

EFFECTIVENESS OF MODELING AND REHEARSAL TO TEACH FIRE SAFETY  
SKILLS TO CHILDREN WITH AUTISM

by

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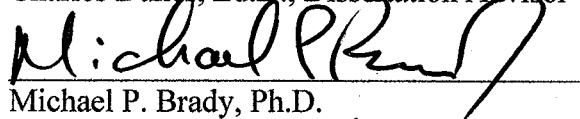
David Garcia

This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Charles Dukes, Department of Exceptional Student Education, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the College of Education and was accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

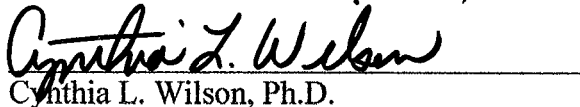
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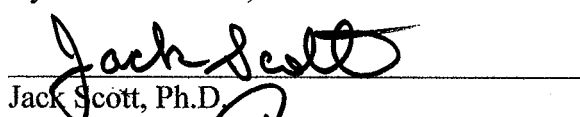
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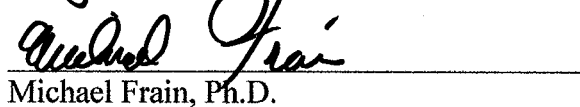
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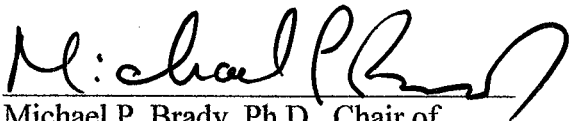
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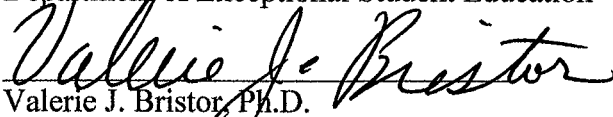
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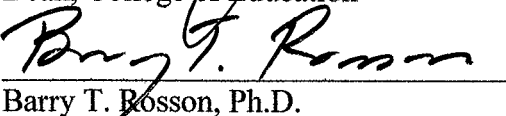
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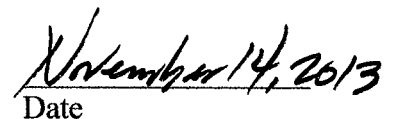
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## ABSTRACT

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Autism is a disorder that affects children at an alarming rate. One out of every 88 children is diagnosed with autism in the United States. The disorder is characterized by communication, social, and behavioral deficits. Children with autism often require specialized teaching methods to learn basic skills that most children acquire without specialized instruction. Relatively few studies have examined strategies for teaching safety skills to individuals with autism. The current study utilized a multiple baseline across participants' design to evaluate whether a modeling and rehearsal strategy is effective for teaching fire safety skills to children with autism between 4 and 5 years of age. Results indicated that modeling and rehearsal were effective in teaching fire safety skills, the skills generalized to novel settings, and maintained 5-weeks following the completion of training. Implications for safety skill instruction and future research are discussed.

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LIST OF TABLES .....	vii
LIST OF FIGURES .....	viii
Chapter 1: Introduction .....	1
Safety Risk Concerns .....	4
Lack of Safety Skill Research .....	5
Chapter 2: Literature Review .....	7
Fire Safety Literature and Individuals with Developmental Disabilities .....	7
Research Questions .....	12
Chapter 3: Method .....	13
Participants .....	13
Inclusion and exclusion criteria .....	13
Setting .....	14
Dependent Variable (Safety Responses) .....	15
Experimental Procedures .....	16
Baseline Phase .....	16
Training Phase .....	16
Generalization and Follow-Up Phase .....	18
Experimental Design .....	19

Data Collection .....	20
Across All Phases .....	20
Modeling and Rehearsal .....	20
Generalization and Follow-Up.....	21
Observer Training and Interobserver Agreement .....	22
Chapter 4: Results .....	24
Chapter 5: Discussion .....	27
Implications for Safety Skill Instruction.....	28
Limitations .....	30
Implications for Future Research.....	31
Appendixes	
A Data Recording Sheet.....	34
B Figure 1.....	36
References.....	38

## LIST OF TABLES

Table 1	Participant Characteristics .....	14
Table 2	Four Trial Training Sequence .....	17

LIST OF FIGURES

Figure 1 Percent of Correct Responses per Session Across Baseline and Training  
Phases for All Participants .....36



## **Chapter 1: Introduction**

Autism is a neurological disorder that currently affects 1 out of every 88 children. The prevalence increases between 10–17% annually and it currently affects an estimated 1.5 million people in the United States (Centers for Disease Control, 2013). Leo Kanner first described autism in 1943 (Kanner, 1943). From the 1950s through much of the 1970s, a psychodynamic view prevailed suggesting symptoms of autism were the result of poor mother-child relationships or an emotional disturbance (Fein, Robins, Liss, & Waterhouse, 2001). From the 1980s through today research has revealed more about the biological origins of the disorder and the dominant view is that autism is a disorder of brain development (Fein et al., 2001). Although there is significant speculation about the causes of autism, there is no confirmed cause.

There are clear indications that children with autism generally exhibit certain characteristics. Diagnostic criteria for autism fall into three general categories (Hartley & Sikora, 2010). First, there are deficits in communication. Often, a child with autism will demonstrate difficulties verbally indicating basic needs and preferences, while other children with the disorder may have effective basic communication skills, but struggle with more advanced forms of language, such as conversations. The second category is repetitive or unusual behavioral patterns. The problematic behaviors children with autism may exhibit can vary significantly from simple stereotypy (e.g., hand-flapping) to severe self-injury (e.g., banging head against hard surfaces). The third category is social skill

deficits. Many children with autism show a lack of interest in interacting with others and often seem to be only interested in what they themselves are doing. To varying degrees, a child with autism will demonstrate challenges in these three areas (Centers for Disease Control, 2013).

In addition to the challenges noted above, children with autism typically do not learn well via traditional teaching methods (Green, 2001). As mentioned, children with autism often have learning deficits related to language, particularly their ability to express themselves (i.e., expressive language) such as not being able to indicate when they are thirsty or when they are tired. Similarly, they often have difficulty understanding spoken instructions by others (i.e., receptive language) such as being asked to “do this” or “come here” (Sundberg, 2008). Green (2001) stated, “the kinds of cues that are effective with typically developing children (such as spoken instructions) are not effective when first introduced to a learner with autism.” This is problematic because when teaching new skills, common teaching practices consist largely of spoken instructions. For effective learning to occur children with autism require multiple learning opportunities presented in a structured and systematic fashion. As a result, specialized teaching methods are often required to facilitate instruction. This too potentially limits learning capacity because essential daily living skills that most typically developing children acquire with minimal instruction are often not acquired at all by children with autism without the use of explicit and direct specialized instruction.

Lovaas (1987) published perhaps the most frequently cited behavioral study demonstrating the effectiveness of providing children with autism with specialized instruction that consisted of frequent learning opportunities presented in a systematic

fashion. The teaching methodology generally consisted of carefully arranging the delivery of each instruction, prompting the child to respond, and reinforcing only correct responding to make it more likely that the child would learn the skills and repeat them in the future under similar desired conditions. Results of his study showed that 47% of the children with autism achieved normal intellectual and educational functioning.

Furthermore, they were able to perform successfully in first grade. It is worth noting that McEachin, Smith, and Lovaas (1993) followed-up with the children in the Lovaas (1987) study and found that they maintained their gains and remained successful. Fortunately, a significant body of literature has continued to develop over the past few decades detailing instructional strategies that are effective for teaching children with autism such as prompting, time-delay, fading, errorless learning, incidental teaching, modeling, rehearsal, and differential reinforcement procedures (Fentress & Lerman, 2012; Goldsmith, LeBlanc & Sautter, 2007; Green, 2001; Kleeberger & Mirenda, 2010; McGee & Daly, 2007; Napolitano, Smith, Zarcone, Goodkin, & McAdam 2010; Schrandt, Townsend, & Poulson, 2009; Soluaga, Leaf, Taubman, McEachin, & Leaf, 2008).

Since essential daily living skills must be explicitly taught to children with autism, instruction is often focused on functional skills necessary for daily living such as feeding, self-care, and communication. Skills related to safety are critical, but are not used on a daily basis so they are not likely to be a priority for daily instruction (Dixon, Bergstrom, Smith, & Tarbox, 2010). Although, it is understandable that functional skills related to safety are not necessarily a daily need for every child, for children with autism these skills are a priority, as the prevalence of unintentional injury and other safety hazards that disproportionally affect this population can't be ignored. Having these skills

in their repertoire and being able to exhibit them when needed may someday save their lives. In recent years, safety risk concerns for children with autism have received greater attention from parents and others (Agran & Krupp, 2010).

### **Safety Risk Concerns**

The inability of many children with autism to acquire basic essential skills unless they are explicitly taught with specialized instruction poses significant concerns for caregivers. Since basic skills related to safety are not likely to be acquired by traditional teaching methods, each safety skill must also be explicitly identified and directly taught to most children with autism to acquire the critical skill sets.

The lack of safety skill acquisition is a general concern for parents. Ivey (2004) investigated parents' expectations about safety skill acquisition using focus groups. Twenty-five parents in two mid-western states participated in the investigation. Results of the study indicated that parents had serious doubts about the safety and protection of their children and were extremely concerned about their future safety. Similarly, Agran and Krupp (2010) conducted a survey of 121 parents of children with disabilities on issues related to safety skills. They found that 93% of parents stated that safety skill instruction was very important for their children. Interestingly, 81% of the parents stated that safety skills had never been included in their children's Individualized Educational Programs (IEP). Considering the high volume of functional daily living skills that require direct instruction, perhaps it is no surprise that the acquisition of safety skills is not a priority in educational settings. Unfortunately, IEPs are not the only area in which safety skill instruction has received little attention. There has also been a paucity of research in this

area. Few investigations exist related to safety skill instruction for children with autism and related disabilities.

### **Lack of Safety Skill Research**

Dixon and colleagues (2010) conducted a review of the safety literature related to persons with developmental disabilities. They reviewed the literature over a 39-year span (i.e., 1970 to 2009). Surprisingly, the authors identified only 27 empirical investigations for their review. Certain safety skill areas were sparsely represented in peer-reviewed journals. Specifically, fire safety received minimal attention. Since 1970 there have only been nine empirically validated studies examining effective methods for teaching fire safety skills to persons with developmental disabilities. This is alarming, considering the number of deaths due to fire annually. In 2007 alone, 510 children died due to fires. In 2010 there were over 300,000 building fires in the United States (United States Fire Administration, 2012). Although, specific data related to fires and children with autism are not available, the rapid increase in the number of children being diagnosed with autism spectrum disorder makes fire safety a great priority for this population given that there is an average of over 6,000 building fires per state as of 2010 (United States Fire Administration, 2012).

Despite the prevalence of autism, only one study to date, has utilized participants with autism to evaluate the efficacy of fire safety instruction (Self, Scudder, Weheba, & Crumrine, 2007). In this study, Self and colleagues (2007) examined the effects of two treatment packages consisting of a virtual reality computer simulation and an integrated visual treatment package involving a variety of components such as stories, mazes, and comprehension questions related to fire and tornado safety skills. Results showed that

participants learned the skills, but most were unable to demonstrate mastery of the safety skills during generalization and maintenance trials. There is a significant need for experimental evaluations that examine and identify effective teaching methodologies related to fire safety for this population. Chapter 2 is a review of studies that have targeted fire safety skill acquisition for individuals with developmental and related disabilities.

## **Chapter 2: Literature Review**

### **Fire Safety Literature and Individuals with Developmental Disabilities**

A number of fire safety investigations were published between 1980 and 1991 (Bannerman, Sheldon, & Sherman, 1991; Cohen, 1984; Katz & Singh, 1986; Luiselli, 1984; Matson 1980; Rae & Roll, 1985; Rowe & Kedesdy, 1988). In the past decade, only two investigations have evaluated fire safety instruction with persons with developmental and related disabilities (Padgett, Strickland, & Coles, 2006; Self et al., 2007).

Matson (1980) conducted one of the first studies related to fire safety skills and individuals with developmental disabilities. Using a multiple baseline design across participants, five adults with moderate intellectual disabilities were taught appropriate steps to follow to evacuate a home in case of a fire. The instruction was delivered in a classroom and consisted of two phases. First, participants were taught to vocally describe the appropriate steps. Verbal instructions, corrective feedback, and praise for correct responding were used in this phase. During the second phase, they were taught to demonstrate the steps using figurines of people and a cardboard model that resembled a living room. In this phase, training consisted of modeling, verbal prompts, and physical guidance. Results showed that participants were able to describe the correct steps when evacuating a home and maintained these new skills at a 7-month follow-up.

Luiselli (1984) conducted a study in which an adult with intellectual disabilities was taught to exit his bedroom, evacuate the residence, and meet at a predetermined location within 2.5 minutes of hearing a ringing fire alarm. Fire drills were provided daily at varying times. Verbal instruction, prompting, corrective feedback, and reinforcement were used throughout the study. The participant maintained the skills at a one-year follow-up. The same year, Cohen (1984) conducted a similar study with a blind adult with profound intellectual disabilities. Verbal instruction, forward chaining, verbal prompts contingent on incorrect responses and reinforcement were used throughout the study. Fire drills were randomly administered twice per day. This participant also acquired the safety skills and maintained them at a one-year follow-up.

Rae and Roll (1985) evaluated the effectiveness of a combined intervention package that included: (a) verbal instructions, (b) least-to-most prompting hierarchy (verbal, gestural, physical), and (c) reinforcement in the form of praise to teach fire safety skills to 10 individuals with profound intellectual disabilities. The fire drills were randomly presented, but were announced verbally rather than by the presentation of a fire alarm. As the participants demonstrated acquisition of the safety skills during the drills, the experimenters gradually presented the drills during times that resembled “real-life” situations. Results showed that the skills generalized from the verbal announcement of the fire drills to randomly activated fire alarms. Participants also maintained the skills at a 16-week follow-up.

Katz and Singh (1986) used a multiple baseline across behaviors designed to evaluate the effectiveness of fire safety skill instruction for nine adults with intellectual disabilities. These adults were taught to evacuate a residence, report the fire, and stop,



drop, and roll to extinguish fires. Training consisted of verbal instructions, demonstration, rehearsal, physical guidance, and reinforcement. Results showed that most participants acquired the safety skills and maintained the skills during 6- to 18-week follow-ups.

Rowe and Kedesky (1988) examined the effectiveness of fire safety instruction using the largest sample size to date. They utilized backward chaining, delayed least-to-most prompting sequence, and reinforcement to teach 37 adults with intellectual disabilities to evacuate their residence. The majority of participants acquired the safety skills and maintained them at 3- and 6-month follow-ups.

Interestingly, all of these studies used behavioral teaching strategies with adults with intellectual disabilities as participants and all of them demonstrated maintenance of the fire safety skills learned. However, these studies did not seem to systematically build on each other. For instance, while all of them utilized reinforcement for correct responding and prompting, they all utilized significantly different training packages to teach the fire safety skills. What we learned was that combining reinforcement-based behavioral teaching strategies was generally effective in generating acquisition of fire safety skills by adults with intellectual disabilities and that the acquisition maintained when re-evaluated following a period of time without training. The studies did not demonstrate whether the fire safety skills generalized to different settings, which is critical for individuals who acquire the skills. An individual who learns safety skills needs to be able to apply these skills whenever needed regardless of the setting.

Bannerman et al. (1991) were the first to demonstrate the generalization of fire-safety skills to novel settings. They taught adults with intellectual disabilities to leave a

setting in the presence of a fire alarm. In this study, the authors used prompting, modeling and differential reinforcement to teach three non-verbal adults with severe to profound intellectual disabilities to exit their group home in the presence of a fire alarm using a multiple baseline across participants design. All participants acquired the fire safety skills and most importantly generalized them across different settings within the group home. Although, generalization was only evaluated in different locations within their group home this was a significant contribution to the fire safety skill literature as it represented the first study to show that behaviorally-based teaching strategies could result in meaningful generalization.

At this time, there have been only two studies conducted to teach fire safety skills to children with developmental and related disabilities (Padgett et al., 2006; Self et al., 2007). Padgett and colleagues (2006) evaluated the effectiveness of a virtual reality computer-based program to teach five children with fetal alcohol syndrome between the ages of 5 and 7 fire safety skills. A multiple baseline multiple probe design was utilized. The computer program consisted of a virtual house, which would “catch” fire at different locations within the home. A virtual character would teach the participants what to do using arrows as prompts indicating the correct response. As the participant responded correctly, the arrow prompts were faded. The animated character provided corrective feedback in the form of further explanation contingent on incorrect responses and provided praise for correct responses. The skills taught included: (a) identifying a fire, (b) evacuating, and (c) meeting at a predetermined location. After children mastered the skills on the computer program, a 1-week follow-up was conducted. All participants demonstrated the skills during a real-life simulation.

As previously mentioned, Self et al. (2007) provided the only study addressing fire-safety skill instruction for children with autism. Eight children participated in the study ranging between 6 and 12 years of age. They compared the effectiveness of a virtual reality computer program to an integrated visual treatment package to teach fire and tornado safety skills. The computer program consisted of a virtual building and visual prompts that guide the participant to fire alarm detectors and related items like simulated smoke. All prompts were gradually faded contingent on correct responding. The integrative visual treatment package consisted of stories, comprehension questions, mazes, picture sequences, videos, and role-play. The participants were divided into two groups. For fire-safety training, one group was exposed to the virtual reality computer program and the other group was exposed to the integrated visual treatment package. For the tornado safety training, the groups were reversed. Participants in both training groups demonstrated improvement, but generalization and maintenance trials yielded mixed results with most participants failing to respond independently.

In summary, there has been very limited research in fire safety skill instruction for individuals with developmental disabilities (Dixon et al., 2010). The limited studies that do exist have primarily been conducted with adults with intellectual disabilities. Only two studies in the last two decades have included children. Furthermore, only a single study has evaluated fire safety skill instruction for children with autism and the results were mixed (Self et al., 2007). Considering that the number of children continues to increase, it is critical that fire safety skills be taught to this population. Additionally, it is not clear that any effective instructional methods have been validated to teach children with autism fire-safety skills. If such skills are critical to independent living, it is critical that such

skills be added to comprehensive interventions for children with autism. The current study hopes to begin to fill this void.

### **Research Questions**

This study was conducted to answer the following questions:

1. Are modeling and rehearsal an effective methodology for teaching fire safety skills to children with autism?
2. Does this teaching methodology result in generalization of fire safety skills in novel settings?
3. Does this teaching methodology result in maintenance of fire safety skills at least 5 weeks after training ends?

## Chapter 3: Method

### Participants

Participants were children diagnosed with Autism Spectrum Disorders (ASD) between 4 and 5 years of age. Participants were recruited from Behavior Analysis, Inc. (BAI), an agency that provides applied behavior analysis therapy (ABA) in southeast Florida to treat challenging behavior and teach functional skills including receptive and expressive language, and other related skills in children with autism.

**Inclusion and exclusion criteria.** To qualify for participation in the study, each participant was required to meet four criteria. First, each child's parents had to express a desire for their child to learn fire safety prevention skills. Second, each child had to score at level 3 on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) in the areas of expressive and receptive language (Sundberg, 2008). The VB-MAPP is a language and social skills assessment program for children with autism or other developmental disabilities. Children scoring at level 3 have expressive and receptive communication, social skills, and imitation skills comparable to typically developing 30- to 48-month old children. Third, no participant could demonstrate fire-safety skills when probed and fourth, they did not exhibit challenging behavior. During screening, each potential participant was told, "Show me what you do when a fire alarm sounds." A fire alarm was then set to ring within 5 seconds and the child's use of safety skills was recorded. To meet this criterion for inclusion in the study, the child had to

correctly perform no more than one of the required safety skills responses without exhibiting any challenging behaviors. Table 1 describes each participant’s characteristics.

Table 1

*Participant Characteristics*

Participants	Aaron	Walter	Alec
Age	5	4	5
Disability	Autism Spectrum Disorder	Autism Spectrum Disorder	Autism Spectrum Disorder
School Placement	Kindergarten with 1:1 aide	ESE Pre-kindergarten	Autism cluster Pre-kindergarten
Language Capacity	Follows basic instructions, expresses self vocally, limited conversational skills VB-MAPP level 3	Follows basic instructions, expresses self vocally, limited conversational skills VB-MAPP level 3	Follows basic instructions, expresses self vocally, limited conversational skills VB-MAPP level 3

**Setting**

Sessions were conducted in two different settings for each participant, one for acquisition training and one to assess generalization. Acquisition training was provided in a therapy room at one of Behavior Analysis, Inc. Treatment Centers for Alec, in a simulated therapy area in Walter’s home, and in a therapy room at Aaron’s school. Each room was approximately 4 by 7 feet with a two-person table suitable for children, a television, and shelves located approximately 6 feet from the ground, out of the reach of participants. Additionally, generalization of the safety skills was assessed at different settings for each participant. For Aaron, generalization probes were conducted at his

home. Walter's generalization probes were conducted at an Autism Treatment Center. Alec's generalization was assessed at an office building where Behavior Analysis, Inc's administrative offices are located. No training was ever conducted for the participants at their generalization settings.

### **Dependent Variable (Safety Responses)**

The dependent variable consisted of the safety responses described below.

Participants had to demonstrate the responses in the order listed.

1. Going to exit door – defined as walking or running until arriving at an exit door that leads to the outdoors.
2. Stepping outside of building or house – defined as going through exit door and arriving outdoors.
3. Taking a minimum of 20 steps away from building or house – defined as walking a minimum of 20 footsteps starting from the exit door and moving away from the building or house.
4. Saying to adult “fire alarm” – defined as facing an adult outside of building and vocally stating “fire alarm”
5. Staying outside of the building or house until given instructions by adult – remaining at least 20 steps away from building until instructed by adult to go elsewhere.
6. Safety skill sequence completed within 3 minutes or less of fire alarm starting to ring.

The 3-minute time requirement for completing the sequence was selected based on sample trials conducted by the experimenters. During these trials the experimenters measured the duration required to complete all the steps in several different locations

including a home, therapy clinic, and office building. It was determined that all steps could be completed within 3 minutes even accounting for variability in children's walking pace.

### **Experimental Procedures**

**Baseline phase.** During the baseline phase, each participant was presented with a probe trial consisting of a ringing fire alarm. The probe was delivered upon arrival to the regularly scheduled therapy session at home, school, or a Behavior Analysis, Inc. Treatment Center. During each probe, data were recorded on whether or not the participant exhibited each fire safety response correctly and whether or not the skill was performed independently. Baseline occurred in the same setting as the training phase and only one probe trial was conducted per day. No feedback or instruction was provided during this phase. The baseline phase continued until a stable data pattern was established, consisting of at least five data points at or near zero levels. Probe trials were conducted daily during weekdays, Monday through Friday until the criterion was met.

**Training phase.** The training phase consisted of modeling and rehearsal of the safety skills using a four trial training sequence. Table 2 below illustrates the four trial sequence beginning with Trial #1. Immediately prior to beginning each trial in the sequence, the experimenter said to the participant: "Anytime you hear a fire alarm you have to do all the safety steps quickly."



Table 2

*Four Trial Training Sequence*

Trial	Alarm	Experimenter	Participant	Intervention
1	Rings	Models & labels each safety skill in sequence	Observes No responding required	n/a
2	Same as above	Same as above	Same as above	Same as above
3	Rings	Models each safety skills.  As each skill is modeled says, "What am I doing?"	<u>Labels</u> each safety skill as each skill is modeled	If child <u>doesn't label</u> a skill correctly or fails to respond within 3 seconds of being asked, a <u>correction procedure is used</u>
4	Prior to alarm ringing experimenter says: "When the alarm sounds, show me what you do." Within 5 seconds alarm rings	No modeling No verbal behavior	<u>Demonstrates</u> each safety skill in sequence	If child doesn't demonstrate a skill correctly or fails to respond within 3 seconds of being asked, a <u>correction procedure is used</u>

The correction procedure for Trial 3 consisted of the following:

If the participant *did not label* the safety skill within 3 seconds of being asked or responded incorrectly, the experimenter would say, "Say, (*insert name of skill being demonstrated*)." When the participant repeated correctly, the experimenter would then say "That's right!" The experimenter would then continue with the next safety step in the sequence. If the participant responded correctly and independently the first time, the experimenter would also say, "That's right" and proceed to the next safety skill response.

The correction procedure for Trial 4 consisted of the following:

If the participant *did not demonstrate* the safety skill within 3 seconds of the activation of the fire alarm or responded incorrectly, the experimenter would prompt the participant by saying, “Show me (*insert name of skill not being performed or being performed incorrectly*).” When the participant performed the skill correctly, the experimenter would say, “That’s right! Go ahead and continue.” This process was repeated anytime the participant did not demonstrate the safety skill within 3 seconds of completing the previous step. If the participant demonstrated all of the safety skill steps correctly and independently the first time, the experimenter would say, “Excellent, you did it!”

The duration of each individual trial approximated the real time in which the skill would be performed in the presence of an actual fire alarm drill. Each trial was presented within 3 minutes of the end of the previous trial. Only one sequence of the trials was conducted per training day (a sequence is defined as completing Trial 1 through Trial 4, once). Each training session lasted approximately 10 minutes per day and was typically conducted weekdays Monday through Friday. The training phase continued until each participant correctly and independently demonstrated each safety response correctly and in the proper sequence on a minimum of four consecutive probes.

**Generalization and follow-up phase.** Generalization was assessed for each participant at least once during each phase of the investigation. Aaron’s generalization probes were conducted at his home. Therefore, during the generalization probes once he arrived at home after his school days the fire alarm was activated and data were recorded. For Walter arrangements were made to have his mother bring him to the Autism

Treatment Center (he did not receive any services at the center) for his generalization probes and after a few minutes in the waiting area the alarm was activated and data were recorded. For Alec arrangements were made for a behavior therapist to bring him to an office building. After a few minutes in the office building the alarm was activated and data were also recorded. For all participants, prior to activating the alarms during these probes, there were no comments related to fire safety, there were no pre-warnings, and once activated, there were no instructions or feedback provided at any time. The observer recorded data as described in the *Data Collection, Generalization and Follow-up* section.

A follow-up probe was also conducted for each participant 5 weeks following the conclusion of the training phase. The follow-up probes were conducted in the training setting and the generalization setting for each participant. The purpose of the follow-up probes were to determine if the safety skills maintained in the absence of any further training in the training setting, as well as a novel setting in which no training had occurred. During follow-up probes, a fire alarm rang and the observer recorded data as described in the *Data Collection, Generalization and Follow-up* section. No instructions, training or feedback was provided to the participant during any follow-up probes.

### **Experimental Design**

A multiple-baseline across participants design was utilized for this study. All participants began in baseline at the same time, but the training phase was implemented with one participant at a time (i.e., staggered). This design demonstrated experimental control, since the treatment phase initially started with one participant, while the others remained in baseline. While in baseline, participants did not show any significant

increase in the percent of safety responses exhibited until they were exposed to the training phase. As a result of this multiple-baseline across participants design changes in the dependent variable can be attributed to the effects of the training phase.

Generalization probes were conducted at least once in every phase of the study (i.e., during baseline, training, 1.5 weeks after the end of the training, and again 5 weeks after training). This ensured that any generalization of the safety skills in a new setting could be attributed to the effects of the training phase and were not present during baseline.

### **Data Collection**

**Across all phases.** Each participant's safety responses were recorded during each trial in the study. During all phases of the study (baseline, training, generalization and follow-up) each participant was presented with a single daily event consisting of a ringing fire alarm. This event occurred each day upon arrival to the regularly scheduled therapy session at home, school or Behavior Analysis, Inc. Treatment Center. During each event, data were recorded on whether or not the participant exhibited each fire safety response correctly and independently. No feedback or instruction was provided during any event at any point in the study. These are the data that are graphically displayed in Appendix B. Each event was conducted at least 5 minutes before any training was provided each day to control for any practice effects that may have existed if events were conducted immediately following training. Additional data were recorded as described in each phase below. All data were recorded by trained observers employed by Behavior Analysis, Inc. Refer to Appendix A for the data-recording sheet.

**Modeling and rehearsal.** During the modeling component, which consisted of Trials 1 through Trial 3 of the training phase sequence, the experimenters demonstrated

the correct safety responses in the presence of a ringing fire alarm. Data were recorded on whether the participant correctly labeled each safety response as it occurred on Trial 3 of each sequence. Since Trial 1 and Trial 2 of the sequence only consisted of the experimenter modeling the fire safety responses, no data were recorded for the participants because they were not required to respond during these trials. During the third trial of each sequence the participants were required to label each safety step so data were recorded on Trial 3 of each sequence. The observer scored “yes” for each safety response labeled correctly, “no” for each response labeled incorrectly or “not labeled at all” depending on the participant’s response during each third trial of the sequence.

Trial 4 of the training sequence consisted of the rehearsal component. The final portion of the daily training sequence (i.e., Trial 4) required each participant to correctly demonstrate each safety skill. Data were collected in the same manner as in Trial 3 of the sequence (in which the participants had to label each safety skill as they observed them) with the only exception being that data were recorded on whether each safety skill was demonstrated correctly (instead of labeled correctly). The observer scored “yes” for each safety skill performed correctly, “no” for each safety skill performed incorrectly or not performed at all during these trials. Data recorded within the training trials are available from the author upon request.

**Generalization and follow-up.** During this phase, data were recorded on whether or not the participant correctly demonstrated each safety skill in the presence of a ringing fire alarm. Data collection procedures were the same as in the baseline phase.

## **Observer Training and Interobserver Agreement**

Each observer completed competency-based training on data collection prior to participation in the study. The training consisted of having each observer watch pre-recorded videos of a child demonstrating the fire safety responses and the experimenter implementing the modeling and rehearsal training procedures. The child in the video demonstrated several responses correctly and others incorrectly. For each video, the observer recorded each safety response as: (a) correct, (b) incorrect, or (c) did not occur at all. Videos were displayed continuously without pausing at any time to closely resemble real-time data recording. The primary investigator scored each video clip in advance. The observers recorded data independently and the results were compared to the primary investigator's data. Observers were required to obtain 100% agreement with the primary investigator's data before qualifying to be an observer in this study. Each observer remained in training until a 100% score was achieved. In addition to participating in the observer training, experimenters also received training on the implementation of the modeling and rehearsal procedures. This training consisted of observing the primary investigator model the procedures and then each experimenter had to demonstrate correct implementation of the modeling and rehearsal procedures during role-play scenarios. During this training, praise and corrective feedback were provided to the experimenters and the training continued until they achieved a correct score of 100% using the same criteria as described above for the observer training. The experimenters were responsible for implementing the training phase of this study.

Participant performance was scored for 42%, 42%, and 65% of sessions for Aaron, Walter, and Alec, respectively. To calculate interobserver agreement (IOA) two

observers recorded data independently of each other during the baseline and training phase for each participant. IOA scores were 100%, 98.5%, and 99% for Aaron, Walter, and Alec, respectively. In some cases, sessions were video recorded if a second observer was not available. Video recorded sessions were only used for IOA data by a second observer. When recording data from a video recorded session, the observer scored data while watching each session only once and without pausing the video at any time during the viewing of a session. In each IOA session both observers scored each occurrence or nonoccurrence of every safety response. For each session each safety response was scored as an agreement or disagreement depending on whether both observers scored it the same.

To evaluate the training phase fidelity, IOA for the independent variable was also calculated to determine whether the experimenter implemented all of the steps correctly. IOA was calculated for 24% of the total training phase sessions conducted for all participants combined. An IOA score of 96.5% was achieved. Interobserver agreement for each participant was calculated by dividing the number of agreements by the number of agreements plus disagreements for each probe trial and multiplying by 100.

## Chapter 4: Results

Modeling and rehearsal were effective in teaching all three participants fire safety skills. The safety skills also maintained and generalized to novel settings for all participants 5 weeks after the training was discontinued (see Figure 1).

During the baseline phase, all participants scored zero or near zero levels when required to demonstrate fire safety skills. Two of the three participants scored zero during every baseline session. As shown in Figure 1 (top panel), Aaron demonstrated 17% of the safety skills correctly during 3 of the 7 baseline sessions (range: 0–17%). Although, he scored 17% on several baseline sessions, this only accounted for Aaron saying “fire” or “fire alarm” occasionally when the smoke detector was ringing. He did not demonstrate any of the other safety skills required to safely evacuate the setting during this phase. During the training phase Aaron demonstrated 100% of the safety skills by the fourth session (range: 0–100%). He continued to demonstrate 100% of the safety skills during five consecutive sessions. Generalization probes were also conducted in the home during the baseline, training, and follow-up phases. During baseline, Aaron did not demonstrate any of the safety skills during the generalization probe. During the training phase, he demonstrated 100% of the safety skills and then during a 5-week follow up he maintained the safety skills by demonstrating 100% of the skills correctly in the classroom setting and also in a home setting in which no training had ever been provided.



As shown in Figure 1 (middle panel), Walter did not demonstrate any of the safety skills during the baseline phase. During the training phase he showed great variability in correct responding (range: 0–100%). In the third session of this phase (Session 13) he demonstrated 100% of the safety responses, which was followed by scoring 17% correct in the next session. During the next five sessions (sessions 15–19), his correct responses ranged from 83% to 100%. However, in each of these sessions when he scored 83%, he was demonstrating all of the safety skills correctly except for saying, “fire alarm” to a nearby adult. In Session 20, he did not demonstrate any of the safety responses correctly. During this session when training was being conducted Walter was intermittently engaging in disruptive behavior. Therefore, it is suspected that this may have affected his responses during this session since it is the only session in the training phase in which he scored 0% correct. Following this, he demonstrated 100% of the safety skills during the following four sessions. During his generalization probes at the Autism Treatment Center, Walter did not demonstrate any of the safety skills when they were probed during baseline. A week and a half following the discontinuation of the training phase he scored 100% during a generalization probe. Generalization and maintenance were again evaluated 5 weeks following the discontinuation of the training phase. He maintained the safety skills by demonstrating 100% of the skills correctly in the home training setting and also at the Autism Treatment Center in which no training had ever been provided.

As shown in Figure 1 (lower panel), Alec did not demonstrate any of the safety skills during the baseline phase. During the training phase he also showed great variability in correct responding (range: 0–100%). In Session 21 he demonstrated 100%

of the safety responses, which was followed by Sessions 22 and 23 in which he scored 0% correct. During both of these sessions his parent reported that Alec had recently been sick, but should be able to attend sessions as scheduled. During the next five sessions (Sessions 24–28) his correct responses ranged from 83% to 100%. However, similar to Walter, when he scored 83%, he was demonstrating all of the safety skills correctly except for stating, “fire alarm” to a nearby adult. In Session 28 additional training on saying, “fire alarm” was provided. This consisted of saying to Walter “When you see an adult outside say, “fire alarm.” “What do you say outside?” and requiring him to say “fire alarm. This teaching sequence was repeated twice, immediately before the training session was conducted. This training sequence was only utilized on Session 28. As displayed, the following four sessions (Sessions 29–32) he scored 100%. Alec did not demonstrate any of the safety skills when a generalization probe was conducted in an office building during baseline. He demonstrated 100% of the safety skills during a generalization probe (Session 33) in the training phase. Generalization and maintenance were again evaluated 5 weeks following the discontinuation of the training phase. Alec maintained the safety skills by demonstrating 100% of the skills correctly in the training setting and also in the office building in which no training had ever been provided.

## **Chapter 5: Discussion**

Since the 1970s there have only been nine empirical studies evaluating fire safety skills instruction with persons with developmental disabilities (Dixon et al. 2010). Most of these studies examined safety skills instruction with adults. Only two of these studies utilized children. The first study was by Padget and colleagues (2006) in which they evaluated the effectiveness of a virtual reality computer simulation program to teach children with fetal alcohol syndrome fire safety skills. Results showed that the children acquired the skills and maintained them at a brief 1-week follow-up. Self et al. (2007) conducted the only study addressing fire-safety skill instruction with children with autism. They compared the effectiveness of a virtual reality computer program to an integrated visual treatment package (i.e., stories, comprehension questions, mazes, picture sequences, videos, and role-play) to teach fire and tornado safety skills. Results of the generalization and maintenance trials showed that most participants failed to respond independently. While both of these fire safety studies utilized children as participants neither of them demonstrated a teaching methodology that generalized to novel settings after at least a month since training had been completed. Furthermore, both studies require special software programs limiting their utility by caregivers and professionals that may not have access to such computer programs.

The current study contributes to the fire safety literature by utilizing existing empirically validated behavioral strategies (modeling and rehearsal) that can be easily

utilized by any caregiver or professional and applying them to teaching fire-safety skills to children with autism. It is also the first study with children with autism to demonstrate a teaching methodology that produced generalization of fire safety skills across all participants following 5 weeks since the training phase was completed. Specifically, results of this study show that modeling and rehearsal were effective in teaching all participants fire safety skills and that these skills maintain after an extended period of time after training.

### **Implications for Safety Skill Instruction**

These results have several implications for safety skills instruction related to children with autism. First, while modeling and rehearsal have been shown to be effective in teaching children with autism a variety of different skills (DeQuinzio, Townsend, Sturmey, & Poulson, 2007; Schrandt et al., 2009), this study is the first to evaluate their effectiveness as a combined training procedure to teach children with autism fire safety skills. This training “package” provides practitioners with a methodology that can easily be used to teach such skills. Second, training was provided in a different setting for all three children (i.e., clinic, school, and home) demonstrating that practitioners, teachers and other professionals can also use this methodology in a variety of settings.

A third implication of this study is that the methodology used did not require participants to verbally respond to questions about what to do when there is a fire. Such verbal instructions are often the first component of traditional safety skills instruction for young children and can consume a significant amount of time. In 1988, Miltenberger and Thiesse-Duffy demonstrated that simply answering questions correctly about what to do in a “safety-risk” situation did not result in the children actually exhibiting the safety

skills when presented with a contrived safety-risk situation. As a result, the current study did not include such a component, but rather simply modeled what to do under a simulated fire-risk situation and subsequently required participants to label each step demonstrated. By not including an extensive verbal instruction component participants were simply taught “what to do” and “when to do it” which ultimately is what matters most when one’s safety is at risk. This study demonstrated that a verbal instruction component is not necessary for acquisition of these skills by children with autism.

Since a verbal training component was not utilized in this study, the training procedures required less time to be implemented during each session of the training phase. As a result, the training package used in this study required minimal training time for each session, which is ideal for children with autism who sometimes have limited attention spans. By not including an extensive verbal component, each session typically lasted less than 10-minutes per day for each participant.

An important outcome of this study is the generalization of the safety skills for all participants. While it is important that modeling and rehearsal were effective in teaching the participants fire safety skills, what is most critical is that these skills were functional for each child. That is, each participant demonstrated the fire safety skills in a setting where training had never been provided when presented with an activated fire alarm. In addition to the difference in settings there were other people present in the generalization settings that were not associated with any training, there were no familiar training materials present, and the alarms were activated randomly as the children freely wandered and engaged in any activity as they would in any non-instructional location. This makes it more likely that each participant would demonstrate the skills

independently if they ever encountered a situation where a fire alarm indicated the need to evacuate regardless of the setting.

### **Limitations**

There were several limitations that should be considered when interpreting these results. First, the study included only three participants. Similarly, all participants had imitative and vocal repertoires, which allowed them to demonstrate modeled responses as well as label the steps being demonstrated. During the training phase when a participant failed to label a step, the experimenter simply asked the child to repeat what the experimenter had stated. If participants were unable to speak or imitate responses that were modeled, it is likely that the training phase would have resulted in slower skill acquisition or possibly limited acquisition of the safety skills. For instance, if a participant did not speak he would not have been able to say “fire alarm” to a nearby adult as required in the current study and as a result the child would not have achieved complete mastery of all of the fire safety skills being taught.

A further limitation of the study is the inability to account for the variability demonstrated by two of the three participants during the training phase. Walter and Alec both had sessions during the training phase in which they demonstrated 100% correct responses in a session which was then followed by 0% correct responses in a following session. Such variability in correct responses was likely due to motivational factors in which the value of praise as a reinforcer was diminished during those particular sessions. However, such variability ultimately did not limit mastery of the fire safety skills which occurred as well as generalization to novel settings.

Generalization of the fire safety skills was certainly a strength of this study. However, only one type of fire alarm was used throughout the investigation. We did not evaluate whether the fire safety skills would be exhibited by the participants if a fire alarm that sounded differently than the one used in training was utilized.

### **Implications for Future Research**

There are several implications for future research based on the results of this study. The current study should be replicated with more participants. If the results of this study could be replicated with more participants it would strengthen the viability of the training procedures as a teaching intervention for children with autism who need to acquire fire safety skills. In addition, generalization should be evaluated with different fire alarms that will provide novel auditory stimuli that should still be expected to evoke the sequence of fire safety skills taught during the training phase. If participants demonstrate the safety skills in the presence of an activated fire-alarm sound that they have never previously encountered it would signify a significant contribution to the literature; the results would suggest that fire safety training should occur with multiple types of fire alarms for generalization.

The effectiveness of modeling and rehearsal should also be examined with participants with more limited verbal and motor imitation skills as well as of different age groups. This would determine if the training package used in this study is most effective for a subset of individuals with autism that have characteristics similar to the participants in this study, or if the training procedures can be successfully adapted for children with autism who have a wider range of characteristics and of different ages. In addition, such a study should closely evaluate the rate of acquisition of the skills for children with

different characteristics. It is possible that the training procedures are effective for a wider range of individuals with autism, but that the rate of skill acquisition may vary depending on the participants' characteristics.

Future studies should also conduct a component analysis of modeling and rehearsal. It would be of great interest to isolate which components of modeling or rehearsal result in acquisition of fire safety skills. It may be that all of the components of modeling and rehearsal used in this study are not necessary for acquisition of fire safety skills with children with autism. Any component analysis should also examine the rate of acquisition. It is possible that the rate of learning varies depending on which components of the training procedures are utilized. For example, future studies may find that rehearsal alone results in acquisition of fire safety skills with a subset of children with autism, but at a significantly slower rate than modeling and rehearsal combined. This would have significant implications for applied practitioners and caregivers who may use such procedures when teaching children with autism.

Finally, as noted in the figure, Aaron showed rapid acquisition during the training phase while Walter and Alec required significantly more training sessions to acquire the skills and show stability in responding. As previously noted, each session during the training phase usually lasted less than 10 minutes as each participant was exposed to the training sequence once per session. Future studies should evaluate whether acquisition would have been quicker if the training sequence would have been implemented two or three times each session for each participant. Researchers may find that the length of the training phase could be reduced significantly just by increasing the number of training sequences provided each session.



The current study adds to the limited fire safety skills literature with children with autism by demonstrating an effective teaching methodology that requires very little time to implement, can be easily applied in a variety of settings, and results in generalization of the safety skills to new environments even after a significant amount of time has passed since training was completed. The current study shows that perhaps when teaching children with autism important safety skills the focus should be simplified to just teaching them “what to do” and “when to do it.” It is our hope that perhaps this study can begin to “spark” other researchers’ interests in further investigating this critically important area for children with autism and that such research can begin to fill the huge void that currently exists in the literature.

**Appendix A**  
**Data Recording Sheet**

DATA RECORDING SHEET  
Fire safety Skills

**Participant:** \_\_\_\_\_ **Location:** \_\_\_\_\_ **Phase (circle one):** Baseline Training Generalization Follow-up

**Instructions:** For each trial enter the date and initial in the corresponding "observer" cell. For each trial enter one or more of the following letters that apply.

**PROBE:** + if child demonstrates step correctly. Score – if child demonstrates step incorrectly or omits

**Trial 1s and 2s:** + if experimenter labels and demonstrates step correctly. – if experimenter labels or demonstrates step incorrectly or omits

**Trial 3s:** + if experimenter demonstrates and asks "What am I doing?" correctly. Score – if experimenter demonstrates and asks "What am I doing?" incorrectly or omits; + if child labels step correctly. Score – if child labels step incorrectly or omits

**Trial 4s:** + if child demonstrates step correctly. Score – if child demonstrates step incorrectly or omits

35

		Date & Observer							
STEPS		Trials		PROBE	1 (Exp)	2 (Exp)	3 (child)	3 (Exp)	4 (child)
1	Goes to exit								
2	Steps outside								
3	Takes a minimum of 20 steps away from location								
4	Says to adult "fire alarm"								
5	Stays outside until given instructions by adult								
6	Completed routine w/in 3 minutes of alarm starting								
		Date & Observer							
STEPS		Trials		PROBE	1 (Exp)	2 (Exp)	3 (child)	3 (Exp)	4 (child)
1	Goes to exit								
2	Steps outside								
3	Takes a minimum of 20 steps away from location								
4	Says to adult "fire alarm"								
5	Stays outside until given instructions by adult								
6	Completed routine w/in 3 minutes of alarm starting								

**Comments:** (note date): \_\_\_\_\_

## **Appendix B**

### **Figure 1**

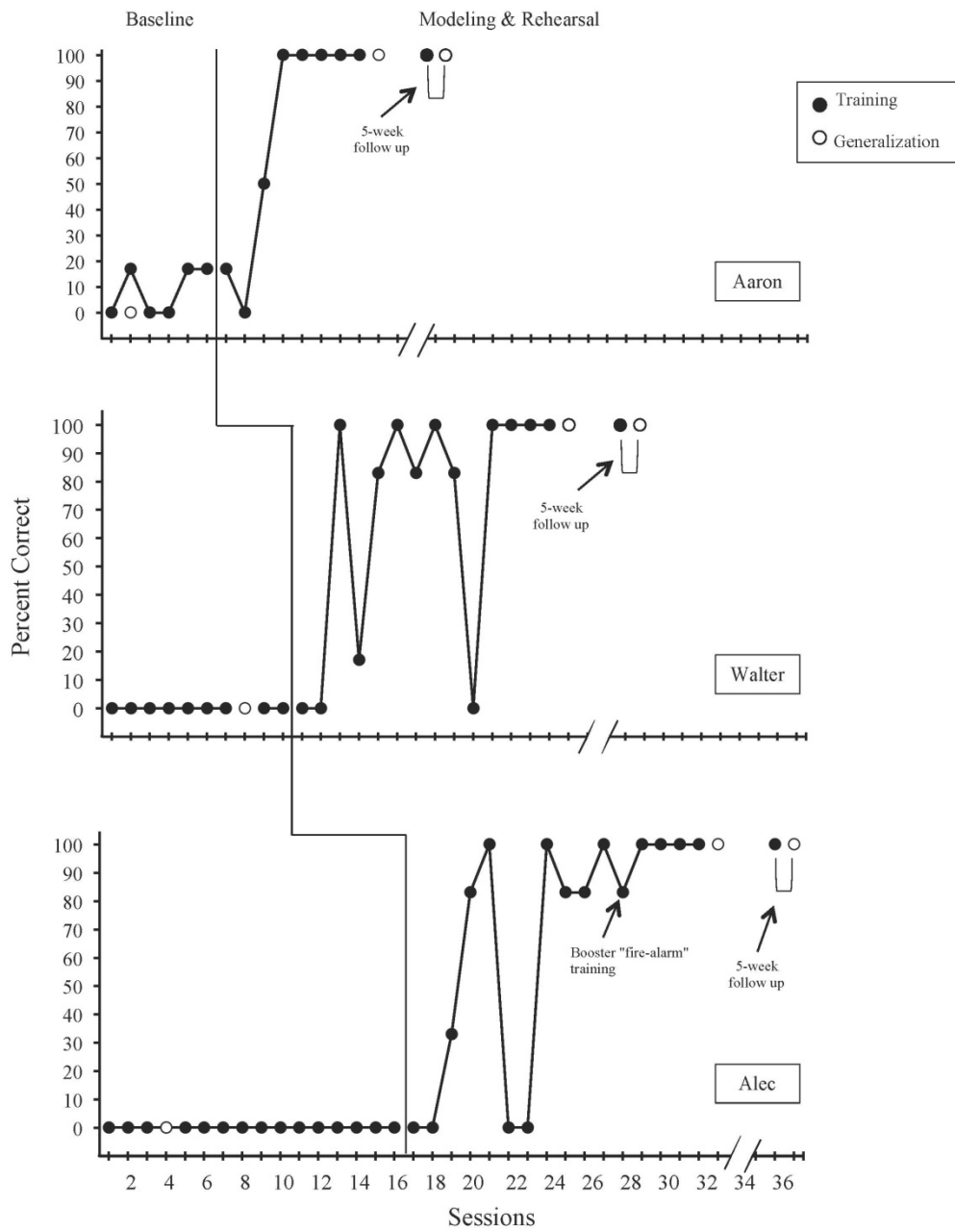


Figure 1. Percent of correct responses per session across baseline and training phase for all participants.

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