TEACHING SAFETY SKILLS TO CHILDREN WITH AUTISM SPECTRUM DISORDERS: A COMPARISON OF STRATEGIES

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I have examined the final copy of this thesis for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Arts with a major in Communication Sciences and Disorders.

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Rosalind Scudder, Committee Chair

We have read this thesis and recommend its acceptance:

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Trisha Self, Committee Member

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Teresa Graham, Committee Member

DEDICATION

To my mom, my fiancé, and my dear friends

You must do the thing you think you cannot do…

Eleanor Roosevelt

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There have been so many people who have made this journey possible. They have given me encouragement and support, without them this project would not have been possible

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ABSTRACT

This study investigated the question, if children diagnosed with ASD who learned safety skills through traditional teaching methods transferred them to real world situations more effectively and efficiently than children who learned safety skills through VR strategies.

Eight children diagnosed with ASD were selected for this study. Participants were randomly assigned to form two groups of four children each. Two training phases were used for each condition ("Teaching As Usual" and VR). Training sessions were conducted twice a week for a maximum time limit of 30 minutes per session. Training phases lasted for five weeks and included instruction on fire safety (Phase I) and tornado safety (Phase II). A generalization and maintenance phase followed the training phases to assess learned skills. Results indicated that training via VR was a more efficient means; however, when effectiveness was measured both groups appeared to yield similar results.

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INTRODUCTION

Statement of the Problem

Autism Spectrum Disorder (ASD) is a pervasive developmental disorder that is characterized by a severe impairment in social, communicative, cognitive, and behavioral functioning (Strickland, 1997). It is estimated that ASD is the fastest growing developmental disability in the United States. More children are diagnosed with ASD in one year than with AIDS, diabetes, and cancer combined. Despite the growing rate of ASD and the high prevalence rate, ASD receives less than 5% of research funding when compared with many lesser prevalent childhood diseases (www.autismspeaks.org, 2005).

Children diagnosed with ASD tend to be visual learners as a result of their language processing deficits. Traditional teaching methods have focused on creating a visually structured learning environment through the use of picture cues, comic strip conversations, social stories, role playing, and video modeling. Traditional teaching methods will be referred to in this paper as “Teaching As Usual” (TAU). There is, however, limited research to support the use of these traditional teaching methods. Most of the literature reports are of small participant numbers and case studies. More research needs to be conducted to examine the specific components of traditional teaching methods that are most effective to better understand how children with ASD learn. An investigation of traditional teaching methods should be supported by stronger evidence based practice to allow researchers to explore other teaching methods.

Over the years there have been many attempts at experimenting with new techniques to teach children diagnosed with ASD. Researchers have been exploring the possibility of using Virtual Reality (VR) to teach children with ASD. VR refers to a computer generated, interactive, three-dimensional environment. A key principle of VR is the theory that the brain can process information more effectively when it is presented through combining sight, sound, and touch (Hamilton, Smith, McWilliams, Schwartz, & Carey, 1992). It is thought that the characteristics of VR match the learning needs of children with ASD; however, there has been little research investigating the potential of using VR to teach children with ASD.

Since children diagnosed with ASD have difficulty interpreting social situations and generalizing learned skills to different environments, this study will focus on teaching fire and tornado safety skills. There has been limited research on the effectiveness of fire and tornado safety programs in preventing injuries and deaths with typically developing children. The research that has been conducted with teaching safety skills to children diagnosed with ASD has had many limitations and the results have been viewed with caution.

Purpose

The purpose of this research is to examine how effective and efficient “Teaching As Usual/Traditional” (TAU) teaching methods are when compared to VR models in teaching fire and tornado safety skills to children diagnosed with ASD. Eight children diagnosed with ASD were selected for this study and formed two groups of four children each. The first group of children received instruction for fire safety using TAU methods and the second group received instruction through the VR model. Baseline and transfer data were evaluated using a real world fire drill within their school, for both groups. After fire safety skills were taught, the two groups switched. Group one then received instruction on tornado safety through the VR model and group two received instruction through TAU teaching methods. Baseline and transfer data were conducted with both groups, within their school, using a real world tornado drill. A maintenance phase was included to assess fire skills for both groups after a four week period with no further treatment.

The research question posed in this investigation asked if children with ASD who learned safety skills through TAU teaching methods transferred them to real world situations more effectively and efficiently than children who learned safety skills through VR.

Results of the data analysis indicate that teaching children with ASD via VR is a more efficient method than TAU. The results indicate that the training time for VR is significantly less when compared to the training time via TAU. Data from this research implies that TAU is as effective as VR when transfer skills to real situations were examined.

CHAPTER II

LITERATURE REVIEW

This chapter will provide a general definition of Autism Spectrum Disorders (ASD), a broad discussion of the changing prevalence rate for the disorder, a discussion of relevant characteristics and behavior patterns, as well as highlight specific cognitive theories associated with ASD. The literature review also presents research on traditional teaching methods “Teaching As Usual” (TAU) and an instructional process using virtual reality (VR). This paper will refer to traditional teaching methods “Teaching As Usual” as TAU. TAU includes visually structured traditional teaching methods such as, picture cues, comic strip conversations, social stories, role play, and video modeling. These strategies have been referred to in the literature and have been represented through workbooks. Literature from research studies of fire and tornado safety programs concludes the chapter.

General Definition of Autism Spectrum Disorders

The syndrome of autism has been surrounded by controversy over the years and the definition of the disorder has changed drastically from Kanner’s first description in 1943. Autism was originally thought to be an emotional disorder resulting from improper parenting. Bettleheim (1967) speculated that during development children experience “critical periods”, where they are prone to pervasive psychological damage affected by parental expressions of negative emotions. Bettleheim believed that autism was the result of this psychological damage. Over the years, biological models of causation have now become widely acknowledged along with the fact that many different causative factions are involved (Schuler, 1995). The definition of autism has also changed to include an umbrella of disorders and is now referred to collectively as Autism

Spectrum Disorder (ASD). In this paper the term ASD will be used to acknowledge the fact that autism occurs in differing degrees and in a variety of forms.

Prevalence of Autism Spectrum Disorders (ASD). According to the Autism Society of America (www.autismspeaks.org, 2005), autism is becoming the fastest growing developmental disability in the United States. Recent epidemiological studies conducted indicate that autism occurs in 1 in 166 births. It is estimated that 67 children are diagnosed per day with autism at a rate of almost 1 per every 20 minutes. In comparison with other disorders/diseases, current research indicates that ASD is slightly more common than Down syndrome, which occurs in 1 in 800 births. It is estimated that there are more children diagnosed with autism in one year than with AIDS, diabetes, and cancer combined. Despite the high prevalence rate of autism, the disorder receives 5% of the research funding of many lesser prevalent childhood diseases. Autism spectrum disorders are currently the second most common developmental disability after mental retardation. Within the academic population of special education, ASD is the 6th most common classified disability in the United States. The number of children placed in public special education programs who are classified as having ASD has increased from 22, 664 in 1994 to 141,022 in 2003 (www.cdc.gov).

Autism Spectrum Disorder is more common in males than females with a ratio between 3:1 and 4:1 (Volkmar, Szatmari, & Sparrow, 1993). Researchers do not know the reason for this imbalance. Females diagnosed with ASD often have a more severe form of the disorder with a higher incidence of mental retardation (Whitman, 2004). The incidence of Autism Spectrum Disorder is not more predominant in higher socioeconomic status families as once indicated in the research. Although the research indicates an increase in the prevalence of ASD there is some research which suggests that the increase could be due in part to the reclassification of children from the mental retardation to the autism category (Whitman, 2004).

Defining Characteristics of Autism Spectrum Disorders. Although Autism Spectrum Disorder is unique to each individual there are characteristics of the disorder that are common within this population. Individuals with ASD typically have deficits developing appropriate social skills. They do not understand reciprocity between communication partners and prefer to be alone. Children with autism tend to observe, imitate, approach, and interact with their peers less often than typically developing peers (Zager, 2005). They often interact with inanimate objects, animals, and adults more than with their peers (Hollander & Nowinski, 2003). Individuals with ASD do not seek out other peers for the purpose of sharing feelings, similar interests, or to communicate their wants and needs. Furthermore, this population experiences difficulty with joint attention and struggles with the ability to communicate through nonverbal means.

Children with ASD have significant impairments with interpreting appropriate facial expressions and social interaction gestures (Whitman, 2004). Individuals with autism often have a poor understanding of social rules, social engagement, and maintaining interactions with peers. Adolescents and young adults with ASD may fail to understand social intent, predict the thoughts, feelings, and behaviors of others even in straightforward social situations. They may make socially inappropriate comments or behave inappropriately due to their highly literal and concrete problem solving skills (Zager, 2005).

Individuals with Autism Spectrum Disorder often have impairments in the area of expressive and receptive language and communication. They may have a delay or absence of expressive language development and may alternatively communicate with gestures (Whitman, 2004). Persons with ASD are highly literal and concrete in their thought processing and language interpretations. They often do not understand abstract ideas such as; metaphors, irony, sarcasm, or humor. Some individuals with ASD interpret rules and laws literally and do not understand exceptions to the rule. They therefore have difficulty generalizing information to new situations. This population may also experience difficulty understanding the prosody, or intonation, of language. Prosody and inflection may be left out completely or over-exaggerated due to the lack of understanding emotions and expressing feelings. As a result of deficits in pragmatics and literal thought processing, individuals with ASD often use echolalia, scripted phrases, or question-like intonation when making comments (Zager, 2005).

Distinctive Behavior Patterns. One of the defining features of autism is the preference for routines or rituals. People with ASD are often rigid and inflexible in response to changes and transitions in their environments or daily schedules. It is thought that this population seeks consistency and resists change because they do not understand the social priorities that typically direct schedules, resulting in a focal point of inanimate markers of time (Zager, 2005). Interests, thoughts, or preferred activities are often restricted as a result of a deficit in generalization abilities and a need for sameness. Individuals with autism can often experience different levels of anxiety when certain routines or schedules are interrupted.

Some individuals with ASD often exhibit repetitive or compulsive behaviors. Examples of repetitive behaviors include organizing or rearranging items in a consistent manner, walking and pacing, and compulsive obsessions with certain parts of mechanical devices (Zager, 2005). Others may exhibit more stereotypical repetitive behaviors such as; hand flapping, finger licking, or rocking (Whitman, 2004). There is a range of compulsive behaviors that can occur in autism, even though there is not one type of behavior that is consistently seen in all individuals with ASD.

Different Teaching Methods

There have been many different theories over the years that attempt to explain the underlying deficits that manifest the profound impairments in socialization, communication, and cognition associated with ASD. The TAU philosophy is based on elements from the social learning theory, executive dysfunction theory, and the central coherence theory. Elements are taken from each theory to device a program that targets the specific characteristics and learning styles of children with ASD.

The social learning theory of Bandura (1977) emphasizes the importance of observing and modeling behaviors, attitudes, and emotional reactions of others to acquire new skills. Human behavior is explained by Bandura in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences. The social learning theory is composed of three main principles: 1) individuals can learn through observation, 2) learning can occur without a change in behavior, and 3) cognition plays a role in learning. The social learning theory implies that an individual must encompass four areas before they can model a learned behavior 1) attention, 2) retention, 3) motor reproduction, and 4) motivation.

Executive function is an umbrella term that includes planning, working memory, impulse control, inhibition, as well as the initiation and monitoring of actions. These functions have been linked to the frontal lobe, specifically on the prefrontal cortex. The theory of executive dysfunction suggests that damage to the frontal structures of the brain can result in cognitive deficits that are associated with the key characteristics of ASD (Hill, 2004).

Visuospatial skills, enhanced rote memory, and an uneven IQ profile are often seen as strengths associated with ASD. The central coherence theory first described by Frith (1989) attempted to explain the weaknesses and strengths connected with ASD. The theory proposed that individuals with ASD exhibit a preference for processing information in terms of parts instead of wholes. Thus, they interpret information for local details instead of global detail, at the expense of higher level meaning.

Teaching As Usual. People with ASD tend to be visual learners as a result of language processing problems. Temple Grandin (1996), an individual with autism who has learned to recognize and overcome certain limitations of her disability, has expressed that she transforms both spoken and written words into pictures. Traditional teaching methods have focused on developing a structured environment through visual cues. Various strategies have been implemented to decrease behavior issues by allowing the child to communicate effectively and to provide a clear understanding of expectations for a given task, as well as a concrete beginning and end to a specific activity. Individuals with ASD on average function at a higher level when materials are presented in a sequential step by step manner. Educational materials are often broken into smaller simpler steps that build up to a finished project (Doyle & Doyle-Iland, 2004). Traditional teaching methods for individuals with ASD have included techniques such as; picture cues, comic strip conversations, social stories, and role playing or video modeling.

Picture Cues. It is thought that visual cues aid in the comprehension of oral language. Picture cues can be used to aid language comprehension and communication or as an environmental prompt to aid in organizational skills and self management (Quill, 1997). Using picture cues as a form of instruction matches the learning style of individuals with ASD. Visual cues provide a tangible recognition cue to enable the child to communicate effectively.

Individuals with autism have impairments in the area of oral language comprehension; therefore, picture cues represent a visual image for the spoken message. People with autism often have difficulty processing changing social communication and instructions. When picture cues are paired with oral language instruction it is supposed that the child processes the information and understands the message.

Picture cues have been used as an augmentative communication system for children who are nonverbal or who are developing expressive language. Graphic symbols can be used to request items and label objects. Picture cues can be used to expand the expressive language abilities and increase spontaneous requests and responses. Individuals with autism who have a limited expressive vocabulary have learned to use visual cues that help them become engaged in relevant activities, change tasks independently, and interact with peers.

Picture cues can also be used to create visual schedules for individuals with autism. Visual schedules have been shown to decrease inappropriate behaviors by providing structure for the sequence of daily activities, organizing time, marking the beginning and ending of a task, and clarifying expectations. Individuals with ASD often have difficulty acquiring daily living skills and can become too reliant on verbal prompts. Visual schedules help create independent behaviors and help maintain daily living skills (Quill, 1997).

Dettmer, Simpson, Smith, and Myles, (2000) conducted a research study with two children; ages 5 and 7, diagnosed with autism, who were evaluated using various visual supports. According to evidence-based reports, the visual interventions reduced the amount of time between transitions and the level of prompting needed. The visual schedule also appeared to facilitate the emergence of longer utterances. The research results implied that the visual cues were an effective means for intervention; however, the research design did not separate the numerous visually structured materials, making it difficult to determine which picture cues were most valid.

Comic Strip Conversations. Comic strip conversations are conversations between two people using simple drawings, symbols, and different colors to represent thoughts, ideas, feelings, and abstract concepts. This tool can be used to help individuals with autism work through problem situations in a visual manner. Comic strip conversations provide a visual means to identify what people might say, do, or might be thinking (Gray, 1998). Individuals with autism can use comic strip conversations as a way to learn appropriate social behaviors. Comic strip conversations are created simultaneously with guiding questions that enable the person with autism to share information about a given situation. Preparing for new situations or unfamiliar events are periodically explained through comic strip conversations (Gray, 1998). The rationale behind comic strip conversations is consistent with research indicating that individuals with ASD learn through visually structured tasks; however, there is currently limited evidence to support the effectiveness of using comic strip conversations as an intervention method with individuals with autism. As mentioned in the literature, comic strip conversations use similar aspects of social stories to help develop appropriate skills and behaviors for individuals with ASD. Comic strip conversations are often paired with social stories explaining the limited research devoted only to comic strip conversations.

Social Stories. As discussed previously, individuals with ASD have difficulty with social interactions and have deficits in interpreting emotions and abstract concepts. Social stories are one way to help children with ASD begin to understand complex social situations, appropriate behaviors, and to teach new and different information. Gray (1998) describes social stories as short stories that follow specific formats and guidelines to objectively describe a person, skill, event, concept, or social situation. Social stories are usually two to five sentences in length and include descriptor sentences about the environment, individuals, and their actions (Gray & Garand, 1993). Social stories are typically taught through repetition, priming, opportunities to practice, and corrective feedback.

Although social stories are often used to teach children with autism specific skills, there is little research that supports the effectiveness of this intervention. Research that has been conducted in this area has been limited to studies involving a select number of participants ranging from one to three and with no emphasis on treatment generalization. Sansosti, Powell-Smith, and Kincaid (2004) reviewed the published research available in this area, which included 10 published research articles and determined that there is preliminary evidence that social story intervention can be effective; however, the results of these studies should be considered with caution. As a result of the lack of experimental control, weak treatment effects, and confounding variables it is difficult to determine if social stories alone were responsible for the progress made.

Barry and Burlew (2004) conducted a research study using social stories to teach choice and play skills to two children with severe autism. The researchers interpreted the data to show that both children demonstrated gains in their abilities to make independent choices and to play appropriately during free play time, within a classroom environment. Social stories allow children with autism to learn how to respond to certain situations; however, the skills that are learned through social stories are often specific to that particular scenario and are rarely generalized to new or different situations. Individuals with ASD usually do not generalize information learned in one setting to a different setting (Doyle & Doyle-Iland, 2004).

Norris and Dattilo (1999) investigated the use of social story intervention with an 8-year-old girl with autism who exhibited inappropriate social interactions during lunch time at school.

The social stories were used to address the inappropriate social behaviors and to introduce alternative behaviors. The results of this study were variable and only a correlational relationship can be inferred as a result of the design of the study. The design of the study did not allow for a replication of the effect of the intervention, therefore it is difficult to determine if the behavior changes were due to the intervention. The social stories seemed to help decrease inappropriate behaviors (e.g., singing, yelling, or gagging) by 50% but did not influence appropriate social interactions such as, responding to other students using verbalizations, gestures, or physical contact. The research findings of this study were consistent with most of the literature in this area indicating that there has been little empirical evidence to support social story interventions.

Hagiwara and Smith-Myles (1999) conducted a research study using an adapted form of the traditional social stories with three boys diagnosed with autism. They created individualized social stories and then presented them to the participants via a computer. This method is referred to in the literature as Multimedia Social Story Program. The program included a book-like format which included social stories, movies of the participants' actions, a computer animated voice, and navigational buttons. The social stories were consistent with following the traditional formats but included visual stimulation and sound presented by the computer. The purpose of this research was to examine the effects of the intervention for improving social or behavioral problems and to investigate the ability of the participants to generalize new behaviors to three different environments. The authors found that there were no consistent effects in using the multimedia social intervention. The intervention increased the skill levels of some of the boys in certain situations and one participant was able to generalize skills across all three situations. A positive outcome of this research study was that advanced technology was shown to be used effectively by children with ASD.

Role Play. Children with ASD often have difficulty developing pretend play skills. Deficits in pretend play skills can affect the development of social skills since daily routines, social rules, and peer interaction are developed through pretend play. A technique referred in the literature as role play or guided play has been used with children diagnosed with ASD. This technique has been used to teach pretend play skills and social skills to children with ASD. Role play can involve an adult play partner who interacts with the child during a play setting. The adult provides scaffolding techniques to help the child engage in pretend play scripts and develop appropriate play schemas. Role play can also include an adult partner who helps the child act out a specific social situation using cues and props in the environment. Role play techniques can be paired with reading stories aimed at a specific social situation or play schema and then retelling the story through role play activities. According to a study conducted by Hess (2006), role play along with hearing a story on the same play topic was shown to help verbal children with ASD learn about social roles and needs and intentions of others.

Video Modeling. Video modeling is another technique that is often used to teach new skills to children with ASD. Typically, video modeling includes showing a video tape of a person exhibiting a specific behavior for a child to learn. In some cases, the child with ASD is video taped performing appropriate target behaviors through prompts and scaffolding. The video tape is then edited to omit the prompts, showing only the child performing the correct skill or behavior. This method is described in the literature as video self monitor. Both methods of video modeling have shown to be effective in teaching children with ASD specific skills or behaviors. These research studies, however; have not shown a generalization of learned skills to new environments or tasks.

Nikopoulos and Keenan (2004) conducted a study with three children diagnosed with ASD using video modeling to teach social initiations and reciprocal play skills. The researchers video-taped a typically developing peer engaging in social interactive play with a toy and then showed the video tape to the three participants. All three participants improved their interactive play skills and were able to maintain the learned skills at a 1 and 3 month follow up. It is difficult to say that this identical method would work for all children with ASD given the wide range of characteristics with this disorder.

A study conducted by Charlop and Milstein (1989) also displayed similar results indicating that video modeling is an effective procedure for teaching children with ASD. In this research study 3 boys diagnosed with ASD were taught conversational speech skills using video modeling. The participants watched different video tapes of two people discussing a specific toy. After viewing the tape three times the participant was tested to see if he could duplicate the conversation. The authors interpreted the data from this research study to indicate that all 3 boys acquired new conversational skills and that these skills generalized to different probes. The limitation of this study involved the development of a specific dialogue script that could not be generalized to other situations under different contexts.

Video modeling also has been used along with reinforcement to teach children with ASD. LeBlanc, Coates, Daneshvar, Charlop, Morris, and Lancaster (2003) provided information indicating that video modeling was an effective teaching tool for children with ASD when paired with reinforcement. The authors concluded, however, that the data from the study indicated that the participants were not able to generalize learned behaviors to other situations. Further research has paired video modeling with other traditional teaching methods such as, visual cues, role play, and drill. Social communication skills have been shown to increase in children with ASD using a variety of traditional teaching methods along with video modeling (Thiemann & Goldstein, 2001).

Apple, Billingsley, and Schwartz (2005) included self management along with video modeling. The authors indicated that video modeling along with a self monitoring system was effective in teaching children with ASD social initiation skills. They further indicated that a self monitoring system such as a checklist can be effective when video modeling alone fails. Spontaneous requesting has also been shown to improve in children with ASD with the use of video self modeling. Wert and Neisworth (2003) conducted a study with four preschool children diagnosed with ASD and described their research results supporting the effectiveness of this method.

Video modeling and video self modeling are thought to be effective in teaching children with ASD new skills and behaviors for several reasons. Children with ASD typically feel uncomfortable with social interactions with peers and adults, they are visual learners, video tapes are easily controlled, and irrelevant stimuli can be filtered out. Video modeling has been proven to be effective in certain situations with a limited number of participants because this technique can be adapted to meet the needs of children with ASD, creating an environment where learning can be successful.

Defining Virtual Reality (VR)

VR refers to a computer generated, interactive, three-dimensional environment. People can visualize, manipulate, and interact with simulated environments through the use of VR. Within the VR program a computer-generated environment is created in the memory of the computer and through the equipment. The focus behind VR is to recreate an environment that accurately resembles the real world. The VR environment is created through the use of 3-D images, auditory stimuli, artificial smell, and force feedback (Reichbach, 1996).

Reichbach (1996) reports that there are three general experiences in VR: passive, exploratory, or interactive. Passive VR means that the individual is only a spectator in the experience. An individual may watch, hear, and feel the simulated environment, but will have no ability to control the environment in any way. Exploratory VR allows a person to be more than a spectator. The user can explore a simulated world and actually move through space, such as taking a tour of a building and walking through its hallways. Interactive VR combines exploratory VR allowing one to watch and move through a simulated world and adds to this experience by giving the user the ability to manipulate the environment and cause changes to occur within the simulated environment. For example, radios and televisions could be turned on and tuned in, lights could be turned off and on, or drawers could be open or shut.

VR has four general categories: modeling, communication, control, and arts/leisure/entertainment (Reichbach, 1996). Creating mental and physical models to better understand our world falls under the modeling category. VR allows individuals to experience and manipulate more complex and sophisticated models than could be created in the real world. Communication can be improved by using VR to create environments that foster communication. Meetings and demonstrations can be created in the virtual environment to give individuals an opportunity to communicate and gain knowledge. VR can also help individuals organize, manage, and control complex information. VR is also a part of the entertainment industry with video games, virtual museums, and virtual play areas for children allowing the participants to gain experiences that might not be achievable in the real world. In summary, VR is a new technology that can be used as a learning tool for individuals to experience and practice skills needed in the real world.

VR Training with Other Disabilities. A key principle of VR is the theory that the brain can process information more effectively when it is presented through combining sight, sound, and touch (Hamilton, Smith, McWilliams, Schwartz, & Carey, 1992). Professionals who teach children with disabilities typically use strategies that include the above mentioned senses, inferring that VR would be beneficial in teaching children with special needs. A review of PsychInfo, ERIC, and ComDisDome databases revealed limited research in the areas of VR and disabilities. The research studies that were located included informational reasoning for using VR with children who have disabilities rather than experimental data. Despite the limited research, there was some evidence of experimental data that represent VR as an effective teaching tool with children who have disabilities.

Cass and Roblyer (1999) hypothesized that VR could allow children with disabilities to learn certain skills with greater physical and/or emotional safety, in a more timely and cost effective way, in ways that do not emphasize their disabilities, and in a way that better meshes learning and learner characteristics. Brown, Kerr, and Wilson (1997) also implied that VR could help children with physical disabilities experience mobility and dexterity, giving them the same experiences to learn from as their peers. VR could also accommodate the needs of children with different or changing levels of literacy, language, or cognitive skills. Another benefit of VR is that it can provide a simulated world that allows children with disabilities to train and practice life skills in an environment that is safe and motivating. The simulated environments in VR allow children with disabilities to gain a sense of independence, control, and success.

Neale, Brown, Cobb, and Wilson (1999) examined the use of communication virtual learning environments (VLEs) in the education of children with severe learning disabilities at the Shepherd School in Nottingham. The researchers have developed three application areas within the Learning in Virtual Environments (LIVE): experiential environments which allow students to practice everyday life skills; communication environments where students are encouraged to develop their speech, signing, and symbol system skills; and personal and social education environments that are designed for students to practice appropriate social behaviors. The researchers found that Virtual Learning Environments (VLEs) were an effective method for teaching children with severe learning disabilities and in some cases the skills learned in the VLE generalized to the real world.

For children with severe learning disabilities there are seven characteristics of virtual environments (VEs) that are conducive to learning (Brown, Mikropoulos, & Kerr, 1996). The VEs encourage self directed activity by giving the student complete control of the navigation and interaction, which in turn facilitates an active role in the learning process. Motivation is important for the student to participate fully in the learning process and VEs provides this element. VEs provide a more naturalistic learning component by using three-dimensional concepts that mirror the real world. Providing a learning environment that is safe for students to practice situations that are multifactoral and to learn from the consequences of their actions is an important component of VR. VEs can be programmed on desktop computers allowing for public access where students can share and discuss the consequences of certain situations, allowing for an assisted learning component. VEs can also create an opportunity for students to experience the same learning principles as other more physically able students.

A study conducted by Padgett, Strickland, and Coles (2006) revealed positive results using a virtual reality computer game to teach fire safety skills to children diagnosed with fetal alcohol syndrome. Five participants who were diagnosed with fetal alcohol syndrome and who fell within the mild mental retardation range were included in this study. Pretest data showed that none of the participants demonstrated knowledge of correct home fire safety procedures. The researchers interpreted the results of the final data to indicate that all five children were able to correctly identify fire safety procedures 100% of the time and four participants were able to correctly perform all three safety steps in both the real world and during the sequencing test with 100% accuracy after the training was finalized.

Research studies have also been conducted using VR to teach life skills with other populations who experience some form of handicapping behavior, including traumatic brain injury (Christiansen, Abreu, Ottenbacher, Huffman, Masel, & Culpepper, 1998; Grealy, Johnson, & Rushton, 1999; Schultheis & Rizzo, 2001), Parkinson's disease (Albani, Pignatti, Bertella, Priano, Semenza, Molinari, Riva, & Mauro, 2002), cerebral palsy (Reid, 2002), and right hemisphere stroke (Katz, Ring, Naveh, Kizony, Feintuch, & Weiss, 2004).

Even though the review of the literature revealed a limited quantity of evidence-based research for the use of VR with a wide range of disabilities, there is still strong evidence to support the effectiveness of this treatment instrument when compared to the fact that VR is considered to be a new technology that is understudied. VR has many components that facilitate learning in children with special needs, with applications for the use of VR with children diagnosed with ASD.

Research Findings of VR with ASD. Trepagnier, Gupta, Sebrechts, and Knott (1999) examined the use of VR in face processing with individuals with ASD. The study included one individual diagnosed with ASD and four non-disabled individuals. Participants in the study used a VR display with a gaze angle detection system located in the head mounted display (HMD). A descriptive review of the data revealed that the four non-disabled individuals demonstrated an eye gaze mainly in the eye area or upper face region of the computer generated face image, whereas the individual with ASD demonstrated variability in his face gaze. It was noted that by the end of the session the individual with ASD was beginning to look at some of the computer generated faces in a more typical manner. The limitations of the study include a small sample size used to represent individuals with ASD and vague methodology. Although this research does contribute to the body of evidence using VR with individuals diagnosed with ASD, the limitations of the study create confounding variables which might interfere with any implications suggested by the researchers.

Strickland (1997) investigated the use of VR to teach object recognition skills with two minimally verbal children diagnosed with ASD. The duration of the study was six weeks, which included two training phases with the maximum exposure to the VR being five minutes at any given time. The first phase entailed training on recognizing and tracking a car within the virtual environment and the second phase included training on identifying an object, walking to it, and stopping. The virtual environment for both training phases included a simplified street scene with all irrelevant objects removed, leaving only a street and textured buildings. The VR was presented to the children using a VR helmet.

The researcher found that both children were able to find an object and walk toward it within the virtual environment; however, only one child was able to stop when the object was located. The children in this study demonstrated an adaptation to the technology and repeatedly immersed themselves into the virtual environment, where they were able to verbally label colors and objects. The researchers also indicated that high to mid functioning children with ASD might benefit from a low cost flat screen VR interaction without the use of a helmet. The researchers stated that future research will investigate how skills learned in the virtual environment generalize to a real world setting.

Strickland, with a team of volunteers from Treatment and Education of Autistic and Related Communications Handicapped Children (TEACCH) and members of North Carolina State's Computer Science Department, devised an experiment using VR to test whether severely learning challenged children with ASD could learn a basic, real world skill such as street-crossing in a virtual environment. Strickland and team members created a simple virtual environment that included a street, sidewalk, buildings, one stop sign, and one moving car. The study included one participant who was exposed to the VR training environment for five minutes a day over several weeks. The participant wore a VR helmet, which displayed the simulated street environment. The researchers indicated that by the last training session in the virtual environment, the participant was able to walk down a sidewalk, turn around, find the stop sign, walk up to it, and wait for the car to pass by. It was noted that the participant was not able to perform the street-crossing task on her own in the real world environment; however, a two year maintenance test in a real world environment revealed that the girl was able to stop at the curb, watch for cars, and look both ways. A follow-up study, with the same participant from the street-crossing study and several other children with ASD, was conducted where Strickland taught the children to use objects within a virtual kitchen. After training, the participants were able to use the same kitchen objects in the real world (Brandt, 2000).

Parsons and Mitchell (2002) studied the potential of VR in social skills training with ASD. The researchers stated that VR might be an ideal tool for allowing children to practice target behaviors in role play situations within a safe environment. They also noted that there is a need for a training package that is easy to administer and successful in promoting learning across contexts with children diagnosed with ASD.

Safety Issues

Fire Injury Statistics. According to the National Fire Data Center an estimated 2,500 children age 14 or younger were killed in residential fires in the United States in 2002. Of these fire causalities, approximately half were under the age of five and 70 percent were under the age of 10 (www.usfa.fema.gov, 2005). It has been reported that fires and burns are the third-leading cause of unintentional injury-related death among children ages 14 and younger. Children are at a greater risk for fire related deaths as a result of a limited ability to react promptly and properly to a fire, less control of their environment, and a lack of awareness of danger (www.bettendorf.org, 1997). Children account for a substantial portion of the nation's fire deaths and injuries; however, there is limited research to support the effectiveness of fire safety programs or to evaluate the criteria of each program.

Fire Safety Programs for Typically Developing Children. There are several national fire safety programs designed for school-aged children; however, a review of the literature indicated that there was not a specific required curriculum to teach fire safety skills to children. In general, fire safety programs focus on teaching children to stay low, simple discriminations for choosing the safest exit, and stop-drop-and- roll. There are a number of internet websites for children that teach fire safety skills through the use of cartoon characters and simple games.

Learn Not to Burn® (LNTB) was first released by the National Fire Protection Association in 1979 and teaches 22 key fire safety behaviors. The program addresses issues such as responding correctly during a school fire drill, developing home escape plans, stop-drop-and-roll procedures, and crawling low when there is smoke. The curriculum is designed to be used within an individual classroom and includes three different learning levels. Learn Not to Burn® incorporates fire safety behaviors into the general curriculum, so that children can learn fire safety skills while developing skills in reading, math, art, history, and science. The LNTB program offers resource books for kindergarten through third grade that include reproducible activity sheets and evaluation forms to assess knowledge gained through the program. For preschool-aged children the program uses songs, games, and activities to teach burn prevention behavior to children. Areas addressed for the preschool-aged child are, recognizing a smoke detector sound, stop-drop-and-role procedure, and staying away from hot things (www.nfpa.org, 2005). The LNTB program includes a variety of important concepts that address fire safety skills; however, a review of the literature did not find any sound evaluations for the effectiveness of this program.

Another fire safety program that uses an educational approach is Kid Safe. This program was developed in 1987 by the Oklahoma City Fire Department with support from the Federal Emergency Management Agency (FEMA). Kid Safe is a 30 hour program that includes 20 minute daily sessions over an 18 week period that covers nine lessons. The lessons include information regarding the use of matches and lighters, the importance of smoke detectors, the stop-drop-and-role procedure, escaping a house that is on fire, and introduces the role of the firefighter. The main instructional method of this program includes situations to avoid and things not to play with. Other teaching methods include modeling, role play, and rehearsal during simulated emergency situations. Kid Safe also incorporates a home component where parents can reinforce safety skills learned in school. The Kid Safe program focuses on many important elements for teaching fire safety skills to children (Carthen, 1987).

McConnell, Leeming, and Dwyer (1996) evaluated the effectiveness of the Kid Safe program involving 443 children ages 3, 4, and 5 years. The children were divided into two groups, a treatment group and a delayed treatment group. The delayed treatment group did not receive instruction on fire safety skills using the Kid Safe program. Both groups of children were given a pretest to measure fire safety knowledge before the program and were then given the same posttest after the program was implemented. The children who received fire safety instruction through the use of the Kid Safe program showed an improvement in their knowledge of fire safety. Although the researchers of this study suggest that the Kid Safe program is an effective means of teaching fire safety skills to preschool-aged children, the results should be interpreted with caution. The researchers compared the enhanced knowledge of fire safety skills to a group that did not receive fire safety instruction. This research design creates a confounding variable which affects the validity of the research results. Another point to consider is that even though the children demonstrated an increased knowledge of fire safety skills, it does not necessarily result in increased fire safety behavior in a real life emergency.

Jones, Kazdin, and Haney (1981) investigated the ability to train five children with normal levels of intelligence to respond appropriately in simulations of fire emergencies at home during the night. The researchers simulated a bedroom environment within the children's school using a bed, a throw rug, a chair, and an article of clothing. During the testing procedure the experimenter would describe the situation and have the child lie down and then said "show me everything you would do". The child would then receive a sequence score and an occurrence score. The sequence score indicated how well the child performed the correct response within the correct place of the sequence. The occurrence score indicated a correct response whether it was in the correct sequence or not.

Training was conducted within the simulated bedroom environment on an individual basis for five days with two 20 minute training sessions per day. Behavioral and verbal responses were included in the training phase. The children were initially asked a variety of questions regarding fire safety, and then later training sessions focused on behavior responses to fire safety. The training process included 13 distinct steps that the trainer was to perform when teaching the sequence of fire safety skills. The trainer included a verbal review of the previous training session followed by a model of the correct responses, new material was reviewed and then taught, proper feedback was given for correct and incorrect responses, and a self rewarding system was used.

The researchers concluded that a multifaceted behavioral training package that included instructions, shaping, modeling, rehearsal, feedback, and self reinforcement was effective in teaching children to properly exit a house in an emergency fire situation. The children in this study did not have the opportunity to practice fire safety skills in a real home environment or during an actual emergency situation. A review of the literature and internet revealed that there are no national fire safety education programs for children with developmental disabilities. There are research studies that attempt to teach children with various disabilities fire safety skills, however the research is limited and involves small participant sample size and different techniques across a variety of environments.

Teaching Fire Safety Skills to Children with Disabilities. Children with disabilities often have special learning difficulties that current educational fire safety programs do not address. Research focusing on teaching children with disabilities fire safety skills is variable and is dependant on various variables specific to the environments used in the study. Researchers suggest that children with disabilities can be taught fire safety skills with different levels of prompting and teaching techniques.

Jones, Sisson, and Van Hasselt (1984) examined emergency fire safety skills with eight children who were visually impaired in a residential school setting. The intervention was taught using simulated conditions in the participant's actual rooms and consisted of verbal instructions, feedback, behavioral rehearsal, and token reinforcement. After the intervention process, the participant's fire skills were evaluated in simulated fire emergency situations and during unannounced nighttime fire drills. All participants demonstrated an increase in fire safety skills after the intervention process and six participants were able to generalize the fire safety skills to actual fire drills. This study incorporated a group training strategy rather than individual treatment used in previous fire safety studies. The researchers stated that participants' newly learned fire safety skills were not adequate for unmonitored evacuations during emergencies.

Cohen (1984) investigated an operant conditioning procedure to elicit a non-prompted, independent, appropriate response to a fire alarm in an apartment with a 30 year old male diagnosed with profound mental retardation and total blindness. The training procedure included breaking down the exiting procedure into a ten step process and using reinforcements of verbal praise and ice cream. The training and generalization took place in two separate locations, the participant's bedroom and living room areas. The participant was able to produce a completely independent response to a fire alarm in a total of 139 trials with an average training time of 2 ½ hours. This research did not address other fire safety factors such as exiting through doors that were not hot and crawling when smoke was present. Generalization to other individuals with similar disabilities would be difficult to construct from this investigating of fire safety skills with this participant.

In summary, it appears that children with disabilities can learn fire safety skills when presented with the appropriate teaching strategies. Several conclusions can be made from a review of the literature focusing on teaching fire safety skills to children with disabilities (Bannerman, Sheldon, & Sherman 1991; Cohen 1984; Haney & Jones 1962; Holburn & Dougher 1985; Jones, Kazdin, & Hanley, 1981; Jones, Sisson, & Van Hasselt 1984; Jones & Thorton, 1987; Matson 1980). It seems that generalization and maintenance of fire safety skills is more difficult for children with disabilities as a result of the variety of different situations and environments in which a fire can take place. When teaching fire safety skills to children with disabilities it is important to include direct instruction, rationale, modeling, practice, feedback, reinforcement, and self-evaluation. During training sessions, the teacher should review and model the steps in the task and explain why they are important. The child should be given the opportunity to practice the fire safety skills in a simulated environment that closely matches a real fire situation. Simulations could include controlled smoke, blow dryers to create the presence of heat, and objects that might be found in the environment. After the child learns the fire safety skills, surprise fire drills should be implemented. To enhance generalization and maintenance of fire safety skills, monthly fire drills should be conducted (Bannerman-Juracek, 1994).

Teaching Fire Safety Skills to Children with ASD. Bigelow, Huynen, and Lutzker, (1993) used a shaping and criterion design to teach a nonverbal nine-year-old female diagnosed with early infantile autism to exit her home when hearing the verbal prompt “fire”. Training involved placing the child 11 feet from the front door in her home. The participant was reinforced with a hugs and a tangible reward when she walked to the front door with either physical prompts or independently. After 12 weeks of training, once a day with a counselor for 30 minutes to 1 hour, and daily with the care provider for shorter sessions, the participant increased her distance from the door by 11 feet. The ultimate goal of this research was to teach the participant to exit her home from any location within the house with the verbal prompt of “fire”. The participant did not meet this criteria and generalization of learned skills was not evaluated. The researchers indicated that future research should include a larger sample size of participants to investigate training programs and procedures in a variety of settings for generalization purposes.

The research conducted by Bigelow, Huyen, and Lutzker (1993) had many limitations that interfere with the validity and reliability of the research findings. The skills taught to the participant were not a true measure of fire escape skills and were specific to one environment. The participant would more than likely not be able to generalize learned skills to a different environment because the participant was not instructed on the underlying concepts needed for developing fire safety skills. Since the participant was only able to exit her home when placed directly in front of the door, it could be argued that the participant simply learned a specific routine for walking out a door and not fire escape skills.

Israel, Connolly, Von Heyn, Rock, and Smith (1993) designed a set of interventions to teach 52 severely self-abusive individuals with autism and mental retardation to exit a community residence when a fire alarm was sounded during the night. This study consisted of three tests (pretest, post test, and follow-up test) and four phases (Exploratory, Intensive I, Maintenance, and Intensive II training), in six different residences, over a two year period. The following procedures were used during the 10 week Exploratory Training phase: daytime practice once or twice a week for two hours, verbal instructions prior to sounding the alarm for correct procedure to exit the building, physical prompts in the form of a light touch from behind or a full push, and treats to reward exiting the building.

During Intensive Training I many different changes were made to the environment and training procedure. A supplemented alarm system with louder horns and electronic beeps, bed shaker, and rotating spotlight were installed so all residents would be wakened from their sleep. A recorded message telling residents to get out of bed and leave the building was repeated during the course of the fire drill. Reward vans and temperature control within the house were implemented to promote the residents to evacuate the building. The staff opened windows throughout the building and turned down the thermostats to motivate the residents to leave their beds and locate a reward van which was heated and contained treats. During this training phase mealtime food was used as a reward for performing the correct fire escape procedures. If students did not complete the fire escape procedure correctly, they were served a bland make up meal at the end of the day. Some students became too reliant on prompting from staff, and others refused to perform the exiting procedure after demonstrating successful skills, therefore aversive punishments were implemented. Aversive punishments used included the following: aromatic ammonia, an unpleasant taste, a squeeze to the muscle on the shoulder, a hand spank to the thigh, or a spank with a flexible rubber spatula.

Maintenance training began six months after the posttest. During this time students practiced one night a week and were required to do seven consecutive successful exits. Intensive Training II began 10 months after maintenance training which included the same procedures from Intensive Training I except more daytime practice was included. By the end of the training program all participants exited with a 100% success rate within 60 seconds.

The drawbacks of this study are the length of the training program and the intense training procedures. A training program that lasts two years creates the potential for participants to become bored with the exiting criteria. During a two year period there is the possibility that participants might not be able to finish the program due to relocation. Also, some of the aversive punishment techniques seem unethical and potentially harmful.

The Use of VR to Teach Fire Safety Skills. Padgett, Strickland, and Coles (2006) assessed the effectiveness of a computer-based VR game in teaching five children diagnosed with fetal alcohol syndrome (FAS) fire safety skills and to generalize the skills to real world simulations. The participants ranged in age from 5 to 7 and functioned cognitively in the mild mental retardation range. Participants were trained to identify key elements necessary to play the game such as, fire, meeting place, follow, sit, and wait. The VR game was based on the following three steps from the USFA 2002 guidelines: recognizing a fire in the home, leaving the home immediately by the shortest and safest route, and waiting by a predetermined meeting place.

Participants were involved in a pre-assessment phase before the actual treatment began. The participants were given a pretest to assess prior knowledge of fire safety skills. The examiner asked the children what they would do if they saw a fire and none of the children were familiar with the proper steps either through verbal response, sequencing pictures, or demonstration. A VR game also was included to train the children on proper navigation through the VE. All children were able to successfully navigate through the VR game either with a joystick or arrow keys.

The training phase of this experiment included two conditions (no fire present and fire present in different places) within the VR fire safety game. The VR game included three levels in each condition: an animated guide using yellow arrows to indicate the correct path out of the house, an animated guide with no arrows, no animated guide or arrows. The design of this program allowed the participants to navigate throughout the VE with decreasing prompts, creating the opportunity for the participant to play an active role. The VR program reinforced appropriate actions with a verbal response of “good job” and a visual response exhibited by the cartoon character of jumping. Inappropriate or dangerous actions were followed by an explanation of the dangerous action and the VR game started over from the beginning. Instructions for participating in the VR game were explained via the computer with either auditory commands or a demonstration by a cartoon character. After the participants demonstrated the appropriate skills and actions within the VE they were reassessed using the three-step picture sequence and were exposed to a real world simulated fire within the building. One week after the training procedures were completed the children attended another session where they were evaluated using the same picture sequencing task and response to a real world simulated fire situation.

After the VR training all participants were able to successfully complete the three safety steps within the VE. Immediately after the computer training four of the five participants were able to sequence the three safety steps in the proper order and generalize the steps to the real world simulated fire situation. The interpretations of the results from the study indicated that fire safety skills can be taught through a VR program and the learned skills can generalize to real world situations. Despite the positive results of this research there were limitations created by the design of the study.

The data from this investigation should be interpreted with care due to the use of the same picture sequencing task for training and evaluation, and the short maintenance period of one week. The use of the three step picture sequencing task to test learned skills and behaviors created a confounding variable because the same task was used during the training process. A maintenance period of one week limits the strength of the findings in this study because it does not demonstrate the participant’s ability to generalize or apply learned fire safety skills.

Tornado Injury Statistics. Tornados can occur almost anywhere in the United States at anytime of the year. On average, 1,200 tornados are reported each year in the United States with a reported death toll of 55 people. Fatalities associated with tornados can fluctuate based on how heavily populated an area is, for example; in 1999 one tornado killed 38 people in the Oklahoma City metropolitan area. Most injuries or deaths linked to tornadoes were the result of extremely high force winds that propelled debris, collapsed buildings, or overturned vehicles (www.ametsoc.org, 2000). The risk and death associated with tornados can be reduced through education, planning, and following basic safety rules.

Tornado Safety Programs. A review of the literature and numerous searches on the internet revealed that there are no regulated programs to teach tornado safety skills to children. The safety procedures and plans for educational facilities are similar but there is not a specific curriculum to teach these skills to children. Each school is responsible for implementing and creating a tornado safety plan specific to their school. There are different websites for children to learn tornado facts and procedures through games and nonfiction literature. Federal Emergency Management Agency (FEMA) has a website where children can read about other children's' real life experiences with tornados, learn about the Fujita tornado scale and tornado intensity scale, and look at photographs of tornados. Other websites provide information on the proper safety procedures during tornados in different situations and offer coloring books with safety information presented in a story format (www.weatherwizkids.com).

The National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service advises that all schools develop plans and conduct routine drills to prepare for a situation involving a real tornado. When developing tornado safety procedures the NOAA suggests that professionals consider specific elements. Teachers and students should be able to recognize the difference between a tornado warning/watch and respond appropriately. Each school should be inspected and have specific shelters designated for tornado drills. If a school has a basement this should be the first choice for a shelter area. In a tornado drill students should know the designated shelter areas to go to, they should know the proper body position to protect their head and neck areas, and they should know how to respond to a specific command such as “everybody down” (www.doe.state.in.us, 2005).

There is limited research on how effective tornado safety programs are within the educational system. Researchers may not have explored this area because the procedures vary from each state and school district and there have been limited instances where tornados have struck during school hours. Although the prevalence of tornados that have destroyed schools in the past while students were in attendance is low, there are instances where it has occurred. On April 27, 1967 300 children were injured in Belvidere, Illinois when a tornado hit a local high school. On March 18, 1925 an estimated 32 children were killed when a tornado touched down during school hours (www.tornadoproject.com). Tornados are unpredictable and the possibility of a tornado warning being issued during school hours is a valid concern warranting more research to be conducted in this area.

The Need for Teaching Children with ASD Safety Skills. There is limited research investigating the effectiveness and efficiency of using traditional methods to teach children diagnosed with ASD. Researchers who have conducted research using traditional teaching methods with children diagnosed with ASD have stated that future research should include incorporating a larger sample size, have precise experimental control, include a maintenance and generalization component, and compare treatment effects with other groups or methods (Barnhill, Tapscott-Cook, Tebbenkamp, & Smith-Myles, 2002; Barry & Burlew, 2004; Dettmer, Simpson, Smith-Myles, & Ganz, 2000; Gray, 1998; Hess, 2006; Pierson & Glaeser, 2005; Sansosti, Powell-Smith, & Kincaid, 2004).

There are a small number of studies that attempt to teach fire safety skills to children with ASD. These studies focused on teaching fire safety skills specific to one environment, therefore the participants were not taught true safety skills, but were simply taught a repetitive behavioral response to one form of stimulus that could not be generalized to a different environment. There are also no materials specifically designed to match the learning needs of children with ASD. Social stories, comic strip conversations, role playing scenarios, and visually structured tasks have all been cited in the literature as methods used to teach children with ASD; however, the available materials are limited.

Learning tornado safety skills are important for every child, especially for children with ASD. Children with ASD tend to not pick up on the environmental and social skills around them unless they are taught to key into them. There has been no research to investigate tornado safety skills with typically developing children or with children diagnosed with ASD. Further, the materials available to teach tornado safety to children were not created to match the learning needs of children with ASD. Available materials to teach safety skills to children with ASD would have to be modified for the concepts to be understood and effective.

It is essential that research be conducted to evaluate how traditional teaching methods can be effective in teaching children with ASD safety skills. Research should focus on a larger sample size, controlling for confounding variables, measure concept knowledge as well as the ability to rationalize learned skills to different situations, and provide stronger evidence-based data that supports the use of traditional teaching methods.

CHAPTER III

METHODOLOGY

This chapter will describe the participants involved in the research study as well as the design and procedures used during the experiment. Two training phases were used for both conditions (TAU and Virtual Reality). Level of cueing and prompting were matched across conditions to provide an equal level of instruction for each condition. Training sessions were conducted twice a week for a maximum time limit of thirty minutes per session. Training Phase I included instruction which focused on developing fire safety skills and training Phase II consisted of teaching tornado safety skills. Initially, each training phase (Phase I – fire safety and Phase II – tornado safety) consisted of 4 weeks of training. Another level was added for each phase for a total of 5 weeks per phase to account for individual differences and to promote generalization of learned skills.

After each phase was completed the participants entered a generalization phase. During this phase the participants were placed in a real time situation to assess the generalization of learned behaviors to the real world. Approximately 3-4 weeks after the generalization phase the participants then took part in a maintenance phase to evaluate learned behaviors over time.

Participants

Twelve children diagnosed with Autism Spectrum Disorder were selected for this study. Eight children participated as a result of two permission slips not being returned, one child being absent for baseline data collection, and one child who was unable to enter the classroom and approach the computer monitor for the virtual reality tasks. All participants were from two self contained classrooms in one school within the Wichita Public School District, Wichita, Kansas. Participants were randomly assigned to form two groups of four children each. All participants were independently mobile, had normal or corrected vision, hearing within normal limits, and had prior experiences with computers. Individual participant characteristics are reported in Table 1.

After obtaining permission from the participant's parents/guardian, necessary teachers and school administrators, as well as the Wichita State University Institutional Review Board, the researchers began the pre-experimental procedures of the research study (see Appendix A for consent forms). Participants first received pre-experimental instruction on controlling a computer-based mouse. Computer-based mouse training was administered using a virtual reality program. The virtual reality program was designed around the layout of an unfamiliar location to the participants. Participants were given instruction on how to control and manipulate the mouse to navigate appropriately through the virtual world. Once the participants were able to manipulate the mouse successfully, they chose a snack in the virtual world and were then reinforced in real time with the actual snack.

Materials

Materials used for TAU group (Condition 1) included social stories, picture cards, role play/rehearsal, visually structured directions, mini work systems, comic strip conversations etc. Training used for the VR model (Condition 2) was presented via a laptop computer with a CPU – Intel Pentium 4@ 2.6 GHz with 2 GB RAM, using EON Professional 5.0; 3DS Max 6.0 software, a separate 19" UltraSharp Dell® flat panel monitor, a ScentPalate®, and a mouse in a classroom setting.

Table 1

Participant Characteristics

Group 1

Participant	Age	Sex	Cognitive Score	Manipulate Mouse
1	10	M	42	Yes
2	12	M	68	Yes
3	10	M	63	Yes
4	8	F	38	Yes

Group 2

Participant	Age	Sex	Cognitive Score	Manipulate Mouse
5	8	F	69	Yes
6	9	M	NA	Yes
7	7	M	67	Yes
8	6	M	79	Yes

Classroom Setup. Both groups, TAU (Condition 1) and VR (Condition 2) received training in a separate but familiar classroom, different from their typical classroom used during the day for instructional purposes. The classroom used for this study was located across the hall from the regular classroom and was divided into two separate training areas. The training area used for TAU (Condition 1) was created in one corner of the room using dividers and shelving to provide a physically structured learning environment. Plastic bins designated with numbers were used to visually separate individual tasks and to identify the beginning and end of a task, were placed on a shelf. A visual schedule was also used to help participants complete the tasks in order as indicated by the plastic bins. A similar training area was created using dividers, for the VR teaching model in a separate corner within the same room. A visual schedule was represented by simple pictures indicating the order of tasks to be completed.

Reinforcements (Doritos®, Cheetos®, KC Masterpiece chips®, and Rold Gold pretzels®) were used for both conditions after the participants had completed the tasks for the day. Reinforcements were represented visually (photographs or snack picture) for the participants to select their snack choice in both conditions.

Baseline Procedures for Fire Safety

To obtain baseline data on the response to a fire drill, all eight participants were placed in random locations throughout their elementary school to practice a school wide fire drill. Two locations were used within the elementary school, the library and the office. Participants were situated in a manner where other children were not visible. The eight children were randomly divided into two separate groups of four children each. Baseline data were collected on two separate days with one group of children at a time. Each participant was accompanied by an adult and a person with a video camera. Participants were engaged in an activity with the adult until the fire drill was initiated. Adults engaged with the children were instructed to give no cues or ask questions concerning a fire drill. Participants' ability to recognize and respond appropriately to the visual and auditory signals typically used to represent a fire drill were observed and video recorded during the real-time fire drill.

Design and Procedures

Phase I, Training Via TAU. Four participants received training to develop fire safety skills through TAU strategies (Condition 1). Participants in this group were instructed on fire safety using traditional methods (social stories, picture cards, role play/rehearsal, visually structured directions, mini work systems, comic strip conversations etc). Training during week one included prompts from the trainer, visual cues of a fire (using a simulated fire pot) and a prerecorded fire alarm sound.

The activities for week one included a social story, a fire safety book with questions, a paper and pencil Maze, and a role play scenario. The social story described the process required for exiting a school building during a fire drill. Specific visual and auditory cues that participants would need to attend to during a fire drill (e.g., exit signs, arrows on the exit signs, door leading outside, fire alarm, and fire alarm noise) were included in the social story. Feelings that the participants might experience during a fire drill such as, panic or fear were also addressed in the social story.

A fire safety book was read during week one to build a general schema for fire safety knowledge. While the book was read to the participants, they were required to answer questions relating to fire safety. A fire safety Maze was also included during week one to help participants develop a routine for following exit signs to leave a building during a fire drill. The Maze was constructed on 8 ½ x 11” paper with a picture of a fire in one corner and a door leading outside in another corner. Fire exit signs were placed throughout the Maze and participants followed the exits to the door leading outside.

During the role play scenario a visual jig was used to help visually structure the activity for the participants. A strip of construction paper with six pictures of fire exit signs, a picture of the playground outside, and a picture of the reinforcement all attached with Velcro were used for the visual jig. Participants located and followed the exit signs in their school building, placing their picture of an exit sign with an exit sign found at their school until they found their way outside. Each week of training prompts were eliminated and the participants played a more active role in the instruction. Props such as a pretend fire pot, fire exit signs, and a pre-recorded fire alarm noise were used to create the cueing necessary for training.

During the first week of training the participants were provided with maximal cues to help them learn how to navigate successfully out of the training room in response to a fire drill (role play/rehearsal). Training during week one included maximum prompts from the trainer, visual cues of a simulated fire using a pretend fire pot, visual representation of pre-made fire exit signs, and an auditory stimulus of a prerecorded fire alarm. Training during week two consisted of the same auditory stimulus and visual cues represented by the fire pot and pre-made fire exit signs; however, the exit signs were decreased from six to four. Week three of training removed the visual prompt created by the fire pot, and the visual cues generated by the fire exit signs were decreased to two. By week four, participants assumed the most active role in the training phase. Participants received only the auditory cue of a prerecorded fire alarm and were required to navigate out of the training classroom independently without the aid of visual cues (pre-made fire exit signs). Week five required the participants to navigate from a different, unfamiliar location within their school in response to the auditory cue of a prerecorded fire alarm only.

Participants in the TAU (Condition 1) also engaged in various traditional teaching tasks (sequencing/retelling, comprehension questions, navigational mazes, video modeling) to enhance the concepts of fire safety and teach the skills necessary for a school fire drill. Traditional teaching strategies increased in level of difficulty and prompting as the training phase progressed. Level of cueing and prompting were matched across conditions to provide an equal level of instruction for each condition. Activities and training weeks for TAU are represented in Table 2.

Table 2

TAU Activities and Training Weeks for Fire Safety

Activities per Week	Concept and Skill Knowledge	Activity Criteria
Week 1:	Week 1:	Week 1:
1. Social story 2. Fire safety book/questions 3. Maze 4. Role Play – Maximum cues (fire pot, fire alarm, and visual jig with six pictures of exit signs.)	1. Script building to teach specific skills 2. Comprehension 3. Skill practice 4. Practice and develop routine for fire drill	1. Attend to social story 2. Focus on story and comprehension of fire safety 3. Use pencil to locate/follow exit signs 4. Match exit signs on visual jig to exit signs found in environment to walk self out of building

Activities per Week	Concept and Skill Knowledge	Activity Criteria
Week 2: 1. Social story 2. Fire safety book/questions 3. Maze 4. Three-step sequence 5. Role play – Decreased cueing (fire pot, fire alarm, and visual jig with four pictures of exit signs.)	Week 2: 1. Script building to teach specific skills 2. Comprehension 3. Skill practice 4. Develop routine and script 5. Practice and develop routine for fire drill	Week 2: 1. Attend to social story 2. Focus on story and comprehension of fire safety 3. Use pencil to locate/follow exit signs 4. Order sequence cards correctly and verbalize steps 5. Match exit signs on visual jig to exit signs found in environment to walk self out of building

Activities per Week	Concept and Skill Knowledge	Activity Criteria
Week 3:	Week 3:	Week 3:
1. Social story 2. Fire safety book/questions 3. Maze 4. Five-step sequence 5. Role play – Minimal cueing (fire pot, fire alarm, visual jig with two pictures of exit signs.)	1. Script building to teach specific skills 2. Comprehension 3. Skill practice 4. Develop routine and script 5. Practice and develop routine for fire drill	1. Attend to social story 2. Focus on story and comprehension of fire safety 3. Use pencil to locate/follow exit signs 4. Order sequence cards correctly and verbalize steps 5. Match exit signs on visual jig to exit signs found in environment to walk self out of building

Activities per Week	Concept and Skill Knowledge	Activity Criteria
Week 4:	Week 4:	Week 4:
1. Social story 2. Comic strip conversation 3. Five-step sequence 4. Video modeling 5. Role play from different locations in room (no visual jig, or fire pot)	1. Script building to teach specific skills 2. Script, comprehension, schema building 3. Skill practice 4. Script, comprehension, schema building 5. Practice and develop routine for fire drill	1. Attend to Social story 2. Attend to reading/answer questions 3. Order sequence cards correctly and verbalize steps 4. Attend to video/answer questions 5. Locate/follow exit signs to walk self outside
Week 5:	Week 5:	Week 5:
1. Social story 2. Video modeling 3. Role play from different location in school building (no visual jig, or fire pot.)	1. Script building to teach specific skill 2. Script, comprehension, schema building 3. Practice and develop routine for fire drill	1. Attend to Social story 2. Attend to video/answer questions 3. Locate/follow exit signs without prompting to walk self outside

Phase I, Training Via VR. During the first week of VR training (Condition 2) the participants were only required to watch the simulation of the virtually guided tour. Training during week one included prompts from the trainer, visual cues of a fire and a fire alarm, olfactory stimulus of smoke emulated by a ScentPalate®, and an auditory representation of a fire and fire alarm. The participants took part in another instructional lesson in mouse training during week one. Prompts decreased with each week of training, allowing participants to gradually play a more active role. Training during week two required the participants to manipulate objects while being virtually guided through the program. Participants were required to recognize and click on a door and four exit signs while the program zoomed in on these objects. Week three of training eliminated the visual prompt of a fire and the olfactory cue of smoke. Participants were required to perform the same tasks as in week two but without the zoom feature. By week four participants assumed the most active role in the VR program. Participants received only the auditory cue of hearing a fire alarm and were required to click on a door and navigate through the simulation independently. Week five was added to allow the participants the ability to practice learned skills in a real time environment. During week five the participants were required to navigate out of the training room in response to the auditory cue of a fire alarm. A generalization phase took place after week five to determine if the fire safety skills taught transferred to real-world environments. VR activities and training weeks are shown in Table 3. A maintenance phase followed approximately 3- 4 weeks after the generalization phase to evaluate learned skills over time.

Table 3

VR Activities and Training Weeks for Fire Safety

Activity	Level of Cueing	Criteria
Week 1:	Week 1:	Week 1:
1. VR simulation	1. Alarm sound provided	1. Attend to VR simulation
	2. Navigation provided	2. Answer questions
	3. Zooming to relevant cues (e.g., exit signs)	
	4. Doors opened	
	5. Fire is visible in the Simulation	
Week 2:	Week 2:	Week 2:
1. VR simulation	1. Alarm sound provided	1. Attend to VR
	2. Navigation provided	2. Answer questions
	3. Smoke scent provided	3. Click on doors to open
	4. Zooming to relevant cues (e.g., exit signs)	4. Click on exit signs to Navigate

Week	Concept and Skill Knowledge	Activity Criteria
Week 3:	Week 3:	Week 3:
1. VR simulation	1. Alarm sound provided	1. Attend to VR
	2. Navigation provided	2. Answer questions
		3. Click on doors to open
		4. Click on exit signs to Navigate
Week 4:	Week 4:	Week 4:
1. VR simulation	1. Alarm sound provided	1. Attend to VR
		2. Answer questions
		3. Click on doors to open
		4. Click on exit signs to Navigate
Week 5:	Week 5:	Week 5:
1. VR simulation	1. Alarm sound provided	1. Attend to VR
2. Practice real world fire drill	2. Program orients out of the Door	2. Physically navigate way out of the building

Generalization Phase for Fire Safety. After the completion of Phase I, all participants were assessed to determine if the fire safety skills taught transferred to the real world environment. Participants were placed in the school library and were engaged in an activity with an adult. Each participant was video-taped by a trained adult. Adults were instructed on the same procedures as described in the baseline procedures. A fifth level of training was added to the training design after trainers and observers documented that additional cueing was needed to allow the participants to perform the learned fire safety skills. A second generalization phase was conducted one week after the completion of level five.

During the second generalization phase participants were placed throughout their school environment to practice a school wide fire drill. Adults again video-taped each participant but this time were given specific cueing guidelines to prompt participants to perform learned fire safety skills. The level of prompting needed if participants did not respond spontaneously to fire drill alarm was as follows: 1) Visual – adult pointed to exit sign, 2) Verbal – adult prompted with "show me", 3) Physical – adult gave a gentle touch from behind. Level of cueing needed to respond appropriately to a fire drill was recorded and video-taped. After the completion of the generalization phase participants then entered the maintenance phase.

*Maintenance Phase for Fire Safety. Ap*proximately 3-4 weeks after the completion of Phase I, the participants were reintroduced to the real-world fire drill scenario in their natural school environment, to assess the maintenance of learned fire safety skills. The previously stated procedures for documentation, level of cueing, and video-taping were used during this phase of the experiment.

Baseline Procedures for Tornado Safety (Phase II)

Baseline data were collected for tornado safety by observing and video recording how the participants reacted to a tornado drill in their school environment. Participants were randomly placed throughout their school and accompanied by an adult with a video camera. Participants were engaged in an activity until the tornado drill was initiated. Adults who video taped the children were instructed to give no cues relating to the tornado drill. Participants' ability to recognize and respond appropriately to the visual and auditory signals typically used to represent a tornado drill were observed and video recorded during the tornado drill.

Phase II, Tornado Safety. After the completion of Phase I the two groups alternated for Phase II of the experiment, tornado safety. Participants who were in the TAU group (condition 1) for Phase I were switched to the VR group (condition 2) for the second Phase of the experiment. Trainers did not alternate with the groups so that each trainer instructed a new group of participants, controlling for prior trainer participant effect variables.

Phase II, tornado safety, followed the same procedures as in Phase I. Participants in the VR group (Condition 2) received training to develop tornado safety skills presented via a laptop computer, a separate 19" inch screen, and a mouse in a classroom setting. Participants in the TAU group (Condition 1) received training through traditional strategies (social stories, picture cards, role play/rehearsal, visually structured directions, mini work systems, comic strip conversations etc.) Activities and training weeks for TAU are illustrated in Table 4. Activities and training weeks for VR are reported in Table 5. Both condition groups received training twice a week for a maximum length of 30 minutes per session, over a five week period. Participants were video recorded during each training session and data were collected by the trainers on the participant's reactions/responses, level of cueing, and comprehension of presented materials. The generalization phase followed the same procedures as mentioned previously for Phase I. A maintenance phase was not completed as a result of the school year ending before an additional school wide tornado drill could be scheduled.

Data Analysis

Reliability. Investigators and additional graduate students were recruited and trained regarding participant response data so that intra- and inter- reliability were accurately calculated and reported. Reliability judgments were calculated using two participants per week in weeks two and four, across both conditions (Condition 1, TAU and Condition 2, VR). A sample of 59 responses for fire safety were drawn for duplicate scoring. Percentage of agreement was 95%.

Statistical Analysis. The research question posed in this investigation asked if children with ASD who learned safety skills through traditional teaching methods transferred them to real world situations more efficiently and effectively than children who learned safety skills through VR. Descriptive statistics and an independent t-test were used to answer this question.

Table 4

TAU Activities and Training Weeks for Tornado Safety

Activities per Week	Skill and Concept Knowledge	Activity Criteria
Week 1: 1. Social story 2. Tornado safety Book/questions 3. Identification of “safe/not safe places” 4. Role play – Maximum cueing (tornado siren, visual jig with windows marked out and pictures cues taped to walls, tornado siren)	Week 1: 1. Script building to teach specific skills 2. Comprehension 3. Identify/distinguish between “safe/unsafe” places during a tornado 4. Practice and develop Routine for tornado drill	Week 1: 1. Attend to social story 2. Focus on story and answer Questions 3. Correctly place pictures under either “safe” or “not safe” categories 4. Locate unsafe places (windows) using visual jig, find safe room, and crawl under table

Activities per Week	Skill and Concept Knowledge	Activity Criteria
Week 2:	Week 2:	Week 2:
1. Social story	1. Script building to teach specific skills	1. Attend to social story
2. Tornado safety book/questions	2. Comprehension	2. Focus on story and answer Questions
3. Identification of "safe/not safe places"	3. Identify/distinguish between "safe/unsafe" places during a tornado	3. Correctly place pictures under either "safe" or "not safe" categories
4. Role play – Decreased cueing (visual jig and Velcro on wall, tornado siren)	4. Practice and develop routine for tornado drill	4. Locate unsafe places (windows) using visual jig, find safe room, and crawl under table
Week 3:	Week 3:	Week 3:
1. Social story	1. Script building to teach specific skills	1. Attend to social story
2. "Safe/not safe game"	2. Find and locate safe place to go during a tornado	2. Correctly identify "safe/not safe" places to go during a tornado
3. Role play – Minimal cueing (visual jig, and tornado siren)	3. Practice and develop routine for tornado drill	3. Locate unsafe places (windows), using visual jig, find safe room, and crawl under table

Activities per Week	Skill and Concept Knowledge	Activity Criteria
Week 4: 1. Social story 2. Self video modeling 3. Role play (no visual jig, tornado siren)	Week 4: 1. Script building to teach specific skills 2. Script, comprehension, schema building 3. Practice and develop Routine for tornado drill	Week 4: 1. Attend to social story 2. Script, comprehension, schema building 3. Locate unsafe places (windows), without using a visual jig, find safe room, and crawl under table
Week 5: 1. Social story 2. Role Play from different locations in the school building (no visual jig, tornado siren)	Week 5: 1. Script building to teach specific skills 2. Practice and develop routine for tornado drill	Week 5: 1. Attend to social story 2. Locate unsafe places (windows), without using a visual jig, find safe room, and crawl under table

Table 5

VR Activities and Training Weeks for Tornado Safety

Activity	Level of Cueing	Activity Criteria
Week 1:	Week 1:	Week 1:
1. VR Simulation	1. Alarm sound provided	1. Attend to VR
	2. Navigation provided	2. Answer questions
	3. Zooming to relevant cueing (e.g., windows)	
	4. Rain is visible in Simulation	
Week 2:	Week 2:	Week 2:
1. VR Simulation	1. Alarm sound provided	1. Attend to VR simulation
	2. Navigation provided	2. Answer questions
	3. Zooming to relevant cueing (e.g., windows)	3. Click on desk
	4. Rain is visible in Simulation	
Week 3:	Week 3:	Week 3:
1. VR Simulation	1. Alarm sound provided	1. Attend to VR
	2. Navigation provided	2. Answer questions
		4. Click on desk

Week	Concept and Skill Knowledge	Activity Criteria
Week 4: 1. VR Simulation	Week 4: 1. Alarm sound provided	Week 4: 1. Attend to VR 2. Answer questions 3. Navigate away from Windows 4. Click on desk
Week 5: 1. VR Simulation 2. Role play in real world	Week 5: 1. Alarm sound provided	Week 5: 1. Attend to VR 2. Physically located safe room in real world

CHAPTER IV

RESULTS

This chapter presents the research findings relating to the question asked in this study, do children with Autism Spectrum Disorder (ASD) who learn fire and tornado safety skills through traditional teaching methods transfer them to real world situations differently than children who learn safety skills through VR. To answer the research question posed in this study the following behaviors were recorded and analyzed: 1) generalization and transfer of learned skills to real world situations, 2) the lengths of total training times for TAU compared to the total lengths of training time for Virtual Reality (VR) and, 3) the skills and concept knowledge learned in the training phases for the TAU group (Condition 1) and the VR (Condition 2) group. The results of this study will be presented to answer how effective and efficient the training procedures were.

First, the participants' progress of skill levels during the baseline phase, through the generalization, and maintenance phases for each participant in both teaching conditions for fire safety (Phase I) will be presented. The total training times for both conditions (Condition 1, “Traditional/”Teaching As Usual and Condition 2, VR) will then be compared using an independent t-test. The progress of each participant during the five week training period in the TAU training group (Condition 1) for fire safety is presented, followed by the progress of each participant in the VR training group (Condition 2) during the fire safety phase. The chapter will conclude with the results of the tornado safety training (Phase II) for both conditions, using the same sequence of phases as mentioned for fire safety (Phase I).

Baseline for Fire Safety, Both Conditions (Phase I)

During the baseline procedure for fire safety, participants from both conditions (TAU and VR) reacted to the school-wide fire drill in relatively the same manner. All eight participants had to be led out of the building by an adult. Participants from both conditions did not react in an appropriately safe manner in response to the fire drill. Participants' responses varied from covering their ears while rocking, standing still and looking around, or continuing to look at a book. None of the participants mentioned a fire drill, associated the fire alarm with leaving the building, or attempted to leave the building. Before the training phase began none of the participants noted the necessary visual and auditory cues necessary for leaving a building that might be on fire.

Generalization for Fire Safety, (Condition 1)

The results for the participants who received training via TAU varied in the level of prompting needed to leave the building in response to a fire drill. All participants in the "Traditional/Teaching As Usual condition required some level of prompting. None of the participants in this condition were able to exit the building in response to the fire drill spontaneously with no prompting, during this phase.

During the generalization phase for fire safety (Phase I) participant 1 covered his ears in response to the fire alarm and became distracted by the flashing lights of the fire alarm. He required all 4 levels of prompting to leave the building safely. When the adult prompted this child with a visual cue of a fire exit sign, he responded, "That's fire" and pointed to the exit sign. When prompted with the verbal cue of "show me", he had no response. No response was given by participant 1 when prompted with a physical touch. He was led out of the school building by the adult.

Participant 2 responded by saying, "Fire drill" and pointing to the exit sign when he heard the fire alarm. When prompted with a visual cue of an exit sign, this child pointed to the exit sign and went to a door leading outside. The adult used a verbal prompt of "show me" in an attempt to get him to complete the task and go outside. After the prompt of “show me” participant 2 found an exit sign and then went back to the door and proceeded to go outside on his own.

Participant 3 instantly covered his ears in response to the fire alarm. When given the first level of prompting (visual/exit sign) he pointed to the exit sign and then covered his ears again. After a verbal prompt (show me) this child started to walk toward an exit sign but then turned around and covered his ears again and rocked. Participant 3 was able to leave the building in response to a physical prompt.

Participant 4 heard the fire alarm and grabbed the adult’s hand. The adult prompted the child with a visual (exit sign) and she responded by saying, “Fire”. A verbal prompt (show me) cued participant 4 to go to the door leading outside and point to the exit sign. The adult prompted again with the verbal “show me” and she went outside.

Generalization for Fire Safety, Condition 2

The participants who received training via VR (Condition 2) also required varying levels of prompting to leave the school building in response to the fire alarm. All participants required some level of prompting to leave the building, resulting in no spontaneous responses to the fire alarm. No data were collected for participant 5 as a result of an absence during the scheduled school wide fire drill. Teacher report did indicate that this child responded to fire alarms in the past with flapping her hands while jumping and needed to be led out of the building by an adult at all times.

Participant 6 heard the fire alarm, covered his ears, and asked, “What is that?” The adult used the first level of prompting (visual) and pointed to the exit sign. The child had no response to this level of prompting so a verbal prompt of “show me” was used. He then stated “This way.” and went to the door, going outside.

Participant 7 responded by stating “Fire, have to get out” after hearing the fire alarm. He did not move in any direction so a verbal prompt of “show me” was used. The child still did not respond and a second verbal prompt was used, which allowed him to find the door and go outside.

Participant 8 stopped what he was doing when he heard the fire alarm but did not proceed to leave the building. The visual prompt was used and the child looked at the exit sign. When the verbal prompt was used he walked towards another participant in the study and stopped. Participant 8 was able to leave the building with a second verbal prompt.

Maintenance Phase for Fire Safety, Condition 1

During the maintenance phase participant 1 and participant 2 were able to leave the school building spontaneously and independently. Both participants were observed having a discussion about a fire drill. The participants were repeating the script that they had learned during the training phase to each other and pointing to the exit signs. Participant 3 left the building after a tactile cue was given. Participant 4 heard the fire alarm, pointed to the exit sign, went to the door and gently pushed on the door. She did not go out the door and appeared to be unsure of whether or not she should go outside. The adult gave a visual prompt (exit sign) and the participant pushed on the door again. A tactile cue was given and the participant did not respond. She was led out of the building by the adult.

Maintenance Phase for Fire Safety, Condition 2

Participant 5 heard the fire alarm and walked to a door leading outside. She stopped at the door, waited, and then returned to stand next to the adult. The adult gave a visual prompt (exit sign) and the child again walked to the door and stopped. A verbal prompt of “show me” was given with no response from the child. A tactile cue was then given with no response. Participant 5 was then led out of the building by the adult.

Participant 6 heard the fire alarm and asked, “What’s that”. A visual prompt (exit sign) was given and the child stated, “Fire drill.” and looked towards the door leading outside. A verbal prompt “show me” was used and he walked towards the door and followed the rest of the students outside.

Participant 7 heard the fire alarm and stated, “Fire alarm”. A visual prompt (exit sign) was given and the child again stated “Fire alarm”. A verbal prompt “show me” was given and he responded, “Outside” and slowly began to walk towards the door. When he saw the other students exiting the building he stated, “Hurry” and started to run towards the door and then outside.

Participant 8 heard the fire alarm and looked around. A visual prompt (exit sign) was given and the child looked in the same direction. A verbal prompt (show me) was given but he had no response. A physical prompt (touch from behind) was given and the child again had no response. The participant saw a familiar student who was also in the study exiting the building, and followed him out of the building.

Participant spontaneous correct responses for baseline, generalization, and maintenances phases in TAU (Condition 1) are illustrated in Figure 1. Participant spontaneous correct responses for the same phases in VR (Condition 2) are reported in Figure 2.

Total Training Times

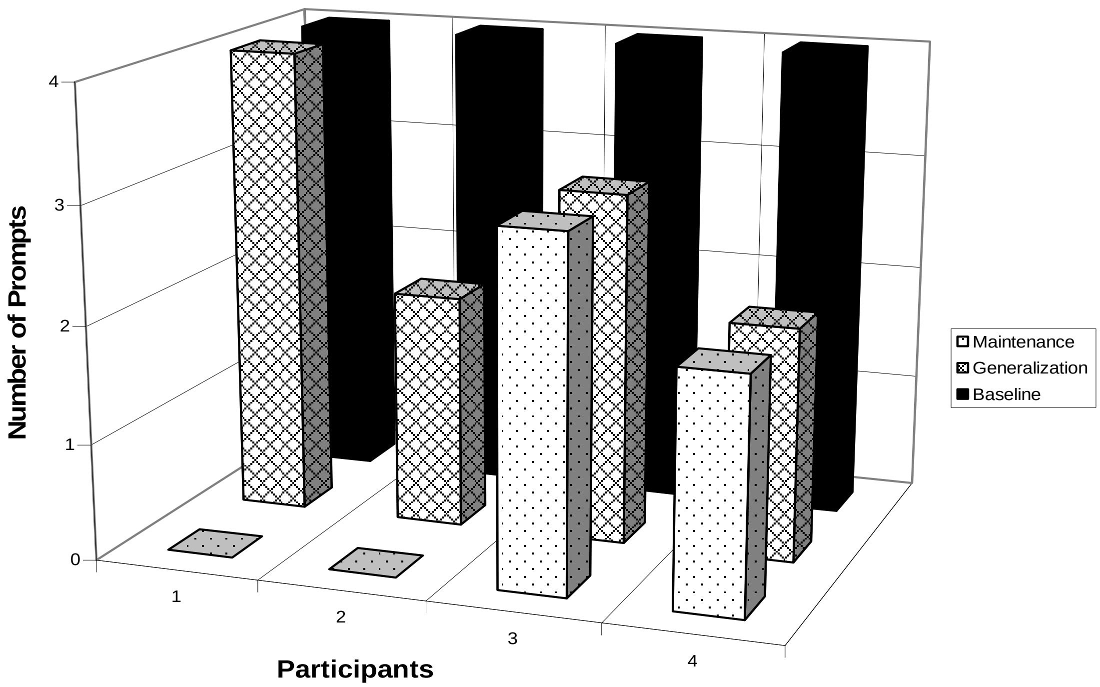
Fire Safety, Both Conditions. An independent t-test was used to compare the mean length of training times between conditions (Condition 1, TAU and Condition 2, “VR). The mean length of training time for TAU (Condition 1) was 10 minutes 14 seconds compared to the mean length of 6 minutes 44 seconds in the VR (Condition 2). The results were significant at the .05 alpha level, $F(1,6) = .350$, $p<.05$.

Skill and Concept Knowledge

In addition to baseline, generalization, and maintenance measures and total training time, the participants' spontaneous responses during training were measured to demonstrate learning that occurred in the training session.

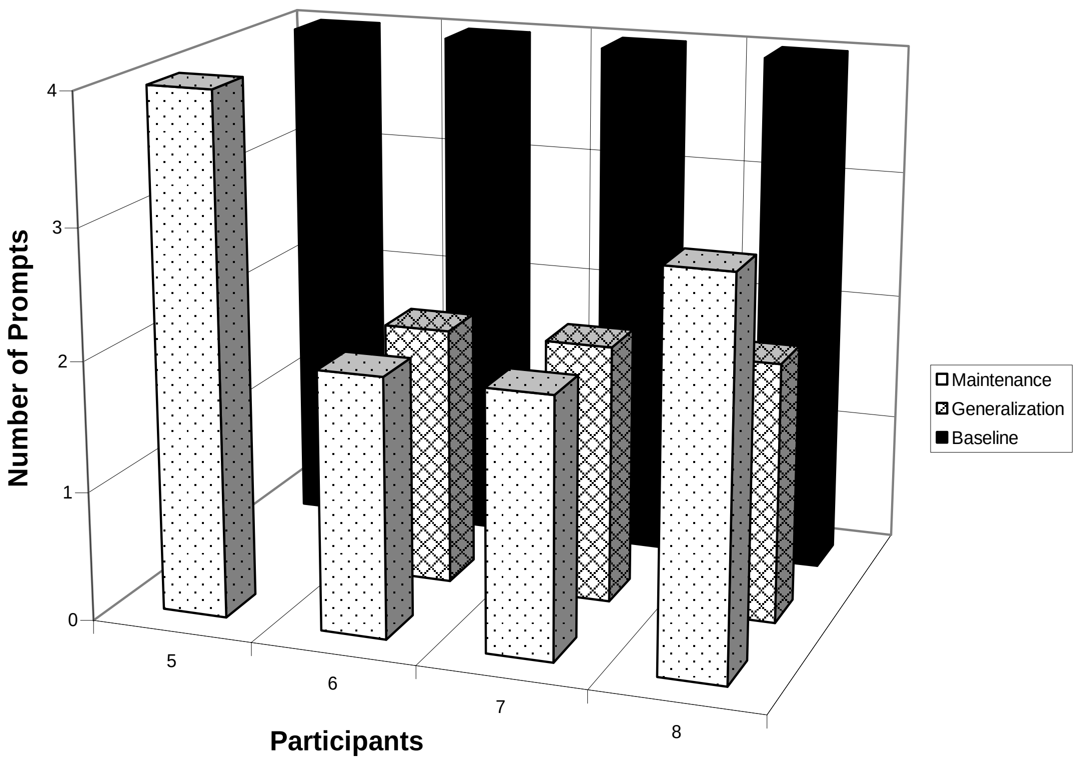
Training Results for Fire Safety, Condition 1. Participants 1-4 received training through the TAU (Condition 1) and completed various tasks to learn skills relating to fire safety. Data were not collected for all activities (e.g., social stories, comic strips) because the criteria for these tasks were measured by the ability to attend and listen. These activities were designed to establish a script and learn about the procedure necessary for fire safety skills. Tasks and activities changed from week to week as indicated in Chapter 3. Data were only calculated for the second training day in a training week and only spontaneous responses were recorded. The percentage of spontaneous participant responses during the training phase for the TAU (Condition 1) are reported in Table 6.

Figure 1: Fire Safety Results for Transfer Phases in "Traditional/Teaching As Usual", Condition 1.



Level of Prompts
4 = Adult led participant out of the building.
3 = Tactile, participant left building with a gentle push from behind.
2 = Verbal, participant left building with "show me".
1 = Visual prompt , participant left the building when exit sign was pointed to.
0 = Spontaneous, no prompts needed to exit building.

Figure 2: Fire Safety Results for Transfer Phases in VR, Condition 2.



Level of Prompts
4 = Adult led participant out of the building.
3 = Tactile, participant left building with a gentle push from behind.
2 = Verbal, participant left building with "show me".
1 = Visual prompt , participant left the building when exit sign was pointed to.
0 = Spontaneous, no prompts needed to exit building.

Training Results for Fire Safety, Condition 2. Participants 5-8 received training through VR (Condition 2). Level of prompting and cueing required to complete the VR program decreased with each training week as reported in Chapter 3. The percentage of spontaneous participant responses for VR (Condition 2) are reported in Table 7.

Baseline for Tornado Safety, Both Conditions (Phase II)

For Phase II of the experiment, tornado safety, participants 1-4 who were in the TAU group (Condition 1) for Phase I were switched to the VR group (Condition 2) for the second phase of the experiment. Participants numbered 5-8 received training via VR teaching methods described earlier and were switched to the TAU for Phase II. Participants from both conditions (TAU and VR) reacted to the school wide tornado drill in the same manner. All participants had to be led by an adult to the designated "safe" room for the tornado drills. During the school wide tornado drill participants appeared to be unaware of the tornado alarm sound, watched the other students as they walked to the "safe" room, or reacted by covering ears and rocking. Participants responses varied based on how close they were to the tornado alarm and their location in the building.

Table 6

Percentage of Spontaneous Participant Responses for Fire Safety in TAU, Condition 1

Participant 1

Training Weeks	Activities			
	Book Questions	Sequencing	Role Play	Video Modeling
Week 1	20%	NA	83%	NA
Week 2	100	100	100	NA
Week 3	40	100	100	NA
Week4	NA	100	100	100
Week 5	NA	NA	100	100
Average	53.3%	100%	96.6%	100%

Participant 2

Training Weeks	Activities			
	Book Questions	Sequencing	Role Play	Video Modeling
Week 1	20%	NA	100%	NA
Week 2	50	100	100	NA
Week 3	40	80	100	NA
Week4	NA	100	100	100
Week 5	NA	NA	50	100
Average	36.7%	93.3%	90%	100%

Participant 3

Training Weeks	Activities			
	Book Questions	Sequencing	Role Play	Video Modeling
Week 1	0%	NA	0%	NA
Week 2	75	100	50	NA
Week 3	40	60	100	NA
Week4	NA	60	100	80
Week 5	NA	NA	0	100
Average	38.3%	73.3%	50%	90%

Participant 4

Training Weeks	Activities			
	Book Questions	Sequencing	Role Play	Video Modeling
Week 1	40%	NA	67%	NA
Week 2	25	100	100	NA
Week 3	60	0	100	NA
Week4	NA	0	100	60
Week 5	NA	NA	50	100
Average	41.6%	33.3%	83.4%	80%

Table 7

Percentage of Correct Spontaneous Participant Responses for Fire Safety in VR, Condition 2

Training Levels	Participants			
	Participant 5	Participant 6	Participant 7	Participant 8
Level One	28%	22%	72%	16%
Level Two	80	80	100	80
Level Three	100	100	100	100
Level Four	100	90	100	70
Level Five	100	83	100	0
Average	81.6%	75%	94.4%	53.2%

Generalization for Tornado Safety, Condition 1

The results for the participants who received training via TAU varied in the level of prompting needed. Participant responses varied from spontaneous reactions to reacting with minimal prompting. During this phase of the experiment all participants in the "Traditional/Teaching As Usual (Condition 1) were able to complete the tornado drill without being led by an adult.

During the generalization phase for tornado safety participant 5 heard the tornado alarm and spontaneously followed the other students into the safe room. She was able to react appropriately to the tornado drill without a verbal prompt of "show me" from the adult. Once the child was in the "safe room" she was able to stand quietly for the duration of the drill.

After hearing the tornado alarm participant 6 responded with, “Find a room with no windows”. The adult then gave the verbal prompt of “show me” and the child again replied, “Find a room with no windows” and began to make his way to the safe room. Once he saw the large number of students also trying to enter the “safe” room and stated, “Too big, the room’s gonna break!” When participant 6 had entered the safe room he began to repeat the learned script and said, “If real tornado, under table, cover head”. He then proceeded to go under the table and cover his head. During the tornado drill, participant 6 became anxious and unable to sit quietly until the drill was over.

Participant 7 responded to the tornado drill by stating, “Fire control”. The adult gave the verbal prompt “show me” and the child followed the other students into the “safe” room. Once this child was in the “safe” room he was overwhelmed by the number of students and held the adult’s hand

Participant 8 responded to the tornado alarm without prompting from the adult and spontaneously followed the other students into the “safe” room. Once in the “safe” room he went into a play toy house.

Generalization Phase for Tornado, Condition 2

Participants who received instruction via VR (Condition 2) also required varying levels of prompting to respond appropriately to the school wide tornado drill. Participant 1 heard the tornado alarm and stated, “Find, hide place” while standing in one spot. The adult gave the verbal prompt “show me” and he followed the other students into the “safe” room. Once in the safe room, this child was able to go under a table with another verbal prompt of “show me”. During the course of the tornado drill participant 1 stated to participant 6, “No real tornado, practice” in what appeared to be an attempt to calm him.

Participant 2 heard the tornado alarm and stated “Tornado, tornado, my school” and proceeded to walk into a “safe” room. He required no prompting from the adult to respond appropriately to the tornado alarm. Once in the “safe” room he did not sit down and wanted to play with the toys in the room.

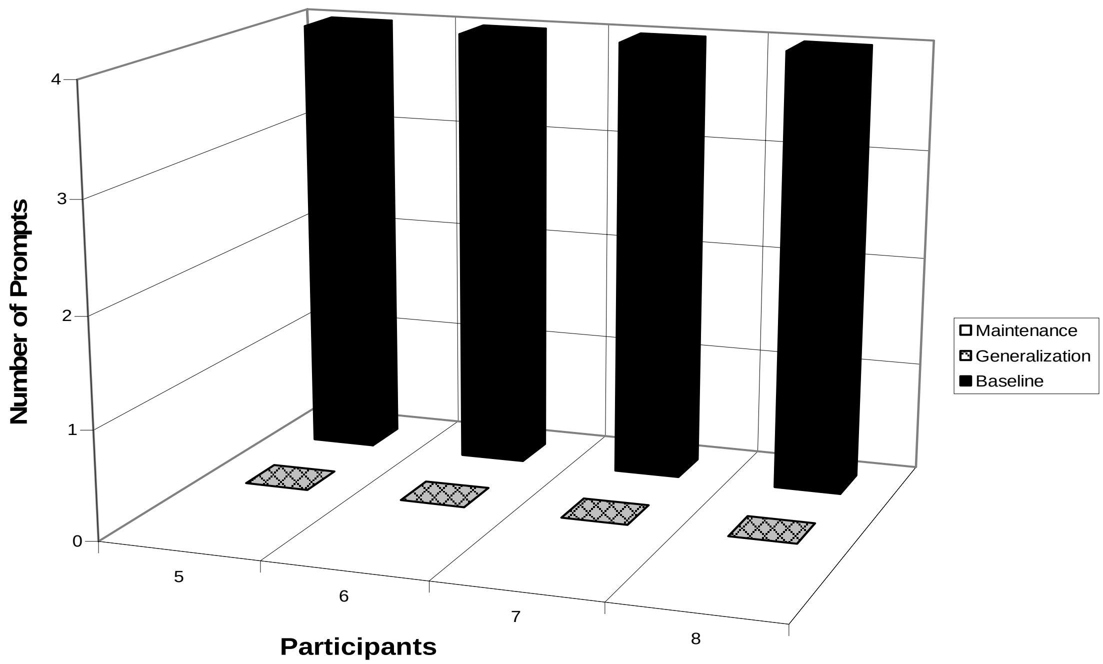
Participant 3 immediately covered his ears when the tornado alarm went off. A verbal prompt of “show me” was given and he stood by the “safe” room. It appeared that he would not go into the room because there was a long line of other students trying to enter into the room. Participant 3 eventually went into the room and sat with the other students already in the room.

Participant 4 required a verbal prompt of “show me” to proceed to the “safe” room in response to the tornado alarm. When the child heard the verbal prompt she followed the other students into the “safe” room. It appeared that she was scared and overwhelmed by the number of students in the “safe” room as indicated by her grabbing the adult’s hand.

Maintenance Phase for Tornado Safety, Both Conditions

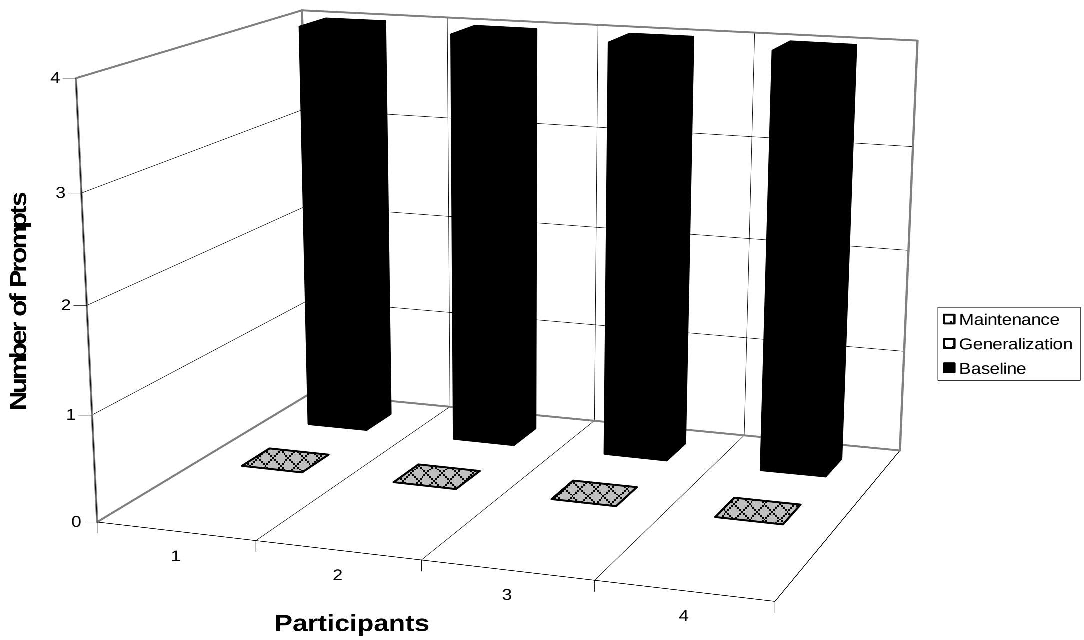
A maintenance phase for tornado safety (Phase II) was not completed as a result of the school year ending before a school wide tornado drill could be scheduled. Participant spontaneous correct responses for the TAU (Condition 1) are shown in Figure 3, followed by the results for the same phases in the VR, (Condition 2) in Figure 4.

Figure 3: Tornado Safety Results for Transfer Phases in "Traditional/Teaching As Usual", Condition 1.



Level of Prompts
2 = Adult led participant to "safe" room.
1 = Tactile, participant went to "safe" room with a gentle push from behind.
0 = Spontaneous, Verbal Prompt "Show me what to do at your school".

Figure 4: Tornado Safety Results for Transfer Phases in VR, Condition 2.



Level of Prompts
2 = Adult led participant to "safe" room.
1 = Tactile, participant went to "safe" room with a gentle push from behind.
0 = Spontaneous, Verbal Prompt "Show me what to do at your school".

Total Training Times

Tornado Safety, Both Conditions. An independent t-test was used to compare the mean length of training times between both conditions (Condition 1, TAU and Condition 2, VR). The mean length of training time for TAU (Condition 1) was 10 minutes 40 seconds compared to the mean length of 6 minutes 42 seconds in the VR (Condition 2). The results were significant at the .05 alpha level, $F(1,6) = .000$, $p<.05$.

Skill and Concept Knowledge

As mentioned for fire safety, individual spontaneous responses during tornado safety training are reported to demonstrate learning that occurred in the training session.

Training Results for Tornado Safety, Condition 1. Participants 5-8 received training through TAU (Condition 1) and completed various tasks to learn skills and concept knowledge relating to tornado safety. Tasks and activities changed from week to week. Data were calculated only for the second day in a training week and only spontaneous responses were recorded. Participant responses for TAU (Condition 1) are reported in Table 8.

Training Results for Tornado Safety, Condition 2. Participants 1-4 received training through VR (Condition 2). Level of prompting and cueing required to complete the VR program decreased with each training week. Participant spontaneous responses for VR (Condition 2) are reported in Table 9.

Table 8

Percentage of Spontaneous Participant Responses for Tornado Safety in TAU, Condition 1

Participant 5

Training Weeks	Activities			
	Book Questions	Identification	Role Play	Game
Week 1	40%	NA	100%	NA
Week 2	50	88	100	NA
Week 3	NA	NA	0	100
Week4	NA	NA	100	NA
Week 5	NA	NA	0	NA
Average	45%	88%	60%	100%

Participant 6

Training Weeks	Activities			
	Book Questions	Identification	Role Play	Game
Week 1	83%	NA	100%	NA
Week 2	100	100	100	NA
Week 3	NA	100	100	NA
Week4	NA	NA	100	100
Week 5	NA	NA	50	NA
Average	91.5%	100%	90%	100%

Participant 7

Training Weeks	Activities			
	Book Questions	Identification	Role Play	Game
Week 1	40%	NA	100%	NA
Week 2	75	88	100	NA
Week 3	NA	100	0	NA
Week4	NA	NA	100	100
Week 5	NA	NA	100	NA
Average	57.5%	94%	80%	100%

Participant 8

Training Weeks	Activities			
	Book Questions	Identification	Role Play	Game
Week 1	67%	NA	33%	NA
Week 2	100	88	50	NA
Week 3	NA	50	0	NA
Week4	NA	NA	100	60
Week 5	NA	NA	50	NA
Average	83.5%	69%	46.6%	60%

Table 9

Percentage of Spontaneous Correct Participant Responses for Tornado Safety in VR, Condition 2

Training Levels	Participants			
	Participant 1	Participant 2	Participant 3	Participant 4
Level One	75%	100%	0%	50%
Level Two	100	100	83	67
Level Three	83	100	100	67
Level Four	100	100	0	100
Level Five	100	100	100	100
Average	91.6%	100%	56.6%	76.8%

CHAPTER V

DISCUSSION

The purpose of this investigation was to explore whether children with Autism Spectrum Disorder (ASD) who learned safety skills through traditional teaching methods transferred them to real world situations more effectively and efficiently than children who learned safety skills through VR. The research question was answered by analyzing 1) generalization and transfer of learned skills to real world situations, 2) the lengths of total training times for TAU compared to the total lengths of training time for Virtual Reality (VR) and, 3) the skills and concept knowledge learned in the training phases within the TAU group (Condition 1) and the VR (Condition 2) group. The results of this study will be discussed to answer how effective and efficient the training procedures were. Clinical and research implications will then be provided as well as limitations of the study.

Generalization and Maintenance Phases for Fire Safety, Both Conditions

When examining how the participants transferred learned fire safety skills to the real world situation, the participants' responses varied greatly in both conditions. Participants who received training via VR (Condition 2) were able to respond to the fire alarm in a more independent manner with only a verbal prompt (show me). Participants in the TAU (Condition 1) made improvements when compared to baseline and varied in their level of prompting. This could be due to the variability seen in children with ASD and the difficulty they exhibit in generalizing new skills to different environments with new stimuli. All participants in the TAU (Condition 1) required some level of prompting to leave the school building in response to the fire alarm. This could be due in part to different stimuli that were part of the school wide fire drill. During the practice fire drills, participants learned fire safety skills in response to a prerecorded fire alarm that differed from the actual fire alarm used during the real world situation. Participants also seemed overwhelmed with the number of students and teachers exiting the building, as in the practice fire drills there were almost no other students present. Another factor that could be related to the varying responses to the fire drill could be the presence of the video cameras, which created an unnatural environment. Although participants were not able to respond to the fire alarm independently they were observed to have been repeating the learned script for exiting a building during a fire drill. They were also observed to be more aware of the exit signs, fire alarm, and the need to leave the building. This implies that the training received via TAU might have helped the participants become more familiar with fire safety skills.

During the maintenance phase participants in the TAU (Condition 1) demonstrated a more independent ability to leave the building in response to the fire alarm when compared to the VR (Condition 2). This again demonstrates the variability seen with ASD and the difficulty obtaining consistent results of learned skills.

Total Training Times

Fire Safety and Tornado Safety, Both Conditions. To answer the research question concerning the efficiency of training, the total length of training time were compared for both conditions. It was found that the training time via VR was statistically significantly less for both fire safety (Phase I) and tornado safety (Phase II). This might be explained by the number of activities participants were required to complete during a training session using TAU compared to the VR training. Another explanation could be that part of the training session in the TAU

(Condition 1) was taught in various locations throughout the school building during every training session increasing the time for training.

Training for Fire and Tornado Safety, Both Conditions

The performance of participants in both conditions during the training phase for fire and tornado safety was also highly variable depending on the task. Participant 3 received training via TAU for fire safety and received low scores during week one. Teacher report indicated that participant 3 had not received his medication during week one, which could account for his inability to focus and participate in the activities. Training via TAU incorporated different media as mentioned in previous chapters which might have helped participants develop a greater concept base for fire and tornado safety skills. Participants who received training via TAU (Condition 1) were also exposed to different situations involving fire and tornado safety skills than through the VR (Condition 2).

Generalization Phase for Tornado Safety, Both Conditions

Participants in both conditions performed the same during the generalization phase for tornado safety. All participants from both conditions were able to react independently during the tornado drill. A verbal prompt of, “This is a tornado drill, show me what to do at your school” was used and still recorded as an independent response. Typically developing children at the same school received the same signal (this is a tornado drill) from the principal before a drill to help the children distinguish the tornado drill from a fire drill.

Relation of Current Findings to Previous Research

Bandura’s social learning theory (1977) suggests learning occurs through observation and the modeling of behaviors, attitudes, and emotional reactions of others. The social learning theory also implies that learning can occur without a change in behavior and cognition plays a role in the degree of learning that takes place. According to Bandura's theory, an individual must have attention, the ability to retain information, and motivation before learning can take place.

The current data from this research study supports Bandura's theory. Participants in this study demonstrated the necessary components for learning. Instruction was presented through TAU methods and participants had the opportunity to observe and model safety skills, which may have influenced the ability to learn new skills. Bandura's theory also states that learning can occur without a change in behavior which paired with the characteristics of ASD could account for learning taking place in the training phases but not consistently transferring to real world situations.

Frith's (1989) central coherence theory states that individuals with ASD tend to process information in terms of parts instead of wholes, creating a tendency to interpret information in terms of local details instead of global details. The data from the current research study supports the central coherence theory. Participants were able to focus on minor details related to real world fire/tornado drills but often times could not organize the environmental cues to independently complete the drill.

Executive function is an umbrella term that includes planning, working memory, impulse control, inhibitions, as well as the initiation and monitoring of actions. The theory of executive dysfunction attempts to explain the characteristics associated with ASD in terms of damage to the frontal lobe creating cognitive deficits (Hill, 2004). The current data from this research study supports the theory of executive dysfunction. Participants from both conditions appeared to have deficits in planning, working memory, impulse control, and the initiation and monitoring of their actions. Participants in this study appeared to have difficulty planning how to react to the fire and tornado drills and seemed to have trouble initiating the proper response. Participants could often tell observers what they should do but could not initiate the proper sequence of steps to complete the tasks.

Limitations of the Study

The sample size in this study was relatively small due to the difficulty of recruiting children with ASD who met the necessary criteria and who also attended school in the public school system. Attempts were made to select participants with relatively similar ages, cognitive levels, and skills; however, selected participants demonstrated a range of different abilities. Children with ASD are highly individual and variable when demonstrating new skills to different environments, which was evident in this study. These factors could have influenced the research findings. There was also a time limitation that could have affected transfer of learned skills to real world drills. All participants started the study with what appeared to be little knowledge, skill, and ability in regards to safety skills after five weeks of training all participants made gains. Participants' ability to transfer learned skills to real world drills might have increased if more weeks were added to the training phases. Another possible limitation of this study was accounting for participant absence. Participants who were absent during a training day were required to make up the training session during the next training session along with the current session. This could have affected participants learning levels.

Clinical Implications

The results of this study suggest that materials associated with TAU (Condition 1) can be an affective means to teach children with ASD safety skills. Results from this study suggest that participants who received instruction via TAU performed as well as or better than participants who received training via VR (Condition 2). The data from this study also indicated that participants in the TAU condition seemed to demonstrate a greater concept and skill base knowledge when compared to participants in the VR condition. Participants in the TAU condition were able to repeat the learned scripts for both tornado and fire safety. These participants were observed reciting the correct steps and procedures for evacuating a building on fire, pointing to exit signs, and fire alarms. During the tornado drill participants in the TAU condition were also observed to be repeating, “No windows”. These results imply that TAU is an effect teaching method for children diagnosed with ASD.

The results from this study contribute and add to the limited research supporting the use of TAU methods. Picture cues have been shown to help create independent behaviors and reduce frustration in children with ASD (Dettmer, Simpson, Smith, & Myles, 200; Quill, 1997). Comic strip conversations and social stories have been used to teach new skills and to reduce inappropriate behaviors (Barry & Burlew, 2004; Norris & Dattilo, 1999). Role play when combined with other TAU strategies has been used to teach social skills (Hess, 2006) Until VR programs become more available children with ASD can benefit from instruction through TAU methods to enhance safety skills.

Research Implications and Future Directions

This study provides additional support for using a TAU method to teach children with ASD safety skills. The complex characteristics and behaviors associated with the learning styles of children with ASD suggest that visually structured learning environments hold a potential for enhanced learning. Further research should focus on teaching different safety skills (e.g., bike, pedestrian, stranger, etc.) to children with ASD. Replication of this study should include additional training weeks at the fifth level of training to allow for practice of new skills in real situations.

Conclusion

Participants from both conditions in this study made gains in their ability to transfer learned safety skills to real situations, however, participants in the TAU condition appeared to have learned more concept and skill knowledge relating to safety skills when compared to participants in the VR condition. Participants in the TAU condition seemed to have been able to attend to relevant features during both the tornado and fire drills and understand the potential danger associated with each more effectively than participants in the VR condition. Parental report also indicated that participants in the TAU condition were beginning to generalize learned fire safety skills to other environments. These participants were observed locating exit signs in public places and reciting the procedures to evacuate a building.

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APPENDIX

APPENDIX A

PARENT/GUARDIAN CONSENT FORM

PARENT CONSENT FORM

PURPOSE: Your child is invited to participate in a study that will determine if safety skills (specifically, fire and street crossing) can be taught to children more effectively and efficiently using Virtual Reality (VR) modules versus Traditionally Visually Structured Teaching (TVST) modules to children with Autism Spectrum Disorders.

EXPLANATION OF PROCEDURES: Two classrooms from one school in the district will be used for this project. A total of twelve children from both classrooms will receive training on safety modules using Virtual Reality (VR) models presented via a laptop computer in the classroom. This training will be presented by the co-investigators who will be trained. Additionally, these same twelve children will receive safety training using Traditional Visually Structured Teaching (TVST) strategies used to instruct students with ASD (e.g., social stories, picture cards, role play/rehearsal, visually structured directions, mini work systems, etc.).

PARTICIPANT SELECTION: Your child was selected as a possible participant in this study because she/he attends the school site that was selected to participate in this study within the Wichita Public School System. Additionally, she/he is enrolled in a classroom designed specifically for children diagnosed with Autism Spectrum Disorders.

BENEFITS: Current research has found parents of children with ASD report concerns with teaching safety skills for crossing the street and evacuating a building on fire. Children involved in this research will receive instruction in crossing the street safely and evacuating his/her normal school building during a fire drill. This research is also aimed at discovering effective and efficient teaching/learning strategies for the ASD population that can be used by parents and teachers. Furthermore, should this investigation indicate that VR is an effective learning/teaching tool for safety skills; then, additional investigation may provide evidence for the effectiveness of this tool for additional educational purposes for individuals diagnosed with ASD.

DISCOMFORTS/RISKS: For the cross walk baseline, transfer, maintenance phases (which will involve actually crossing a “street”, each participant will be accompanied (e.g., hand-in-hand) by the investigator and at least 2 other adults. Assessment will take place a to cross walk that has little traffic, Should this cross-walk be located at a distance to far from the school itself, the use of a school bus will be arranged by the investigator. A crosswalk internal to a major corporation (e.g., Boeing) may be accessed to incorporate further safety measures. All other “training sessions” will involve the use of the computer to practice “crossing the street” in a safe manner and or training within the classroom or school environment.

APPENDIX A (continued)

For the fire safety assessment, the participants will be subject to an alarm and the *simulated* smell of smoke (for 2 weeks) via the VR simulation. There will be no real fires. The participants will be continuously monitored and supported during the baseline, training, generalization, and transfer phases. All training for the fire safety modules will be done in the classroom or school environment.

**Please note: It is not the intention of the investigators to put any child a risk for the sake of conducting research.*

BENEFITS: Should this investigation indicate that VR is an effective learning/teaching tool for safety skills; then, additional investigation may provide evidence for the effectiveness of this tool for additional educational purposes for individuals diagnosed with ASD. Tools that can help children with ASD learn more quickly and transfer information learned into their everyday life are desperately needed!

CONFIDENTIALITY: Any information during this study in which your child can be identified will remain confidential and will be disclosed only with your permission. All files, data sheets, video tapes, etc. will remain with the primary investigator and will be kept locked in the investigator's office files within the Communication Sciences and Disorders Department located in Ahlberg Hall on the campus of Wichita State University.

REFUSAL/WITHDRAWL: Participation in this study is entirely voluntary. Your decision whether or not to allow your child to participate will not affect his/her future relations with Wichita State University or the Wichita Public School System. If you agree to allow your child to participate in this study, you are free to withdraw him/her from the study at any time without penalty.

CONTACT: If you have any questions about this research, you can contact me at: Trisha Self, Assistant Professor, at Wichita State University, Department of Communication Sciences and Disorders, 978-3240. If you have questions pertaining to your rights as a research subject or about research-related injury, you can contact the Office of Research Administration a Wichita State University, Wichita, KS 67260-0007, telephone (316)978-3285.

You will be given a copy of this consent form to keep.

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Signature of Legal Guardian Date

____

Witness Signature Date