of Parent Date

Parent's Agreement to permit video clips of child to be shown at professional conferences:

I have read all of the information provided above. I will permit video clips of my child to be shared at professional conferences.

_____ _____

Signature of Parent Date

My child's favorite activities, characters, or toys are:

_____

_____

_____

_____

Appendix C

Teacher Consent to Participate in Research Form

University of North Carolina at Chapel Hill
Teacher Consent Form
Consent Form Version Date: 09/24/2011
IRB Study # 11-1558
Title of Study: Evaluating the effectiveness of a computer based intervention, The Transporters, on both recognition and understanding of emotions in young children with autism
Principal Investigator: Neri Romero
Principal Investigator Department: School of Education
Principal Investigator Phone number: 904-874-3519
Principal Investigator Email Address: rneri@heelmail.unc.edu
Faculty Advisor: Samuel Odom,Ph.D.
Faculty Advisor Contact Information: slodom@unc.edu

What are some general things you should know about research studies?
You are being asked to take part in a research study. To join the study is voluntary.

You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty, but if you do not choose to be in the study, then your students will not be able to be in the study.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study, but we expect that participation may be of some benefit to the students who participate.

There also may be risks to being in research studies. Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study.

You have been given two copies of this consent form, one to keep for your records, and one to turn in to the researchers. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?
The purpose of this research study is to learn whether a computer based intervention, *The Transporters* is effective in teaching young children with Autism Spectrum Disorder (ASD) to recognize and understand emotions. Children who participate will watch episodes from *The Transporters* and take quizzes which look at their ability to match similar expressions,

identify a named expression, and determine how someone might feel as a result of an action or consequence.

Information about The Transporters

I am an educator who has worked with children with autism spectrum disorder (ASD) for the last thirteen years. I have worked with numerous children and service providers to promote the educational and social development of children with ASD. Presently, in Duval County, there is no adopted curriculum for teaching social skills to children with ASD. I want to contribute to the preliminary research on *The Transporters* in order to assess whether it is effective in teaching young children with ASD to recognize and understand emotions. If my research supports that of others, Duval County and other counties in Northeast Florida might consider purchasing the DVDs and using them in self-contained Communication Social Skills classrooms.

The Transporters was developed to accelerate understanding of emotions through entertainment and simple repetition. The DVD was created with funding from the UK government and developed by the Autism Research Centre in Cambridge University and a Manchester-based production company. The DVD centers on eight animated vehicles with predictable patterns of movement (tram, cable car, train, chain ferry, etc.). Real human faces of various ages and ethnicities were grafted onto each of the animated vehicle characters in the DVD.

The characters are part of a toy set in a child's bedroom that comes to life when their owner leaves for school. A narrator helps the children focus attention on emotions displayed rather than watching characters talking. Each episode focuses on one key emotion, presented in different contexts throughout the story. This central emotion is expressed by more than one character, to allow children to explore the expressions on different faces.

There are 15 episodes that last five minutes each and present both basic (happy, sad, etc.) and complex emotions (jealous, ashamed, etc.). In addition, the DVD offers episode-based quizzes, as well as one that presents questions from several different episodes. The Transporters was developed to accelerate understanding of emotions through entertainment and simple repetition. The Transporters DVD is commercially available through Changing Media.

Some preliminary research showed that using *The Transporters* significantly improved levels of emotion comprehension and recognition in four to seven year old children with high functioning ASD in only four weeks.

You are being asked to be in the study because you currently serve students between the ages of four to nine years in your classroom.

How many people will take part in this study?

Up to 12 classroom teachers may be invited to be in this study, but not all will be included. Up to 40 children and their parents may be invited to take part in the initial part of the study, which helps to find children who meet specific study requirements. Four to eight parent +child pairs in up to four schools will be involved in the second part of the study.

How long will your participation in this study last?
If you decide to participate, we will be asking you to show a brief, five minute video, twice daily over a period of four to five weeks to your children who are participating in the study.

In addition, you will be asked to provide us with access to the psycho-educational testing of the students who are participating in the study (their parents have given permission for that access). In addition, you will be asked to complete a short questionnaire, regarding whether you feel that the intervention made an impact on/changed your student(s). Completing that questionnaire should take no longer than fifteen minutes. The overall length of time that you will be asked to participate is 4-10 weeks, depending on how many of your students are involved, and how quickly they go through the DVD. The children will be completing a follow-up quiz which will take between 4-8 minutes, one month post-intervention.

What will happen if you take part in the study?
You would be asked to complete a brief questionnaire about how much your student(s) who are in the study talked about feelings prior to and at the completion of the study. The questionnaire should take between 5-15 minutes to complete for each child (up to two).

You will be asked to show student participants an episode from *The Transporters* twice daily. Tell them "It is movie time," and then lead them to an area to watch the video. You will be asked to write down what times the videos were shown. You will not be asked to provide any additional information. If your student(s) meets eligibility requirements, he or she may participate in the study. First, he or she will be asked by the researcher "Do you want to play with me?" before I do research activities with him/her.

If your student chooses not to participate in the second part of the study when first asked, your student will be asked again, and if necessary, will be asked a third time. Even if you agree to participate, your student(s) may choose not to participate.

Next, he/she will be introduced to a live play scenario based on interests/characters/toys that the parent determined to be highly liked by your student, and asked questions regarding emotions of the actor/s involved.

Following the live scenario, your student will participate in taking quizzes that include 8 questions selected randomly from the content of the DVD for 4-16 times. Your student will be videotaped every 5th viewing session to both monitor his engagement and his responses. Next, your student will be shown the first five minute episode of *The Transporters* three times daily (twice by you, and once by the researcher) and then given a quiz. The following school

day, he/she will watch the second episode of *The Transporters* three times daily followed by a quiz. This process will continue until your student has watched all 15 episodes of *The Transporters*.

Then, your student will have the opportunity to choose an episode to watch at three different times during the school day and will take the random quiz following the third episode/viewing each day. Your student will follow this procedure of choosing episodes for a total of five school days.

After a total of twenty school days of watching episodes from *The Transporters*, your student will be exposed to the same live play scenario. Afterwards, you will receive the teacher survey to complete. You will no longer show videos from *The Transporters* to your student(s). One month later, however, in order to determine whether any acquired skills were maintained, your student(s) will again take a quiz from *The Transporters.*

As noted above, we are also asking for you to provide access to and possible copy, for research purposes, the educational and psychological testing scores for the children in the study (parent permission for access and copying was included in the parent permission form).

What are the possible benefits from being in this study?
Research is designed to benefit society by gaining new knowledge. You are unlikely to benefit directly, but there may be benefits to your student(s) from being in this study, such as an increased awareness of how other people are feeling.

What are the possible risks or discomforts involved from being in this study?
The potential risks foreseen for you or your student(s) if you participate in this research study are minimal. The children involved might experience infrequent frustration from taking the quizzes repeatedly. A visual token economy will be provided to each child prior to the start of the quiz which will help clarify expectations and reinforcement in the form of a small self-nominated prize will be provided once the task/quiz has been completed.

Your questionnaire is very short, and the questions are not sensitive in any way. Even if you are willing to participate in the study, your student(s) may refuse to participate. We will monitor your student's behavior and do what we can to prevent your student(s) from losing interest or getting frustrated. However, your student(s) may still refuse to participate at any particular time, and we will respect that.

How will your privacy be protected?
You and your students will not be identified in any report or publication about this study. Names will not be used by the research staff to identify your information or your student's information. Instead, a research ID code will be used. Only research staff will know which ID code refers to which teacher and child.

The list that links names and ID codes will be kept secure in a locked file. Your signed teacher consent form will be stored in a locked cabinet. All information obtained from or about you or your student(s) as part of this study, such as the educational assessments, will be stored securely. As noted above, they will not contain names, only an ID code.

Video recordings will be used to monitor your student's engagement and to keep accurate records of responses. We will keep them in a secure location, and only people involved in the study will be able to watch them, unless parents have given us permission to show parts of them at professional conferences.

Will you receive anything for being in this study?
Neither you nor your student will receive anything for being in this study.

Will it cost you anything for you to be in this study?
It will not cost anything to be in this study.

What if you have questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If there are questions about the study, complaints, concerns, contact the researchers listed on the first page of this form**.**

What if there are questions about your student's rights as a research participant?
All research on human volunteers is reviewed by a committee that works to protect your rights and welfare, and that of your students. If there are questions or concerns about your rights, or those of your students, as a research subject, or if you would like to obtain information or offer input, you may contact the Institutional Review Board at the University of North Carolina at Chapel Hill at 919-966-3113 or by email to IRB_subjects@unc.edu.

Teacher's Agreement:
I have read the information provided above. I have asked all the questions I have at this time. I voluntarily give permission to participate in this research study.

_____
Signature of Teacher

_____
Date

_____
Printed Name of Teacher

_____
Signature of Researcher

_____
Date

Appendix D:
Assent Script

This script will be used only with the researcher who will show the episode for the third time and record responses on a quiz afterwards. For each question answered, regardless of response, the researcher will check a box in the child's token economy.

In order to obtain the child participant's assent, the principal investigator will follow the prescribed script:

Do you want to play with me? What do you want to work for today? The child participant will be able to choose from a variety of pictures of reinforcers (stickers, small pieces of candy, stamps, etc.) to affix to their token economy board. The board will say, after 8 checks, I will get _____. The child will affix a picture of their preferred reinforcer to the board in the blank. The token economy will be used in order for the child participant to better ascertain expectations of the task and when it will be completed.

Appendix E:

In Vivo Questions for Participants

In Vivo Questions: Angel

1) **Ms Romero is feeling happy. Who else is happy? Is it**

Mr. Al (looking angry) Ms. Mia (looking happy) Ms. Jon (looking sad)

2) **Who is feeling scared? Is it**

Ms. Romero (looking scared) Mr. Al (looking happy) Ms. Jon (looking sad)

3) **Ms Romero is disgusted. Who else is disgusted? Is it**

Ms. Mia (looking angry) Mr. Al (looking disgusted) Ms. Jon(looking tired)

4) **Who is feeling surprised? Is it**

Ms. Jon (looking angry) Mr. Al (looking happy) Ms. Romero (looking surprised)

5) **Ms Romero is playing with the ball. Ms Romero likes playing with the ball. How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

Worried ? or happy? Or disgusted?

6) **Ms Romero is going to kick the ball. Here she goes…Oh, Ms Romero missed the ball. How is Ms Romero feeling? Is she** (Point to the pictures)

Proud? or kind? Or embarrassed?

7) **Ms Romero's friend is coming to play ball with her. Ms Romero can't wait until they can play ball together. Ms Romero loves playing ball with her friend. How is Ms Romero feeling? Is she** (Point to the pictures)

Excited? Or Surprised? Or afraid?

8) **Mr Al just stole the ball from Ms Romero. How is Ms Romero feeling? Is she** (Point to the pictures)

Playing Around? Or Tired? Or angry?

In Vivo Questions: Bella

1) **Ms Romero is feeling happy. Who else is happy? Is it**

   Mr. Al (looking angry) Ms. Mia (looking happy) Ms. Jon (looking sad)

2) **Who is feeling scared? Is it**

   Ms. Romero (looking scared) Mr. Al (looking happy) Ms. Jon (looking sad)

3) **Ms Romero is disgusted. Who else is disgusted? Is it**

   Ms. Mia (looking angry) Mr. Al (looking disgusted) Ms. Jon (looking tired)

4) **Who is feeling surprised? Is it**

   Ms. Jon (looking angry) Mr. Al (looking happy) Ms. Romero(looking surprised)

5) **Ms Romero is playing with the dollhouse. Ms Romero likes playing with the dollhouse. How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

   Worried ? or happy? Or disgusted?

6) **Ms Romero and Ms Jon are playing with the dollhouse. Ms Romero farted. How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

   Proud? or kind? Or embarrassed?

7) **Ms Romero's friend is coming to play barbies with her. Ms Romero can't wait until they can play barbies together. Ms Romero loves playing barbies with her friend. How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

   Excited? Or Surprised? Or afraid?

8) **Ms Jon just stole all of Ms Romero's Barbies! How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

   Playing Around? Or Tired? Or angry?

In Vivo Questions: Darius

1) **Ms Romero is feeling happy. Who else is happy? Is it**

   Ms Cathy (looking angry) Ms Mia (looking happy) Ms Jones (looking sad)

2) **Who is feeling scared? Is it**

   Ms Romero (looking scared) Ms Cathy (looking happy) Ms Jones (looking sad)

3) **Ms Romero is disgusted. Who else is disgusted? Is it**

   Ms Mia (looking angry) Ms Cathy (looking disgusted) Ms Jones (looking tired)

4) **Who is feeling surprised? Is it**

   Ms Mia (looking angry) Ms Cathy (looking happy) Ms Romero (looking surprised)

5) **Ms Romero is playing with SpongeBob. Ms Romero likes playing with SpongeBob. How is Ms Romero feeling? Is she** (Point to the pictures as you ask each question)

   Worried ? or happy? Or disgusted?

6) **Ms Romero and Ms Jones are playing with the toys. Ms Jones lets Ms Romero play with her Mr Crabs. How is Ms Jones feeling? Is she** (Point to the pictures)

   Proud? or kind? Or embarrassed?

7) **Ms Romero's friend is coming to SpongeBob with her. Ms Romero can't wait until they can play SpongeBob together. Ms Romero loves playing SpongeBob with her friend. How is Ms Romero feeling? Is she** (Point to the pictures)

   Excited? Or Surprised? Or afraid?

8) **Ms Jones just took Ms Romero's SpongeBob. How is Ms Romero feeling? Is she** (Point to the pictures)

   Playing Around? Or Tired? Or angry?

EFFECTIVENESS OF A COMPUTER BASED INTERVENTION

Appendix F: Time: _____

Name: _____ Time: _____

Date: _____ Time: _____

Circle one: Baseline Intervention Circle one: Recorded Not recorded

1. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

2. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

3. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

4. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

5. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

6. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

7. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

8. M.E.F. M.F.F. T.O.M.

   Response #1 Response #2 Response #3

Appendix G:

The Transporters Parent Survey

1) **Did your child talk about his feelings prior to this study taking place?**

Yes No

2) **If yes, how often?**

N/A Frequently Sometimes A Little

3) **Did your child talk about other people's feelings prior to this study taking place?**

Yes No

4) **If yes, how often?**

N/A Frequently Sometimes A Little

5) **Does your child talk about feelings now?**

Yes No

6) **If yes, how often?**

N/A Frequently Sometimes A Little

7) **Would you consider purchasing your own copy of *The Transporters*?**

Yes No

8) **Would you recommend *The Transporters* to other parents of children with autism?**

Yes No

9) **Why or why not?**

_____
_____
_____

Thanks for your participation

Appendix H

The Transporters Teacher Survey



1) **Did you feel that *The Transporters* was easy to use?**

Yes No

2) **Do you feel that your students enjoyed viewing episodes from *The Transporters*?**

Frequently Sometimes A little Not at all

3) **Do you feel that the students benefitted from using the software?**

Yes No

4) **If so, in what way? (If you answered "No" for question 3, please mark N/A for this question)**

_____

_____

_____

5) **If you had access to your own copy of *The Transporters,* would you use it with other students?**

Yes No

6) **Would you recommend *The Transporters* to other parents and or teachers of children with autism?**

Yes No

7) **Why or why not?**

_____
_____
_____

Thanks for your participation!

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