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EFFECTS OF USING COMPUTER SOFTWARE TO
TEACH FACIAL EMOTION RECOGNITION TO LOW-FUNCTIONING
4- TO 7-YEAR-OLD CHILDREN WITH AUTISM

A Dissertation

Presented to

The Faculty of the Morgridge College of Education

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Gary A. Butcher

March 2012

Advisor: Kent Seidel

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ABSTRACT

Autism Symptom Disorder (ASD) is one of the fastest growing developmental disorders in the United States. This study investigated the development of facial emotion recognition in 3 individuals aged 4–7 years old with ASD. It incorporated both objective measures for facial recognition and subjective measures for motivation, time on task, and increased enjoyment of school. A multiple-baseline design was utilized that included establishment of the baseline for each of the students and then a period of intervention and evaluation. It was hypothesized that the use of the DVD, the Transporters, would increase facial recognition, improve motivation, increase time on task, and increase levels of enjoyment of school. However, the impact of the intervention on correct answers, motivation, time on task, and enjoyment of school was minimal and resulted in little benefit and improvement for each of these students. The impact of the intervention for correct answers, motivation, and time on task was minimal and resulted in little benefit and improvement for each of these students. Visual analysis, use of the split-middle trend estimation, and statistical analysis all indicated minimal change resulting from the intervention for Students 1 and 3. The results from Student 2 demonstrated minimal involvement in the Baseline or Intervention Phase activities. Results of paired *t* tests all suggested no significant benefits to the students in being able to correctly identify facial emotions, motivation, time on task, or enjoyment from the use of the Transporters DVD and the computer. Though the Transporters software was found to be ineffective with the

students in the current study, it must be noted that the small sample size did not lend itself to definitive conclusions towards the general population. The results of the current study were contradictory to those of several other studies. There are several possible explanations for the differences. Previous studies focused on older, high-functioning individuals with ASD, whereas this one focused on younger, low-functioning individuals with ASD. This study has identified several notable cautions that should be considered prior to the start of any additional formal research.

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Chapter 1: Introduction

Since the development of the computer, educators have dreamed, predicted, and even feared the application of its technological potential to the classroom and their educational domain. The desire for their students' success has motivated many of these educators to dream of being able to assist students at all levels and abilities. As technology has gained popularity in the classroom, technology-based instruction associated with brain-compatible learning research has been concurrently established as a viable and credible instructional strategy. Implications of brain-compatible learning research have led to development of technology-aided instruction that has been and is being adapted and introduced into the classroom as a valuable and effective aid to understanding benefits of different pedagogical options.

The growing popularity of and numerous legal mandates emphasizing individualized instruction are increasingly bringing classroom technology and alternative pedagogies to the attention of classroom educators and district administrators (Chung et al., 2007). Additionally, the ever-increasing diversity of the traditional student population presents the classroom teacher with a daily challenge to provide effective and beneficial individualized instruction. The difficulty of this challenge increases disproportionately when the classroom population includes students with learning disabilities. The Individuals With Disabilities Education Improvement Act (IDEA, 2004) legislation identified students with learning disabilities to include "mental retardation, hearing

impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance, . . . orthopedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities” (§ 602[3][A][i]). The inclusion of students with learning disabilities into a traditional classroom creates a more challenging circumstance for educators.

The diverse and demanding instructional needs of students with learning disabilities create unusual and in many situations extreme requirements to be met in order to provide assistance to these students. Computer-assisted classroom instruction offers the opportunity to blend technology with innovative pedagogy, positioning classroom instructors on the cusp of making phenomenal advances in creating and offering individualized instruction (Neri, Cucchiarini, Strik, & Boves, 2002; Tomei, 1997). These advances result from research discovering the complexities of learning disabilities and brain-compatible learning strategies in combination with progress being made in the development of software that can adapt to situational changes and learner requirements.

The IDEA (2004) requires student individualized education programs (IEPs) to consider assistive technology for students to assist in offering students a fair and appropriate education, not only in the classroom but also outside of the school building, at home, and in other circumstances. The integration of technology to existing information instruments offers the potential for dramatic advances in assistive technologies by creating optimal learning environments for students with learning disabilities while providing instruction influenced and potentially controlled by student input and monitored or observed by the students’ parents. The addition of technology can also offer distribution options through the use of web-based applications, making

instructional programs available from any Internet connection. The potential benefits increase by also offering accurate monitoring with appropriate feedback to the students, instructors, and parents. In addition to these instructional benefits, there are innovative possibilities for collaboration between parents and classroom instructors online utilizing web-based programs, with each logged on simultaneously and communicating through the Internet similar to the functionality of online service programs such as GoToMeeting.com or WebEx.com. However, even with the potential for benefits in the near future, many questions remain to be identified and answered. Responding to these unanswered questions may be complicated by new or modified laws placing additional requirements on schools and increased financial strain on school districts and educational systems.

A particular category of learning disabled students who may benefit from technological advances in instruction and who present a broad range of symptoms and characteristics is students with autism spectrum disorder (ASD). An individual diagnosed with ASD does not necessarily fall into a neat symptomatic classification. Each child with autism is likely to have a unique combination of characteristics from the following three categories: (a) social skills, (b) language, and (c) behavior (Siegel, 2003).

The many combinations of characteristics from these three categories create difficulty in developing and implementing effective instructional programs with proactive assessments and efficient delivery systems for students with ASD. The problem is further complicated by the growing numbers of children diagnosed with ASD. The rate of autism is estimated to range from 2–4 per 1,000 (Palmer, Blanchard, Jean, & Mandell, 2005) or approximately 1 in 91 at the high end (Autism Speaks, 2009), making it one of the fastest

growing developmental disorders in the United States. The U.S. Department of Health (2003) estimated that the number of diagnosed cases is increasing at approximately 20% per year. Studies have shown that accurate diagnosis is possible in a child as young as 18 months. However, Palmer et al. (2005) found that a “large majority of these children are not identified until they are of school age” and that “more than 75% of children with ASDs were identified through the school system” (p. 125). Though school districts play an integral part in the successful identification of students with ASD, not all districts effectively identify children with ASD. Palmer et al. stated, “The U.S. Department of Education reports that there are considerable inequities in both revenues and special education spending by district across the United States” (p. 126).

Statement of the Problem

The expansion of the Internet and its accompanying technology into every aspect of life has created a situation where its presence and availability have become the norm (Wellman & Haythornthwaite, 2002). However, areas in education remain where the application of such technology is still restricted and only now starting to become more widely available. The combination of technology and education includes an area known as assistive technologies. This combination of technology and education is of great interest to classroom instructors but is of particular interest to special-education instructors and parents of children with learning disabilities. The IDEA (2004) defines *assistive technology* as “any item, piece or equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability” (§ 300.5)

It is imperative that educators and parents be offered the latest and greatest technologically advanced assistive technologies and devices available with “out of the box” thinking and innovative, effective instructional pedagogies. Care must be taken to evaluate digital instructional materials for accessibility and proper adherence to the National Instructional Materials Accessibility Standard with regard to ease of availability of (IDEA, 2004, § 300.172). The National Assistive Technology Institute (2006) reported,

Although the focus of technology applications appears to be changing, one thing seems clear: Most researchers and other authorities who are knowledgeable about technology (e.g., Behrman, 1984, 1988; Blackhurst & Edyburn, 2000; Bowe, 1984; Church & Bender, 1989; Goldenberg, Russell, & Carter, 1984; Johnson, 1987; Lewis, 1993; Lindsey, 2000; Male, 1994) have concluded that technology has the potential for dramatically improving the quality of education and the quality of life for people with disabilities. (The Importance of Assistive Technology sec.)

Providing special-needs students with the best opportunities for learning while still adhering to budgetary constraints is possible by applying current technology, promoting instructional creativity incorporating brain-compatible learning research, and innovative thinking combined with the tenacity necessary to achieve the desired benefits (Rose & Dalton, 2002). The caution here is the unpredictability of the results, the ever-increasing developmental costs (skilled developers being drawn to other industries paying higher salaries), easy student accessibility, parental acceptance and emotional support, product sustainability, and school district support and acceptability (Rose & Dalton, 2002).

As the financial resources of school districts face more pressure and the demands from the IDEA (2004) require more resources to become available, web-based resources offer options and opportunities for effective distribution and collaboration among all

interested parties. Administrators and educators will be forced to give more serious consideration to the web as a delivery system with its ease of application maintenance, less restrictive distribution, more accountability, and accuracy in assessing the effectiveness of assistive software programs (Rose & Dalton, 2002). Web-based programs also provide easier student access, both at school and at home, and can be built on a foundation resulting from the application of sound pedagogical principles and research.

For instance, software called the Transporters was designed using current brain research and pedagogical principles specifically to assist children with ASD in acquiring the skill of facial emotion recognition (Baron-Cohen, Golan, Chapman, & Granader, 2007). The software utilizes animation with human faces superimposed on cartoon vehicles. The design incorporates the observed preferences of children with ASD that include predictability, spinning tops, rotating wheels, and repetitive motion (Baron-Cohen et al., 2007). Preliminary investigations have shown promising results. However, little empirical research has been conducted to assess its effectiveness for children diagnosed with ASD. The Autism Research Centre (2008) noted that research to date, though still in its infancy, has shown that “children with high-functioning autism caught up with typically developing children of the same age in their performance on emotion recognition tasks” (§ 1).

Every student, regardless of governmental mandates, is entitled to the best educational opportunities, which should include individualized instruction, adapted curriculum and lesson plans, adaptive testing methods, and technological advances

smoothly integrated into their curricula. These challenges become more difficult to successfully address for students with ASD.

Purpose of the Study

The primary purpose of this study, using a multiple baseline design, was to investigate the effects of a software program called The Transporters on facial emotion recognition, time on task, and motivation for low-functioning 4- to 7-year-olds with ASD. The secondary purpose was the investigation of whether the use of this software program would positively influence the students' perceived enjoyment while at school as evaluated by their teachers.

Research Questions

This study was guided by two research questions:

1. How effective is the Transporters software program with regard to ASD students' (a) facial emotion recognition, (b) motivation, and (c) time on task?
2. How effective is the Transporters software program with regard to influencing ASD students' perceived enjoyment while at school as evaluated by their teachers?

Chapter 2: Review of the Literature

The review of the literature was designed to accomplish several goals relevant to the study problem. The first was to introduce the topic of autism, including its history, definition, and the educational requirements and definitions required by IDEA (2004). Then, how students with ASD learn and cognitive challenges for those students were investigated. Learning theories were reviewed as well as instructional options for students with ASD. Finally, the limited research on the Transporters (2008) software program evaluated in this study was reviewed.

Autism

Historical perspective. Howard (2006) stated, “Learning is defined as the establishment of new neural networks composed of synaptic connections and their associated chemotaxic patterns” (p. 53). Howard further referenced a definition by Hart:

Hart (1983) defines learning as the acquisition of useful schemas, which he calls *programs*. He defines a program or schema as a sequence used for attaining a preselected goal. Programs are triggered when the learner recognizes a pattern or situation that somehow fits with the program or schema. (p. 483)

Parents expect their children to learn each and every school day. However, parents of children with ASD struggle to balance hope, optimism, and expectations. The term *autism* was originally coined by Bleuler in 1911 after observing a patient (“Bleuler,” 2008). Bleuler’s application of this term was used to mean avoiding reality and denying many of the people and things around the patient. The focus of his work was observing and treating patients afflicted with symptoms and behaviors creating a condition he called

schizophrenia (“Bleuler,” 2008). The term appeared periodically in the literature until its meaning and application changed several decades later.

In 1943 Kanner and Asperger observed 11 child patients and reviewed recorded observations by the parents of each of the children (Wobus, 2003). After observing these children, Kanner and Asperger described their behavior as early infantile autism. The following year Asperger identified a behavioral syndrome that bears his name, Asperger’s syndrome, to identify high-functioning autistic individuals. Kirby (2005) noted it was five decades before “Asperger’s Syndrome was added to the DSM IV [*Diagnostic and Statistical Manual of Mental Disorders*], and only in the past few years has AS been recognized by professionals and parents” (§ 1).

Definition of autism. The Autism Society (2008a) has defined autism as a “complex developmental disability that typically appears during the first three years of life” (§ 1). *The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV; American Psychiatric Association, 2000) includes the term *autism* in a more general category of psychological and biological disorders collectively referred to as pervasive developmental disorders. Pervasive developmental disorders include five diagnostic subcategories: (a) autistic disorder; (b) pervasive developmental disorder; (c) Asperger's disorder; (d) Rett’s disorder; and (e) childhood disintegrative disorder.

IDEA 2004. In 1990, Congress enacted the IDEA, an update of the 1975 Education for All Handicapped Children Act. The original intent of the law was to ensure that children with disabilities, including autism, had the opportunity to receive a free appropriate public education. The law has been revised several times since its original

release. The most recent version, IDEA (2004), specifically defines a “child with a disability” as a child

(i) with mental retardation, hearing impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance (referred to in this title as “emotional disturbance”), orthopedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities; and (ii) who, by reason thereof, needs special education and related services. (§ 602[3][A])

For children aged 3–9, IDEA (2004) expands the definition to include a child “experiencing developmental delays” ” (§ 602[3][B]).

The IDEA (2004) defines an assistive technology device as “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability” (§ 300.5).

How Students With ASD Learn

Diagnosis. School districts are facing increasing numbers of autistic students and concurrent difficulty in the diagnosis of their students with ASD. Diagnosing students with ASD is complex. According to the Autism Society (2008b),

Because many of the behaviors associated with autism are shared by other disorders, various medical tests may be ordered to rule out or identify other possible causes of the symptoms being exhibited. At first glance, some persons with autism may appear to have mental retardation, a behavior disorder, problems with hearing, or even odd and eccentric behavior. To complicate matters further, these conditions can co-occur with autism. (¶ 1)

Many school districts are providing classroom teachers with professional development training. The Autism Society of Alabama (2008) offers classroom teachers training in symptom identification and comparison while recognizing that “symptoms can range from mild to debilitating, include lack of communication, avoidance of eye contact

and repetitive behaviors. It can only be diagnosed by observing a child's behavior" (§ 8). An accurate diagnosis of autistic disorder is dependent upon a collection of diagnostic criteria divided into three categories or domains of symptoms and behaviors: (a) communication, (b) reciprocal social interaction, and (c) restricted and repetitive behaviors and interactions (Volkmar & Lord, 2007). Autism is a complex combination of symptoms from these three domains. In fact, diagnosis requires a total of six symptoms, with a minimum of two from the communication domain, one from the domain of reciprocal social interaction, and one from the domain of restricted and repetitive behaviors and interactions. The many combinations of symptoms create monumental challenges for treatment designs and measurement instruments.

The rate of diagnosed individuals with autism has increased in recent years. The rate of autism for school-age children in 1990 was 1 in 10,000. That figure has increased dramatically to approximately 1 in 150 students (Autism Society, 2008a) or even 1 in 91 live births (Autism Speaks, 2009).

Parents with autistic children know that each day with an autistic child presents unique, challenging, and often unpredictable situations. These parents are abruptly faced with a steep learning curve on a topic that is probably one of the most difficult to share with others. Once in this situation, it becomes a lifetime commitment to provide care, love, and every possible educational opportunity to the child. The challenge is complicated further when the autistic child creates behavior management issues, displays resistance to do tasks, and lacks interest in others. This can cause a parents' optimism to quickly turn to frustration and guilt. Answers for parents of autistic children have been slow to develop, and research has created as many questions as it has answers.

The evolution and development of more complex software programs offers opportunities for a free, appropriate public education to students with ASD. These same software programs more than adequately comply with the requirements of IDEA (2004) by offering increased and improved functional capabilities that are maintainable with the added benefit of offering hope and encouragement to the parents of children with ASD.

Learning styles analysis. When school districts list the responsibilities of educators, the list often includes the following responsibilities: ensure success in their classes, be the facilitator of knowledge acquisition, motivate students to willingly participate, and provide the most effective learning environment possible for their students (Colorado Department of Education, 2008). Creating an optimal learning environment necessitates individualized instruction (Salser, 2001). Commonly used strategies include individualized lessons, identifying students' preferred learning styles, and integration of technology. According to Salser, the most effective method for providing individualized instruction is dependent upon identifying the individual student's preferred learning style or styles. Educator and researcher Tomlinson (2003) encouraged educators to implement individualized instruction because "attention to a student's preferred mode of learning or thinking promotes improved achievement" (pp. 153–154). She also stated, "Modifying instruction to draw on student interests is likely to result in greater student engagement, higher levels of intrinsic motivation, higher student productivity, greater student autonomy, increased achievement, and an improved sense of self-competence" (p. 154).

It is generally accepted by classroom instructors that identifying learning styles is dependent upon several activities that include observations, discussions with students,

sensory responses, and student answers to questionnaires (Gordon, 1998). These strategies can work effectively when used in a traditional classroom. The effectiveness of these methods depends upon active student involvement and participation in these activities. When students do not participate, either intentionally or for other reasons, the task of identification becomes increasingly difficult. Intentional poor participation on the part of students often is exhibited by defiance or resentment. Other reasons for nonparticipation can include deficiencies in social, behavioral, or communication skills such as those observed in students with learning disabilities. This discussion focuses on students with ASD.

Instructors of students with ASD must be prepared to apply adaptations in order to identify the learning styles of their students. These students exhibit deficiencies in the areas of social, behavioral, and communication skills that can negatively impact the effectiveness of traditional methods used for identifying preferred learning styles (Siegel, 2003).

Lotem and Halpern (2008) proposed a data-acquisition model that focuses on the concept that autism is the result of the symptomatic disorder and not the cause of it and is complicated by insufficient information or disproportional amounts of sensory input. They also argued that even if sensory reception is functioning correctly, disproportionate quantities can cause the characteristics of abnormal behavior associated with autism. The significance of sensory processing is further evidenced in Dunn's (1999) model of sensory processing that focuses on the impact of sensory processing in daily life. The basic concept of this model is that a person's way of responding to sensory events is a

combination of sensory threshold (high or low) and the person's responding strategy (passive or active).

Siegel (2003) listed the following characteristics as autistic learning disabilities (ALD): social isolation, low interest in peers, echolalic speech, inability to hold a conversation, perseveration, no imagination, and odd motor movements. Students with ASD present a challenge to instructors who wish to identify student learning styles because often those students also exhibit behaviors and actions collectively categorized as ALD. An individual diagnosed with ASD does not necessarily fall into a neat syndromatic classification. Each child with autism is likely to have a unique combination of characteristics from the three categories of (a) social skills, (b) language, and (c) behavior.

Social skills characteristics include the following: fails to respond to his or her name, has poor eye contact; appears not to hear others at times; resists cuddling and holding; appears unaware of others' feelings; and seems to prefer playing alone, retreating into his or her own world (Mayo Clinic, 2008). Language characteristics include the following: starts talking later than other children, loses previously acquired ability to say words or sentences, does not make eye contact when making requests, speaks with an abnormal tone or rhythm, may use a singsong voice or robot-like speech, cannot start a conversation or keep one going, and may repeat words or phrases verbatim without understanding how to use them (Mayo Clinic, 2008). Behavior characteristics include the following: performs repetitive movements such as rocking, spinning or hand-flapping; develops specific routines or rituals; becomes disturbed at the slightest change in routines or rituals; moves constantly; may be fascinated by parts of an object, such as

the spinning wheels of a toy car; and may be unusually sensitive to light, sound, and touch and yet oblivious to pain (Mayo Clinic, 2008).

The many combinations of characteristics and actions from each of these three categories create difficulty in identifying learning styles of students with ASD. The characteristics and learner disabilities of both ASD and ALD negatively impact and influence how each is expressed. The complexity of this disorder negatively impacts the efforts of educators trying to develop and implement effective instructional programs.

When attempting to identify learning styles of students with ASD, Kern, Garver, Carmody, Andrews, Trivedi, and Mehta (2007) noted, “Sensory experiences could be different to the point of being altered” (p. 186), which could result in coming to wrong conclusions. Kern et al. proposed based on their personal observations that students with ASD assign varying levels of significance to the inputs to their senses, contributing additionally to the behaviors considered to be much different from their peers. If educators are to accurately assess the learning styles of students with ASD from carefully observing their students, it will behoove them to seek “a better understanding of sensory processing in autism, including threshold differences . . . and how their sensory experience may shape their behavior and their response to their world” (Kern et al., 2007, p. 186).

These responses to the world around them are also the result of inefficient data acquisition, as identified by Lotem and Halpern (2008), who suggested that the impairments result in fewer data being acquired by autistic students about their surroundings and the people in it. Early intervention programs have been shown to be especially effective as they provide the necessary assistance to students with ASD in

moderating the world around them and minimizing the possibility of too much input and the individual shutting down or responding negatively (Lotem & Halpern, 2008). Every individual has a preferred learning style or combination of styles. The application of this preferred learning style and the effectiveness of the learning depends upon the informational input supplied by the individual's senses. When that input is limited and ineffective or interpreted incorrectly, the observations used as the basis for learning style identification may be incorrect and most likely will result in the wrong conclusion.

Identification is the dilemma often faced by instructors of students with ASD. This dilemma is complicated further by ALD and requires instructors to focus on the “understanding of how learning is different for children with autism than for those without autism and how learning is different among different children with autism” (Siegel, 2003, p. 7). Due to the restrictive nature of poor participation by students in the learning styles identification activities, teachers of students with ASD must often rely upon anecdotal research. Results of limited studies of learning styles of students with ASD suggest that they are primarily visual learners (Sparkenbaugh, 2006). This same conclusion is voiced by speaker and author Grandin (1996), who has autism herself, and who has regularly commented that she thinks in pictures.

Learning and Cognitive Challenges for Students With ASD

ALDs. Researchers historically have focused on identifying weaknesses in autistic students, including learning disabilities. Three major learning disability domains are used to explain the restrictions of autistic student learning styles: (a) social ALD, (b) communicative ALD, and (c) nonsocial ALD (Siegel, 2003). Each can negatively impact the application of traditional learning strategies available to be used with these students.

Social ALD. The first domain category of social ALD includes three subcategories: (a) Little or no interest in what is happening around them, (b) Little or no demonstration of interacting with others around, and (c) no demonstrated interest in reflecting the actions or words of individuals around them. A child who has little or no interest in what is happening around him or her does not benefit from the experience of observing activities and circumstances and misses any meanings that are associated with the activities. The detrimental effects are compounded from the resultant sensory deprivation and hence inferential learning (Siegel, 2003).

A significant disability is caused by a child having little or no interest in interacting with others around him or her. A child who expresses little or no interest in interaction is not susceptible to positive pressures created by the need for approval. One of the key sources of learning for children is in seeking approval of parents, teachers, and other significant adults in their world. Parents or other adults unable to apply influence grounded in approval seeking by younger children are severely hampered in their ability to contribute to the learning of that child (Siegel, 2003).

The third subcategory of social ALD is also very significant and a natural action of most individuals. The natural response in many situations is mimicking, which includes repeating the actions, words, and deeds of those around us. Autistic students generally show little or no interest in copying those around them, resulting in yet another source of significant learning unavailable to these individuals.

Communicative ALD. The second domain, communicative ALD, has three subcategories: (a) recognizing facial expressions and body language, (b) demonstrating facial expressions and body language, and (c) understanding conversational content. This

second domain is a critical component in learning and can be called nonverbal communication. Such communication is significantly dependent upon attention to surroundings, which is a primary characteristic of the previous domain category. Autistic students limit valuable learning that students not possessing this restriction acquire just by living their lives and participating in what may be classified as normal activities. Closely associated with the concept of nonverbal communication is inflection in the spoken word. Autistic students often are unable to interpret or apply inflection and instead demonstrate “immediate echolalia or delayed echolalia” or “other idiosyncratic phrasing” (Siegel, 2003, p. 95).

Nonsocial ALD. The third domain of nonsocial ALD includes (a) minimal or diminished ability to play imaginatively and (b) stereotyped and repetitive interests (Siegel, 2003). These are best explained as a conditions where autistic students “show little fantasy, limited representation of social situations, and limited language use as part of play” and focus or fixate on “familiar actions with new or old objects . . . which leads to a limited, stereotyped, and repetitive play repertoire” (Siegel, 2003, p. 98). ALD negatively impacts learning styles identification; hinders cognitive development; and prevents social, language, and behavioral development when compared to individuals without ALD. The many combinations of ALD are demonstrated in “what the learning implications of such problems in perception and information processing are, and what qualities of the child’s experience and learning are influenced by having a particular autistic learning disability” (Siegel, 2003, p. 90) or combinations of them.

Facial recognition. Researchers have recognized for some time that communication is a key component in education and learning. Individuals with ASD

often display deficits in communication skills in the form of poorly developed or limited abilities in interpreting facial emotions and expressions. The impairment of facial emotion recognition has additional consequences including improper cue recognition and acknowledgment, not understanding voice inflection and tone, and a lower natural interest in making eye contact. Facial recognition research has followed several themes ranging from gender, to parsimony, to complex facial patterns and more. Hinton, Fee, De Vivo, and Goldstein (2007) acknowledged that individuals with Pervasive Developmental Disorder were “less likely to accurately remember faces, match faces, and describe faces appropriately” (p. 123). Wright, Yang, Ganesh, Sastry, and Ma (2009) evaluated facial recognition, applying the theory of sparse representation where individuals use “a small subset of features for classification or visualization” (p. 1) to assist in the identification of facial emotions. Irwin, Jones, DeBruine, Williams, and Mon-Williams (2005) demonstrated that facial recognition “abilities are highly dependent upon the ability to understand others' intentions and desires by 'reading' facial expressions and eye gaze direction” (p. 1). Swan (2002) reported,

Over the years there's been a lot of research interest into how children with autism perceive faces . . . [and] autistic children only look at the lips of the actor speaking and miss all the other clues in the action, including what the other actors are doing. (p. 1)

Gelder, Vroomen, and Van der Heide (1991) reported, “Autistic children are impaired in face identity recognition and that no impairment . . . found as far as the lip-reading ability of autistic children” (p. 80).

A different direction was investigated by Carver and Dawson (2002) from the University of Washington, who evaluated at the neurobiological level. They identified a

minimum of three possible reasons contributing to the brain dysfunction impairing facial recognition:

1. An “innate ‘starter set’ for face recognition may be absent, or may be different from that found in typically developing children” (Carver & Dawson, 2002, p. 19).

Carver and Dawson observed that this impairment “might be genetically based differences in the neural components of the face system that do not allow the system to form typically” (p. 19).

2. The second reason, according to Carver and Dawson (2002) is “that children with autism fail to attend to social stimuli, including faces, [and] . . . they do not develop the expertise needed for a specialized face recognition system to develop” (p. 19).

3. Finally, a possible interaction between each of the previous reasons causes “impairments at the molecular level” (Carver & Dawson, 2002, p. 19).

Perceptual cognition may be negatively affected by anxiety (Burnette et al., 2005). Baron-Cohen (2002, 2006) showed that students with ASD demonstrated anxiety resulting from input overload due to a preference for consistency, predictability, and systems. He used the term *systematizers* to identify a particular trait demonstrated by individuals who organize and construct items in groups, which collectively can represent a system.

Joseph and Tanaka (2003) studied holistic and part-based face recognition in children with ASD and stated that previous research provided “evidence suggesting that individuals with autism are deficient in face recognition abilities and engage in atypical face recognition strategies” (p. 529) and that they “use feature-based visual processing strategies that are normally used to discriminate among objects, such as chair and cars, to

discriminate among faces as well as non-face objects” (p. 531). This suggests that observation of faces not considered to be associated with inanimate objects makes emotions more difficult to accurately interpret for students with ASD.

Golan, Baron-Cohen, and Golan (2008) demonstrated significant improvement in facial recognition resulting from an intervention utilizing the program the Transporters. These improvements were observed with significance at $p < .001$ for all tests measured. The data also showed an “improvement in the intervention group” using the Transporters “that was indistinguishable from the typically developing group” (Golan et al., 2008, p. 23) that was used as a control.

Theory of Mind

Leslie (1987) originally referred to theory of mind as an “early manifestation” that he called pretense and described “in terms of the infant’s capacity for internal representation” (p. 412). Leslie’s position on theory of mind places him categorically as a cognitivist as his attention is focused on the “underlying mechanisms and with the information-processing tasks these mechanisms have to perform in generating pretense” (p. 413). The question of theory of mind effectiveness in viewing a situation correctly and accurately assigning value to it is evidenced in pretend play. According to Leslie, such play can be representational of real or unreal events and situations, thus offering primary or secondary pretense thoughts, respectively.

An additional concept of theory of mind and its impact upon the defining behaviors of ASD are provided by Siegel (2003), who wrote, “An absent theory of mind (in its purest, cognitive sense) in combination with a lack of affiliative orientation can be seen as core to many (though certainly not all) of the signs and symptoms of autism” (p.

65). This characteristic deficit negatively affects peer interaction and peer play for students with ASD (Siegel, 2003).

Mindblindness. One ALD is a condition known as mindblindness, a term first used by Baron-Cohen (1995) in his research identifying the inability of individuals with ASD to creatively imagine what others around them were thinking. Mindblindness in the literature is used synonymously with the term theory of mind (Baron-Cohen, 1995). Baron-Cohen (1995) suggested, “In autism there is a genuine inability to understand other people’s different beliefs” (p. 71), thus creating the condition of mindblindness. Baron-Cohen (1995) wrote, “Attributing mental states to a complex system (such as a human being) is by far the easiest way of understanding it” (p. 21). Baron-Cohen (1995) continued that mindreading “allows us to make sense of communication” (p. 26) and assists us to “hypothesize about mental states” (p. 27). Mindblindness and theory of mind work together to help a person with the ability to pass a “false-belief test” (Baron-Cohen, 1995, p. 70) and distinguish ambiguously between the child’s (true) belief and the child’s awareness of someone else’s different (false) belief” (pp. 69–70).

Cognitive empathy. Individuals with ASD demonstrate limited ability to self-reflect upon their own emotions easily and also lack sufficient skills for social interaction, defined as the *self-reference effect* (Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007). Lombardo et al.’s research also showed that cognitive ability is related to the skill of mentalizing, which occurs in the frontal lobe region of the brain, an area that has been shown to be underdeveloped in individuals with ASD.

Volbrecht (2008) stated,

Empathy consists of cognitive, emotional, and behavioral components. Cognitive empathy is the ability to understand a distressing situation, recognize another's emotional state, and assume that person's perspective. . . . Development of empathy is related to positive affect, such as laughing, smiling, and clapping. (p. 1)

A different choice of wording describing cognitive empathy comes from Preston and deWaal (2002), who described empathy as

situations in which the subject has a similar emotional state to an object as a result of perceiving the object's situation. Empathy is thought to preserve the distinction between self and other, with an emotional state that is object-focused. (Sec. 0.1)

The largest volume of research on empathy has utilized the foundational knowledge of the perception-action model of empathy discussed by Preston and de Waal. The components of this model include an automatic response to circumstances around an individual, which also serve as the foundation for sharing thoughts and reactions (Preston & de Waal, 2002). Some individuals with autism deliberately avoid eye contact, whereas others may engage in it and still not possess or display cognitive empathy. Preston and deWaal stated, "Because expression, imitation, and recognition of expressions and gestures are impaired in individuals with autism, it is likely that the disorder is characterized by an impairment early on in the perception-action pathway" (Sec. 2.1.2.4) This statement hints at the low probability of students with ASD acquiring significantly improved cognitive empathy.

Intellectual potential. Evaluating intellectual potential is generally questionable at best for children under the age of 8 and very questionable when the subjects are under the age of 5 (Schechter, 2008). The potential problem is based upon intelligence tests that compare the scores of children with ASD with the scores of others the same age that took

the test. Schecter (2008) explained, “It is usually difficult to determine if poor performance accurately reflects ability, or if it is due to a host of other influences such as illness, uncooperativeness, or fatigue” and that “the reliability and validity . . . is good for children older than eight” (§ 8). These conditions and the circumstances surrounding children with ASD may make it difficult at best to accurately evaluate intellectual potential.

Instructional Options for Students With ASD

Instructional options for parents with autistic children have been slow to develop. Programs have ranged from instructional programs to behavior-based strategies, to balancing ALD with compensating programs. The effectiveness of each of these programs is limited by how the individual student with ASD learns. The following sections briefly describe some of the behaviors displayed by students with ASD and instructional options available.

Mesibov (2004) identified several characteristics and conditions contributing to ALD: (a) organizational difficulties, (b) distractibility, (c) sequencing programs, (d) inability to generalize, and (e) uneven patterns of strengths and weaknesses. Each of these can present unique, debilitating challenges resulting in a complex set of conditions that must be correctly recognized and effectively addressed by educators to ensure the least amount of stress negatively impacting the learning.

Poor organizational skills. Organizational tasks can be stressful to almost anyone but particularly stressful to students with ASD. This challenge can cause students with ASD to become immobilized and so traumatized that they never start the required tasks. To compensate and decrease the debilitating effects, the instructor must assist the

student with ASD in developing habits and routines that systematically will minimize or eliminate the monumental challenges perceived by the student. Assisting the student with viewing the task as a series of regularly practiced habits and actions that are part of regular routines, organization is completed without presenting the autistic student with potential failure. The instructor can assist through the use of “checklists, visual schedules, and visual instructions concretely” showing progress and tasks still to be worked on (Mesibov, 2004, ¶ 3). The observant instructor must be on guard to minimize the circumstances that cause autistic students to become frustrated and overwhelmed resulting in a reaction of shutting down and being nonresponsive.

Distractibility and time on task. Distractibility can be a challenge to anyone at any time. Even under the most ideal circumstances, minimizing the effects of distractions can be tiring. In his research with TEACCH instructional methods and working with students with autism, Mesibov (2004) identified distractibility as a common problem. The specific cause or distraction can differ from one individual to another. Mesibov further stated, “Identifying what is distracting to each student is the first step in helping them. For some it might be visual stimuli, while for others it might be auditory” (¶ 4). Once the distraction has been identified, swift elimination or modification to decrease the significance of the distraction must be addressed. If the distraction is the environment, the environment must be changed or modified to assist the autistic student in focusing on work and not on the distraction created by things around them.

Problems sequencing tasks. The task of putting things in a certain order is dependent upon understanding and identifying how each item relates to every other item or what can be termed the relationships between these same items. This requisite

relationship is a necessity for conceptualizing and developing the sequencing or order for a group of things or tasks. Students with autism have great difficulty conceptualizing abstract thoughts such as identifying relationships and then being able to use these relationships to develop sequences.

To assist autistic students with sequencing difficulties, strengths can be utilized to assist the weaknesses by incorporating “consistent work routines and visual instructions” (Mesibov, 2004, ¶ 7). This practice includes such actions as observing to determine if the student works from left to right or conversely right to left and then applying that to assist the student in successfully sequencing a group of items or tasks. Repetition of task sequences offers further assistance to autistic students.

Inability to generalize. Research has documented that students with autism have great difficulty in generalizing concepts and transferring ideas learned in one setting to conditions or circumstances in another setting (Siegel, 2003). These students often focus so intensely upon a few specific details and hence lose sight of the bigger picture that they are unable to see how everything is connected. This contributes to an inability to transfer this connectedness to other situations and circumstances. To assist autistic students in the development of transference skills, generalization programs have coordinated instruction between school and home with reinforcement and repetition being provided at each location in cooperation with what the other is doing. As the instruction progresses, students should be exposed to situations out of the classroom setting and closely resembling work environments and other daily activities, offering students the opportunities to apply the classroom concepts and strengthen their abilities to apply these generalizations.

Strengths and weaknesses not easily identified. One of the most difficult activities to do with autistic students is to correctly identify strengths and weaknesses in learning skills and abilities. Mesibov (2004) stated, “An autistic student can have the extraordinary ability to see spatial relationships or understand numerical concepts but be unable to use these strengths because of organizational and communicative limitations” (¶ 11). During these times, the skill of the teacher is paramount to the success of the student and depends upon keen observations and highly adaptable learning situations. The totality of the learning environment must constantly be monitored and modified to incorporate “learning styles, distractibility, functioning in group situations, independent skills, and everything else that might impact the learning situation” (Mesibov, 2004, ¶ 12).

Applied behavior analysis. During the 1950s, B. F. Skinner (as cited in Sundberg & Michael, 2001) investigated behavior and responses as well as strategies for combining these components in such a way as to influence and positively modify behavior in lab animals. Key principles from his work on operant behavior include the following three ideas:

1. Reinforcement supplied as a response to positive behavior given periodically can be very effective.
2. Small amounts of information are the most effective method for modifying unacceptable behavior.
3. The positive reinforcement can produce both primary and secondary behavioral modifications.

During the early 1960s, Skinner's concepts of behavior modification were adapted and applied with autistic students by various researchers (Baer, Wolf, & Risley, 1968; Fester, 1953; Lovaas, 1962; Risley, 1968). Each pursued research in a different way, and each researcher still has followers and critics. One of the more popular methods resulted from a series of papers published between 1964 and 1967 by Wolf and his associates (as cited in Cambridge Center for Behavioral Studies, 2008). Their work focused on development of techniques applied in the hospital with children with ASD and continued by the child's parents after returning home. Wolf's work is considered as being very influential in framing the current procedures and strategies incorporated in modern-day applied behavioral analysis treatments (Cambridge Center for Behavioral Studies, 2008).

With ABA the person's behavior is observed and documented in great detail prior to careful review and analysis. Every action and decision is time stamped along with a list of decisions and actions that the person does not do while being observed. This includes what happens before and after as a result of the actions and decisions. As the training progresses, fewer clues and instructions are given to encourage the person to act and think independently. Along with fewer clues and instructions is an increase in complexity of the tasks. One of the key components of ABA, as with many instructional programs, is that negative behavior is not reinforced. To maintain objectivity and consistency, the therapist's behavior is also observed and evaluated. When needed, helpful suggestions and advice are provided to the therapist.

The technique of discrete trial training (DTT) is most often identified as having its origins with procedures and strategies originally proposed by Lovaas (as cited in Autism

Spectrum Disorders Program, 2006). This intervention method has been used primarily with children and uses the strategy of “cue-value” or “response marking” (Grindle & Remington, 2002, p. 187). The foundation of his system incorporated the key principles of applied behavior analysis with the primary objective of the method being modification of undesirable behavior. The major difference between each of these strategies is that cue-value focuses on desired behavior, whereas response marking acknowledges all behaviors. Discrete trial training utilizes one-to-one instruction consisting “of an antecedent, a “directive” or request for the individual to perform an action; a behavior, or “response” from the person; and a consequence, a ”reaction” from the therapist based upon the response of the person (Autism Spectrum Disorders Program, 2006, p. 41).

Skills are introduced one at a time, with a new one introduced only after the current one is mastered. The rewards initially incorporated in the process are concrete items that represent wanted items by the subject. It is inherent in the process that these rewards should be replaced as quickly as possible with other rewards such as praise (Autism Spectrum Disorders Program, 2006). The intensity of the procedures is directly dependent upon the progress of the individual. This intervention strategy loses some of its effectiveness when too much time passes between sessions or too much time passes between the time of the action and reinforcement applied. Additionally, it is recommended that discrete trial training interventions be 40 hours per week, which can be prohibitive for family members having additional responsibilities. This intervention method, even with its shortcomings, does have merit in that it offers a strategy with proven results. It is imperative that careful consideration be given to this method with

attention to the overall demands for its implementation prior to starting it and then being forced to terminate prior to achieving desired results.

IEP. According to the U.S. Department of Education (2000),

The IEP is a very important document for children with disabilities and for those who are involved in educating them. . . . By law, the IEP must include certain information about the child and the educational program designed to meet his or her unique needs. (Sec. 4, A Closer Look)

An IEP must contain the following information: current performance, annual goals, special education and related services, participation with nondisabled children, participation in state and district-wide tests, dates and places of services, transition service needs, and measurement of progress (U.S. Department of Education, 2000).

The significance and importance of the IEP cannot be overemphasized. It contains instructional direction, environmental factors, personal interactions, and benchmarks for measuring and evaluating progress. Though the document is required by IDEA (1990), it is a critical foundation for educational success for any student with ASD. The IEP is the culmination of collective efforts of the parents, teachers, special education teachers, school psychologist, occupational therapist, physical therapist, speech therapist, a vision or hearing specialist, and other professionals, depending upon the unique or specific needs of the students (U.S. Department of Education, 2000)

Picture Exchange Communication System (PECS). According to Pyramid Educational Consultants (2006), “The Picture Exchange Communication System (PECS) was developed in 1985 as a unique augmentative/alternative training package that teaches children and adults with autism and other communication deficits to initiate communication (§ 1). The PECS system uses a foundation of applied behavioral analysis in combination with active participation by the student. The student initiates

communication by combining pictures to create effective requests, fulfilled by the teacher or other adult present. Though the system is grounded in ABA principles, effective communication is dependent upon minimal behavioral problems or outbursts. Abhorrent behavior by the student must be addressed before successful and effective communication can be learned. Formal evaluation of the PECS systems by Charlop-Christy, Carpenter, LeBlanc, and Kellet (2002) showed participants had increases in verbal speech, increases in social-communicative behaviors, and decreases in problem behaviors.

TEACCH. TEACCH is a program developed by Schopler and his colleagues at the University of North Carolina in the early 1970s (Division TEACCH, 2006). TEACCH offers a combination of “clinical services such as diagnostic evaluations, parent training and parent support groups, social play and recreation groups, individual counseling for high-functioning clients, and supported employment” (Division TEACCH, 2006, ¶ 1). TEACCH has been used with individuals of all ages and at all levels of development. This intervention technique includes parents with its family-centered approach. It includes structured teaching and can be successfully implemented in a variety of settings. The results of implementing the TEACCH intervention method have been partially anecdotal, including reports from parents and other caregivers. The fact that it can be used in a variety of situations has contributed to these results as well as its application to students who did not have ASD. These facts have contributed to a wide range of levels of success with a certain level of unpredictability with this intervention method.

Software Technologies and Advances Relevant to Children With ASD

Curricula. Asking a classroom instructor to define technology can be compared to asking them to define the concept of learning. The answers will probably span the continuum from very detailed and definitive to the vaguest, most nondescript sentence imaginable. It is from this platform that the discussion of technology and its potential for classroom integration and adaptation begins. In his article “Integrating Technology into Instruction” Robertson (2000) wrote that curriculum and in particular classroom instruction should include “the use of educational technology within a task” such that the “learner has a reason to use the application” (§ 3). Seamless integration of technology into classroom curricula is the paramount challenge for the classroom instructor with time limitations, budgetary restraints, insufficient training, and technology undergoing dynamic change before it is even implemented. With this scenario, classroom instruction comes under constant scrutiny and criticism for state-of-the-art performance and results. Adding to this mix is the continual supply of research and theories being published daily. Foundational pedagogies have stood the test of time—until the arrival of the computer and the information superhighway called the Internet. The prevalence of the Internet in every aspect of most people’s lives can lead classroom instructors to stretch their thinking regarding pedagogy, delivery systems, and student–computer interactivity as part of the learning situation.

Technology. The second component in this dyad is technology. The Internet has experienced phenomenal growth and evolved to be the largest source of information in the world. Educational software has acquired additional functionality and appeal for

students of all ages. For example, an individual is now able to talk to the computer and watch as the words appear on the screen (Murdock, 2007).

Dell (2006) noted, “While information technology has sparked extraordinary economic and human progress during the past few decades, it’s also true that its potential is only beginning to be met” (p. 3). Rapid advances in technology have lowered the cost and improved its distribution. Almost all students in the United States have some access to educational technology. Cuban (2001) stated, “In 1981 there were, on average, 125 students per computer in U.S. schools. A decade later, the ratio was 18 to 1. By 2000 it had dropped to 5 students per computer” (p. 17). The introduction of the computer into education has created both enormous potential and at the same time great controversy for researchers and educators. The dynamic findings relating to brain-compatible learning research coupled with the accelerated developments in computers offers increasing opportunities for creatively designed and uniquely individualized learning programs for all students and especially students with ASD.

The ultimate challenge for educators is to promote controlled, accurate, and consistent data flow to students with ASD. Technology may offer assistance as a delivery system available to create this type of consistent information control. The computer as a delivery system has proven beneficial in the classroom and offers some useful and beneficial solutions to educators working with students with ASD. Herskowitz (1996/2002) observed that children with ASD are at first hesitant to interact with computers but after a few times work with them with little hesitation, possibly due to the predictability and repeatability of the activities. She also suggested that the ease with which these students interact with computers in part may be the result of their fascination

with computer animation and the way that a computer displays its content. The National Autistic Society (2006) based in London stated, “Computer use offers a flexible, high status means of providing opportunities for people with autism in education” (Introduction sec., ¶1). Some research has shown promising results in the use of computers not only for education, but also therapeutic applications for students with ASD. Murray (1997) noted that many people with ASD seem to have monotropic interest systems: Their attention tends to be fixed on isolated objects which are viewed as though through a tunnel, apart from the surrounding context. Computers are an ideal instructional resource for students with disabilities because they allow adjustment and adaptation of the material to offer varying levels of difficulty, predictability, and controllable levels of input, and they allow others to join the individual's activity (Trehin, 2004).

Some software programs have proven to offer higher levels of attraction to the computer to younger children with ASD (Lahm, 1996), which contributes to the positive and encouraging outcomes from offering these students the availability of computer-based instruction. Lee and Vail (2005) observed that young children with disabilities can be convinced to interact with the computer with relative ease. This may result from the creation of a situation where external events can be more easily ignored when focusing on a computer screen, as the area of concentration is limited to the bounds of the screen. The small area of focus might explain why some people with autism can tolerate higher sensory input via a computer than they can apparently tolerate elsewhere. Computer-assisted learning offers a more controlled environment by varying the intensity and duration of the input during the intervention (D. Moore, McGrath, & Thorpe, 2000). Though differently worded, Murray and Lesser (1999) described “clear-cut contained

boundaries, context-free, predictable, and safe” as some of the potential benefits from computers offered to children with ASD (p. 2).

Additional benefits from computerized interventions include simulation applications providing virtual-reality learning environments where students are free to make mistakes and learn from them (D. Moore et al., 2000). D. Moore et al. stated that virtual reality

does however offer users the chance to become part of a controlled 3-D world. . . . Offering simulated conversations between a student and someone who appears on the computer screen, and a system such as this may be applicable to the coaching of conversational skills for students with autism. (p. 222)

The National Autistic Society (2006) referenced the research of Murray and Lesser (1999) that demonstrated the use of computers by children with autism often led to increased confidence and decreased unacceptable behavior levels. Students with ASD when using computers exhibited forethought, exploration, concentration, creativity, playfulness, self-awareness, self-esteem, other-awareness, a desire to show others, relevant speech, cooperation, turn-taking, communication, and sociability, which are characteristics and actions often not demonstrated by students with ASD (Murray & Lesser, 1999). The positive interaction and relationship between students with ASD and computers was also found by M. Moore and Calvert (2000); students were more attentive with computers than with their instructors and learned more.

The use of technology as a delivery system is documented in the literature, offering positive results and increasing in popularity. Though the amount of research is increasing and the positive results are encouraging, this research is still in its infancy. D. Moore et al. (2000) reinforced this position by stating, “There is good evidence that computer-aided learning is well accepted by students with autism and is of great potential

benefit to them” (p. 218). Other researchers (e.g., Bernard-Opitz, Ross, & Tutas, 1990; Chen & Bernard-Opitz, 1993; Panyan, 1984; Navarro, Ruiz, Alcalde, Marchena, & Aguilar, 2001; Russo, Koegel, & Lovaas, 1978) have been exploring the use of computer-aided learning with students with ASD. However, a formal study of the use of applications only recently was completed by Shane and Albert (2008). Shane and Albert acknowledged that, until their actions, “no study” had explored the idea “that individuals with ASD have a strong preference for visual media,” even though “it has been widely observed” (p. 1507) and reported in the literature. Shane and Albert also noted that their subjects “demonstrated strong preferences for certain animated characters” (p. 1507).

The Transporters. Baron-Cohen (2002, 2006), Golan et al. (2008), and other researchers have investigated the use of computers for interventions. Some of their research has evaluated younger students with ASD functioning at various levels. The age groups included subjects ranging from 2–10 years old with different levels of functioning abilities. This same research confirmed that students with ASD often interact more favorably with computers than with their instructors. Furthermore, researchers’ observations have shown that the levels of learning are enhanced for these students (Baron-Cohen, 2002, 2006; Golan et al., 2008). The United Kingdom’s Department for Culture, Media and Sport commissioned the Autism Research Centre at Cambridge University to design and create a software program demonstrating facial expressions and the emotions that normally accompany them. This software program is called the Transporters and has been an effective intervention when used with children aged 4–8 with ASD (Baron-Cohen, Golan, Chapman, & Granader, 2007; Transporters, 2008.).

Preliminary results show it to be an effective method to teach emotion recognition to children with ASD, and the learning transfers to other faces and situation.

The Transporters was designed using current brain research and pedagogical principles specifically to assist children with ASD in acquiring the skill of facial emotion recognition (Baron-Cohen et al., 2007). The software utilizes animation with human faces superimposed on cartoon vehicles. The design incorporates the observed preferences of children with ASD, such as predictability, spinning tops, rotating wheels, and repetitive motion (Baron-Cohen et al., 2007). Initial results are promising; the Autism Research Centre (2008) noted, “Children with high-functioning autism caught up with typically developing children of the same age in their performance on emotion recognition tasks” (¶ 1). Golan et al. (2008) demonstrated statistically significant improvement resulting from an intervention utilizing the Transporters program. Golan et al.’s data also showed an “improvement in the intervention group” using the Transporters “that was indistinguishable from the typically developing group” (p. 23) used as a control. Little empirical research has been conducted to assess the software’s effectiveness for children diagnosed with ASD. The current research is designed to fill that gap in the research.

The challenge before educators is the adaptation of technology on to existing measurement and instructional tools and instruments. This adaptation of technology is crucial and requires the researcher to correctly and accurately measure the effectiveness of these new combinations. Careful evaluation of these new instruments is of paramount importance to their successful implementation.

Chapter 3: Method

The primary purpose of this study, using a multiple-baseline design, was to investigate the effects of a treatment for facial emotion recognition for low-functioning children aged 4–7 with ASD. The secondary purpose was the investigation of motivation, time on task, and any positive influences the students perceived that contributed to their enjoyment while at school as evaluated by their teachers. The researcher’s hypothesis was that the Transporters (2008) software program designed to teach facial emotion recognition would result in positive change in facial emotion recognition, motivation, time on task, and enjoyment of school. The researcher’s request and approval to use the Transporters program are found in Appendices A and B, respectively.

This chapter provides a description of the multiple-baseline design, a description of participants and participant selection, procedures, information about the software program used, instruments and delivery methods, and a detailed description of the various visual and statistical data analysis methods employed in this study.

Multiple-Baseline Design

This study utilized a multiple-baseline research design. According to Kazdin (1982), the effectiveness of this design was in the fact that “multiple-baseline design demonstrates . . . that behavior changes when and only when the intervention is applied” (p. 126).

A multiple-baseline research design is one of the many single-case designs available. It is identified by the use of two or more baselines providing repeated measurement of performance on the dependent variable that is being evaluated. Additionally, it has “been described as occurring across behaviors, people, settings, stimuli, or times” (Kennedy, 2005, p. 152). This procedure offered the researcher control over the flexibility of the intervention timing and adapted easily to different situations. Multiple-baseline research involves the introduction of an intervention to the first baseline once a stable response pattern had been noted. When stability is noted in the intervention phase, and the second person’s baseline is stable, the intervention is introduced to the second participant, behavior, or setting, and so on. The control available to the researcher over the environment strengthens the soundness of the internal validity resulting from unwanted influence negatively impacting the relationship between the independent and dependent variables (Richards, Taylor, Ramasamy, & Richards, 1999).

When researchers are intending to analyze the influence of a specific intervention on an individual case, single-case design is the preferred methodology. The intention of testing intervention effects on individuals and not groups made the single-case design the primary tool due to its usefulness in maintaining ecological validity and experimental control (Ram & McCullagh, 2003). Single-subject designs were initially used in research in experimental psychology, and larger sample sizes yielding group designs did not become popular until the mid-20th century (Kazdin, 1982). The development of more sophisticated techniques for analysis, combined with the advantages of single-case designs, helped regain their popularity and viability. These characteristics contributed to

the frequency of use and successful application of single-case designs in many areas of research, but especially education.

A key additional advantage offered by multiple-baseline design was that it did not require the intervention to be withdrawn to demonstrate association with any of the observed behavioral changes (Kazdin, 1982; Shambrook & Bull, 1996). The ability to adapt assessment procedures to meet the needs of individuals in their environment made the multiple-baseline design of particular interest for this investigation due to the sensitivity of children with ASD to any changes in their environment or routine (Baron-Cohen et al., 2000; Siegel, 2003).

Research validity is a key consideration to the applicability of the results to other situations and individuals. The validity is characterized as either internal or external. There are eight types of internal validity: (a) history, (b) maturation, (c) testing, (d) instrumentation, (e) regression to the mean, (f) participant selection, (g) attrition, and (h) the possibility of other reasons for any observed changes (Johnson & Christensen, 2004). These threats to internal validity are critical to single-subject designs but pose minimal threat to multiple-baseline designs. External validity refers to the possibility to apply the research results to other individuals and situations. This research was not an attempt to establish external validity but rather to determine whether the intervention worked.

The baseline was established by presenting the students with pictures of faces, displaying different facial emotions, and asking if the person in the photo displayed one emotion or another. Each picture had two choices for participants. Testing included the emotions of happy, sad, angry, afraid, excited, and disgusted.

One of the ethical concerns of a single-subject A-B-A-B design and multiple elements is that “the return to baseline may not be ethically desirable . . . because the baseline condition may have exposed the person to some undesirable situation” (Kennedy, 2005, p. 150). The use of a multiple-baseline design addressed this concern; in fact, it was desirable that the participant not return to baseline. In this study, it was desirable that participants not return to baseline after interacting with the facial emotion software and then looking at pictures demonstrating facial emotion, due to the potential for cognitive improvement while concurrently experiencing minimal or no cognitive deterioration.

One of the most critical informational components of single-subject design is the recording of baseline data. Kennedy (2005) discussed two types of baselines. The first is the uncontrolled baseline where “existing practices” (Kennedy, 2005, p. 38) are used to establish the baselines. The second type is the controlled baseline where the researcher chooses “to hold all conditions constant, except for the variable that is the focus of comparison between baseline and intervention” (Kennedy, 2005, p. 38). The initial period of time when information is gathered is the baseline phase (Kazdin, 1982), which provides data identifying the “level of behavior before a special intervention begins” (p. 108) and describes “the existing level of performance” (p. 108). Though the baseline phase information was critical, it was the predictive function that provided credibility for the impact of the intervention by trying to predict the level of performance at some point in the future without the occurrence of an intervention.

Participants

Participants in this study were three male students ages 5, 5, and 7 with ASD. The participants had a medical or an educational diagnosis that met the criteria for ASD as defined by the DSM-IV-TR (American Psychiatric Association, 2000). Each participant was qualified to be included in this study by meeting selective criteria such as exhibiting dysfunctional verbal communication and impaired social communication. Participants were also evaluated for freedom from vision, hearing, or physical motor impairments that would hinder their participation in this study. The original desire was for an attend time of 20–25 minutes. However, these students could attend for only 10–15 minutes. The parents of each participant were informed of the study and their consent was received prior to the start of this study. Assent was not required from the students, as they did not have the capacity to provided informed assent. Informed consent forms were required from the parents (Appendix C). The participants' classroom teachers were also involved in the identification of students who participated in this study. Teachers also completed informed consent forms (Appendix D). These participants were screened for any signs of ASD and their parents were asked to confirm that there had been no history of learning disabilities or other related symptoms of ASD.

Procedures

Kennedy (2005) identified procedures, curriculum, instructional procedures, and types of materials provided as the key components of a well-designed and useful baseline. The following sections discuss each of these components.

Baseline. According to Kennedy (2005), the accepted consensus among researchers is that “three data points . . . constitute a minimum baseline” (p. 38). Kennedy

also stated, “The goal of a baseline is to establish patterns of behavior to compare to an intervention,” and it “needs only to be long enough to adequately sample this pattern” (p. 38). During the baseline, the participants were shown pictures of individuals displaying emotions from the DVD, the Transporters, and asked to identify which emotion they saw. The DVD program could also state the answer to each question, but that feature was not used during the baseline activities. For Student 1, this activity occurred for 3 days, as determined by the strength of the baseline data. At the end of the 3 days, it was determined that the baseline data were stable enough, and an additional 3 days were not added. Students 2 and 3 each had baseline durations of 3 days. Due to the nature of the students’ behavior and attendance, the sessions for each of the participants were not consecutive. The scheduling of the baseline activities was determined by the classroom teacher to identify the optimal time.

During the intervention phase, participants were again shown the Transporters software program in the same environment that was used to establish the baseline. The timing of all presentations was again determined by the classroom teacher to identify the optimal time for the intervention activities.

Intervention. The intervention sessions for Students 1, 2, and 3 lasted 6 days, 6 days, and 5 days, respectively. The schedules for presenting the information and the session length for each participant were as similar as possible to those used for establishing the baseline data. The delivery times were determined by the participants’ classroom instructors. The instructors were given the flexibility to implement the presentation or delay it if, in their opinion, the participants were not receptive or able to attend to the activity for a minimum time period. It was the intention of the researcher to

minimize any disruption or stress to the participants. The delivery times and session lengths were standardized as much as possible for each participant.

The objective of each session was to complete the topic lesson. The six emotions were presented in pairs of happy and sad, afraid and angry, and excited and disgusted, with each session lasting 20–25 minutes. In each session, the software displayed an animation demonstrating the facial emotion for that session. Upon completion of each session, the participant was evaluated using eight quizzes of pictures displaying facial emotions. Participants were asked to identify the facial emotion presented during that session. The participants were given 5 seconds to correctly identify the facial emotion. This evaluation tool was included in the Transporters software program.

Curriculum (setting and sessions). All material presented in sessions were moderated by the participants' classroom instructors. Research has shown that students with ASD are stressed when changes occur in their environment. Siegel (2003) referred to this as a "preference for sameness and familiarity" (p. 51). All sessions for both the baseline and the intervention occurred in the participants' regular classrooms. Every effort was made to keep the classroom environment as consistent as possible, replicating as closely as possible everyday circumstances in order to minimize distractions and any negative impact on the validity of the results. The regular classroom had a computer that was used for all of the sessions. The optimal timing of any material presented was evaluated and designated by the classroom instructors. Once the optimal time was identified, the presentations were scheduled and implemented as much as possible at the same time for each participant. The baseline and intervention sessions each day lasted 20–25 minutes.

Instructional procedures. The following procedures were implemented during the establishment of the baseline for each student. First, three sessions occurred over 7 days to establish a baseline for Student 1. An eight-step procedure was used for these sessions with Student 1:

1. The computer was turned on and the software program, the Transporters, started.
2. The student was positioned in front of the computer screen.
3. The program was started demonstrating 2 of the 6 facial emotion scenarios during each of the three sessions. The six emotions were presented in three pairs: (a) happy and sad, (b) angry and afraid, and (c) excited and disgusted.
4. The participant was given a 5- to 10-minute break when needed.
5. The quiz that was used gave the student two choices, and the student was asked to point to the correct face for each question. The sound was muted during this phase to avoid having the student hear any information regarding the correct answer.
6. The participant was presented each of the emotions and quizzed eight times. The instructor recorded the correct number of correct and incorrect answers as well as a no response for the each pair of emotions.
7. This procedure was repeated once per day for a minimum of 3 days.
8. An acceptable baseline was established and identified by the instructor based upon the ability of the participant to attend for 20–25 minutes without resisting participation.

The eight steps listed for Student 1 were repeated at approximately Day 2 of the baseline phase for Student 1 and continued for three sessions to establish the baseline for Student 2. The three sessions to establish a baseline for Student 2 occurred over 8 days.

The eight steps listed for Student 1 were repeated at approximately Day 36 of the intervention Phase 1 period for Student 1. The eight steps were used in three sessions to establish the baseline for Student 3. For Student 3, these three sessions occurred over a period of 15 days.

The instructors had the option to cease the procedure temporarily if, at any time, the participants showed resistance or displayed defiant behavior towards the activity. Then, if possible, they were to resume. Otherwise, the procedure was discontinued and rescheduled at a later time.

This starting point was determined based on Kennedy's (2005) advice: "The default response among single-case researchers has been that 'three data points'" (p. 38) is a minimum. However, Kennedy added, "A baseline needs to be as long as necessary but no longer" (p. 38). Acceptable baselines were established after the minimum of 3 school days for each of the participants and additional days were not needed.

Materials. The materials used in this study were a DVD containing a software program and a desktop computer that provided the delivery method. The software program was the Transporters (2008) and was developed by the Autism Research Centre at Cambridge University in England. It combined animation with predictable movements, displaying human faces on vehicles with various facial expressions, voices, and dialog. The concept of predictable movement for this program was based upon research by Baron-Cohen (2006) demonstrating a preference for what he termed "hyper-

systematizing” (p. 5). Baron-Cohen’s (2006) research also showed “that all human beings have a systematizing mechanism” (p. 5) and varying levels of sensitivity to the organizational structure around them. This software program appeals to the need for higher organizational structure or systematizing exhibited by individuals with ASD. Prior to the development of this program, careful consideration was given to the fact that videos displaying structural movements, like Thomas the Tank Engine, have been favorites of children with ASD (Baron-Cohen, 2006).

The Transporters program demonstrated 15 facial emotions: (a) happy, (b) sad, (c) angry, (d) afraid, (e) excited, (f) disgusted, (g) surprised, (h) tired, (i) unfriendly, (j) kind, (k) sorry, (l) proud, (m) jealous, (n) joking, and (o) ashamed. Each episode had an associated interactive quiz to help the child associate facial emotional expressions and review the name of the featured emotion both visually and verbally. This research used 6 of the 15 emotions: (a) happy, (b) sad, (c) angry, (d) afraid, (e) excited, and (f) disgusted.

Measures. The primary dependent measure was the correct identification of facial emotions displayed on the photos. Additionally, observations were made of each participant and evaluated for increased levels of motivation qualitatively, increased time on task quantitatively, and increased levels of enjoyment for the students as perceived by their teachers qualitatively. The values used to evaluate motivation were 0, 1, 2, and 3. If the students displayed no interest, looked away from the computer, and refused to sit down during the sessions, a value of 0 was assigned. A 1 was assigned if the participant showed no interest but remained seated during the session. When some interest was demonstrated and the student remained seated, a 2 was given. The value of 3 was only

assigned when the student showed interest in the activity, remained seated, and participated in the event.

The values for time on task were also 0, 1, 2, and 3. However, the values were assigned according to the amount of time that the student remained seated during the sessions. If the student would not sit down or resisted sitting down, a 0 was given. A 1 was used when the student participated for up to 9 minutes during the session. The value 2 was assigned when the time went from 9 minutes 1 second to 18 minutes, and any amount over 18 minutes received a 3.

The level of enjoyment utilized the same values of 0, 1, 2, and 3. Instructors assigned the value of 0 if the student showed minimal or no enjoyment when the sessions were begun and conducted. If the student participated minimally, a 1 was given. The value of 2 was received if the student participated willingly but displayed minimal enjoyment. If the participant was willing and enjoyment was observed, the student received a 3.

The effectiveness of the data is dependent upon how much the “observers agree in their scoring behavior” (Kazdin, 1982, p. 42), which has been referred to as interobserver agreement. It is inherent in the quality of the data that fewer observers are desirable. For this research, two classroom teachers were the key observers. Kazdin identified three key areas of concern affecting data reliability: (a) consistency, (b) bias, and (c) definition. The need for consistency is in establishing a repetitive behavior pattern. Kazdin stated that if “variation is large, no systematic pattern of behavior may be evident” and that “a change in behavior . . . might not be detected” with “inconsistent assessment” (p. 49). The interobserver agreement helps to minimize this variation source in the data.

The second source of data variation results from observer bias. The causative agent is time, which can result in increased leniency or perceiving improvement when none occurred. For this research, time was adjusted to offer the best experience for each participant and kept to a minimum as much as possible.

The third source for data variation and equally as significant as the previous two is the definition of different behaviors. Kazdin (1982) stated that the interobserver agreement “ensures that the target behavior is well defined” and “sufficiently objective, clear, and complete” (p. 49) to minimize its effect. The clarity of the behavior definition also serves as the basis for consistent intervention application (Kazdin, 1982). For this research the behavior definitions were those that had been used previously by each of these instructors and were standards established and used by the school. Agreement was inherent in this situation.

The validity of research data should be a primary concern of any researcher. Validity has several definitions but may have been best summed up by Johnson and Christensen (2004) as “the appropriateness of the interpretations” and by an instrument measuring “what we want it to” (p. 140). A note of caution was expressed by Trochim (2001) to remember that the validity of the results is “influenced by the circumstances in which they are made” and that researchers often reference validity when “referring to the conclusions they reach” (p. 20).

Reliability was evaluated by calculating the interrater reliability coefficient. Participants were recorded while watching the software program and taking the quizzes. A second observer viewed a percentage of the total number of student observations using the same guidelines as the original observer. The results from each observer were

compared for agreement or nonagreement with the results from the original observer. The second observer viewed approximately 50% of the total number of observations.

The validity evaluation focused on content validity. This process provided assurance that the measures were appropriate outcomes for the research questions. The measures were evaluated by four individuals who were knowledgeable on the topic of this research. These individuals had expertise in autism research and in teaching autistic students. They were provided with the research questions and a detailed explanation of all outcome measures for these activities. They determined whether the measures were appropriate.

Research Question 1. How effective is the Transporters software program for ASD students with regard to (a) facial emotion recognition, (b) motivation, and (c) time on task? These three measures are discussed in the following sections.

Correct identification of facial emotions displayed on photos. For the first measure, students were shown a photo of a person displaying an emotion and asked to identify the emotion when given a choice of three answers. This measure was easily defined and evaluated. The software program included two types of quizzes: easy and difficult. For this research the difficult quizzes were used. Each of these quizzes displayed segments with dialog and faces with emotion from the story that the participant watched during the intervention and displayed three answer choices. The easy-level quizzes displayed a facial expression; asked the student which emotion was showing; and offered two choices, one of which came directly from the quizzes and the stories. When the participant answered the question, the appropriate feedback was provided. Each emotion quiz included eight questions. Participants were given 5 seconds to answer

before proceeding to the next question or section. The difficult quizzes used the same format, with the primary difference being three choices instead of two, and were used for this research to improve data credibility. This minimized the possibility of the participant getting the correct answer by guessing.

Level of motivation. There are two classic types of motivation: intrinsic and extrinsic. Motivation has been defined as something that motivates or provides an incentive. Ryan and Deci (2000) defined intrinsic motivation

as the doing of an activity for its inherent satisfactions rather than for some separable consequence. When intrinsically motivated a person is moved to act for the fun or challenge entailed rather than because of external prods, pressures, or rewards. (p. 56)

Deci and Ryan (1985) expanded on the definition of extrinsic motivation in terms of their self-determination theory, proposing that “extrinsic motivation can vary greatly in the degree to which it is autonomous” and contrasting their definition to the more traditional views that “extrinsically motivated behavior as invariably nonautonomous” (p. 60).

Maslow (1943) proposed in his theory of human motivation that motivation is partially the result of needing to belong and avoiding loneliness and social anxiety. Ryan and Deci stated, “Internalization is the process of taking in a value . . . so that it will emanate from their sense of self” (p. 60).

For this research the more traditional perspectives of both types of motivation were adapted and modified to accommodate the personality characteristics of students with ASD. The initial adaptation allowed the classroom instructors to ask the participants about working with the computer and looking at the photos and identifying how the person was feeling. To this request the participant could offer one of the following intrinsic responses. The value of 3 was only for when the student showed interest in the

activity, remained seated, and participated in the event. When some interest was demonstrated and the student remained seated, a 2 was given. If the student showed no interest but remained seated during the session or offered a negative response, the score was recorded as 1. When students displayed no interest, looked away from the computer, and refused to sit down during the sessions, a value of 0 was assigned. A defiant response was recorded as 0. The observations during baseline and intervention sessions also provided data for signs of extrinsic motivation. Reinforcers were needed to keep the participants' attention focused on the activity.

Time on task. The measurement of time on task was the total time that the participants sat in front of the computer and looked at the screen. This measurement was evaluated by the participating instructors and from observing the tapes of the participants' time in the classroom. Length was listed in minutes and 10-second intervals. The participants' scores were determined as being high, medium, low, or none. High was considered to be more than 18 minutes of the time of the session and given a numerical value of 3. Medium ranged from 9 minutes and 1 second to 18 minutes of the session time and was recorded as 2. Low was considered to be looking at the screen and focusing on the program from 3 minutes and 1 second to 9 minutes of the time during the session and given the value of 1. Any time amount less than 3 minutes was considered to be none and given a value of 0.

Research Question 2. How effective is the Transporters software program with regard to influencing ASD students' perceived enjoyment while at school as evaluated by their teachers? The measurement of enjoyment level was evaluated by the classroom instructors and by observing the videos using the values of high, medium, low, or none. If

the participant showed interest in participating in the activity with little or no prodding or encouragement, or possibly suggested the activity and demonstrated an improved mood with other activities, the enjoyment level was identified as high and assigned a value of 3. The medium level was when some prodding or encouragement was required and there was no noticeable difference from the norm; this was recorded as 2. The low level was defined as the participant demonstrating minimal interest in participating in the instructional activity and was recorded as 1. If the student required more than 5 minutes of prodding or encouragement from the instructor before making any visible movement towards the computer, the level was recorded as 0.

Chapter 4: Results

This chapter presents the results of the research study described in the previous chapter. The study incorporated both objective measures for facial recognition and subjective measures for motivation, time on task, and increased enjoyment of school. A multiple-baseline design was employed, as often used with research in special education. It was hypothesized that the use of the DVD, the Transporters, would increase facial recognition, along with improved motivation, increased time on task, and higher levels of enjoyment of school. Therefore, the desired outcome of this intervention was a demonstrable improvement in each of these areas. The results of analysis of the baseline and intervention activities are described in this chapter.

Visual analysis is often criticized for the lack of formal criteria guidelines used as a basis for evaluations. Kazdin (1982) stated that visual analysis “refers to reaching a judgment about the reliability or consistency of intervention effects by visually examining graphed data” (p. 232) and that “the process of visual inspection would seem to permit, if not actively encourage, subjectivity and inconsistency in the evaluation of intervention effects” (p. 239). Thus, in this study visual analysis was supplemented by statistical analyses.

Data Screening Procedures

The results were first evaluated using visual analysis that included the components of “level, trend, slope, and variability” (Hojem & Ottenbacher, 1988, p.

984). Any “abrupt change observed between the last data point in the baseline . . .and the first data point in the treatment was identified as level” (Hojem & Ottenbacher, 1988, p. 984). Any “direction indicated in the set of data points” was identified as a trend, more specifically “defined as stationary, accelerating, decelerating, or curvilinear” (Hojem & Ottenbacher, 1988, p. 984).

Results for Research Question 1

Research Question 1 was the following: How effective was the Transporters software program for ASD students with regard to improving (a) facial emotion recognition, (b) motivation, and (c) time on task? These variables were measured by the students’ correct identification of facial emotions displayed in photos, observed reactions, and the total time that students sat in front of the computer and looked at the screen.

Facial emotion recognition. The results for total correct responses by session are shown in Table 1 and Figure 1 for the three students in the study. It should be noted that some sessions, as indicated in Table 1, ended prematurely when students were inattentive. The first three observations for each student reflect the baseline, whereas the remaining observations for each student reflect responses to the intervention.

Table 1

Facial Emotion Recognition: Total Correct Responses by Student by Session

Student	Session								
	1	2	3	4	5	6	7	8	9
Student 1	3	2	2	6	4	1	3	3	0
Student 2	0	0	0	0	0	0	0	0	0
Student 3	0	0	2	1	3	3	4	2	3

Note. Responses out of a total possible score of 8.

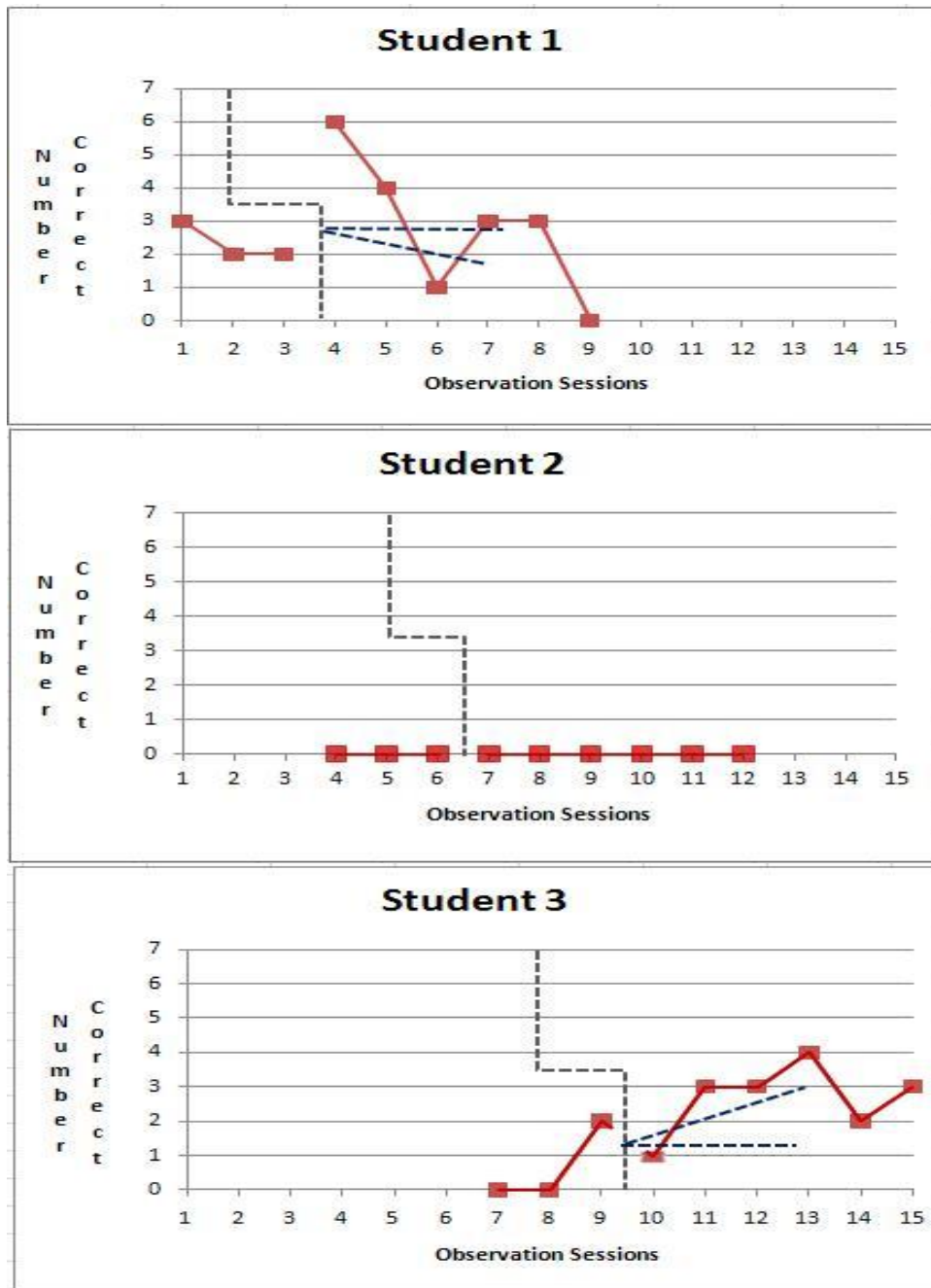


Figure 1. Facial emotion recognition: Total correct responses by student by session.

The baseline phase for Student 1 included Sessions 1–3. These three values, as shown in Table 1, generated a mean value of 2.33 for the baseline phase. The intervention phase for Student 1 was introduced during Session 4. This initial intervention session resulted in a score of 6 correct answers out of 8. After the initial success with the

introduction of the intervention during Session 4, a score of 4 was obtained for Session 5, and during Session 6, Student 1 gave only 1 correct answer. Three correct answers were obtained in Sessions 7 and 8. In Session 9 there were no correct answers. Five of the 9 sessions went the full time, with 4 out of 9 ending early.

The split-middle method of trend estimation was applied in quantitative analysis. The application of this method is shown in Figure 2. For Student 1 the split-middle trend estimation line displays a negative trend. The trend line was negative, though the intervention-phase mean score of 2.83 was higher than the mean of 2.33 for the baseline phase.

Student 2 showed little or no interest in participating and interacting with the computer. The first session (Day 4) and the last session (Day 12) went the full time. Sessions 2–8 (Days 5–11) ended early, with the majority only going 50% of the scheduled time period. The early-ending sessions and lack of responses were counted as zero correct answers. The value of zero correct answers for each of the baseline sessions created a stable level value but also resulted in no observable trend, no difference in level, and no variability.

Student 3 showed a relatively stable initial baseline level with zero correct answers for the first and second sessions (Days 7 and 8) and 2 correct answers in the third session (Day 9). These three values produced a baseline mean of 0.67. The intervention was introduced during Session 4 (Day 10); Table 1 shows the number of correct answers by session. All nine sessions for Student 3 ended early, with Sessions 7 and 8 (Days 13 and 14) lasting only approximately 25% of the planned time and the remaining seven sessions lasting approximately 50% of the planned time. Though the trend initially

appears curvilinear from visual analysis for Student 3, further observation suggested a slight increasing trend and so a small effect of the treatment.

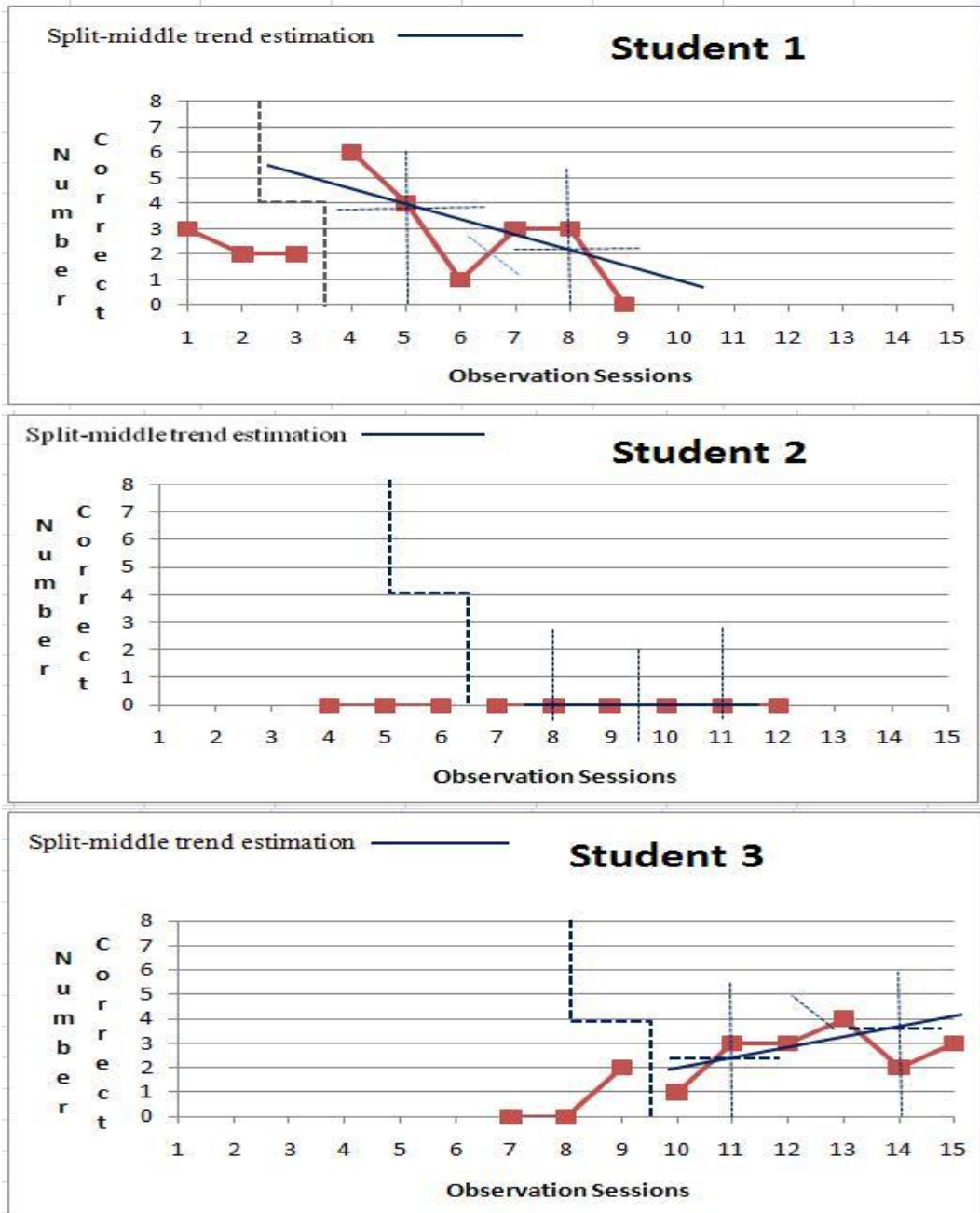


Figure 2. Facial emotion recognition: Split-middle trend estimation.

The intervention phase for Student 3 had a mean of 2.67 compared to a mean of 0.67 for the baseline phase. Applying the split-middle method of trend estimation to the

intervention phase shown in Figure 2 concurred with the visual analysis and displayed a slight positive trend.

During the sessions, students were shown facial emotion pairs of happy–sad, Pair 1; angry–afraid, Pair 2; and excited–disgusted, Pair 3. The results for the facial emotion pairs are shown in Table 2 and Figure 3. Table 3 shows mean baseline and intervention scores for each student by emotion pair.

Table 2

Emotion Pair Recognition: Total Correct Responses by Student by Session

Student	Session								
	1	2	3	4	5	6	7	8	9
Student 1	3	3	6	2	4	3	2	1	3
Student 2	0	0	0	0	0	0	0	0	0
Student 3	0	1	4	0	3	2	2	3	2

Note. Responses out of a total possible score of 8.

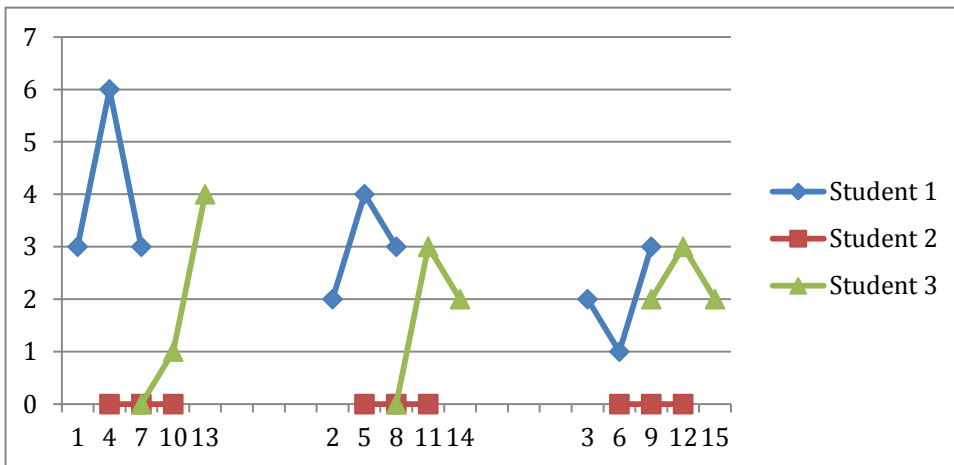


Figure 3. Total correct responses by emotion pair by student by day. The first pair of emotions was happy–sad, the second pair angry–afraid, and the third pair excited–disgusted.

Table 3

Mean Scores for Each Emotion Pair by Student

Pair	Student 1	Student 2	Student 3
Pair 1: happy–sad			
Baseline	3.0	0.0	0.0
Intervention	4.5	0.0	2.5
Pair 2: angry–afraid			
Baseline	2.0	0.0	0.0
Intervention	3.5	0.0	2.5
Pair 3: excited–disgusted			
Baseline	1.0	0.0	2.0
Intervention	2.5	0.0	3.5

Note. Mean scores out of a total possible score of 3.

Table 3 shows the baseline and intervention values for the emotion pairs for Student 1. The higher values for Pair 1 might have been the result of more easily distinguished facial differences between happy and sad than the other pairs. The scores became progressively lower as Student 1 advanced through the various emotion pairs. The values for Student 2 showed no change during the nine sessions. Student 3 showed a higher mean for Pair 3 than for Pairs 1 and 2 (Table 3).

The difference in number correct for facial emotion aggregated over the three students between baseline and treatment phases of the study was also assessed using a paired t test. No statistically significant difference was found between the baseline mean number correct and the treatment mean number correct, $t(2) = -1.63, p = .25$.

Motivation. The motivation levels for each session are shown in Tables 4 and 5 and are presented in Figure 4 for the three students in the study. The use of the computer and DVD animation was considered a possible motivator for the participants in this study. However, as shown in Table 5, the motivation mean values for Students 1, 2, and 3

for the intervention phase were not much greater than those for the baseline phase. Student 1 demonstrated a minor amount of interest in the DVD as exhibited by both correct and incorrect responses. Visual analysis of Figure 4 indicates minimal positive effect of the treatment on the motivation of each of the participants in this study.

Table 4

Motivation: Score by Student by Session

Student	Session								
	1	2	3	4	5	6	7	8	9
Student 1	1	0	1	1	0	0	0	1	1
Student 2	1	0	0	1	0	0	1	0	0
Student 3	1	0	0	0	0	0	1	0	0

Note. Responses out of a total possible score of 3.

Table 5

Mean Scores for Motivation by Student

Student	Baseline	Intervention
Student 1	0.67	0.50
Student 2	0.33	0.33
Student 3	0.33	0.17

Note. Mean scores out of a total possible score of 3.

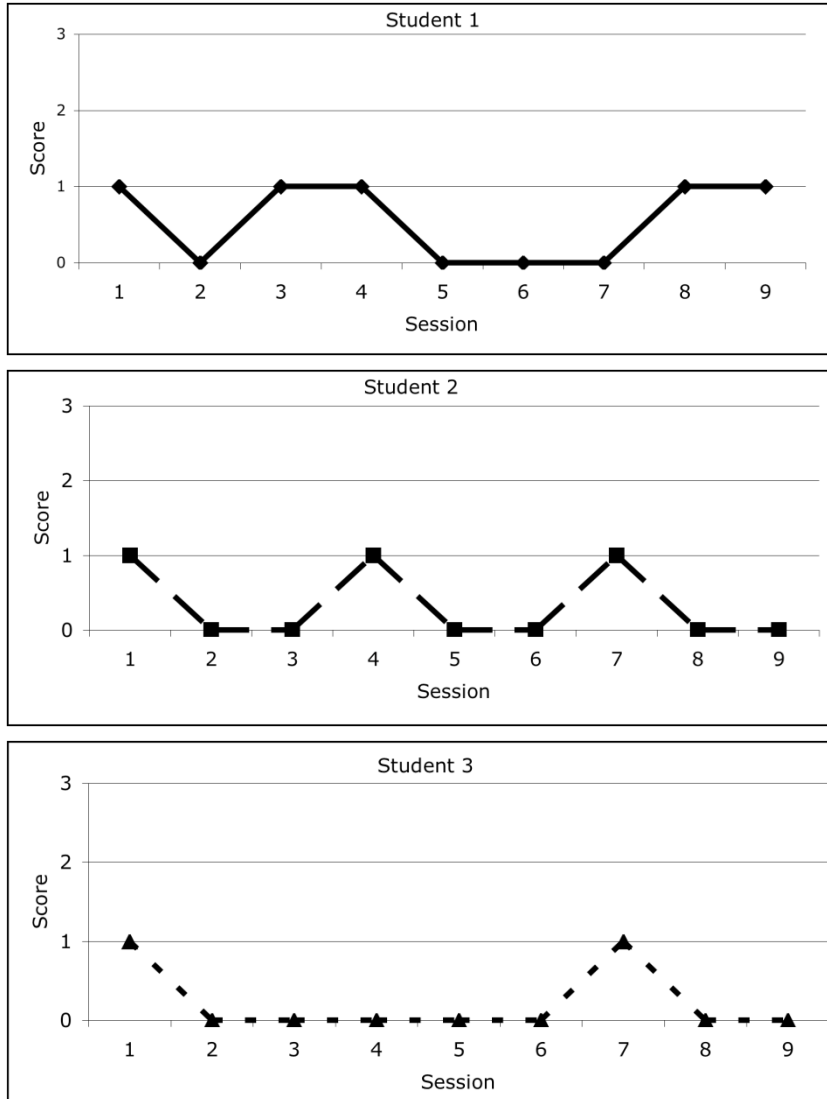


Figure 4. Motivation by student by session. Sessions 1–3 were baseline.

Though the split-middle trend estimations for each of the students indicated a positive influence on motivation, as shown in Figure 5, this as an initial conclusion is tenuous. The difference in motivation aggregated over the three students between baseline and treatment phases of the study was also assessed using a paired *t* test. No statistically significant difference was found between the baseline mean motivation level and the treatment mean motivation level, $t(2) = 2.0, p = .18$.

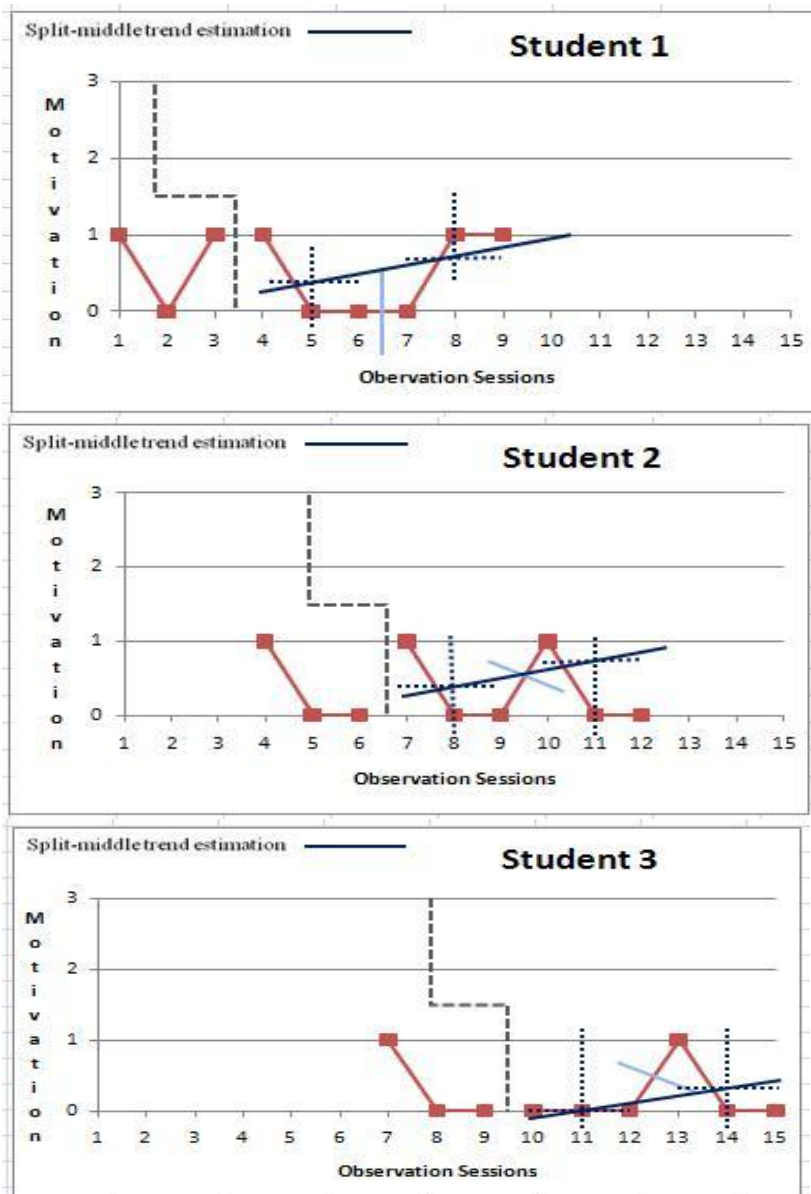


Figure 5. Motivation: Split-middle trend estimation.

Time on task. The time on task for each session is shown in Tables 6 and 7 and presented in Figure 6 for each of the three students in the study. The values were recorded in 10-second intervals and given a score of 0, 1, 2, or 3. As shown in Table 7, mean scores showed minimal improvement.

Table 6

Time on Task by Student by Session

Student	Session								
	1	2	3	4	5	6	7	8	9
Student 1	2	2	1	2	2	1	1	1	2
Student 2	1	0	1	1	0	0	1	0	1
Student 3	1	1	2	2	1	2	1	1	1

Note. Responses out of a total possible score of 3.

Table 7

Mean Scores for Time on Task by Student

Student	Baseline	Intervention
Student 1	1.67	1.50
Student 2	0.67	0.50
Student 3	1.33	1.33

Note. Mean scores out of a total possible score of 3.

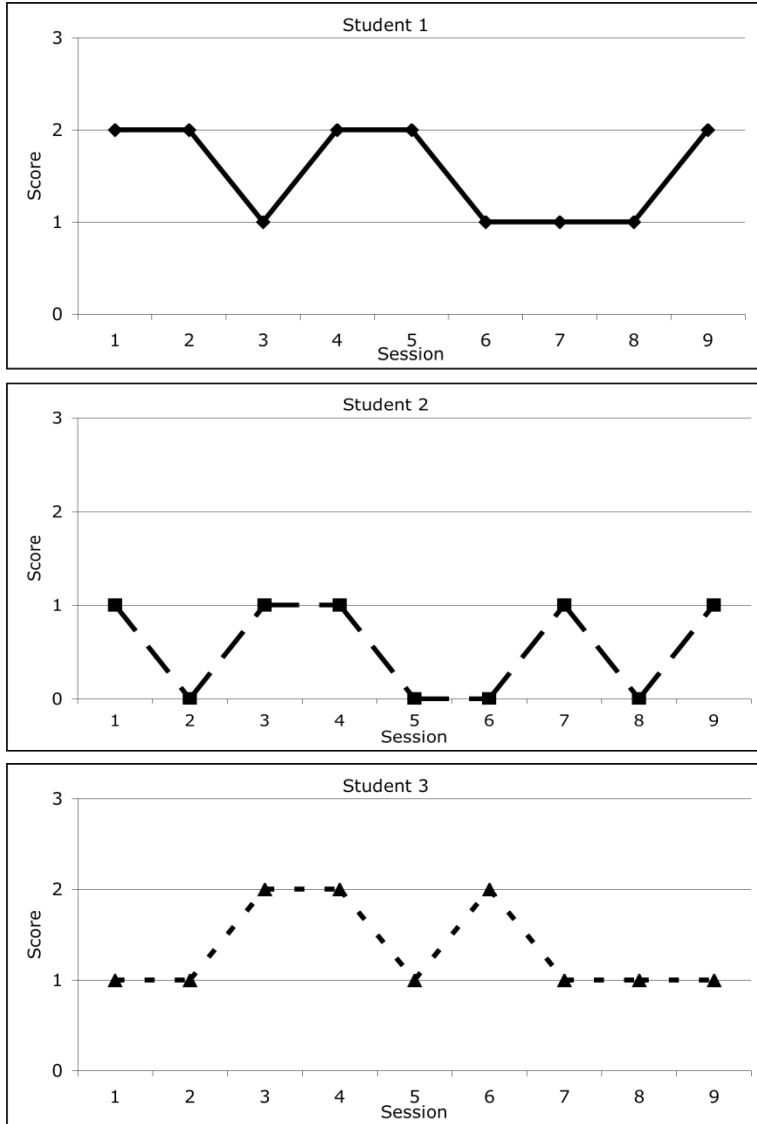


Figure 6. Time-on-task scores by student by session. The baseline was Sessions 1–3.

Figure 7 shows the split-middle trend estimations. Although the estimations for Student 2 indicated a positive time on task, the split-middle trend estimations for Students 1 and 3 displayed negative trends.

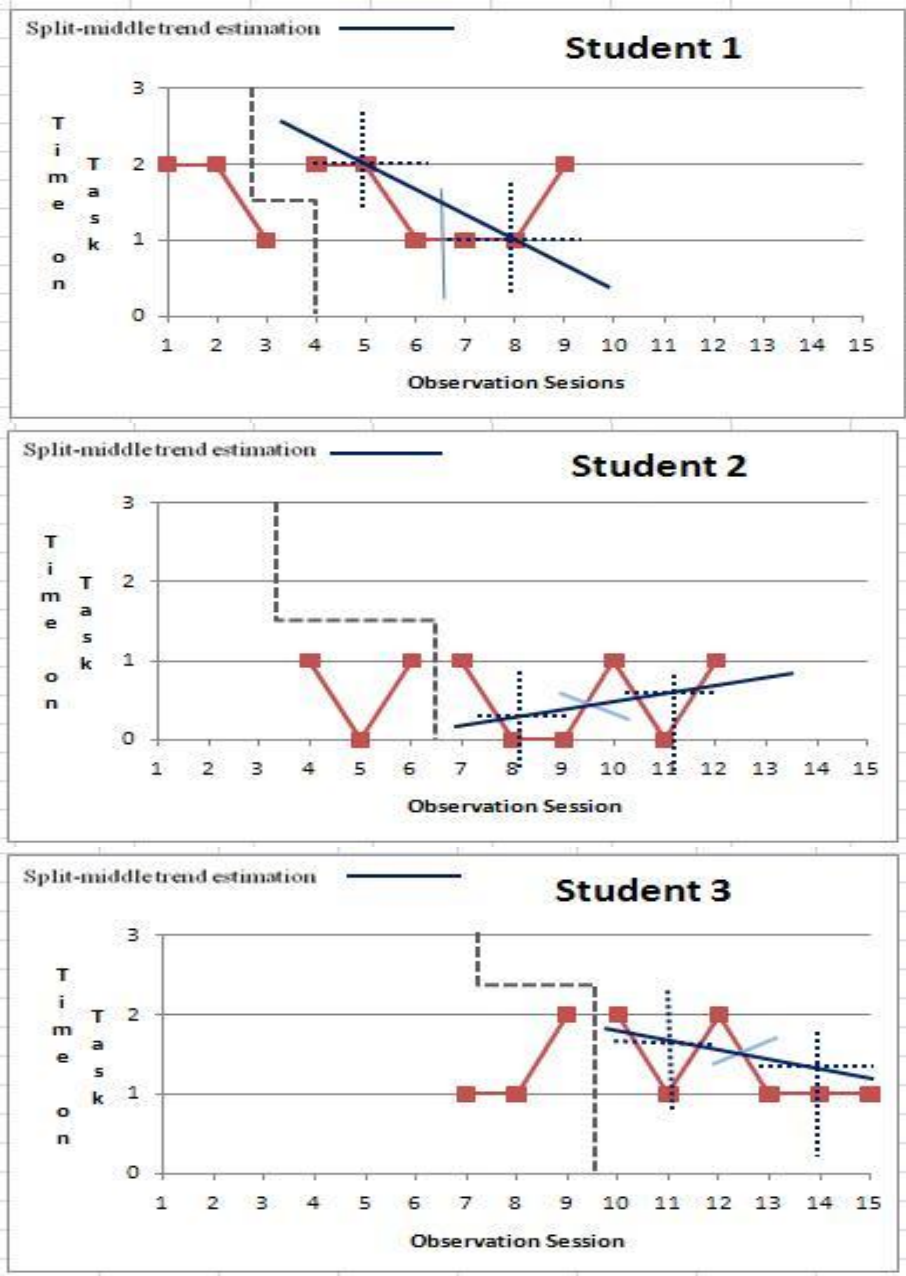


Figure 7. Time on task: Split-middle trend estimation.

The difference in time on task aggregated over the three students between baseline and treatment phases of the study was also assessed using a paired *t* test. No statistically significant difference was found between the baseline mean of time on task and the treatment mean time on task, $t(2) = 0.72, p = .54$.

Results for Research Question 2

Research Question 2 was the following: How effective was the Transporters software program with regard to influencing ASD students' perceived enjoyment while at school as evaluated by their teachers? The enjoyment levels of the participants were evaluated by the instructors for each session. The numerical evaluations for each participant's sessions are listed in Table 8 and are displayed in Figure 8. Table 9 shows mean values for baseline and intervention sessions.

Table 8

Level of Enjoyment by Student by Session

Student	Session								
	1	2	3	4	5	6	7	8	9
Student 1	1	0	1	1	0	1	0	1	1
Student 2	1	1	0	1	1	0	0	0	0
Student 3	0	1	0	0	0	1	0	1	0

Note. Responses out of a total possible score of 3.

Table 9

Mean Scores for Enjoyment by Student

Student	Baseline	Intervention
Student 1	0.67	0.67
Student 2	0.67	0.33
Student 3	0.33	0.33

Note. Mean scores out of a total possible score of 3, based on teacher observations.

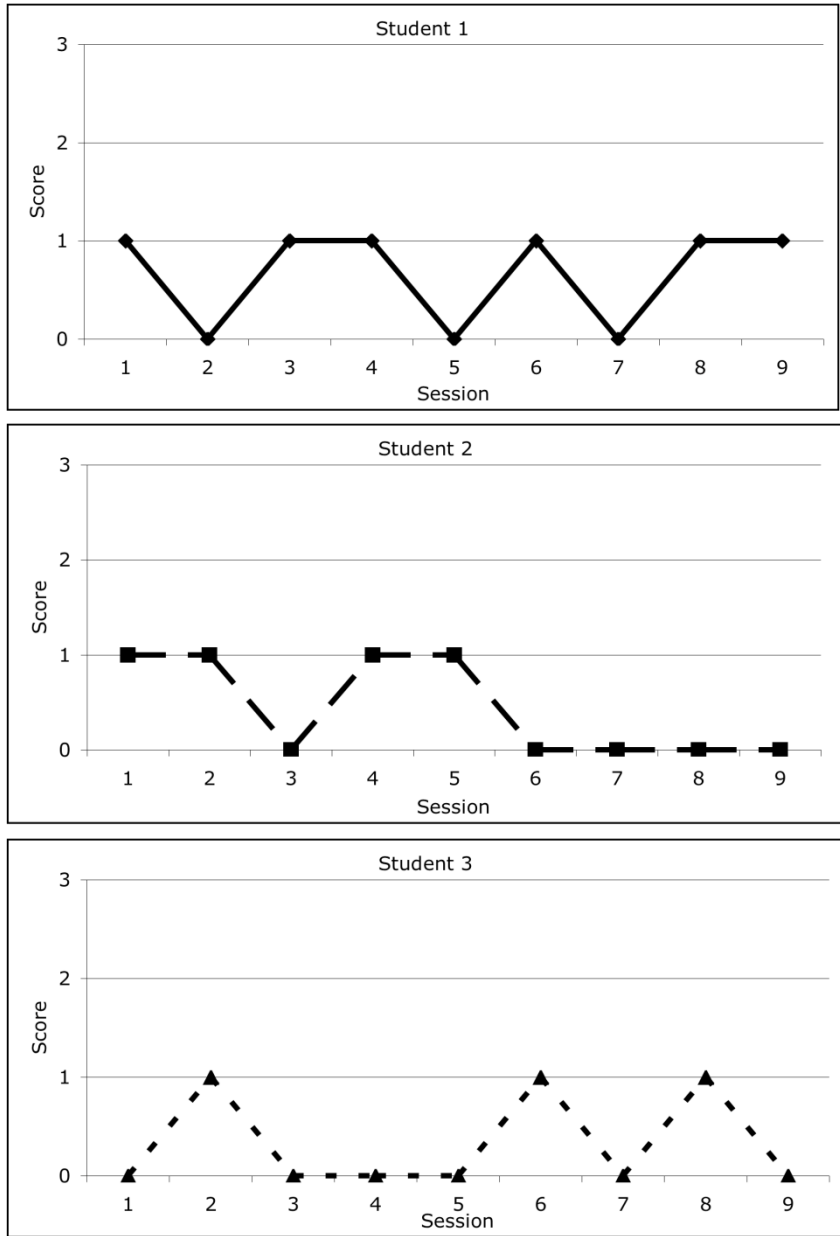


Figure 8. Level of enjoyment by student by session.

Visual analysis of the data on level of enjoyment exhibited by Students 1 and 3 suggested no change either positively or negatively during the baseline or intervention phases. Student 2 showed a negative change. Results of the split-middle trend estimations for each of the three students are shown in Figure 9. Results corresponded to results of the visual analysis indicating a low level of enjoyment.

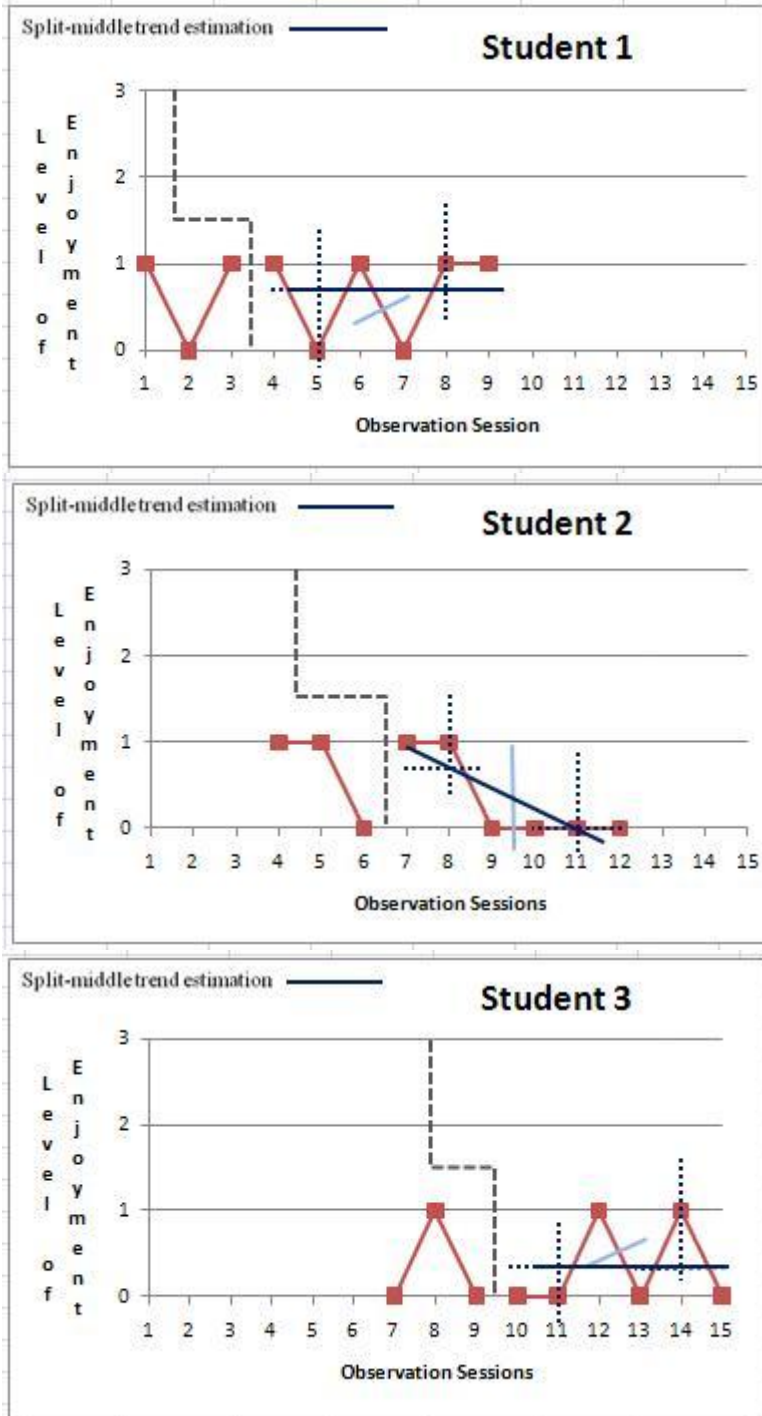


Figure 9. Enjoyment: Split-middle trend estimation.

The difference in enjoyment aggregated over the three students between baseline and treatment phases of the study was also assessed using a paired t test. No statistically

significant difference was found between the baseline mean of enjoyment and the treatment mean enjoyment, $t(2) = 1.00, p = .42$.

Summary of Analyses

This chapter consists of a review of the visual and numerical analyses completed to answer the research questions posed in the first chapter. These analyses revealed that the use of the Transporters program did not offer evidence of improvement in facial emotion recognition, motivation, time on task, or perceived enjoyment while at school for the three participants in this study. Every effort was made to keep the classroom environment stable for all three students during each of their sessions. Exceptions to this included time change from Daylight Savings to Standard Time between Days 8 and 9, and two occurrences of severe weather. It is difficult to evaluate the impact of these circumstances on the variability of the session environment.

The impact of the intervention on correct answers, motivation, time on task, and level of enjoyment was minimal and resulted in little benefit and improvement for these students. Student 2 demonstrated limited engagement with the computer program, which might have contributed to seven of the nine sessions ending early. This nonengagement was probably also instrumental in the overall poor results for Student 2, including no correct answers and only two responses, which were both incorrect. The inconsistency in correct answers for Student 1 during the intervention phase posed questions about the treatment impact and the possible influence of variability. No clear pattern of either improvement or decreased score was discerned in the visual analysis. Visual analysis using the split-middle trend estimation suggested minimal improvement resulting from the intervention for Students 1 and 3. The results for Student 2 demonstrated minimal

involvement in the baseline or intervention phase activities. Visual analysis showed no effect of treatment, and statistical analysis was irrelevant given the flat profile. The levels of motivation and time on task demonstrated by each of the three students overall were considered low or very low by the instructors and were possibly more the result of outside motivators such as food rather than from the DVD animation or the computer. The slightly higher levels of motivation might have been anomalies.

The time-on-task measurements were subjective at best, as the instructors were also the time keepers and distractions might have influenced the values. The time on task for each student was considered to be average or above the expectations by the instructors for these students. The low level of interest exhibited by Student 1 resulted in Sessions 2, 5, 6, and 7 ending early, resulting in higher numbers of nonresponse data. The third participant, Student 3, also showed a low degree of engagement as evaluated by the instructors. The level of active engagement of this student resulted in each session ending early. However, Student 3 gave more responses, both correct and incorrect, than did Students 1 and 2. The slightly higher values for time on task again might have been anomalies.

Results of paired t tests all suggested that there were no significant benefits to the students in being able to correctly identify facial emotions, motivation, time on task, or level of enjoyment. It was concluded that the intervention was not powerful enough to effect improvement in the participants' responses and actions. Furthermore, the application of the computer as a delivery method showed minimal or no effect in enhancing the overall impact of the DVD animation program.

The interrater reliability coefficient was calculated using the number of measures in agreement, which was 72, divided by the total number of possible measures, which was 81. This calculation yielded a reliability coefficient of .8642. This value offers validity to the results of this study.

Chapter 5: Conclusions and Recommendations

This chapter provides an overview of the study. There is also a discussion of the results and the limitations of the study. Conclusions drawn based on the results and recommendations for further research are given.

Brief Overview

It was 1911 when, after observing a patient, Bleuler coined the term autism (“Bleuler,” 2008). Several decades later, Asperger identified a behavioral syndrome that bears his name, Asperger syndrome, identifying high-functioning autistic individuals (National Institute of Neurological Disorders and Stroke, 2005). The 1975 Education for All Handicapped Act was re-enacted as the 1990 IDEA. The most recent version of IDEA (2004) gives a very explicit definition of a child with a disability and references a specific definition for assistive technology. School districts bear the burden of complying with the current IDEA requirements. The challenge of compliance for school districts is compounded by the difficulty of accurately diagnosing students with ASD. The rate of diagnosed individuals with autism has increased in recent years to approximately 1 in 91 live births (Autism Speaks, 2009).

Since the introduction of the personal computer to the classroom several decades ago, educators have imagined endless possibilities for enhancing instruction for all students. IDEA (2004) requires student IEPs to consider assistive technology for students to assist in offering students a fair and appropriate education, not only in the classroom

but also outside of the school building, at home, and in other circumstances. Instructors of students with ASD must be prepared to apply adaptations in order to identify the learning styles of their students. These students exhibit deficiencies in the areas of social, behavioral, and communication skills that can negatively impact the effectiveness of traditional methods used for identifying preferred learning styles (Siegel, 2003).

Researchers have recognized for some time that communication is a key component in education and learning. Individuals with ASD often display deficits in communication skills in the form of poorly developed or limited abilities in interpreting facial emotions and expressions. Preston and de Waal (2002) stated, “Because expression, imitation, and recognition of expressions and gestures are impaired in individuals with autism, it is likely that the disorder is characterized by impairment early on in the perception-action pathway” (Sec. 2.1.2.4).

Instructional options for parents with autistic children have been slow to develop. The effectiveness of each of these programs is limited by how the individual student with ASD learns. Research has documented that students with autism have great difficulty in generalizing concepts and transferring ideas learned in one setting to conditions or circumstances in another setting (Siegel, 2003). One of the most difficult activities to do with autistic students is to correctly identify strengths and weaknesses in learning skills and abilities.

Seamless integration of technology into classroom curricula is the paramount challenge for the classroom instructor with time limitations, budgetary restraints, insufficient training, and technology undergoing dynamic change before it is even implemented. Educational software has acquired additional functionality and appeal for

students of all ages. The ultimate challenge for educators is to promote controlled, accurate, and consistent data flow to students with ASD. The computer as a delivery system has proven beneficial in the classroom and offers some useful and beneficial solutions to educators working with students with ASD. Herskowitz (1996/2002) observed that children with ASD are at first hesitant to interact with computers but after a few sessions work with them with little hesitation, possibly due to the predictability and repeatability of the activities. She also suggested that the ease with which these students interact with computers in part may be the result of their fascination with computer animation and the way that a computer displays its content. Golan et al. (2008) demonstrated significant improvement in facial recognition resulting from an intervention utilizing the Transporters program. Their participant group was comprised of three groups of students that included an ASC intervention group of 15 males and 5 females, an ASC control group of 15 males and 4 females, and a typically developing group of 12 males and 6 females.

The primary purpose of this study, using a multiple-baseline design, was to investigate the effects of the Transporters software program on facial emotion recognition, time on task, and motivation for low-functioning 4- to 7-year-olds with ASD. The secondary purpose was the investigation of whether the use of this software program would positively influence the students' perceived enjoyment while at school as evaluated by their teachers.

Discussion of Findings

The study incorporated both objective measures for facial recognition and subjective measures for motivation, time on task, and increased enjoyment of school. A

multiple-baseline design was employed, as often used with research in special education. It was hypothesized that the use of the DVD, the Transporters, would increase facial recognition, improve motivation, increase time on task, and increase levels of enjoyment of school. Therefore, the desired outcome of this intervention was a demonstrable improvement in each of these areas. The impact of the intervention for correct answers, motivation, and time on task was minimal and resulted in little benefit and improvement for each of the students. Visual analysis, use of the split-middle trend estimation, and statistical analysis all indicated that there was minimal change resulting from the intervention for Students 1 and 3. The results from Student 2 demonstrated minimal involvement in the baseline or intervention phase activities. Results of paired *t* tests all suggested no significant benefits to the students in being able to correctly identify facial emotions, motivation, time on task, or enjoyment from the use of the Transporters DVD and the computer. The Transporters software program was found to be ineffective with the subjects in this study.

The results of the current study were different from those of several other studies. There are several possible explanations for the differences, with the first two being the level of cognition of the three students participating in this study and their familiarity with using the delivery system. The availability of assistive technology almost always offers the classroom instructor options for alternative delivery systems. However, the student should be familiar with using the delivery system. The level of difficulty of the software being used should not be far beyond the ability level of the student interacting with it. The level of difficulty of the software program used in this study was too advanced for the cognitive level of the students. The next factor was the sample size.

Larger numbers are preferable but not always available. At this location only three students met the functioning level and age range utilized in this study.

An additional difference was with Lotem and Halpern's (2008) finding that early intervention has shown to be effective in providing the necessary assistance to students with ASD by moderating the world around them and minimizing the possibility of too much input and causing the individual to shut down or respond negatively. Their research focused on an older age range and higher functioning population than the current study. The participants in this study exhibited difficulty in concentrating on the program and interacting with the computer. The next difference was with the results observed by Baron-Cohen et al. (2007) and Golan et al. (2008). Again, it is highly likely that the difference was with the larger sample population size and level of functioning of each of their subject populations. Both studies had large sample sizes and focused on high-functioning individuals with ASD, whereas this one had a small sample size and focused on low-functioning individuals with ASD. The difference in level of functioning might have been the principal cause of low ability of the three students to attend for time periods longer than 10–12 minutes during the majority of the sessions. This inability of the participants of this study to attend was also considerably influential in creating the difference to the results of work by Lee and Vail (2005), who observed that young children with disabilities could be convinced to interact with the computer with relative ease.

The research of M. Moore and Calvert (2000) revealed that children with autism were more attentive, more motivated, and learned more vocabulary using the computer. The seven subjects involved in M. Moore and Calvert's study had computer experience

prior to the study. Five of the students had previous experience with the computer and use of the mouse; the remaining two received this instruction prior to the start of the study. Their use of the computer with higher functioning students with ASD showed positive results. However, age and level of ability can limit the potential benefits available from incorporating technology into the instructional activities. The three students involved in this current study had minimal or no exposure to the computer and its use prior to the start of the study. This probably contributed to the lack of gains in any area observed during this study.

Functioning level potentially contributed to the results observed. Bernard-Opitz et al. (1990) evaluated the training of preschool children with autism in learning problem-solving skills using computer-based instruction. The students involved in this study showed significant gains but also received instruction prior to the start of the study and were identified as higher functioning. A brief discussion of the components of external validity includes how much the results of the current study can be generalized to other populations, different settings, treatment variables, and measurement variables. Computer-based instruction can be an option for low-functioning students with ASD as it is for all students.

This study has identified several notable cautions that should be considered prior to the start of any additional formal research. First, larger participant pools to draw from will allow testing with more individuals. In addition to the larger groups, abilities of selected participants can be more closely identified and participants potentially grouped by functioning categories. A larger participant pool also can offer the researcher the option of screening for the students' ability to focus on the proposed activity. The settings

used for the current study were the normal environment for the participants. The baseline and intervention activities occurred in the participants' daily instructional setting to ensure minimal negative impact. Future research should include participants who have had some previous experience with the computer as a delivery system. The results of this study can serve as a foundation for future studies and provide insight to researchers regarding requisite skills and abilities of their subject populations. The recommendation to future researchers, without reservation, is to attempt as much as possible to align the cognitive levels with the software tested. In addition, students should demonstrate a certain level of compliance prior to the start of the study. The three participants in this study had difficulty attending to the activity. This, combined with the treatment variables in the current study, could have hindered positive results from the intervention. Even given these caveats, the results of this study can be applied to larger target populations.

Observations and comments from the instructors were critical regarding the amount of activity on the screen being too much for the participants and hindering their ability to focus on the main characters. This might have been a contributor to the poor ability to attend for longer periods of time, resulting in many sessions ending early. The participants in this study had difficulty sitting for periods of time long enough to perform the activity. It was observed that the music was beneficial but not enough to balance the foreground and background activity on the screen. Participants with limited ability to attend will possibly find simpler screen characterizations less distracting and more acceptable along with offering the ability to distinguish the differences between faces.

The measurement variables and visual analysis offered information that both answered and created questions. The objective measures for facial recognition were

easily observed and recorded. The subjective measures used for evaluating motivation, time on task, and increasing enjoyment of school were largely based upon visual observation. Visual observations are often considered contributors to weak external validity. However, the negative results of both types of measures neutralize the weakening effects normally associated with visual observations. The combination of both subjective and objective measurements being negative offers credibility to the external validity. However, caution should be observed before generalizing the results of this study to other populations of 4- to 7-year-old, low-functioning individuals with ASD due to the small sample population size.

The advances in abilities of computers may offer adaptive software programs that can identify each participant's ability to attend and adjust the lessons accordingly. Programs currently available may still be too complex for these participants unless adaptations to the instructional materials can be made to present the information in smaller amounts for shorter periods of time, possibly several times a day.

The participants' ages and previous experience with the computer were certainly factors in the results of this study but these do not detract from the potential benefits of computer-based instruction for individuals with ASD of all ages, given more research and more variety in software program choices. The software program utilized in this study was too advanced and complex for the participants included in this study. For younger, low-functioning children with ASD it may be more beneficial to have simple animated faces with a few features that are easily distinguishable from each other and no background activity. An enhancement may be to use different colored backgrounds and evaluate which can eliminate or minimize the distraction from the primary activity.

Overall Conclusions

Although the results observed in this study were disappointing, the researcher was unable to locate any referential research previously completed with low-functioning, 4- to 7-year-old students with ASD that showed gains. The two previous research studies with notable and encouraging results were observed with students who were considered to be high or higher functioning individuals with ASD. Other information was anecdotal, resulting from parents relating stories of observed sessions at home. Golan et al. (2008) commented that additional research needed to be done with lower functioning 4- to 7-year-old students. The current study offered results, albeit null results, to address that need.

Limitations

There were several limitations involved in this study. Identifying and locating potential participants can be a serious consideration for researchers and was definitely the situation with this study. Along with identifying potential participants, a location for the study can be a limiting factor. After locating an educational facility, the staff had to be willing and able to participate in this study at the level of involvement that was needed to adhere to the guidelines of the study. Individuals with ASD do not respond well to changes in their routine, and several facilities contacted were hesitant to participate and skeptical about receiving parental permission. The researcher was fortunate enough to locate a facility in Southern Colorado that was eager to assist with this study. However, the small number of students in the desired age range and diagnosed with ASD available at the location to participate in this activity was a limiting factor. There were many students diagnosed with ASD, but most were above the desired age range. Only three

students were within the desired age range. A more desirable situation would have been a larger group to allow for more evaluation regarding the individual student's ability to attend for periods of time longer than approximately 25 minutes.

Another influence was the time of the year during which the study occurred, which included the change from Daylight Savings Time to Standard Time. This caused a change in routines and activities, which impacted the schedule of the participating students.

The next two limitations were weather and illness. Snow storms closed the facilities on two separate days. There were also several occurrences of illness with the participants, which combined with the other items stretched out the total number of days required to complete the baseline and intervention activities longer than originally anticipated. Changing the timing of the activity and avoiding as many changes to routines as possible should be a consideration when possible. It is presumed that the only influence it would have had on this study would have been to shorten the overall time line of the activities and offer minimal improvement to the study findings.

The inability to attend, no previous successful interaction with the computer, and no previous exposure to facial emotions were possibly key factors impacting the results of this study. The measures used for this study also might have contributed to the null results. Though both instructors had worked together and were in agreement with each other's observations, when visual analysis is involved in research, as Kazdin (1982) has stated, it "would seem to permit, if not actively encourage, subjectivity and inconsistency in the evaluation of intervention effects" (p. 239) and adversely affect the reliability of the results.

Recommendations for Future Research

Previous research using the DVD, the Transporters, has focused on the age range of 10–17, and participants in research have been higher functioning individuals. The majority of the information relating to individuals younger than 10 years old is largely anecdotal, collected from conversations with parents who have used the Transporters software program. The instructors participating in this study strongly recommended that students with ASD be carefully evaluated for their ability to attend for a minimum of 20–25 minutes. They also suggested that each student demonstrate the ability to sit in front of the computer and successfully interact with it.

The current study should be replicated with the following modifications. The number of participants should be increased to a minimum of 10 and preferably more after screening for a minimum attend-time ability of 25 minutes. Prior to the study beginning, the participants should have experience and be comfortable with the delivery system. The delivery system should be the computer as it was in the current study. Sometimes scheduling a study is an option and at other times it is not. Future studies should preferably be planned to occur during the regular school year schedule. The software program evaluated should display very simple faces with minimal background distractions to facilitate the student focusing on the main presentation. The facial emotions displayed should have differences that are easily identified by the participants. The baseline time period should be a minimum of 5 days to ensure that a definitive trend line has been developed and observed. The multiple-baseline design and intervention procedures used in the current study can be applied to future studies. However, there still remains the concern expressed by Kazdin (1982) and previously noted about visual

analysis. A larger participant pool may lead to added interobserver discrepancies, but the benefits should outweigh any limitations. These recommendations should enhance the results and strengthen the generalizability of the results to any future studies.

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Appendix A: The Transporters Permission Request

Teaching Emotion Recognition to Low-Functioning Children With Autism, Aged 4–7 Years Old

Individuals with ASC have difficulties in recognizing emotions from facial expressions, intonation and context as well as limited use of emotion words in their language. In addition, individuals with ASC look less at faces and process information from the face less effectively compared to the general population. The purpose of this study is to evaluate the effectiveness of a software program titled "The Transporters" to improve facial emotion recognition for students aged 4 - 7 years old with autism. Previous work has shown that children and adults with ASC can improve their emotion recognition skills with intervention, though with limited generalization. Some of these interventions used schematic faces or still pictures rather than ecologically valid stimuli. This might have made it difficult for the participants to transfer their acquired knowledge into other situations. In the past, interventions have used 'Mind Reading', an interactive guide to emotion that uses real animated faces, to teach adults and primary school children with ASC to recognize emotions in faces and voices.

Younger and lower functioning children may not engage with computers, so in this study a DVD series called 'The Transporters' will be evaluated. Here, emotion recognition is taught through passively watching episodes of the DVD that deal with different emotional situations. In 'The Transporters' children are drawn to looking at social-emotional stimuli and facial expressions using mechanical and spinning stimuli which are very attractive to individuals with ASC. Previous research has shown that this has been effective for 4-7 year olds with high functioning autism and Asperger's Syndrome. Research has also previously shown that the DVD was helpful for 2-5 year olds with high functioning autism, though generalization was more limited. The current study will extend the evaluation of this DVD to evaluate whether it is helpful for children with low functioning autism, between the ages of 4 - 7 years.

Specifically, I will evaluate whether the DVD is successful at increasing the amount of time spent looking at faces in children with low functioning autism and understanding some of the emotions being displayed.

The students will be watching a computer program for approximately 25 - 30 minutes per day during the regular school week. During this time they will watch a software program showing situations and facial emotions along with a dialog. They will then be tested on

correct identification of each emotion. During the baseline period no feedback will be given during the testing. While during the intervention period feedback will be provided. This is a 6 – 8 week study with intervention sessions taking approximately 30 minutes each day. Both video and audio taping will occur to assist in establishing validity of the measures being applied. Upon completion of this research, the tapes will be erased and the erasure confirmed by the Academic Sponsor.


My intention with this Ph.D. research project is purely scientific and non-commercial. It is with respect and the highest regard that I acknowledge that the DVD is owned by the Crown (UK Government).

Respectfully Submitted,

Gary Butcher Ph.D. A.B.D.

Appendix B: Permission Received for Usage of the Transporters DVD

This is a screen shot of the permission email I received from Simon Baron-Cohen, Director of the Autism Research Center and Cambridge Profession, along with permission from Changing Media Development, the producer of the DVD.

☆ Professor Simon Baron-Cohen to me show details Mar 17  Reply ▼

hi gary. here it is again. best wishes, simon

----- Forwarded message -----
Date: 10 Mar 2010 23:48:13 +0000
From: Professor Simon Baron-Cohen <sb205@cam.ac.uk>
To: jonathan.drori@cmdevelop.com, Gary Butcher <gabutcher@gmail.com>
Cc: Claire Harcup <claire.harcup@cmdevelop.com>, Nick Paske <nick.paske@cmdevelop.com>
Subject: Re: Fwd: Re: Fwd: Question

dear gary,

thank you for providing this information. Changing Media Development (CMD) is happy to give you permission to use The Transporters DVD for your research. We wish your project every success.
Should you require the use of any Crown (or CMD) copyright material for actual publication in a scientific paper (eg a still photo or two) then you should approach us about that once you know what you need.

with best wishes,

simon baron-cohen

Simon Baron-Cohen, FBA
Professor of Developmental Psychopathology,
Director,
Autism Research Centre,
Cambridge University,
Douglas House, 18B Trumpington Rd,
Cambridge CB2 8AH, UK.
Tel 01223 746057 Fax 01223 746033,
www.autismresearchcentre.com

Appendix C: Interview Informed Consent Video or Audio Form

Video, Photographic, &/or Audio Recordings Consent for

Participation in a Research Study – Confidentiality Implied

University of Denver

Title: Teaching Emotion Recognition to Low-Functioning Children with Autism, Aged 4 – 7 Years Old

Principal Investigator: Gary A. Butcher

Sponsor: Dr. Kent Seidel

Introduction

As the parent or legal guardian of a minor or a legally authorized representative, you are being asked to allow your child to participate in this research study. The following information will explain the purpose of the study, what your child will be asked to do, and the potential risks and benefits. It will also explain that you do not have to permit your child to be in this study to receive information describing the software program being used. You should ask questions before deciding whether you wish for your child to participate, or at any time during the course of the study. You will be told of any new findings that may change your decision to continue to participate.

Purpose of Study

Individuals with Autism Syndrome Complex (ASC) are characterized by difficulties in empathizing (Baron-Cohen, Wheelwright, Lawson, Griffin, & Hill, 2002). This includes difficulties in recognizing emotions from facial expressions, intonation and context as well as limited use of emotion words in their language (Tager-Flusberg, 1992). In addition, individuals with ASC look less at faces and process information from the face less effectively compared to the general population (Baron-Cohen, Wheelwright, Hill,

Raste, & Plumb, 2001; Grelotti, Gauthier, & Schultz, 2002; Lord et al., 2005). These deficits hamper social functioning in ASC (Hill & Frith, 2003; Hobson, 1993).

Previous work has shown that children and adults with ASC can improve their emotion recognition skills with intervention, though with limited generalization (Golan & Baron-Cohen, 2006a; Hadwin, Baron-Cohen, Howlin, & Hill, 1996; P. Howlin, Baron-Cohen, & Hadwin, 1999; Silver & Oakes, 2001). Some of these interventions used schematic faces or still pictures rather than ecologically valid stimuli. This might have made it difficult for the participants to transfer their acquired knowledge into other situations.

In the past educators have used 'Mind Reading', an interactive guide to emotion that uses real animated faces, to teach adults and primary school children with ASC to recognize emotions in faces and voices (Golan & Baron-Cohen, 2006b).

Younger and lower functioning children may not engage with computers, so in this study a DVD series called 'The Transporters' will be evaluated. Here, emotion recognition is taught through passively watching episodes of the DVD that deal with different emotional situations. In 'The Transporters' children are drawn to looking at social-emotional stimuli and facial expressions using mechanical and spinning stimuli which are very attractive to individuals with ASC (Baron-Cohen, 2003). Previous research has shown that this has been effective for 4-7 year olds with high functioning autism and Asperger Syndrome (Golan et al, in preparation). Research has also shown that the DVD was helpful for 2-5 year olds with high functioning autism, though generalization was more limited. The current study will extend the evaluation of this DVD to evaluate whether it is helpful for children with low functioning autism, between the ages of 4 -7 years.

The purpose of this study is to evaluate whether the DVD is successful at increasing the amount of time spent looking at faces and able to recognize the associated emotion, in children with low functioning autism. You are being asked to allow your child to participate because your child has been diagnosed as having ASC and between the ages of 4 and 7. Remember that the purpose of the study is **not** to improve the health of your child.

Expected Duration of Subject's Participation

This study will include 3 – 4 students. If you choose to allow your child to participate in this study, their participation will involve responding to approximately 12 - 15 questions about facial emotion recognition. The study should take about 25 minutes of their time per day. Participation in this project is strictly voluntary. The risks associated with this project are minimal. If, however, you believe that your child is experiencing discomfort, you may discontinue their participation in the study at any time. We respect your right of your child to choose not to answer any questions that may make them feel uncomfortable. Refusal to participate or withdrawal from participation will involve no penalty or loss of benefits to which you are otherwise entitled.

Description of Procedures

The purpose of standard practice is to develop an initial base line, or reference, demonstrating your child's ability to recognize facial emotion. The research practice, the intervention, is solely to evaluate any improvement of your child's ability to recognize facial emotions after interacting with the software with instructor providing feedback during the sessions. These interventions are undertaken because there is a reasonable expectation of a successful outcome. Research constitutes activities designed to contribute to generalizable knowledge. Typically, in this type research design, a set of activities is consistently applied to several individuals in order to test a hypothesis and draw conclusions. The activities are not necessarily therapeutic in nature.

The standard procedure will include the following steps to establish an initial baseline for each student:

STUDENT #1

1. Turn on the computer and start the software program "The Transporters".
2. Have the students sit down in front of the computer screen.
3. Begin the program.
4. Run the program demonstrating all 15 facial emotion scenarios (this should take approximately 30 minutes.).
5. Give the student a 5-10 minute break.
6. Run the version of the quiz that gives the student 3 versus two choices and ask the student to point to the correct face for each question.

NOTE: The sound will be muted during this phase to avoid having the student hear any information regarding the correct answer.

7. Record the correct number of correct and incorrect answers for the 15 emotions.
8. Repeat this procedure once per day for a minimum of four days.
9. If an acceptable baseline has been established repeat the above procedure for this student but with the sound unmuted so the student hears information about correct and incorrect answers to the quiz questions.

Continue with step 9 for approximately 12 – 15 days to confirm the development or improvement or not.

STUDENT # 2

Repeat the nine steps listed for STUDENT # 1 and continue them for approximately 8 – 10 days, depending upon the length of time required to establish the baseline for STUDENT # 1.

When an acceptable baseline has been established for STUDENT # 2, proceed to step 10 and continue with this step for approximately 8 – 10 days, depending upon the length of time required to establish the baseline for STUDENT # 2.

STUDENT # 3

Repeat the nine steps listed for STUDENT # 1 and continue them for approximately 8 – 10 days, skipping a day in between each session. This length of time is flexible depending upon the length of time required to establish the baseline for STUDENT # 3. When an acceptable baseline has been established for STUDENT # 3, proceed to step 10 and continue with this step for approximately 8 – 10 days, depending upon the length of time required to establish the baseline for STUDENT # 3.

NOTE: If at any time the student shows resistance or other defiant behavior towards the activity, cease the procedure temporarily, if possible, then resume. Otherwise, discontinue the procedure and re-schedule at a later time.

During this study there will be no medical or medical related procedures or activities such as medicine, devices, physical exams, placebo, or dietary requirements. The study is a baseline design which includes activities with no interventions such as instructor assistance for the participant to establish an initial level of proficiency in recognizing facial emotions. The baseline activities will last from 3 – 6 depending upon the results of each day's session. During this time some of the sound from the software will be muted to avoid influencing your child's response to the questions. The intervention activities will repeat the baseline activities lasting from 3 – 6 days but during the intervention, the computer will be unattended and the instructor will be assisting during each session.

Participants in this study will be 3 students with ASD aged 4–7 years. The participants will have a medical or an educational diagnosis that meets the criteria for ASD as defined by the DSM-IV-TR (American Psychiatric Association, 2000). Each participant will need to qualify to be included in this study by meeting selective criteria such as exhibiting dysfunctional verbal communication and impaired social communication. Participants also will be evaluated for freedom from vision, hearing, or physical motor impairments that would hinder their participation in this study and are able to sit in front of a computer for 20 to 30 minutes at a time. As the parents and/or legal guardian of the participant you will be informed of the study and your consent received prior to the start of this study.

The your child's classroom teacher will be involved in the identification of students who will participate in this study. These participants will be screened for any signs of ASD and you will be asked to confirm that there has been no history of learning disabilities or other related symptoms of ASD.

Incomplete Disclosure/Deception

During this study, it will not be necessary to withhold any information from your regarding the true purpose of this study. No deception will be used at any point during this study.

Possible Benefits

There are several possible benefits from allowing your child to participate in this study. The first and probably the most significant is the possible improvement in recognizing facial emotions. The second benefit is increasing your child's comfort level with the use of the computer. A third and probably not the last benefit is determining if your child's time on task can be enhanced with the use of a computer offering instructional opportunities at school and at home.

Keep in mind that not all benefits are necessarily physical or immediate.

Possible Risks/Discomforts

There are three possible risks and/or discomforts to your child during and resulting from participation in this study. During the baseline and/or the intervention sessions your child may find sitting in one place for 25 – 30 minutes uncomfortable and disruptive. Sitting in front of a computer for this length of time may create undesirable experiences and memories associated with the computer. These may also contribute to or cause negative thoughts about their time at school. If at any time these risks and/or discomforts appear the session will be discontinued and an evaluation will be made, with your cooperation, to determine if your child will continue with the study.

Collection of Sensitive Information

None of the questions that your child will be asked will be of a personal nature and there will be no intention to cause embarrassment or stress.

Unknown Side Effects

As with any study, there might be side effects that are unknown at this time. Your child will be monitored for the occurrence of side effects and any unusual events will be reported and communicated to you as soon as possible.

Standard of Care/No Additional Expected Research Risk

Sometimes a study may involve the collection of data from patients who are receiving standard treatment for a particular condition. If there are no additional risks imposed by the research and ALL of the testing done is part of the standard of care, the following statement is appropriate:

Your child's part in this research study consists solely of allowing the researcher to use data from observing your child in their classroom setting. The tests and interventions your child will receive are part of the standard of care for their condition. This study does not require your child to have any additional procedures or treatments. Therefore, being in this study does not involve any risks that your child would not face during their routine classroom activity.

Alternatives to Participation

Your child does not have to participate in the study to receive the information describing the software program that will be used in this study.

Voluntary Participation

Your child's participation in this project is voluntary. If you choose to not allow your child join the study you will not be penalized or lose educational benefits to which your child is entitled. If your child joins the study, you may choose withdraw them at any time without prejudice to their future care.

Be aware that your child's participation may be terminated by the investigator, sponsor, or the IRB under certain circumstances without your consent. The reasons will be given, such as failure to respond to treatment, participation is no longer in the best interest of the individual, inadequate cooperation or non-compliance on the part of the subject.

Additionally any significant findings uncovered during the study which may affect your child's willingness to continue will be passed on to you. If you withdraw your child from the study, information that is already collected may be included in the aggregated results (although no new information will be collected).

Privacy/Confidentiality

Any study information about you will be kept private and will only be given out with your permission. If the results of this study are published, your name will not be used. Your research records will be private to the extent allowed by law. In order to make sure

the research is done properly, the Institutional Review board (IRB - the committee that oversees research at this institution) may need access to information about your participation in this study.

If you agree to allow your child to be in this study, we will instructional information that identifies your child. We may collect the results of tests, questionnaires and interviews. We will only collect information that is needed for the research. This information has been described in this consent form. If you sign this consent form, you are giving us permission to collect, use and share your child's information. This permission is called authorization.

Study records that identify your child will be kept private. You or your child will not be identified in study records or publications disclosed outside of your child's classroom, except as detailed below. (If applicable)

Investigators will share the results of your study tests and procedures with:

Study sponsor and/or its agents,
Other researchers,
Data safety monitoring board.

Contacts for Questions/Access to Consent Form:

If you have any questions about the study, you may contact Gary A. Butcher at 719 – 510 – 0319 or gabutcher36@hotmail.com. This study will be supervised by the course instructor, Dr. Kent Seidel, Department Chair, University of Denver. He can be contacted at 303 – 871 – 2496 or kent.seidel@du.edu. If you have questions about your rights as a research subject, or concerns about being in the study, you may contact the Office of Research and Sponsored Programs at the University of Denver (the committee that oversees research at this institution) at (516) 562-3101. A signed copy of this consent form will be given to you.

Video, Photographic and/or Audio Recordings Consent:

As part of this project I will most likely make photographic, audio, and/or video recordings of your child while they participate in the research. I would like you to indicate below what uses of these records you are willing to consent to. This is completely up to you. I will only use the records in ways that you agree to. In any use of these records, your name will not be identified.

1. The records can be studied by the research team for use in the research project.

Photo _____ Audio _____ Video _____

initials

initials

initials

2. The records can be shown to researchers in other similar research experiments.

Photo _____ Audio _____ Video _____
initials initials initials

3. The records can be used for scientific publications.

Photo _____ Audio _____ Video _____
initials initials initials

4. The records can be shown at meetings of scientists interested in the study of _____

Photo _____ Audio _____ Video _____
initials initials initials

5. The records can be shown in classrooms to students.

Photo _____ Audio _____ Video _____
initials initials initials

6. The records can be shown in public presentations to nonscientific groups.

Photo _____ Audio _____ Video _____
initials initials initials

7. The records can be used on television and radio.

Photo _____ Audio _____ Video _____
initials initials initials

I have read the above description and give my consent for the use of the records as indicated above.

Summation/Signature

You have read the above description of the research study. You have been told of the risks and benefits involved and all your questions have been answered to your satisfaction. A member of the research team will answer any future questions you may have. You voluntarily agree to allow your child to join this study and know that you can

withdraw them from the study at any time without penalty. By signing this form, you have not given up any of your child's legal rights.

Dated signatures that are required are as follows:

Subject's printed name

Subject's signature Date/Time*

Witness's Signature Date
(Preferably someone not connected with the research project)

Witness's Printed Name

If the subject is a child, or is decisionally impaired, the signature of a legally authorized representative or next-of-kin **may** be allowed. The IRB may also require that both parents consent for a child's participation in a study. This will depend on the IRB's decision as to whether it is appropriate for the protocol. (Please refer to the IRB Policies and Standard Operating Procedures for the policy on Research Involving Children and Research Involving Incapacitated or Decisionally Impaired Adults).

When additional signatures are required, the consent form must include additional signature lines as appropriate, as well as a description of the signer's authority to act on behalf of the subject.

Dated signatures required when subject is a child or is decisionally impaired are as follows:

Subject's printed name

Parent's or Legally Authorized Representative's printed name

Parent's or Legally Authorized Representative's signature Date/Time

Description of signer's authority to act on behalf of subject

Witness's Signature Date
(Preferably someone not connected with the research project)

Witness's Printed Name: _____

When permission from both parents is required, the following format may be used:

Subject's printed name

Parent1

Parent2

Print Name

Print Name

Signature

Date

Signature

Date

Appendix D: Instructor Informed Consent Form

CLASSROOM RESEARCH

Teaching Emotion Recognition to Low-Functioning Children With Autism, Aged 4 - 7 Years Old.

You are invited to participate in a study that will evaluate a DVD program called The Transporters. In addition, this study is being conducted to fulfill the requirements of a class in Educational Leadership. The study is conducted by Gary A Butcher. Results will be used to (purpose) and to receive a grade in the course. Gary can be reached at 719 – 510 – 0319 or gabutcher36@hotmail.com. This project is supervised by the course instructor, Dr. Kent Seidel, Department, University of Denver, Denver, CO 80208, phone 719 – 871 - 2496 or kent.seidel@du.edu.

Participation in this study should take about 25 minutes per day of your time. Participation will involve presenting the DVD program and observing the participants' responses about facial emotion recognition. Participation in this project is strictly voluntary. The risks associated with this project are minimal. If, however, you observe the students experiencing any discomfort you may discontinue the presentation until a later time in the day. The objective is to have each student observe the entire program each day. We respect the right of the student to choose to not to answer any questions that may make them feel uncomfortable. Refusal to participate or withdrawal from participation will involve no penalty or loss of benefits to which you or the participants are otherwise entitled.

Student responses will be identified by code number only and will be kept separate from any other information that could identify the participants. This is done to protect the confidentiality of their responses. Only the researcher will have access to the individual data and any reports generated as a result of this study will not include any identification that may compromise confidentiality. However, should any information contained in this study be the subject of a court order or lawful subpoena, the University of Denver might not be able to avoid compliance with the order or subpoena. Although no questions in this interview address it, we are required by law to tell you that if information is revealed concerning suicide, homicide, or child abuse and neglect, it is required by law that this be reported to the proper authorities.

If you have any concerns or complaints about how you or the participants were treated during the interview, please contact Susan Sadler, Chair, Institutional Review Board for the Protection of Human Subjects, at 303-871-3454, or Sylk Sotto-Santiago, Office of Research and Sponsored Programs at 303-871-4052 or write to either at the University of Denver, Office of Research and Sponsored Programs, 2199 S. University Blvd., Denver, CO 80208-2121.

You may keep this page for your records. Please sign the next page if you understand and agree to the above. If you do not understand any part of the above statement, please ask the researcher any questions you have.

I have read and understood the foregoing descriptions of the study called Teaching Emotion Recognition to Low-Functioning Children With Autism, Aged 4 - 7 Years Old. I have asked for and received a satisfactory explanation of any language that I did not fully understand. I agree to participate in this study, and I understand that I may withdraw my consent at any time. I have received a copy of this consent form.

Signature _____ Date _____

(If appropriate, the following must be added.)

___ I agree to be audiotaped.

___ I do not agree to be audiotaped.

___ I agree to be videotaped.

___ I do not agree to videotaped.

Signature _____ Date _____

_____ I would like a summary of the results of this study to be mailed to me at the following postal or e-mail address: