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The effects of skill training on preference for individuals with severe to profound multiple disabilities

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THE EFFECTS OF SKILL TRAINING ON PREFERENCE FOR INDIVIDUALS WITH SEVERE TO PROFOUND MULTIPLE DISABILITIES

by

Anuradha Salil Kumar Dutt

An Abstract

Of a thesis submitted in partial fulfillment of the requirements
for the Doctor of Philosophy degree in
Psychological and Quantitative Foundations (School Psychology)
in the Graduate College of The University of Iowa

July 2010

Thesis Supervisors: Professor Stewart W. Ehly
Professor David P. Wacker

ABSTRACT

Behavioral researchers have investigated procedures for identifying preferred items for individuals with varying levels of developmental disabilities. Some researchers in this area have reported difficulties in identifying preferred items for individuals with severe to profound multiple disabilities (SPMD), in part because the individuals may not possess the motor skills needed to select and manipulate the items included within the assessment. The purpose of the current study was to address three research questions: Would differences in preference patterns be observed if individuals with SPMD could activate toys with a motor response that is within their repertoire (i.e., press a large microswitch to activate the toy) versus when they are required to perform a motor response that may not be within their repertoire (e.g., sliding knobs, twisting dials to activate a toy)? Would teaching specific skills to activate a toy result in increased toy engagement and a shift in preference toward directly operating the toy? Would teaching the participant a motor response to activate the toy directly affect the levels of microswitch engagement observed? Data were collected within a combination multiple baseline (across 2 participants) and multielement (across conditions) design. The results of this study showed that (a) differences in preference were observed when different measures of assessing preferences were conducted, (b) acquisition of specific motor skills resulted in an increase in preference toward directly manipulating items, and (c) acquisition of motor skills also resulted in a decrease in activating items via microswitches. These results extend the preference assessment literature by showing that the motor skills present within an individual's current repertoire may affect the results of preference assessments for individuals with SPMD.

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CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

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has been approved by the Examining Committee for the thesis requirement for the Doctor of Philosophy degree in Psychological and Quantitative Foundations (School Psychology) at the July 2010 graduation.

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To my Guru

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CHAPTER I

INTRODUCTION

The major purpose of this study was to evaluate if preferences for specific leisure items changed following skill training during which individuals with severe to profound multiple disabilities (SPMD) were taught play skills to engage with these toys. A second purpose was to determine if preferences identified via the use of an augmentative device (i.e., a microswitch) remained stable after the individual was trained to directly engage with a toy. A third purpose was to determine if individuals who were trained to directly engage with toys preferred to continue to use the augmentative device with the item. This chapter is divided into four sections. The first section describes characteristics of children/adults with SPMD. The second section describes preference assessment methodologies that have been used to identify preferences and the challenges faced in identifying preferences for individuals with SPMD. The third section describes studies that have used effective skill acquisition programs to teach toy play skills to individuals with SPMD. Finally, the fourth section further describes the purpose of this study and the research questions addressed.

Description of Individuals with Severe to Profound Disabilities

Individuals with SPMD display various combinations of cognitive, physical, sensory, and communication challenges leading some practitioners and researchers to question if effective behavioral technologies exist to teach this population (Green, Reid, Canipe, & Gardner, 1991; Reid, Phillips, & Green, 1991). Since the early 1960s, applied behavior analysis research has demonstrated that specific skill training procedures can be effective in teaching these individuals to engage in daily living and leisure skills. However, despite these successes, effective skill training continues to be very challenging.

Individuals with SPMD are generally considered untestable on intelligence tests because they have difficulties with performing the various motor and vocal responses that are necessary to complete intelligence batteries. Persons with SPMD may display severe forms of neuromuscular dysfunction such as severe spasticity, muscle rigidity, and skeletal deformities. Because of the lack of control over their motor movements, individuals within this population often have very limited self-care or daily living skills, require assistance with most tasks (Bailey, 1981), and are non-ambulatory (Bailey, 1981; Reid et al., 1991), and independent manipulation of objects may be extremely difficult (Reid et al., 1991; Schaeffler, 1988). In addition to motor and cognitive challenges, individuals with SPMD may often have sensory impairments (Bailey, 1981; Reid et al., 1991) and communication deficits that make it difficult for them to express their needs and preferences (Parsons & Reid, 1990). Furthermore, individuals with SPMD often have frequent medical complications such as seizures and eating disorders that may limit their ability to function and increase their dependence on caregivers (Bailey, 1981; Reid et al., 1991). Details on the description of this population are further described in reviews by Logan and Gast (2001), Nakken and Vlaskamp (2007), and Reid et al. (1991).

Preference Assessment Methodologies for Individuals with SPMD

Because of the complex array of impairments experienced by individuals with SPMD, practitioners and researchers often encounter challenges when attempting to teach skills to these individuals. A constant challenge documented in the behavioral literature has been related to the identification of potential reinforcers (Pace, Ivancic, Edwards, Iwata, & Page, 1985; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985). Because of their limited response repertoires (Wacker et al., 1985) and fluctuating levels of alertness (Green, Gardner, Canipe, & Reid, 1994), identification of preferences has been particularly difficult for individuals with SPMD. In this section, I briefly describe selected studies in the behavioral literature that have focused on developing preference assessment procedures to identify reinforcers for individuals with SPMD. I then describe studies that have used assistive technology to assist in identifying preferences for individuals with SPMD.

Several preference assessment methodologies have been developed to identify preference for individuals with SPMD (Dattilo, 1986; DeLeon, Iwata, Conners, & Wallace, 1999; Fisher et al., 1992; Pace et al., 1985; Roane, Vollmer, Ringdahl, & Marcus, 1998; Wacker et al., 1985). Pace et al. (1985) developed one of the first preference assessments for use with this population. Sixteen items were presented individually in a counterbalanced manner. Each item was presented five times and the participant's approach behavior toward the presented stimuli was recorded. If the participant approached the item within 5 s of presentation, the item was made available for an additional 5 s. If the participant did not approach the item, the therapist prompted the participant to sample the item, and then a second probe was conducted to evaluate the occurrence of an approach response. Items that were approached on at least 80% of the trials were defined as preferred stimuli, and items that were approached on 50% or less of the trials were defined as non-preferred stimuli. This procedure was often successful in identifying preferred stimuli but also resulted in false positives. Thus, it did not always identify reinforcers.

Fisher et al. (1992) developed a paired-choice preference assessment methodology that provided greater differentiation in preferences than the Pace et al. (1985) method. Items were presented in pairs and participants were required to choose one item from the pair. Sixteen items were presented and each item was paired once with every other item in a randomized order. The participant's approach behavior toward one of the two items was recorded, and the approach response resulted in access to that stimulus for 5 s. If the participant did not approach either of the two items, the therapist prompted the participant to sample both items, and then both items were presented again to evaluate selection. If the client did not approach either item within 5 s, both items were removed and the next trial was initiated. A hierarchy from most-to-least preferred items was generated based on this assessment, which led to more accurate identification of reinforcers.

Although often effective in identifying reinforcers, a few limitations have been documented within the literature with the paired choice assessment. The length of time the participant has access to an item may influence the preference level of an item. Kodak, Fisher, Kelly, and Kisamore (2009) indicated that preference for a highly preferred activity may be affected if the individual is not allowed to access the item for longer periods of time. Individuals with SPMD, who often have severe motor deficits, may have difficulty with approaching an item within 5 s of presentation (Logan et al., 2001). For these two reasons, duration-based preference assessments, such as the methodology developed by DeLeon et al. (1999), are often used rather than item approach procedures. DeLeon et al. (1999) presented items individually for a period of 2 min, and preference for each item was calculated according to the percentage of total time that the participant made physical contact with the item. Items were then ranked on a continuum from high-preferred to low-preferred items based on the duration percentages obtained for each item.

The procedures developed by Fisher et al. (1992) and DeLeon et al. (1999) have been successfully used with many persons with SPMD. However there is a sub-population of individuals with SPMD for whom identification of preferences remains difficult because the assessments require specific motor skills to access and manipulate items. For this reason, Dattilo (1986) and Wacker et al. (1985) employed assistive technology to identify preferred stimuli for individuals within this subgroup. Wacker et al. (1985) developed a low-effort procedure whereby individuals with SPMD were presented with leisure items individually. These items were attached to a microswitch and participants could press the switch in order to activate the item. Preference was evaluated in terms of the duration of time that the participant made contact with the microswitch.

This approach resulted in greater differentiation in responding between items than the results reported in previous investigations (e.g., Pace et al., 1985). In addition, the results suggested that preference could be assessed even when the individual did not have the motor skills required to manipulate the item.

Recent efforts in the area of using of computer-based assistive technology (Lancioni, Singh, O'Reilly, & Doretta, 2003; Lancioni et al., 2006; Lancioni et al., 2009; Saunders et al., 2005; Shih & Shih, 2009) with individuals with SPMD have primarily focused on evaluating the effectiveness of various technology-based programs for assisting individuals with minimal motor movement to gain more control and access over environmental stimuli. These programs have used various adapted microswitches (e.g., pressure, wobble, mercury, optic, and vocalization-activated microswitches) and mouse drivers, depending on the physical needs of these individuals, that are attached to a computer system or an electronic control unit to access different sensory stimuli (e.g., music, a video, vibration). For example, Lancioni et al. (2009) used adapted microswitches linked to specific sets of sensory stimuli (e.g., tapes of songs and stories, different vibrations) through a computer system. These microswitches utilized specific motor responses that were present within the participant's repertoire. For example, 1 participant's responses included head movements and hand stroking; a pressure device was placed on the headrest of her wheelchair and a touch sensor was placed on her left leg to allow her to use those movements to activate the switches. Activation of one of the switches resulted in sampling one set of stimuli. Two studies were conducted using a multiple probe design across responses. The authors evaluated if the introduction of this technology-based program customized to each participant's needs and ability levels resulted in increased sampling of environmental stimuli. The results suggested that the participants were able to activate the microswitches consistently to sample various stimuli, exhibited increased rates of target response (i.e., hand stroking and head movement), and consistently maintained responding over a 2-week period during the post intervention phase.

Similarly, Shih and Shih (2009) evaluated participants' use of a newly developed mouse driver with motion detectors that could be activated by swinging one's hand over the mouse to access sensory stimuli on a computer. Two individuals with SPMD participated in the study. The effect of mouse drivers on the occurrence of hand swinging was evaluated within a reversal design. The results of the study showed an increase in hand swings was observed when this behavior resulted in activation of the sensory stimulus. In addition, responding was maintained during the post-intervention phase 2 months after the last intervention session was conducted during intervention.

The above mentioned studies showed the effective use of assistive technology in identifying the preferences of individuals with SPMD. In addition, these studies demonstrated how a simple motor response present within the individuals' current repertoire of motor skills could be used to access environmental stimuli or events. In both studies, the rates of target responses (i.e., head movements, hand stroking, and hand swing) increased considerably during intervention, demonstrating that access to the stimuli was reinforcing.

Although this research showed that preferences could often be identified via the use of microswitches and other assistive devices, it did not show if the use of these assistive devices affected preference. For example, would similar levels of preference be seen if the individual was taught to directly access the item identified as preferred via assistive technology? It is possible that preferences may change if the participant is taught the motor skills needed to directly manipulate an item rather than to access it indirectly via a microswitch. It remains unclear if preferences identified via a microswitch or other assistive devices remain stable after an individual is taught the skills necessary for directly accessing those items. Thus, an area that needs to be addressed within the preference literature is if teaching specific motor skills to manipulate toys or leisure items changes preference for those items. To begin to address these issues, two questions need to be answered. First, do preference assessments of toys vary when microswitches are used to activate the devices versus when the toy is directly manipulated by the participant? Second, does preference change relative to using the microswitch following skill training? To evaluate these research questions, an effective method for teaching individuals with SPMD to manipulate or activate items is needed.

Skill Acquisition Research on Object-Related Toy Play Skills

In this section, I describe intervention studies in the behavioral literature that have shown that persons with SPMD can be trained to appropriately play with toys. I briefly summarize the procedures and results from these studies and emphasize the procedures used to train the skills.

A systematic search of articles published in peer-reviewed journals targeting research focused on increasing toy play skills with individuals with SPMD was conducted via PsycINFO and ERIC using the keywords “teaching toy play” and “toy play skills” during the period of 2000-2010. The references within the selected articles were searched for additional relevant sources. Articles were selected based on the inclusionary criteria specified for this search. Studies that adopted a single-case design methodology for evaluating treatment approaches or training programs to increase toy play skills (i.e., toy manipulation, motor responses, play actions with toys) were included. The primary dependent variable for all selected studies was toy play and did not include research that focused primarily on increasing social initiation through play, social interaction, communication skills via play, and so on. Nine studies met the inclusion criteria (see Table 1). Of the nine studies identified, one study was conducted with children with SPMD (DiCarlo, Reid, & Stricklin, 2003). The findings of this literature search indicated that very few studies on teaching toy play skills among children/adults with SPMD have been published in the behavioral literature in recent years. Therefore, I extended the search to include research studies conducted during the past 4 decades to review effective treatment strategies that have been adopted to teach toy play skills to individuals with SPMD. Although 15 studies were identified (see Table 2), for the purposes of this chapter, I will discuss the procedures and results of 8 studies that are directly relevant to the skill training procedures adopted in the current study. The results of this search suggest that the training methods in current use are based primarily on studies conducted 35 years ago. Although these methods often continue to be effective, there is an apparent need to conduct additional studies that replicate these procedures and that extend them to different situations and target behaviors.

Beginning in the late 1970s, researchers devoted greater attention to developing recreational or leisure skills with individuals with SPMD. A specific line of research within this area of skill acquisition focused on teaching appropriate toy play skills (i.e., object-related play). Studies on antecedent variables have evaluated the effectiveness of variables such as types of toys, toy proximity, modeling, and vocal prompts to increase toy play with individuals with SPMD (Bambara, Spiegel-McGill, Shores, & Fox, 1984; Wehman, 1978b). For example, Bambara et al. (1984) compared the effects of three reactive toys and three non-reactive toys on duration of toy play within a concurrent schedules design for 3 children with SPMD. Reactive toys were defined as toys that provided visual, auditory and/or tactile feedback, and non-reactive toys, although identical to their reactive counterparts, did not produce sensory feedback (i.e., the batteries used to activate these toys were removed). The results indicated that reactive toys resulted in longer durations of toy engagement for all 3 participants.

Wehman (1978a) studied the effects of three different environmental conditions—toy proximity, modeling, and instruction plus modeling—on independent toy play with 3 individuals with SPMD. The effects of the three antecedent conditions were evaluated within a combination simultaneous treatment and reversal design. Results showed that each of the three antecedent events resulted in substantially higher levels of independent toy play than baseline sessions when toys were present but not within arm's reach of the participant. However, instructions plus modeling led to higher levels of independent play than the toy proximity and modeling alone conditions.

These results are relevant to the current study as they suggest that toy proximity and material availability alone did not result in increased toy play. A combination of antecedent variables such as modeling and verbal prompts was also required to achieve treatment gains. In addition, selecting appropriate toy materials (i.e., reactive toys) and identifying toy preferences are likely important precursors to increasing toy engagement.

Studies on toy play acquisition have also focused on using a combination of antecedent and consequence variables to develop treatment packages to increase levels of toy engagement. For instance, Wehman and Marchant (1978) examined the effects of a graduated prompting sequence on independent toy play, social play (i.e., social interaction with peers), and problem behaviors with 4 children with SPMD. The graduated prompting sequence consisted of the use of vocal prompts, modeling, physical guidance, and vocal reinforcement (i.e., praise). Reactive toys that produced visual, auditory, and tactile stimulation on contact were presented across all conditions and phases of the study. The results, evaluated within a reversal design, suggested that the effects of the graduated prompting sequence and praise resulted in a marked increase in levels of independent toy play.

Similarly, Singh and Millichamp (1987) evaluated if vocal prompting and graduated physical guidance procedures would be effective in increasing independent and social play among 8 individuals with SPMD. A multiple baseline design across participants was used to determine the effectiveness of these prompts. Results showed that vocal and physical prompts were effective in increasing independent and social play. In addition, treatment gains were maintained over 26 weeks for independent play and 10 weeks for social play. Follow-up checks showed that levels of independent and social play remained stable for all participants over 12 months following the implementation of the last maintenance probe.

DiCarlo et al. (2003) evaluated if choice between preferred toys or a combination of choices between preferred toys, physical guidance, vocal prompts, and praise contingent on toy play increased independent toy play for 3 toddlers with SPMD. The study was conducted within a multiple baseline design across participants, and results showed that presentation of choices between preferred toys increased independent toy play for 2 of the 3 children. For the 3rd child, a combination of choice, verbal prompts, physical guidance, and praise was required to improve overall toy play. Thus, effective procedures should provide choices, hierarchical prompting, physical guidance, and praise.

Haring (1985) used a multiple baseline across responses design to evaluate an extension of the “training sufficient exemplars” strategy described by Stokes and Baer (1977). Four individuals (2 diagnosed with moderate mental retardation and 2 diagnosed with severe mental retardation and Down syndrome) participated in this study. Training was initially conducted with four sets of training toys, and generalization of toy skills to four other untrained toy sets was evaluated. The procedures consisted of using a graduated prompting sequence (i.e., vocal directions, model prompts, and physical guidance) to reach criterion levels of skill acquisition with one toy in each of the four sets. After criterion levels were reached for the first toy, training (using the same prompting sequence) was initiated for the other toys within the trained set. Results of this analysis showed that each participant took fewer trials to learn the skills to operate the generalization toys within each set than were required for the first training toy. Also, generalization from trained to untrained toy sets occurred for all participants with toys that required similar motor responses.

Other studies have shown the benefits of using task analysis for increasing play skills and recreational/leisure skills with individuals with SPMD (Kazdin & Erickson, 1975; Peterson & McIntosh, 1973; Schleien, Wehman & Kiernan, 1981). These programs used a backward or forward chaining format to teach skills and included practice sessions or trials until a particular criterion or percentage of independence was achieved on each step. For instance, Schleien et al. (1981) demonstrated the acquisition and generalization of dart skills by 3 individuals with SPMD. The training program consisted of a seven-step task analysis of the required motor skills, vocal prompting, modeling, physical guidance, and contingent praise for completing each step in the task analysis. The study was conducted within a multiple baseline design across participants. Results indicated that all participants acquired independent dart skills within five practice trials, generalized them to other community settings (e.g., a friend's apartment, neighborhood bar, and training facility) and continued to independently demonstrate this skill during follow-up sessions that were conducted 4 months after the last training session.

Similarly, Kazdin and Erickson (1975) conducted a study using a task analysis within a multiple baseline design across 4 groups of participants (N=15) diagnosed with SPMD. The study evaluated if a task analysis of a group-based play activity (i.e., ball catching) coupled with fading, physical prompting, and edible reinforcement resulted in learning the skills to participate in the game. The task analysis of steps to perform the play activity was developed, and training consisted of using edible reinforcers and physical prompting with the participants to follow each step within the sequence. Gradually, reinforcers for compliance with individual steps were faded and were provided only when the entire sequence in the play activity was completed. Results indicated that training resulted in independent skill demonstration for all 4 groups.

To date, research has shown that toy play can be increased via antecedent and consequence manipulations (Malone & Langone, 1994, 1999; Nietupski, Ayres, & Hamre-Nietupski, 1984; Wehman, 1978). Thus, in the current study, a combination of antecedent (i.e., graduated prompting sequence) and consequence-based procedures (i.e., reinforcement in the form of praise and access to a preferred toy) were used to teach toy play skills to the participants. The review of literature on toy play skills also indicated a need for direct skill training programs with children with SPMD. Thus, further development and replication of procedures for training toy play skills with children with SPMD are warranted.

Purpose of the Study

The present study addressed three research questions. The first question evaluated if different patterns of preference were obtained when individuals with SPMD were required to perform a simple motor response (e.g., pressing a button) within their current repertoire of skills to operate a toy versus when they were required to engage in motor responses such as sliding knobs and twisting dials to activate a toy. This question was addressed by administering two types of preference assessments to children with SPMD: (a) preference assessment without a microswitch (i.e., *Toys Only* condition), and (b) preference assessment with a microswitch (i.e., *Microswitch Plus Toy* condition). The *Microswitch Plus Toy* condition used a low-effort procedure similar to the procedure described by Wacker et al. (1985). Individual toys were attached to a microswitch, and participants were required to press the switch in order to activate the toy. The *Toys Only* condition used procedures developed by DeLeon et al. (1999). Toys were individually presented in the absence of a microswitch, and participants were required to directly manipulate the toys.

The second question addressed if teaching specific toy play skills to operate a toy resulted in an increase in duration of toy engagement during preference assessments in the *Toys Only* condition. In other words, does acquisition of toy play skills result in an increase in preference? This question was addressed by implementing a training program (i.e., task analysis, graduating prompting sequence, and reinforcement) to teach a specific set of skills for a toy that was identified as highly preferred during the *Microswitch Plus Toy* but relatively low preferred during the *Toys Only* condition (i.e., the training toy). I hypothesized that acquisition of toy play skills for the training toy would result in increased preference or toy engagement during the *Toys Only* condition in the absence of prompts or reinforcement.

The third question addressed if participants showed a preference for engaging with toys when toys were presented with an assistive device after they were taught motor skills to operate the toys directly. I hypothesized that learning specific motor skills to operate toys directly would result in decreased toy engagement during the *Microswitch Plus Toy* condition for the training toy.

Table 1
Current Trends in Skill Acquisition Research on Toy Play Skills (2000-2010)

Study	Goals	Population	Treatment	Results
Jahr et al. (2000) *Research in Developmental Disabilities, 21,* 151-169.	To increase number of play responses and cooperative play with peer	6 children Diagnosis: autism, mild developmental disabilities	Modeling, verbal description and imitation Design: Non-concurrent multiple baseline	Increases in play responses and cooperative play after verbal description was introduced
D'Atena et al. (2003) *Journal of Positive Behavior Intervention, 5,* 5-11.	To teach complex play sequences – motor responses and play-related verbalizations	1 preschooler Diagnosis: autism, mild developmental disabilities	Use of video-modeling Design: Multiple baseline across responses	Rapid increases in verbal and motor play responses.
DiCarlo et al. (2003) *Research in Developmental Disabilities, 24,* 195-209.	To increase independent toy play in an inclusive setting	3 toddlers Diagnosis: SPMD	Choice of preferred items vs. choice of preferred items, prompts, and praise Design: Multiple baseline across participants	Toy play increased for all participants. For 1 participant toy play increased with the choice condition only. For 2 participants, toy play increased with choice, prompts, and praise.
DiCarlo et al. (2004) *Journal of Applied Behavior Analysis 37,* 197-207.	To increase pretend play actions in an inclusive setting	5 toddlers Diagnosis: mild developmental delays	Use of choice between preferred activities, prompting, and praise Design: Multiple Baseline across participants	Increases in pretend play rates
Thomas & Smith (2004) *Educational Psychology in Practice, 20,* 195-206.	To increase functional toy play skills and social play	2 preschoolers Diagnosis: autism, mild developmental disabilities	Use of Tabletop Identiplay equipment, play scripts, and adult mirroring Design: Single case design	Increases in functional toy play and social interactions.
MacDonald et al. (2005) *Behavioral Interventions, 20,* 225-238.	To increase play-related verbalizations & toy play skills/actions	2 children Diagnosis: autism, mild developmental disabilities	Use of Video Modeling Design: Multiple probe within child across play sets	Teaching method effective in increasing scripted toy-related verbalization and toy play skills/actions. Treatment gains also observed during follow-up probes.

Table 1 Continued

Study	Goals	Population	Treatment	Results
Hine & Wolery (2006) *Topics in Early Childhood Special Education, 26,* 83-93.	To increase toy play skills/actions	2 preschoolers Diagnosis: autism, mild developmental disabilities	Use of Point-of-View Video Modeling Design: Multiple probe across behaviors and across participants	Teaching method effective in increasing toy play skills. Treatment gains also observed during maintenance probes.
Lifter et al. (2007) *Journal of Early Intervention, 27,* 247-267.	To increase play skills within specific developmental categories	3 preschoolers Diagnosis: PDD, mild developmental disabilities	Use of least-to-most prompting sequence Design: Modified multiple-baseline across play targets	Participants reached skill criteria of 85% for each of the specific play categories.
Paterson & Arco (2007) *Behavior Modification, 31,* 660-681.	To increase independent pretend toy play skills (verbal and motor responses)	2 children Diagnosis: high functioning autism	Use of Video-Modeling Design: Multiple baseline with a reversal across participants	Increases in appropriate play and decreases in repetitive play.

SPMD = Severe to profound multiple disabilities; PDD = pervasive developmental disorder

Table 2
Skill Acquisition Research on Toy Play Skills with Individuals with SPMD

Study	Goals	Population	Treatment	Results
Peterson & McIntosh (1973) *Mental Retardation 11*, 32-34.	To teach tricycle skills	2 children with SPMD	Task analysis; food and social reinforcement Design: Multiple probe	Training program effective in teaching skills but generalized effects across settings not observed.
Kazdin & Erickson (1975) *Journal of Behavior Therapy and Experimental Psychiatry, 6*, 17-21.	To teach group based activity (ball playing)	15 individuals with SPMD	Use of task analysis, fading, physical prompting, and edible reinforcement	Increased independent skills in playing ball across all participants
Wehman et al. (1976) *Education & Training of the Mentally Retarded*, 11, 46-50.	To evaluate the effects of material availability and material availability plus verbal prompting, modeling, and reinforcement on toy play	3 individuals with SPMD	Material availability, vocal prompts, modeling and social reinforcement (i.e., praise) Design: Multiple baseline design	Antecedent plus consequent treatment strategies resulted in higher levels of toy play and lower levels of stereotypy in comparison to material availability alone
Wehman (1977) *Rehabilitation Literature, 38*, 98-105.	Study 1: To evaluate the effect of social reinforcement versus material availability alone on toy play, social play and stereotypy Study 2: To evaluate the effect of modeling plus praise on toy play and peer interaction	3 individuals with SPMD 3 individuals with SPMD	Use of toy availability and praise contingent on appropriate toy play Design: Multiple baseline design Used of modeling and social reinforcement Design: Multiple baseline design	Results of both analysis indicated that the introduction of social reinforcement resulted in highest levels of toy play and peer interaction and reduction in stereotypy.
Wells et al. (1978) *Journal of Applied Behavior Analysis, 10*, 679-687.	To evaluate the effects of overcorrection on toy play and stereotypy	2 children with SPMD	Overcorrection with physical guidance Design: Multiple baseline across participants	Treatment reduced stereotypy in both participants but increased toy play in 1 participant.

Table 2 Continued

Study	Goals	Population	Treatment	Results
Wehman & Merchant (1978) *American Journal of Occupational Therapy, 32,* 100-104.	To evaluate the effects of a behavioral training program on independent and social play	4 children with SPMD	Use of instructions, modeling, physical guidance, and verbal reinforcement Design: Reversal design	The behavioral training program resulted in substantial increases in independent and social play.
Wehman (1978) *The Journal of Special Education, 12*, 183-193.	To evaluate different environmental conditions to increase toy play	3 individuals with SPMD	Toy proximity, modeling, and modeling plus verbal instruction Design: Simultaneous plus reversal design	Increases in toy play observed across all 3 conditions. Highest levels of independent toy play observed in the modeling plus instruction condition.
Coleman et al. (1979) *Behavior Therapy, 10*, 266-280.	To evaluate the effects of positive reinforcement and a modified arm correction technique on toy play and stereotypy	1 individual with SPMD	Use of modified arm overcorrection technique with verbal prompts plus physical guidance and social and edible reinforcers Design: Multiple baseline design	Treatment effective in increasing toy play and reducing stereotypy. Generalized effects across trainers not observed.
Horner (1980) *Journal of Applied Behavior Analysis, 13*, 473-491.	To evaluate the effects of an austere environment versus an enriched environment on toy play and maladaptive behavior	5 individuals with SPMD	Absence versus presence of toys and differential reinforcement of adaptive toy play behavior Design: ABAB reversal design	No changes in toy play and problem behavior were observed if toys were present or absent. Increases in toy and decreases in problem behavior observed when DRA for toy play were used within an enriched play environment.
Schleien et al. (1981) *Journal of Applied Behavior Analysis, 14*, 513-519.	To teach dart-playing skills	3 individuals with SPMD	7-step task analysis, vocal prompting, modeling, physical guidance, and praise Design: Multiple baseline across participants	Training resulted in acquisition of dart skills and generalization in other community settings.

Table 2 Continued

Study	Goals	Population	Treatment	Results
Favell (1982) *Analysis and Intervention in Developmental Disabilities, 2,* 83-104.	Study 1: To evaluate the effect of reinforcement on toy play and hand mouthing	1 individual with SPMD	Use of social reinforcement Design: ABA reversal design	Introduction of reinforcement resulted in increased rates of toy play and decreased rates in hand/toy mouthing.
	Study 2: To evaluate the effect of reinforcement on toy play and eye poking	1 individual with SPMD	Use of social reinforcement Design: ABA reversal design	Introduction of reinforcement resulted in increased rates of toy play and decreased rates in hand/toy mouthing.
	Study 3: To evaluate the effect of reinforcement on toy play and pica	3 individuals with SPMD	Use of social reinforcement Design: Multielement design	Introduction of reinforcement resulted in increased rates of toy holding and decreased rates in pica.
Bambara et al. (1984) *Journal of the Association for Persons with Severe Handicaps*, *9*, 142-149.	To compare the effects of reactive toys and non-reactive toys on toy play	3 children with SPMD	Simultaneous availability of reactive and non-reactive toys Design: Concurrent Schedule	Increased toy play with reactive toys as compared to non-reactive toys.
Jones et al. (1984) *Analysis & Intervention in Developmental Disabilities, 4,* 313-332.	To evaluate the effects of toy positioning and increased environmental control on toy engagement	14 individuals with SPMD	Use of toy holders and Plexiglas frames Design: Multiple baseline across 2 groups of participants	The use of assistive devised increased levels of toy engagement.
Haring et al. (1985) *Journal of Applied Behavior Analysis*, *18*, 127-139.	To examine the effects of generalization training of toy play skills	4 children with SPMD	Use of verbal direction, modeling, physical guidance, and social reinforcement Design: Multiple probe design	Between set generalization from trained to untrained toy sets occurred for all participants.

Table 2 Continued

Study	Goals	Population	Treatment	Results
Singh & Millichamp (1987) *Journal of Applied Behavior Analysis, 20*, 23-34.	To evaluate the effects of vocal and physical prompts on independent and social play	8 individuals with SPMD	Vocal and physical prompts	Training resulted in increased independent and social play. Treatment gains maintained.

SPMD = Severe to profound multiple disabilities

CHAPTER II

LITERATURE REVIEW

Introduction

Individuals with severe to profound multiple disabilities (SPMD) have various combinations of physical, cognitive, sensory, communicative, and neurological deficits (Bailey, 1981; Logan & Gast, 2001; Nakken & Vlaskamp, 2007; Reid et al., 1991). These individuals usually have been diagnosed with severe to profound intellectual disabilities or have been labeled untestable on different intelligence batteries. In addition, a subgroup of this population may exhibit severe orthopedic (e.g., spasticity, muscle rigidity, skeletal deformities) and sensory impairments (e.g., visual blindness, deafness, severe speech delays) further limiting their functioning. Furthermore, individuals with SPMD often have medical complications such as seizures and eating disorders that may increase their dependence on caregivers. Please see reviews by Logan and Gast (2001), Nakken and Vlaskamp (2007), and Reid et al. (1991) for more comprehensive information.

Because of the complex array of impairments experienced by individuals with SPMD, practitioners and researchers have struggled to develop effective assessment and treatment packages to meet their programming needs. One of the greatest challenges faced by care providers is the identification of preferred stimuli that can be used as reinforcers. A specific line of research within the behavioral literature has focused on developing preference assessment procedures to identify effective reinforcers. The primary purpose of this chapter is to critically review the literature and to develop a practitioners' guide for primary care providers (e.g., parents, teachers, residential staff) who are directly involved in the care of individuals with SPMD for selecting appropriate procedures to identify preferences and reinforcers for these individuals.

A systematic search of articles published in peer-reviewed journals targeting research focused on evaluating the effectiveness of various preference assessment procedures developed for individuals with SPMD was conducted via PsycINFO and

ERIC during the previous 25 years (1985-2009). Descriptors such as “preference assessment,” “preference assessment and severe mental retardation,” “preference assessment and profound mental retardation,” “preference assessment and developmental disabilities,” and “reinforcer assessment” were used to conduct this search. The references within the selected articles were searched for additional relevant sources. Articles were selected based on the inclusionary criteria specified for this search. Studies that adopted a single-case design methodology for evaluating the effectiveness of preference assessment procedures to identify reinforcers for individuals with SPMD were included. Studies that assessed the effectiveness of checklists, structured interviews, rating scales, preference assessment procedures based on direct observation, and reinforcer assessments were included within the literature search. Studies that used preference assessment procedures but did not evaluate the effectiveness of the procedure were not included. Forty studies met the inclusion criteria (see Table 3). The results of the studies were used to develop guidelines for practice within five areas: (a) identifying a list of stimuli for preference assessments, (b) identifying an appropriate preference assessment procedure, (c) identifying a modality of presentation of stimuli during preference assessments, (d) identifying target responses to assess preferences, and (e) conducting reinforcer assessments with individuals with SPMD.

Identifying a List of Stimuli/Sampling Options for Preference Assessments

A starting point to identify preferences for individuals with SPMD involves gathering information on items or activities for sampling (Logan & Gast, 2001). This information could be collected through informal methods such as asking caregivers or staff personnel of individuals with SPMD about their preferences (Hagopian, Long, & Rush, 2004; Lohrmann-O’Rourke, Browder, & Brown, 2000). In addition, more formal methods of information gathering such as structured and unstructured interviews (Fisher, Piazza, Bowman, & Amari, 1996), checklists/rating scales (Matson et al., 1999), and surveys/inventories (Newton, Ard, & Horner, 1993) have been developed to generate a list of potential preferences.

Fisher et al. (1996) developed the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD), a structured interview that was designed to generate a list of preferred stimuli. This structured interview was used with primary caregivers of 6 individuals with SPMD, and preference rankings were obtained across seven general domains: visual, auditory, tactile, olfactory, edible, social, and toys. After acquiring the list of potential preferences via the structured interview, a paired-choice preference assessment procedure was conducted with all participants to evaluate the correspondence between preference rankings across items reported by caregivers via the RAISD and rankings derived from the paired-choice preference assessment. Results showed that the correspondence between the two measures was low. However, a benefit of this screening tool included identifying potential reinforcers that were found among the stimuli reported by care providers that could be evaluated further through direct observation for preference.

Matson et al. (1999) developed a rating scale consisting of 49 edible and non-edibles items identified by staff and primary caregivers of 185 participants with SPMD. This checklist was developed via interviews, and checklist items were divided into four major categories: edibles, tangibles, activities, and sensory items. Results showed that this measure was reliable. However, the validity of the checklist in predicting if the stimulus ranking predicted reinforcer effectiveness was not evaluated in the study.

Newton et al. (1993) developed the Resident Lifestyle Inventory and implemented it with primary caregivers of 14 individuals with SPMD. Preference rankings across 144 activities were obtained by having the staff members rate each activity the participant "likes a lot," "likes," or "dislikes." Staff members were also asked to refrain from rating activities that the participants could not do or had not previously participated in. After preference rankings via the inventory were obtained, six selected activities were presented in pairs to the participants, and their selection responses were recorded. Results indicated that staff members' activity preference ratings correctly predicted the participants' choices for 78% of the total trials.

Although the above-mentioned studies demonstrate the efficiency in using these measures, studies within the preference literature have suggested the lack of concordance between care providers' report on client preferences and direct observation of participant preferences (Green et al., 1991; Parsons & Reid, 1990; Reid, Everson, & Green, 1999). Thus these measures might best be considered as screening tools or precursors to more systematic preference assessment procedures based on direct observations (DeLeon & Iwata, 1996; DeLeon, Iwata, Conners, & Wallace, 1999; Fisher et al., 1992; Pace et al.,, 1985; Roane, Vollmer, Ringdahl, & Marcus, 1998; Windsor, Piché, & Locke, 1994). Additionally, it may be important to have a list of multiple items that sample the full range of specific sensory stimuli within each category even though it may not have been mentioned by the participants' primary care takers. Assembling a comprehensive multisensory list of sampling options could also assist in conducting future preference assessments in identifying potential reinforcers, if existing preferences show a decrease in reinforcing value (Logan & Gast, 2001).

Identifying an Appropriate Preference Assessment Procedure

Several preference assessment procedures have been developed to identify preferences for individuals with SPMD (Dattilo, 1986; DeLeon & Iwata, 1996; DeLeon et al., 1999; Fisher et al., 1992; Pace et al., 1985; Roane et al., 1998; Wacker et al., 1985). Preference assessment formats can be broadly divided into three categories based on presentation of stimuli: (a) single stimulus presentation, (b) paired stimulus presentation, and (c) multiple stimulus presentation.

Single Stimulus Presentation

A single stimulus (SS) presentation consists of presenting stimuli/items to participants one at a time during a preference assessment. Pace et al. (1985) developed one of the first preference assessments that involved presenting 16 items individually in a counterbalanced manner. Each item was presented five times and the participant's approach behavior toward the presented stimuli was recorded. If the participant approached the item within 5 s of presentation, the item was made available for an additional 5 s. If the participant did not approach the item, the therapist prompted the participant to sample the item and then a second probe was conducted to evaluate occurrence of an approach response. Items that were approached on at least 80% of the trials were defined as preferred stimuli, and items that were approached on 50% or less of the trials were defined as non-preferred stimuli. The Pace et al. (1985) method has been used in subsequent studies to identify preferences among individuals with SPMD, and results have indicated that this method has been effective in identifying reinforcers for individuals within this population (Green, Gardner, & Reid, 1997; Ivancic & Bailey, 1996; Logan et al., 2001).

Logan et al. (2001) adapted the Pace et al. (1985) method by increasing the time allotted to approach an item from 5 s to 30 s. Given the physical deficits of individuals with SPMD, a short stimulus presentation interval of 5 s may not be long enough for participants to respond to stimuli and could result in under-identification of stimuli in individuals with severe orthopedic impairments. Therefore, Logan et al. evaluated the effectiveness of a 30-s access to each preferred stimulus during the preference assessment phase, and results showed that more preferences were identified via the longer procedure.

Pace et al. (1985) and Logan et al. (2001) both used approach behaviors (e.g., holding the item, playing with item, etc.) as target responses to measure preference with participants. A single stimulus presentation procedure developed by DeLeon et al. (1999) used engagement (i.e., the duration of time spent in manipulating an item) with a stimulus as one index of preference. In this procedure, items were individually presented for a period of 2 min, and preference for each item was calculated according to the percentage of total time that the participant made physical contact with the item. Items were then ranked on a continuum from high preferred to low preferred based on the durations obtained for each item. The effectiveness of this procedure in identifying reinforcers for individuals with SPMD was demonstrated by Hagopian, Rush, Lewin, and Long (2001), who showed that relative rankings of high, medium, or low preference items obtained via the DeLeon et al. (1999) method accurately predicted relative reinforcer effectiveness. In addition, these researchers indicated that this method may be more appropriate for individuals with SPMD who are nonambulatory, have severe motor deficits, and may also have difficulties with scanning a large number of items at one time.

Other variations of the SS method of presentation involve the use of assistive devices as a means of assessing preference with individuals with limited motor and communicative response repertoires (Datillo, 1986; Lancioni et al., 2003; Lancioni et al., 2006; Lancioni et al., 2009; Saunders et al., 2005; Shih & Shih, 2009; Wacker et al., 1985). This method of assessing preference usually consists of attaching assistive devices (e.g., pressure switches, toggle switches, mercury switches, vocalization devices, and mouse drivers) to a computer system, an electronic control unit, or the item itself, and activation of these devices results in accessing different sensory stimuli one at a time. For instance, Wacker et al. (1985) developed a low-effort procedure whereby individuals with SPMD were presented with leisure items individually. These items were attached to a microswitch, and participants could press the switch to activate the item. Preference was evaluated in terms of the duration of time that the participant made contact with the microswitch. Similarly, Lancioni et al. (2009) used adapted microswitches linked to specific sets of sensory stimuli (e.g., tapes of songs and stories, different vibrations, etc.) through a computer system. These microswitches utilized specific motor responses that were present within the participants' repertoire. For example, 1 participant's responses included head movements and hand stroking; a pressure device was placed on the headrest of her wheel chair and a touch sensor was placed on her left leg to allow the participant to use those movements to activate the switches. Activation of one of the switches resulted in sampling one set of stimuli. Furthermore, Shih and Shih (2009) evaluated participants' use of a newly developed mouse driver (different from standard mouse drivers) with motion detectors that could be activated by swinging one's hand over the mouse to access sensory stimuli on a computer. The results of the above mentioned studies showed that the participants were able to activate the assistive devices consistently to sample various stimulus sets and exhibited increased rates of target responses (i.e., hand stroking, head movement, pressing the switch, and hand swings).

An advantage of using assistive technology to assess preferences is that these devices can be used even with the presence of severe physical, communicative, and sensory limitations. The above mentioned studies adopted assistive technology that involved using target responses that were present within the participants' current repertoire of motor skills. This resulted in the participants gaining easier access to target stimuli, thereby providing for an effective means of assessing preference. Kearney and McKnight (1997) indicated that disadvantages associated with using assistive technology with this population includes high cost, retraining staff personnel to use the technology, lack of training in basic computer operations and setting up devices, troubleshooting device malfunctions, and potentially poor matching of participants' needs to technological options.

In summary, although preference assessment procedures using an SS presentation format have been effective with individuals with SPMD, drawbacks include over-identification of stimuli that may not serve as effective reinforcers (DeLeon et al., 1999; Ivancic, & Bailey, 1996; Roscoe, Iwata, & Kahng, 1999) and a lack of differentiation in preference hierarchies between items/stimuli (Fisher et al., 1992; Kodak et al., 2009).

Paired Stimulus Presentation

A paired stimulus presentation consists of presenting two items simultaneously and asking the participant to make a choice. Fisher et al. (1992) developed a paired-stimulus (PS) preference assessment procedure in which items were presented in pairs and participants were instructed to choose one item from the pair of items presented. Sixteen items were presented in pairs and each item was paired once with every other item in a randomized order. The participant's approach behavior toward one of the two items was recorded and the approach response resulted in access to that stimulus for 5 s. If the participant did not approach either of the two items, the therapist prompted the participant to sample both items, and then both items were presented again to evaluate selection. If the client did not approach either item within 5 s, both items were removed and the next trial was initiated. A hierarchy from most-to-least preferred items was determined based on this assessment, which led to more accurate identification of reinforcers. The effectiveness of this methodology in identifying a preference hierarchy has been demonstrated in subsequent studies (DeLeon & Iwata, 1996; Thomson et al., 2007; Windsor et al., 1994), and results have shown good predictive validity in identifying reinforcer effectiveness (Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). A limitation of this procedure is that it takes relatively longer to administer when compared to other preference assessment procedures (DeLeon & Iwata, 1996; Roane et al., 1998).

Multiple Stimulus Presentation

A multiple stimulus presentation consists of presenting more than two stimuli at one time to assess preferences between items. Windsor et al. (1994) developed a multiple-stimulus (MS) presentation procedure in which participants were instructed to select one item among six items presented simultaneously in an array. Items were presented over a series of 10 randomly ordered trials, during which items were not placed more than twice in the same position in the tray during each presentation. After the participant contacted or consumed the item, all items were removed and the next trial was initiated. An item was scored as “selected” if the participant contacted or consumed the item. If the participant contacted or consumed more than one item, then the first item was scored as “selected.” If the participant did not contact or consume any of the items presented, then the trial was scored as a “no response” trial. A hierarchy of preferences was achieved depending on the number of times items were selected across the 10 trials. When compared to the paired-choice preference assessment developed by Fisher et al. (1992), the Windsor et al. method yielded less stable stimulus preference rankings over a 2-month period and the tendency to exclusively select a preferred item across all trials was greater (DeLeon & Iwata, 1996; Windsor et al., 1994; Kodak et al., 2009). To overcome these limitations, DeLeon and Iwata (1996) developed a variation to the Windsor et al. method in which selections were made without replacement (MSWO). More specifically, participants were presented with an array of five to six items and were instructed to select one item from the array. After an item was selected, it was removed from the array on subsequent trials. Trials continued until all items were selected and a hierarchy of preferences across items was achieved. Preference was determined by calculating the percentage of trials each stimulus was selected relative to the number of trials it was presented. The MSWO procedure showed better concurrent validity with the PS procedure (DeLeon & Iwata, 1996) and good predictive validity in predicting reinforcer effectiveness (Carr, Nicholson, & Higbee, 2000; Higbee, Carr, & Harrison, 2000).

Roane et al. (1998) developed a free-operant (FO) preference assessment that involved presenting participants with an array of 10 to 11 stimuli simultaneously and allowing participants free access to all items during a 5-min session. Item engagement with each stimulus was recorded, and a preference hierarchy was developed based on the percentage of total time that contact was made with the items. Studies have shown support for the predictive validity of the FO preference assessment procedure in identifying potential reinforcers (Ortiz & Carr, 2000; Roane et al., 1998). Although a strength of the Roane et al. method includes a short time period in administration when compared to other preference methods (e.g., PS format), a disadvantage of this method involves a lack of differentiation in preference hierarchies between items/stimuli presented and exclusive responding toward one item presented within the array (Kodak et al., 2009). Therefore, a variation of this method was developed by Hanley, Iwata, Lindberg, and Conners (2003) to achieve greater differentiation in preference assessment results between items/stimuli presented. Hanley et al. (2003) developed the response restriction (RR) procedure during which all items/stimuli were simultaneously presented to the participant for 5 min. If the participant engaged with an item for more than 60% of total session time, then the item was removed during the next presentation. If responding was variable (i.e., different items were associated with highest levels of interaction), then sessions continued until responding was consistently and evenly distributed. Preference assessment sessions continued until a hierarchy of preferences between items was achieved. When the results of the RR assessment were compared to those obtained from the extended FO assessment, RR results yielded a more differentiated pattern of preference.

In summary, an advantage of the MS presentation format is that it takes less time to administer as compared to an SS or a PS presentation format and provides differentiated patterns of preferences among items/stimuli. This method of presentation is particularly effective when conducting frequent preference assessments on a daily basis to identify potential reinforcers for participants' programming needs (Roane et al., 1998). However, it is not recommended to use MS preference procedures with individuals with SPMD unless they have adequate motor and visual scanning skills to sample multiple stimuli and display consistent choice-making behavior (Logan & Gast, 2001).

Identifying a Modality of Presentation of Stimuli During Preference Assessments

In addition to evaluating the effectiveness of how stimuli are presented during preference assessments, another area of research has focused on examining the modality of presenting stimuli during preference assessments. Studies have evaluated the effectiveness of using pictorial, vocal, and tangible modes of presentation in identifying preferences in individuals with SPMD (Conyers et al., 2002; Graff & Gibson, 2003; Higbee et al., 1999; Lee et al., 2008; Vries et al., 2005). For instance, Graff and Gibson (2003) used a paired-stimulus preference assessment procedure to compare if a tangible mode or a pictorial mode of presentation was more effective in identifying hierarchies of preferences between items. Two items were presented to participants across several trials to participants in each modality, and participants were instructed to select one of the items. Results showed that both modalities of presentation were effective in identifying preferences in 3 of the 4 participants with SPMD. In addition, results of reinforcer assessments administered with these participants suggested that items identified as high preferred for both modalities functioned as effective reinforcers.

Lee et al. (2008) used a PS preference assessment procedure to evaluate the effectiveness of four modalities of presentation (tangible, auditory, pictorial and video) for identifying preferences of individuals with SPMD. The Assessment of Basic Learning Abilities test (ABLA) was used to assess these participants' discrimination skills across six levels. Each level in this assessment was administered to all participants to evaluate if the individual could perform an imitation task (level 1), a position discrimination task (level 2), a visual discrimination task (level 3), a match-to-sample discrimination task (level 4), an auditory discrimination task (level 5), or an auditory-visual combined discrimination task (level 6). Results of this analysis suggested that participants who could perform level 3 and level 4 discrimination tasks that primarily required visual discrimination skills showed a preference for items presented in object or tangible form.

Participants who could perform level 3, level 4, and level 6 discrimination tasks that require visual and auditory discrimination skills showed a preference for items across all four modalities of presentation. Similar results were obtained by Conyers et al. (2002). Results of their study suggested that the modality of presentation affects the accuracy of results achieved in preference assessments and that a systematic assessment of basic discrimination skills could be used as a precursor to predict the effectiveness of the presentation modality that needs to be used with individuals with SPMD.

In summary, pictorial and auditory modalities of presentation have several advantages, including activities that cannot be presented in a tangible form, time and cost efficiency, flexibility, direct reference to facilitate the interview process, and utility for persons with SPMD who have poor expressive skills and/or visual impairments (Kearney & McKnight, 1997). Although items in preference assessments have primarily been presented in object form, other modalities of presentation can be used while conducting choice assessments with individuals with SPMD. However, the results of previous studies suggest that it is good practice to use a systematic assessment of basic discrimination skills, such as the ABLA (Martin & Yu, 2000), before selecting a visual (i.e., picture, video, etc.) or auditory (i.e., spoken language, vocalization devices or microswitches) modality of presentation.

Identifying Target Responses to Assess Preferences

Target responses chosen to identify preferences and potential reinforcers for individuals with SPMD can affect the accuracy of preference assessment results. Typically, preference assessment methodologies have used approach (e.g., reaching out, grasping, playing with an item) or avoidance (e.g., pushing away, throwing an item) behavior to measure preference across items (DeLeon et al., 1996; Fisher et al., 1992; Pace et al., 1985; Windsor et al., 1994). Other researchers have used duration measures or the amount of time spent in making contact with a toy, engaging with, or playing with a toy (e.g., DeLeon et al., 1999; Roane et al., 1998). Studies that have used assistive devices to assess preferences in individuals with severe orthopedic impairments have typically used motor skills present within the participants' current repertoire of motor responses (Datillo, 1986; Lancioni et al., 2003; Shih, & Shih, 2009; Wacker et al., 1985). For example, in the Wacker et al. (1985) study, participants were instructed to raise their arm or head (i.e., a response consistently displayed by participants) to activate the microswitch to access stimuli. Similarly, Shih and Shih (2009) instructed participants to display hand swing movements to activate a mouse driver to sample various sensory stimuli. Some studies have used passive approach responses (e.g., smiling, looking at item, vocalizations) to assess preferences in individuals who display motor responses inconsistently (Green et al., 1997; Reid et al., 1999; Spevack, Yu, Lee, & Martin, 2006).

These studies suggest that it is important to use target responses and behaviors that are available within the participants' current repertoire of skills to assess preferences and identify potential reinforcers. Studies using active approach behaviors (e.g., reaching, grasping, playing with the toy, switch pressing) have also demonstrated that these preferred items have reinforcing value (DeLeon et al., 1996; Fisher et al., 1992; Roane et al., 1998; Windsor et al., 1994). However, not much is known about the reinforcing value of preferred items using passive approach behaviors in preference assessments. Therefore, if passive approach responses are used to identify preferences, reinforcer assessments are needed to evaluate the reinforcer effectiveness of these items.

Conducting Reinforcer Assessments

A primary goal for conducting preference assessments is to identify reinforcers for use in treatment programs for individuals with disabilities. Typically, identification of reinforcers involves two steps: (a) identifying preferred stimuli via a preference assessment procedure and (b) conducting a reinforcer assessment to evaluate if the stimulus identified as high preferred functions as a reinforcer. A reinforcer assessment of the preferred stimulus is conducted by making access to the preferred stimulus contingent on the participant's emitting specific motor responses. These responses could include sitting in a specific area to access an item (Fisher et al., 1992), activating a microswitch (Wacker et al., 1985), reaching for an item (Pace et al., 1985), or performing a work activity such as stacking rings or placing rings in a basket (DeLeon et al., 1996; Roane et al., 1998). Reinforcer effectiveness is most often evaluated within a reversal design (ABA) across baseline (A) and reinforcement (B). During baseline, participants are instructed to emit the specific response, but no reinforcement is provided following the occurrence of the target response. During reinforcement, occurrence of a target response results in access to the preferred stimuli for a specific period. Response rates of target responses across baseline and reinforcement conditions are compared for high preferred, medium preferred, and low preferred items to evaluate the reinforcing effectiveness for all items.

Studies have been conducted to evaluate if high-preferred stimuli serve as reinforcers for individuals with SPMD (Green et al., 1991; Ivancic & Bailey, 1996; Logan et al., 2001). For example, Green et al. (1991) conducted a preference assessment using the Pace et al. (1985) method and a reinforcer assessment with 9 individuals with SPMD to evaluate if high-preferred stimuli were likely to function as reinforcers. Of the 9 participants, high-preferred stimuli were identified for 5 participants, using the 80% approach criterion for assessing preference. For 4 of the 5 participants, the high-preferred stimulus functioned as a reinforcer during the reinforcer assessment. For the 4 students who did not approach any stimulus on 80% or more of the trials of the preference assessments, no reinforcing effects of any stimulus were apparent during the reinforcer assessment

Ivancic and Bailey (1996) conducted a single stimulus preference assessment and a reinforcer assessment with 15 individuals with SPMD. Of the 15 participants, 10 participants had severe orthopedic impairments and exhibited minimal motor movements. Results showed that high-preferred stimuli were identified for all 5 participants who did not have severe physical deficits but for only 2 of the 10 participants with minimal motor movements. The high-preferred stimuli functioned as reinforcers for 4 of the 5 participants with no motor impairments but for none of the participants with minimal motor movements.

Logan et al. (2001) used an adapted version of the Pace et al. (1985) preference assessment procedure to identify the preferred stimuli of 6 individuals with SPMD. Following the preference assessment, reinforcer testing was conducted to evaluate if high-preferred stimuli functioned as reinforcers. Results showed that although preferred stimuli were identified for all participants, these stimuli either did not function as reinforcers or functioned as inconsistent reinforcers.

Three conclusions can be drawn from the results of the above-mentioned studies. First, for participants who did not show a consistent preference for specific items, no reinforcing effects for any of the stimuli were observed (Green et al., 1991). Second, identification of preferred stimuli and reinforcers for individuals with minimal motor movements seems particularly challenging (Ivancic & Bailey, 1996). Third, discrepancies in preference assessment results and reinforcer assessment results may be observed. Specifically, although preferred stimuli can be identified with individuals with SPMD, it is not necessarily the case that these stimuli will serve as reinforcers. Therefore, preferred stimuli should be assessed to determine if they can function as reinforcers (Logan et al., 2001). It is also important to reassess the stimuli periodically to see if they function as reinforcers via brief pre-session preference assessments (Gast et al., 2000). Logan et al. (2001) suggested that discrepancies in preference assessments and reinforcer assessment results could be prevented by using the same target responses across preference assessment and reinforcer assessment procedures (Spevack et al., 2006).

Summary of Guidelines for Practice

Although advancements have been made over the past 3 decades in developing preference assessment procedures, a constant challenge documented in the behavioral literature has been problems with identifying preferred stimuli that function as reinforcers for individuals with SPMD. In this chapter, 40 research articles were reviewed to guide practice when conducting preference and reinforcer assessment procedures with individuals with SPMD. The results of these studies provide suggestions that should be considered when identifying preferences that function as reinforcers for individuals with SPMD.

Studies within the preference literature have suggested that it is good practice to develop a list of stimuli that can be used to identify preferences that function as reinforcers for individuals with SPMD (Fisher et al., 1996; Logan & Gast, 2001; Lohrmann-O'Rourke et al., 2000). This list should consist of a full range of sensory stimulus categories (e.g., visual, auditory, tactile, olfactory, outdoor activities, toys) and should serve as a reference point for periodic preference assessments. Primary caregivers such as parents, teachers, and residential staff of individuals with SPMD should serve as a source of information when generating the list of stimuli. However, caution should be employed in relying solely on caregiver information to identify preferences because the accuracy of caregiver opinions has been questioned within the preference literature (Green et al., 1991; Parsons & Reid, 1990; Reid et al., 1999). Therefore, caregiver information should be supplemented with direct observations of preferences.

A few guidelines should be used in selecting an appropriate preference assessment procedure. It is important to determine if the preference assessment procedure matches the skill level of the participant (e.g., motor skills, visual scanning skills, etc.). Typically SS presentation formats or variations of the Pace et al. (1985) method have been used to identify reinforcers with individuals with SPMD (Green et al., 1991; Ivancic & Bailey, 1996; Logan et al., 2001). Most individuals with SPMD do not consistently demonstrate choice-making behavior and may have a combination of physical and sensory deficits that make it difficult to interact with multiple stimuli simultaneously. Therefore, it is recommended that practitioners limit their use of forced or multiple stimulus preference assessment procedures with individuals with SPMD who do not have adequate visual scanning and motor skills and consistently demonstrate choice-making behavior (Logan & Gast, 2001).

Assessing stimulus preferences and finding consistent reinforcers for individuals with SPMD who have limited motor skills has proven more difficult than finding reinforcers for individuals with severe to profound mental retardation (Ivancic & Bailey, 1996). Augmentative devices (e.g., microswitches) could be considered in conducting preference assessment procedures that customize the motor skills that these individuals are required to display to assess preferences. However, when considering using assistive devices, it is important to determine if staff or school personnel are motivated to be trained in using these devices and if adequate funds and resources are available to purchase these devices (Kearney & McKnight, 1997).

Although most preference assessment procedures conducted with individuals with SPMD have used stimuli in object form (DeLeon & Iwata, 1996; Fisher et al., 1992; Pace et al., 1985; Roane et al., 1998; Wacker et al., 1985; Windsor et al., 1994), studies have demonstrated the utility of using pictorial and auditory modalities of presentation (Conyers et al., 2002; Graff & Gibson 2003; Higbee et al., 1999; Lee et al., 2008; Vries et al., 2005). One of the advantages of using a pictorial presentation is that sampling options that cannot be presented in an object form could be presented via the use of pictures (e.g., outdoor activities, community-based activities). Despite this benefit, it is important for practitioners to determine the participants' discrimination skills by administering a systematic assessment procedure, such as the Assessment of Basic Learning Abilities test (ABLA; Martin & Yu, 2000), before choosing between a visual, auditory, or tangible mode of presentation.

Research studies on reinforcer testing with individuals with SPMD has suggested that it is imperative to conduct reinforcer assessments after identifying preferred stimuli via preference assessment to determine the reinforcing value of the various stimuli (Green et al., 1991; Ivancic & Bailey, 1996; Logan et al., 2001). A suggestion to avoid discrepancies between preference and reinforcer assessment results is to use the same target responses across both assessment procedures. For individuals with SPMD for whom preferred stimuli and potential reinforcers have not been identified, it is recommended that frequent preference or reinforcer assessments be conducted. These procedures could be brief (two to three trials) and can be embedded within the individual’s routine activities (Parsons & Reid, 1990; Parsons, Reid, Reynolds, & Bumgarner, 1990; Reid, Parsons & Green, 1998).

Table 3
Summary of Studies on Preference Assessment Procedures for Individuals with SPMD

Study	# of Participants	Purpose	Results
Pace et al. (1985) *Journal of Applied Behavior Analysis, 18,* 249-255.	6 participants	To evaluate the effectiveness of a single stimulus presentation format for identifying reinforcers	Preferred stimuli identified for all participants functioned as reinforcers.
Wacker et al. (1985) *Journal of Applied Behavior Analysis, 18,* 173-178.	5 participants	To evaluate the effectiveness in using microswitches to identify reinforcers	Augmentative devices were effective for identifying reinforcers for all participants.
Dattilo (1986) *Journal of Applied Behavior Analysis, 32,* 111-114	3 participants	To evaluate the effectiveness of a computerized assessment in identifying preferences	Idiosyncratic patterns of preferences were observed across all participants.
Parsons & Reid (1990) *Journal of Applied Behavior Analysis, 23*, 183-195.	5 participants	To evaluate if participants showed preferences when choice-making opportunities were embedded within meal times	Participants showed preferences and exhibited choice-making skills.
		To evaluate concordance between caregiver opinions and preference assessment results	Caregiver opinions did not coincide with preference assessment results.
Parsons et al. (1990) *Journal of Applied Behavior Analysis, 23, 253-258.*	4 participants	To evaluate the effects of several choice-related variables on the work performance of individuals with SPMD	Participants engaged with work tasks more when they chose their tasks and when assigned to work on preferred tasks versus when assigned to work on nonpreferred tasks.
Green et al. (1991) *Journal of Applied Behavior Analysis, 24*, 537-552.	9 participants	To evaluate if reinforcers can be identified for individuals with SPMD	Reinforcers were identified for 4 of the 9 participants.
	6 participants	To evaluate concordance between caregiver opinions and preference assessment results	Caregiver opinions did not coincide with preference assessment results.
Fisher et al. (1992) *Journal of Applied Behavior Analysis, 25*, 491-498.	4 participants	To evaluate the effectiveness of the paired stimulus preference assessment in identifying reinforcers	This procedure resulted in greater differentiation among stimuli, and preferred items functioned as reinforcers.

Table 3 Continued

Study	# of Participants	Purpose	Results
Newton et al. (1993) *Journal of the Association for Persons with Severe Handicaps, 4,* 207-212.	14 participants	To evaluate the effectiveness of the Resident Lifestyle Inventory	Staff members activity preference ratings correctly predicted participant choices across 78% of total trials
Windsor et al. (1994) *Research in Developmental Disabilities, 15,* 439-455.	8 participants	To evaluate the effectiveness of a multiple stimulus format without replacement for identifying reinforcers	Items identified as high preferred via this procedure also functioned as effective reinforcers.
DeLeon & Iwata (1996) *Journal of Applied Behavior Analysis, 29*, 519-533.	7 participants	To evaluate the effectiveness of the MSWO presentation format in identifying reinforcers	MSWO method was effective in identifying reinforcers and took less time to administer than the paired stimulus method.
Fisher et al. (1996) *American Journal of Mental Retardation, 101*, 15-25.	6 participants	To evaluate the effectiveness of a checklist (RAISD) in identifying preferred stimuli	Reinforcers were identified from the set of stimuli generated by the caregivers using the RAISD checklist
Ivancic & Bailey (1996) *Research in Developmental Disabilities, 17,* 77-92.	15 participants	To evaluate if reinforcers can be identified for individuals with SPMD	Reinforcers were identified for 4 of 5 participants with no motor impairments. Reinforcers were identified for none of the 10 participants with minimal motor movements
Piazza et al. (1996) *Journal of Applied Behavior Analysis, 29*, 1-9.	4 participants	Compared Pace et al. (1985) method (SS) to Fisher et al. method (PS) in identifying reinforcers	PS presentation predicted relative reinforcer effects among stimuli better than SS presentation.
Green et al. (1997) *Journal of Applied Behavior Analysis, 30,* 217-228.	3 participants	To evaluate the effectiveness of using indices of happiness to identify preferences	Demonstrated a way of operationally defined passive approach behaviors in identifying preferences
Reid et al. (1998) *Journal of Applied Behavior Analysis, 31*, 281-285.	3 participants	To evaluate a pre-work assessment for predicting work-task preferences among workers with SPMD prior to beginning supported work	The assessment predicted tasks that the workers preferred to work on during their job routines.

Table 3 Continued

Study	# of Participants	Purpose	Results
Roane et al. (1998) *Journal of Applied Behavior Analysis, 31,* 605-620.	10 participants	To evaluate the effectiveness of FO procedure for identifying preferred stimuli	FO method was effective in identifying reinforcers and took less time to administer than the paired stimulus method.
DeLeon et al. (1999) *Journal of Applied Behavior Analysis, 19,* 445-448.	4 participants	To evaluate the effectiveness of a single-stimulus duration-based preference assessment in identifying reinforcers	Items identified as high preferred via this procedure also functioned as effective reinforcers.
Higbee et al. (1999) *Research in Developmental Disabilities, 20,* 63-72.	2 participants	To evaluate the effectiveness of using tangible, pictorial, and auditory modes of presentation in identifying reinforcers	Preferred items identified via the tangible presentation resulted in more potent reinforcers than preferred items identified via the pictorial presentation.
Matson et al. (1999) *Research in Developmental Disabilities, 20,* 379-384.	185 participants	To evaluate the effectiveness of a rating scale for identifying preferred stimuli	Rating scale was reliable for identifying preferences in individuals with SPMD.
Reid, Everson, & Green (1999) *Journal of Applied Behavior Analysis, 32,* 467-477.	4 participants	To evaluate concordance between caregiver opinions via person-centered plans and preference assessment results	Caregiver opinions did not coincide with preference assessment results.
Roscoe et al. (1999) *Journal of Applied Behavior Analysis, 32,* 479-493.	8 participants	Compared Pace et al. (1985) method (SS) to Fisher et al. method (PS) for identifying reinforcers	PS effective in assessing relative reinforcer effects whereas SS effective in examining absolute reinforcer effects.
Carr et al. (2000) *Journal of Applied Behavior Analysis, 33,* 353-357	3 participants	To evaluate the effectiveness of DeLeon et al. (1996) method (MSWO) in identifying reinforcers	MSWO method was effective in identifying reinforcers, and stable preferences were observed for 2 of the 3 participants after 1 month.
Gast et al. (2000) *Education and Training in Mental Retardation and Developmental Disabilities, 35,* 393-405.	4 participants	To evaluate the effectiveness of a 2-min brief preference assessment procedure in predicting level of responding	The brief preference assessment procedure had predictive value in identifying preferences that resulted in increased responding in the 5-min experimental session.

Table 3 Continued

Study	# of Participants	Purpose	Results
Higbee et al. (2000) *Research in Developmental Disabilities, 21,* 61-73.	9 participants	To evaluate the effectiveness of the DeLeon et al. (1996) method (MSWO) for identifying reinforcers	MSWO method was effective in identifying reinforcers for 6 of 9 participants.
Ortiz and Carr (2000) *Behavioral Interventions, 15,* 345-353.	3 participants	To compare Roane et al. (1998) method (FO) to Hanley et al. (2003) method (RR) for identifying reinforcers	Both methods were effective in identifying preferred stimuli that functioned as reinforcers.
Hagopian et al. (2001) *Journal of Applied Behavior Analysis, 34,* 475-485.	4 participants	To evaluate the effectiveness of DeLeon et al. (1999) method for identifying reinforcers	DeLeon et al. (1999) method accurately predicted reinforcer effectiveness across preferred stimuli.
Logan et al. (2001) *Journal of Developmental and Physical Disabilities, 13,* 97-122.	6 participants	To evaluate the effectiveness of a variation of Pace et al. (1985) for identifying preferences that functioned as reinforcers	Preferred stimuli were identified for all participants; however, they did not function as effective reinforcers.
Conyers et al. (2002) *Journal of Applied Behavior Analysis, 35,* 49-58.	9 participants	To evaluate the effectiveness of using a tangible, pictorial, and auditory mode of presentation in identifying reinforcers	Presentation modality affects accuracy of preference results, and systematic assessment of basic discrimination skills can be used to predict effectiveness of modality of presentation.
Graff & Gibson (2003) *Behavior Modification, 27,* 470-483.	4 participants	To compare pictorial preference assessments to tangible preference assessments in identifying reinforcers	Both modalities were effective in identifying preferences that functioned as reinforcers in 3 of 4 participants.
Hanley et al. (2003) *Journal of Applied Behavior Analysis, 36,* 47-58.	3 participants	To evaluate the effectiveness of the response restriction (RR) procedure when multiple items were presented simultaneously	RR procedure effectively identified reinforcers and yielded more differentiated patterns in preference when compared to the FO procedure.

Table 3 Continued

Study	# of Participants	Purpose	Results
Lancioni et al. (2003) *Journal of Visual Impairment & Blindness, 97,* 492-495.	2 participants	To evaluate the effectiveness of optic microswitches on identifying preferred stimuli	Participants used microswitches more frequently when access to preferred items was contingent on switch pressing.
Saunders et al. (2005) *Research in Developmental Disabilities, 26,* 255-266.	8 participants	To evaluate the use of microswitches for identifying preferences when 2 items attached to these devices were presented simultaneously	Participants used microswitches and differential preferences among stimuli were observed. Participants showed consistent choice-making behavior.
Vries et al. (2005) *American Journal on Mental Retardation, 110,* 145-154	9 participants	To evaluate the effects of using tangible, pictorial, and auditory modes of presentation in identifying reinforcers	Systematic assessment of basic discrimination skills can be used to predict effectiveness of modality of presentation.
Lancioni et al. (2006) *Journal of Visual Impairment & Blindness, 100,* 488-493.	2 participants	To evaluate the effectiveness of vocalization-activated microswitches on identifying preferred stimuli	Participants used microswitches more frequently when access to preferred items was contingent on switch pressing. Idiosyncratic patterns of preferences were observed across all participants.
Spevack et al. (2006) *Behavioral Interventions, 21,* 165-175.	2 participants	To compare passive approach responses to active approach responses to identify reinforcers	Passive approach responses were effective for identifying reinforcers when the same target responses were used across preference assessment and reinforcer assessment procedures.
Thomson et al. (2007) *Education and Training in Developmental Disabilities, 42,* 107-114.	15 participants	To evaluate if systematic assessment of discrimination skills predicts the best preference assessment procedure to be used with individuals with SPMD	Individuals who exhibited visual discrimination skills identified preferred stimuli using Pace et al. (1985) method and Fisher et al. (1992) method.
Lee et al. (2008) *Education and Training in Developmental Disabilities, 43,* 388-396.	7 participants	To compare 4 modalities of presentation (tangible, pictorial, video, and spoken language) in identifying reinforcers.	A systematic assessment of basic discrimination skills (e.g., ABLA) predicted the effectiveness of the type of modality of presentation to be used in identifying reinforcers.

Table 3 Continued

Study	# of Participants	Purpose	Results
Kodak et al. (2009) *Research in Developmental Disabilities, 30,* 1068-1077.	4 participants	To compare Windsor et al. (1994) method to Roane et al. (1998) method for identifying reinforcers	Windsor et al. (1994) was more effective for identifying reinforcers than Roane et al. (1998) method.
Lancioni et al. (2009) *Research in Developmental Disabilities, 30,* 689-701.	3 participants	To evaluate the effectiveness of using adapted microswitches and pressure devices to assess preferences among stimuli	Participants used microswitches more frequently when access to preferred items was contingent on switch pressing.
Shih & Shih (2009) *Research in Developmental Disabilities, 30,* 1196-1202.	2 participants	To evaluate the effectiveness of a newly developed mouse detector for identifying preferences	Frequency of target responses increased when participants used microswitches to access preferred items contingent on switch pressing.

SPMD = Severe and profound multiple disabilities; MSWO = Multiple stimulus without replacement; RAISD = Reinforcer assessment for individuals with severe disabilities; ABLA = Assessment of Basic Learning Abilities test; FO = free operant; RR = response restriction; PS = paired stimulus; SS = single stimulus.

CHAPTER III

METHODOLOGY

Participants

Two children with severe to profound multiple disabilities and limited toy play skills participated in this study. The participants were referred to the researcher from a local school district because each met the following inclusion criteria: (a) ranged in age from 3 to 17 years, (b) had severe to profound multiple disabilities, (c) possessed minimal toy play skills (less than two skill areas), and (d) were able to press a 12 cm button-style microswitch.

Violet was an 11-year-old female who was diagnosed with severe mental retardation, microcephaly, cerebral palsy, and autism. She was non-ambulatory and used a wheelchair. She was placed in a fifth-grade special education classroom. Violet had limited toy play skills, and increasing her toy play skills was included as an IEP goal for the current academic year. She consistently activated toys by pressing buttons but found it difficult to perform other motor tasks involved in toy play such as twisting a dial, sliding a knob, or pulling a lever. Based on parent and teacher report, she liked toys that provided visual (e.g., light up toys), auditory (e.g., musical toys), or a combination of visual and auditory stimuli.

Ariel was a 14-year-old female who was diagnosed with Sturge-Weber syndrome. She was non-ambulatory and used a wheelchair. She attended a sixth-grade special education classroom. Increasing toy play skills was an IEP goal for the current academic year. Ariel consistently operated toys that had buttons but experienced difficulties with toys that involved other motor skills such as twisting a dial, sliding a knob, or pulling a lever. Based on parent and teacher reports, she preferred toys that provided visual, auditory, and/or tactile stimuli, but mostly preferred toys that were musical.

Settings and Materials

All phases of the study were conducted in the participants' school in a room separate from the classroom. The room was approximately 3.35 m x 3 m and included a table, several chairs, a digital handheld camcorder (placed on a tripod), microswitches, and toys. For Violet, each session was conducted by the researcher with assistance from her teaching associate. For Ariel, each session was conducted by the researcher.

Ariel used a round microswitch (12 cm in diameter) that made a clicking sound when pressed. Violet used a square microswitch (10 cm x 10 cm) without the clicking mechanism.

Toys were initially selected for each participant based on parent and teacher reports. All toys were novel (i.e., participants had no previous histories of interacting with these toys). All toys were battery operated and provided visual, auditory, or tactile stimulation. The same five toys (ABC pad, karaoke, car, ring stacker, and caterpillar) were used for both participants, and a sixth toy (snake) was also used for Violet.

Based on initial baseline preference assessment results across these toys, a training toy and a reward toy were identified for each participant. A toy that consistently maintained high durations of toy engagement in preference assessments with a microswitch (*Microswitch plus Toys* condition) and lower durations of toy engagement in preference assessments without a microswitch (*Toys Only* condition) across three baseline preference assessment sessions was selected as the toy for skill training. A toy that consistently maintained high durations of toy engagement during preference assessments without a microswitch (*Toys Only* condition) and lower durations of toy engagement during preference assessments with a microswitch (*Microswitch Plus Toy* condition) across three baseline preference assessment sessions was selected as the reward toy during skill training. The ABC pad was identified as the reward toy for both participants. The ring stacker and the snake were identified as the training toy for Ariel and Violet, respectively.

Dependent Variables

Response Definitions

Data were collected on three dependent variables for both participants: toy engagement, independent target motor skills, and other motor skills. Toy engagement was defined as the duration of time spent within a 3-min session in hand-to-toy contact or hand-to-microswitch contact. During the *Toys Only* condition, toy engagement was defined as the participant's hand contacting the toy without prompting from the researcher or teaching associate. During the *Microswitch Plus Toy* and the *Microswitch Only* conditions, toy engagement was defined as the participant's hand contacting (Violet) or pressing (Ariel) the microswitch without prompting from the researcher or teaching associate. Toy engagement was scored as the duration of time the participant's hand contacted the toy or pressed or contacted the microswitch.

Independent target motor skills were defined as those required to operate the toy and included pushing a button, twisting a dial, turning a wheel, pulling down a lever, and taking out and placing items without physical prompting. These skills were taught to the participant during the second phase (skill training) of the study. Table 4 provides a list of the target motor skills required to operate each toy for both participants.

Other motor skills were defined as responses (e.g., rattling tail, rocking toy, shaking a ball) that although not targeted during skill training could be independently exhibited by the participant during preference assessment sessions for the training toy. Table 5 provides a list of other motor skills used to play with the training toy for each participant.

Data Collection and Inter-observer Agreement (IOA)

All observations were video recorded using a handheld digital camcorder for later data recording by trained observers. Laptop computers and behavioral data-collection software (i.e., Data-Pal) were used to collect data on toy engagement and independent target motor skills. The software allowed for duration and frequency measures of responses. A task analysis sheet was used to collect paper and pencil data on other motor skills.

For toy engagement, a duration key was switched on each time the participant's hand contacted a toy or pressed/touched the microswitch. The same key was switched off when the participant removed her hand from the toy or the microswitch. Toy engagement was reported in terms of percentage of total session time that the duration key was on. It was calculated by dividing the amount the duration key was on by the total session time multiplied by 100.

For independent target motor skills, a frequency key was pressed if a target skill occurred in the absence of physical guidance at any point during the session. A different frequency key was used for each target skill. Independent target motor skills were reported in terms of occurrence or non-occurrence of target skills for each session.

For other motor skills, a task analysis sheet was developed for each training toy (see Table 5). A tick mark was recorded for a specific motor skill to indicate the occurrence of the skill in the absence of physical guidance at any point during the session.

A second trained data collector independently scored sessions for toy engagement and independent motor skills. For toy engagement, duration data from both data collectors (primary and reliability) were transferred into 10-s intervals using a partial-interval scoring system. An agreement was scored when both observers recorded the same codes within an interval. IOA was calculated by dividing the number of intervals in which both observers agreed by the total number of intervals (agreements plus disagreements) multiplied by 100. For independent target motor skills, an agreement was scored if both data collectors recorded if a target skill occurred or did not occur during a session.

For Violet, IOA was collected for 31% of total sessions for the *Toys Only* condition, 31% of total sessions for the *Microswitch Plus Toy* condition, and 30% of total sessions for the *Microswitch Only* condition. For Ariel, IOA was collected for 31% of total sessions for the *Toys Only* condition, 31% of total sessions for the *Microswitch Plus Toy* condition, and 30% of total sessions for the *Microswitch Only* condition. Tables 6 and 7 summarize the mean IOA scores calculated for each dependent variable during each condition for Violet and Ariel, respectively.

Procedural Integrity Measures

Three measures of procedural integrity data were collected: (a) the delivery of noncontingent attention during all preference assessment sessions, (b) the activation and deactivation of the toy by the researcher during the *Microswitch Plus Toy* condition, and (c) the researcher's adherence to the graduated prompting system during Phase 2 (skill training) of the study.

The delivery of non-contingent attention was defined as the researcher's stating from two to three sentences or phrases on scripted topics (e.g., weather, participant's outfit, weekend, the week's activities, the day, vacations, facial expressions, feelings) on a fixed-time schedule of 25 to 35 s. Data on noncontingent attention were collected across 27% and 29% of total number of preference assessment sessions conducted for Violet and Ariel, respectively. A frequency key was pressed for each instance of attention delivered by the therapist during the session. Noncontingent attention was reported in terms of frequency of occurrences across each session. Correct occurrences were defined as occurrences that were recorded at an interval of 25 to 35 s during each preference assessment session. Procedural integrity was calculated by dividing the number of correct occurrences by the total number of occurrences (correct and incorrect) in each session multiplied by 100.

Activation and deactivation of the toy by the researcher were recorded if the toy was delivered within 3 s after the participant pressed the microswitch or removed her hand from the microswitch. Data on activation and deactivation of the toy by the researcher were collected across 31% of total number of preference assessment sessions conducted for each participant. Frequency keys were pressed as soon as the participant contacted or removed her hands from the microswitch (q key) and the researcher activated or deactivated the toy (r key). Activation or deactivation of the toy by the researcher and the microswitch by the participant were reported in terms of frequency of occurrences across the session. Correct occurrences were defined as every “q” response followed by an “r” response within 3 s. Procedural integrity was calculated by dividing the number of correct occurrences by total number of occurrences (correct and incorrect) multiplied by 100.

Procedural integrity data on the graduated prompting sequence were collected each time the researcher prompted a participant to engage with a toy. A vocal prompt was defined as a verbal direction being stated by the researcher (e.g., “Pick up the ball.”). A model prompt was defined as the researcher’s modeling the target motor skill to the participant (e.g., “Pick up the ball like this. Now you do it.”). A toy prompt was used for Violet within the graduated prompting sequence and was defined as the researcher’s placing the participant’s hand on the toy. A physical prompt was defined as the researcher’s physically guiding the participant to perform the target motor skill required to operate the toy. A different frequency key was pressed when a vocal prompt, model prompt, toy prompt, or physical prompt was delivered. Each prompt was reported in terms of frequency of occurrences across each session. Correct occurrences were defined as prompts delivered in a correct sequence (i.e., vocal prompt, then model prompt, then toy prompt, then physical prompt) before the participant performed the target motor skill for each trial. Procedural integrity was calculated by dividing the number of correct occurrences by total number of occurrences (correct and incorrect) multiplied by 100.

Scores for the three procedural integrity measures were later averaged across all sessions and are summarized in Table 8 for each participant.

IOA was collected on all procedural integrity measures. For noncontingent attention and activation and deactivation of the toy by the researcher, occurrence data were transferred into 10-s intervals using a partial-interval scoring system. An agreement was scored when both data collectors recorded the same codes within an interval. IOA was calculated by dividing the number of intervals in which both data collectors agreed by the total number of intervals (agreements plus disagreements) multiplied by 100. For the graduated prompting sequence, agreement was scored if both data collectors recorded if a specific prompt occurred or did not occur during a session.

For Violet, IOA was collected for 31% of total sessions for noncontingent attention and activation and deactivation of the toy by the researcher, and 25% of total sessions for the graduated prompting sequence. For Ariel, IOA was collected for 31% of total sessions for noncontingent attention and activation and deactivation of the toy by the researcher, and 33% of total sessions for the graduated prompting sequence. Table 9 summarizes the mean IOA scores calculated for each procedural integrity measure during each condition for Violet and Ariel.

Design

Data were collected within a combination multiple baseline (across participants) and multielement (across conditions) design. The study consisted of two phases: (a) preference assessments and (b) skill training. Phase 1 of the study (preference assessments) was conducted within a multielement design during which preference assessment sessions were conducted during baseline (prior to skill training), intermittently during skill training (i.e., after every third skill training session), and post skill training in a randomized order across three conditions: (a) *Toys Only*, (b) *Microswitch Plus Toy*, and (c) *Microswitch Only*. Duration of toy engagement or microswitch engagement (i.e., preference) was compared across the three conditions. During Phase 2 (skill training), a nonconcurrent multiple baseline design across participants was used to evaluate the effects of skill training on the participants' acquisition of independent target motor skills. Skill training sessions were initiated with the training toy following five baseline preference assessment sessions in the *Toys Only* condition for Violet and following nine baseline preference assessment sessions in the *Toys Only* condition for Ariel.

Procedures

Introductory Interview with Parents and Teachers

Before starting the study, the researcher interviewed each participant's parents and teacher. Each interview lasted between 15 and 20 min, and information was collected on the participant's diagnostic history, current repertoire of toy play skills, toy preferences (e.g., preferences for toys with visual, auditory and/or tactile stimuli), and amount of time spent in toy play during the day. Based on this information, five or six novel toys were selected for Phase 1 of the study. Sessions were conducted one (Violet) to three (Ariel) times per week.

Phase 1: Preference Assessments

Baseline preference assessments. Three single-item preference assessment sessions were conducted within each of the three conditions (*Toys Only*, *Microswitch Plus Toy*, and *Microswitch Only)* during baseline with five or six novel toys being selected for each participant prior to skill training.

Toys Only. During the *Toys Only* condition, one toy was presented to the participant (e.g., "It's time to play with this toy.") during each session. Toys were either placed on the participant's wheelchair tray or within arm's reach on a table in front of the participant. Before starting the session, the researcher demonstrated the motor skills required to operate the toy (see Table 4). After the demonstration, a timer was set for 3 min and the participant was allowed to contact or operate the toy directly. Noncontingent attention was provided by the researcher after every 25 to 35 s irrespective of the participant's toy engagement. No programmed consequences were delivered for appropriate (e.g., performing specific motor skills to operate the toy) behaviors. Inappropriate behaviors such as head hitting (for Ariel) and toy banging (for Violet) were neutrally blocked. As soon as the timer sounded, the researcher removed the toy and indicated that it was the end of the session (i.e., "All done with this toy.").

Microswitch Plus Toy. During these sessions, a microswitch was placed on the participant's wheelchair tray or within arm's reach on a table in front of the participant. The researcher held the toy in view of the participant but just beyond the participant's reach. Before starting the session, the researcher demonstrated pressing the microswitch (e.g., "It's time to play with this toy by pressing the switch."). Immediately after pressing the microswitch, the researcher activated the toy by demonstrating all the target motor skills required to operate it (see Table 4). After one or two demonstrations, a timer was set for 3 min and the participant was allowed to contact the switch. The researcher activated the toy within 3 s of the participant's pressing the microswitch and turned off the toy within 3 s of the participant's removing her hand from the microswitch. The researcher provided the participant with noncontingent attention in the same manner and on the same time schedule used during the *Toys Only* condition. No programmed consequences (e.g., praise) were delivered for appropriate (e.g., pressing or touching the microswitch) behaviors. Inappropriate behaviors such as head hitting (for Ariel) and microswitch banging (for Violet) were neutrally blocked. As soon as the timer sounded, the researcher removed the toy and indicated that it was the end of the session.

Microswitch Only. During these sessions, a microswitch was presented alone in the absence of any toy for a period of 3 min. The microswitch was placed on the participant's wheelchair tray or within arm's reach on a table in front of the participant. Before starting the session, the researcher initially demonstrated pressing the microswitch. After one to two demonstration trials, the timer was set for 3 min and the participant was allowed to contact the microswitch. The researcher provided the participant with noncontingent attention in the same manner and on the same time schedule used during the *Toys Only* and *Microswitch Plus Toy* conditions. No programmed consequences were delivered for appropriate behaviors. Inappropriate behaviors were neutrally blocked. After 3 min when the timer sounded, the researcher removed the microswitch indicating the end of the session.

Based on the results obtained from these initial preference assessments, one toy was identified for skill training and one toy was identified as a reward for Phase 2. Additional preference assessment sessions using the procedures described above (*Toys Only* and *Microswitch Plus Toy*) were conducted during baseline for both toys until consistently lower durations of toy engagement were observed with the training toy in the *Toys Only* condition as compared to the *Microswitch Plus Toy* condition and consistently higher durations of toy engagement were observed with the reward toy in the *Toys Only* condition as compared to the *Microswitch Plus Toy* condition. Consistently lower durations of toy engagement for the training toy indicated that the participant did not have the required motor skills to manipulate the toy. In contrast, consistently higher durations of toy engagement for the reward toy indicated that the participant had the pre-requisite motor responses to manipulate the toy. We also conducted an equal number of preference assessment sessions during the *Microswitch Only* condition to evaluate if low durations of engagement continued to be maintained. For Violet, five preference assessment sessions were administered for each condition for both toys. For Ariel, ten preference assessment sessions were administered for the *Toys Only* and *Microswitch Plus Toy* condition for the reward toy, nine sessions were administered for the *Toys Only* and *Microswitch Plus Toy* condition for the training toy, and nine sessions were conducted for the *Microswitch Only* condition.

Preference assessments during baseline served four purposes. The first purpose was to determine if different patterns of toy engagement occurred between toys when the participant engaged with the toy by contacting it directly (*Toys Only)* and when the participant engaged with the toy by pressing a microswitch (*Microswitch Plus Toy*). The second purpose was to determine if the participant activated the microswitch for different durations when pressing the microswitch activated a toy (*Microswitch Plus Toy)* and when pressing the microswitch did not activate a toy (*Microswitch Only*). High duration of engagement with the microswitch (averaged at least 50% or more across the sessions) suggested that the stimulation provided by pressing or touching the microswitch was sufficient to maintain the participant's responding and thus could not be used to assess preference for toys. The third purpose was to select a toy for skill training. The fourth purpose was to identify a highly preferred toy that would serve as a reward during skill training.

Preference assessments during skill training. Preference assessment probes for the training toy, the reward toy, and the microswitch were conducted after every third skill training session using the same procedures described for preference assessments during baseline. These probes were repeated until 80% toy engagement was observed with the training toy in the *Toys Only* condition. For Violet, eight preference assessment probes were administered for both toys in the *Toys Only and Microswitch Plus Toy* conditions. An equal number of probes were conducted in the *Microswitch Only* condition. For Ariel, three preference assessment probes were administered for both toys in the *Toys Only* and *Microswitch Plus Toy* conditions, and the same number of probes were conducted in the *Microswitch Only* condition.

Preference assessment probes during skill training served five purposes. The first purpose was to evaluate if acquisition of independent target motor skills was related to increases in duration of toy engagement for the training toy during the preference assessment probes for the *Toys Only* condition. The second purpose was to compare preference assessment results for the training toy obtained during baseline and during skill training. The third purpose was to determine if the participants would independently perform other motor skills (i.e., skills not taught during skill training sessions) with the training toy during preference assessment probes conducted in the *Toys Only* condition. The fourth purpose was to determine if the reward toy continued to remain highly preferred based on preference assessment results obtained in the *Toys Only* condition for the reward toy. The final purpose was to determine if engagement with the microswitch continued to remain low based on preference results obtained from the *Microswitch Only* condition.

Preference assessments: Post skill training. Single-item preference assessment sessions (*Toys Only*, *Microswitch Plus Toy*, and *Microswitch Only*) were conducted for all toys (i.e., 5-6 toys selected for Phase 1) post skill training. The same procedures were used as described in baseline. Preference assessments for the training toy and the reward toy across the *Toys Only* and *Microswitch Plus Toy* and the *Microswitch Only* conditions were conducted first. Preference assessments were then conducted for the remaining toys in the *Toys Only* and *Microswitch Plus Toy* conditions. For Violet, five preference assessment sessions were administered for each condition (i.e., *Toys Only and Microswitch Plus Toy*, and *Microswitch Only*) across the training toy, reward toy and microswitch, and three preference assessment sessions were administered across the *Toys Only* and *Microswitch Plus Toy* conditions for the remaining four toys. Post preference assessments were conducted over 6 weeks for Violet. For Ariel, 10 preference assessment sessions were administered within each condition (i.e., *Toys Only*, *Microswitch Plus Toy* and *Microswitch Only*) across the training toy and 9 preference assessment sessions were conducted for the reward toy and microswitch. Three preference assessment sessions were administered across the *Toys Only* and *Microswitch Plus Toy* conditions for the remaining three toys. Post preference assessments were conducted over 7 weeks for Ariel.

Post preference assessment sessions served two purposes. The first purpose was to evaluate if preference or duration of toy engagement for the training toy continued to remain at high levels (more than 80% toy engagement) across several weeks (over 5 weeks) following the completion of skill training. The second purpose was to evaluate if different patterns of toy engagement occurred between toys during the *Toys Only* and

Microswitch Plus Toy conditions of Phase 3 when compared to toy engagement results obtained during the *Toys Only* and *Microswitch Plus Toy* conditions of Phase 1.

Phase 2: Skill Training

Skill training sessions in the *Toys Only* condition were initiated following baseline preference assessment sessions to teach the participant target motor skills required to operate the training toy. Skill training sessions were conducted until 80% toy engagement was observed for the training toy. Each skill training session consisted of five trials or opportunities to exhibit a target motor skill with the training toy. During each trial, the researcher presented the training toy and waited 10 to 15 s until the participant performed the target skill. After 10 to 15 s, the researcher provided a vocal prompt to operate the toy. If the participant did not perform the target skill within 10 to 15 s, the researcher modeled the target skill to operate the toy. If the participant still did not to perform the target motor skill within 10 to 15 s, the participant was physically guided by the researcher to perform the target skill. After performing the target skill, the participant was praised enthusiastically and allowed to experience the sensory output of the toy (e.g., music or lights) for 15 to 20 s. The participant then gained access to the reward toy for 2 min. The timer was set for 2 min, and after the timer sounded, the reward toy was removed and the next trial was initiated.

Specific procedures for skill training for Ariel. Skill training sessions for Ariel consisted of the graduated prompting sequence (vocal prompt, model prompt, and physical prompt) to perform target motor skills to operate the training toy (i.e., ring stacker) as described above. All skill training sessions focused on teaching Ariel one motor skill (i.e., pushing the star button on top of the ring stacker). Three training sessions were conducted during this condition.

Specific procedures for skill training for Violet. Initial skill training sessions consisted of the graduated prompting sequence (vocal prompt, model prompt, and physical prompt) to perform the target skills as described in the general procedures with the addition of a toy prompt that was initiated during the seventh session and was continued in all subsequent training sessions. Each skill training session consisted of five trials or opportunities to exhibit target skills with the training toy. A total of 24 skill training sessions were conducted with Violet. Skill Training for Violet consisted of three steps: (a) Skill Training for Skills 1 and 2, (b) Modified Skill Training for Skill 1, and (c) Modified Skill Training for Skills 1 and 2.

Skill Training for Skills 1 and 2. During Training Sessions 1 through 6, Violet was directed to perform two target motor skills in sequence to operate the training toy (i.e., snake). The target skills consisted of picking up the ball (Skill 1) and pushing the ball down the snake's mouth (Skill 2). During each trial, the researcher presented the training toy and waited 10 to 15 s until Violet performed either of the two target skills. If Violet did not pick up the ball and push it down the snake's mouth within 10 to 15 s, the researcher provided a vocal prompt to perform the target skills (i.e., "Pick up the ball and push it down the snake's mouth."). The researcher then modeled the target skills (i.e., "You pick up the ball and push it down the snake's mouth like this. Now you do it.") if Violet did not perform either skill. If Violet still did not perform the target skills after 10 to 15 s, Violet was physically guided by the researcher to pick up the ball and push it down the snake's mouth. After Violet performed the target skills, prompted or unprompted, she was praised enthusiastically and allowed to experience the sensory output of the toy (e.g., music and tail rattling). Violet was then provided with the reward toy (i.e., ABC pad) and the timer was set for 2 min. When the timer sounded, the reward toy was removed and the next trial was initiated. Six training sessions were conducted during this step. Violet did not exhibit the target motor skills without physical prompting by the researcher.

Modified Skill Training for Skill 1. The training steps for Violet were changed to require her to perform only Skill 1 (i.e., pick up the ball) to gain access to the stimulation provided by the training toy and access to the reward toy. During each trial, the researcher presented the training toy and waited 10 to 15 s until Violet performed the first target skill. If Violet did not perform the skill, the researcher provided a vocal direction to perform the target skill (i.e., “Pick up the ball”) after 10 to 15 s. The researcher then modeled the target skill (i.e., “You pick up the ball like this. Now you do it”) after 10 to 15 s if Violet did not perform the skill. If Violet did not pick up the ball, a toy prompt was given that involved the researcher placing Violet’s hand on the toy. A toy prompt was initiated for each trial of Training Sessions 7 through 18 to help Violet contact the toy to perform Skill 1. If Violet did not engage with the toy within 10 to 15 s, she was guided by the researcher to pick up the ball. If Violet engaged with the toy within 10 to 15 s after receiving the toy prompt, the researcher waited until she picked up the ball without any physical guidance (i.e., not more than 5 min). After Violet picked up the ball, prompted or unprompted, she was praised enthusiastically, and the researcher pushed the ball down the snake’s mouth so that Violet could experience the sensory output (i.e., music and tail rattling) provided by the snake toy. Violet was then provided with the reward toy (i.e., ABC pad) and the timer was set for 2 min. When the timer sounded, the reward toy was removed and the next trial was initiated. Twelve training sessions were conducted during this step.

Modified Skill Training for Skills 1 and 2. After Violet performed target Skill 1 for three or more trials in each training session, the researcher initiated teaching Skill 2 (i.e., pushing the ball down the snake’s mouth). During each trial, the researcher presented the training toy and waited 10 to 15 s until Violet performed any of the target skills. Within 10 to 15 s, the researcher provided a vocal prompt (i.e., “Pick up the ball”) to perform the first target skill. If Violet did not perform the skill, a model prompt was provided after 10 to 15 s. This was followed by a toy prompt and then a physical prompt. After Violet performed Skill 1, prompted or unprompted, she was praised enthusiastically and redirected to the toy to perform target Skill 2 (i.e., pushing the ball down the snake’s mouth). The same prompting sequence (i.e., vocal prompt, model prompt, toy prompt, and physical prompt) was followed to teach her to perform the second target motor response. After Violet performed Skill 2, she was praised enthusiastically and allowed to experience the sensory output of the toy (e.g., music and tail rattling). Violet was then provided with the reward toy (i.e., ABC pad) and the timer was set for 2 min. When the timer sounded, the reward toy was removed and the next trial was initiated. The modified skill training sessions for Skills 1 and 2 (i.e., Training Sessions 19-24) differed from the first skill training condition (Skill Training for Skills 1 and 2) because the graduated prompting sequence was performed for each target skill separately. Also, access to the stimulation provided by the training toy and access to the reward toy were provided only following completion of target Skill 2. Six training sessions were conducted during this condition.

Table 4
Target Motor Skills for Each Toy Across Both Participants

Toy Name	Target Motor Skills to Operate a Toy	Sensory Output of Toy
ABC Pad	Pushing buttons Sliding knob from up to down Sliding knob from left to right	Auditory – Music Visual – Lights
Karaoke	Pushing buttons Sliding knob from up to down Twisting a dial	Auditory – Music Visual – Lights
Car	Pushing buttons Sliding lever from up to down Turning the steering wheel Twisting key	Auditory – Music Visual – Lights Tactile – Vibration
Caterpillar	Turning wheels Turning over pages Pushing buttons Sliding knob from left to right	Auditory – Music Visual – Lights
Ring stacker (Training Toy for Ariel)	Pushing big star button on top of the rings Taking off rings and star button Placing on rings and star button	Auditory – Music Visual – Lights
Snake (Training Toy for Violet)	Picking up ball Pushing ball down snake's mouth Sliding knob from left to right	Auditory – Music, Tail Rattling Visual – Lights

Table 5
Other Motor Skills for Training Toy for Each Participant

Toy Name	Motor Skills used to Engage with Toy	Sensory Output of Toy
Ring stacker (Training Toy for Ariel)	Placing hand on toy Holding the toy Rocking toy Moving rings around	Auditory – Music Visual – Lights
Snake (Training Toy for Violet)	Placing hand on toy Holding the toy Rattling tail Shaking balls Hitting balls in the tray against each other	Auditory – Music, tail rattling Visual – Lights

Table 6
Inter-observer Agreement for Dependent Variables: Violet

Conditions	Toy Engagement	Independent Occurrence of Target Motor Skills
Toys Only	90% Range (72% - 100%)	100% Range (100%)
Microswitch Plus Toy	98% Range (88% - 100%)	NA
Microswitch Only	88% Range (77%-100%)	NA

Table 7
Inter-observer Agreement for Dependent Variables: Ariel

Conditions	Toy Engagement	Independent Occurrence of Target Motor Skills
Toys Only	96% Range (88% - 100%)	100% Range (100%)
Microswitch Plus Toy	98% Range (88% - 100%)	NA
Microswitch Only	98% Range (88% - 100%)	NA

Table 8
Procedural Integrity Measures Across Both Participants

Participant Name	Non-contingent Attention	Activation and Deactivation of Toy by Researcher	Skill Training Prompts
Violet	86% Range (60% - 100%)	99% Range (60% -100%)	100% Range (100%)
Ariel	81% Range (33% - 100%)	100% Range (100%)	100% Range (100%)

Table 9
Inter-observer Agreement for Procedural Integrity Measures Across Both Participants

Participant Name	Non-contingent Attention	Activation and Deactivation of Toy by Researcher	Skill Training Prompts
Violet	88% Range (55% - 100%)	95% Range (77% - 100%)	100% Range (100%)
Ariel	90% Range (50% - 100%)	93% Range (66% - 100%)	100% Range (100%)

CHAPTER IV

RESULTS

Individual results for both participants are provided in the following order: (a) preference assessments across all toys, (b) preference assessments for the training toy, (c) preference assessments for the reward toy, (d) preference assessments for microswitch only, and (e) results of independent motor skills (target and other motor skills) across the training toy and reward toy. In each section, results for Violet are described first, followed by Ariel's results.

Results of Preference Assessments across All Toys

Baseline Preference Assessments

The results of baseline preference assessment sessions across all toys are displayed in the top panel (Violet) and third panel (Ariel) in Figure 1. The top panel shows baseline results on the percentage of toy engagement in the *Toys Only* condition and microswitch engagement in the *Microswitch Plus Toy* condition across six toys (i.e., ABC pad, karaoke, car, caterpillar, ring stacker, and snake) for Violet. The third panel shows baseline results on percentage of toy and microswitch engagement for each of the two conditions across five toys (i.e., ABC pad, karaoke, car, caterpillar, and ring stacker) for Ariel. The y axis denotes the percentage of total session time for toy/microswitch engagement and the x axis denotes the number of sessions conducted.

During baseline, for the ABC pad, Violet consistently showed a higher percentage of toy engagement (M = 92% of total session time) and a lower percentage of microswitch engagement (M = 44% of total session time) across all five sessions. This toy was identified as the reward toy for Violet. With the karaoke, similar levels of toy and microswitch engagement were observed. The mean percentage of toy engagement was 78% of total session time and the mean percentage of microswitch engagement was 74% of total session time. Also with the car, equivalent levels of toy and microswitch engagement were observed, and levels of toy and microswitch engagement remained high across both conditions. The mean percentage for microswitch engagement was 98% of total session time and the mean percentage for toy engagement was 95% of total session time. With the caterpillar, the levels of microswitch engagement (M = 76% of total session time) were similar to levels of toy engagement (M = 75% of total session time), although some modest variability was observed in engagement data across all three sessions. With the ring stacker and the snake, Violet consistently showed a higher percentage of microswitch engagement (ring stacker: M = 90% of total session time; snake: M = 89% of total session time) and a lower percentage of toy engagement (ring stacker: M = 60% of total session time; snake: M = 34% of total session time) across all baseline sessions. The snake was identified as the training toy for Violet.

Preference rankings based on baseline preference assessment results across all toys were also calculated for Violet in the *Toys Only* and *Microswitch Plus Toy* condition. These results are displayed in the top panel of Figure 2. These rankings were computed by averaging the percentage of toy engagement scores in the *Toys Only* condition and the percentage of microswitch engagement scores in the *Microswitch Plus Toy* condition for each toy during baseline preference assessment sessions. The rankings for each toy across both conditions are indicated by numbers placed in parentheses above each bar. The y axis shows the mean percentage of total session time for toy/microswitch engagement and the x axis shows the toys used with each participant. The results for Violet in the *Toys Only* condition indicated that the car received the highest ranking (M = 95% of total session time), followed by the ABC pad (M = 92% of total session time), the karaoke (M = 78% of total session time), the caterpillar (M = 75% of total session time), the ring stacker (M = 60% of total session time) and the snake (M = 34% of total session time). Different preference rankings were obtained for a few toys in the *Microswitch Plus Toy* condition. The results in the *Microswitch Plus Toy* condition indicated that the car received the highest ranking (M = 98% of total session time), followed by the ring stacker

((M = 90% of total session time), the snake ((M = 89% of total session time), the caterpillar ((M = 76% of total session time), the karaoke (M = 74% of total session time) and the ABC pad ((M = 44% of total session time). Based on these preference rankings the ABC pad was selected as the reward toy because relatively higher preference rankings were observed in the *Toys Only* condition than in the *Microswitch Plus Toy* condition, and the snake was selected as the training toy because relatively higher preference rankings were observed in the *Microswitch Plus Toy* condition than in the *Toys Only* condition.

Results of baseline preference assessment sessions showed a higher percentage of toy engagement (M = 64% of total session time) with the ABC pad when compared to microswitch engagement (M = 20% of total session time) for Ariel. The ABC pad was identified as the reward toy for Ariel, as she consistently showed higher levels of toy engagement than microswitch engagement across all baseline sessions. Similarly, a higher mean percentage of toy engagement (karaoke: M = 50% of total session time; car: 69% of total session time) was also observed with the karaoke and the car when compared to microswitch engagement (karaoke: M = 23% of total session time; car: 58% of total session time), although variability in engagement data occurred. With the caterpillar, variable levels of toy and microswitch engagement were observed and the mean percentage for toy engagement (M = 15% of total session time) was lower than the mean percentage for microswitch engagement (M = 35% of total session time). With the ring stacker, consistently lower levels of toy engagement (M = 18% of total session time) were observed when compared to levels of microswitch engagement (M = 59% of total session time). The ring stacker was identified as the training toy for Ariel, as she consistently showed a higher percentage of microswitch engagement as compared to toy engagement across all baseline sessions.

Preference rankings based on means of toy engagement and microswitch engagement scores obtained during baseline preference assessment sessions for each condition across all toys for Ariel are displayed in the third panel of Figure 2. The results in the *Toys Only* condition indicate that the car received the highest ranking (M = 69% of total session time), followed by the ABC pad (M = 64% of total session time), the karaoke (M = 50% of total session time), the ring stacker (M = 18% of total session time), and the caterpillar (M = 15% of total session time). Different preference rankings were observed in the *Microswitch Plus Toy* condition. The results in the *Microswitch Plus Toy* condition indicated that the ring stacker received the highest ranking (M = 59% of total session time), followed by the car (M = 58% of total session time), the caterpillar (M = 35% of total session time), the karaoke (M = 23% of total session time), and the ABC pad (M = 20% of total session time). Based on these preference rankings the ABC pad was selected as the reward toy because relatively higher preference rankings were observed in the *Toys Only* condition than in the *Microswitch Plus Toy* condition, and the ring stacker was selected as the training toy because relatively higher preference rankings were observed in the *Microswitch Plus Toy* condition than in the *Toys Only* condition.

Preference Assessments: Post Skill Training

The results of preference assessment sessions post skill training across all toys are displayed in the second panel (Violet) and fourth panel (Ariel) in Figure 1. The second panel shows post skill training preference assessment results on percentage of toy engagement in the *Toys Only* condition and microswitch engagement in the *Microswitch Plus Toy* condition across six toys (i.e., ABC pad, karaoke, car, caterpillar, ring stacker, and snake) for Violet. The fourth panel shows the same results for each of the conditions across five toys (i.e., ABC pad, karaoke, car, caterpillar, and ring stacker) for Ariel.

Post skill training, Violet continued to show high levels of toy engagement (M = 99% of total session time) for the ABC pad (i.e., the reward toy) and low levels of microswitch engagement (M = 32% of total session time) across the four preference assessment sessions. With the karaoke, levels of toy engagement continued to stay high (M = 91% of total session time) while levels of microswitch engagement were lower (M

= 49% of total session time). Higher percentages for toy engagement than for microswitch engagement were also observed for the remaining toys. Percentage of toy engagement continued to stay stable for the car (M = 99% of total session time) while a decreasing trend in microswitch engagement (M = 62% of total session time) was observed across sessions. Similar results were observed for the caterpillar, during which the mean percentage for toy engagement was higher (M = 99% of total session time) than the percentage for microswitch engagement (M = 26% of total session time). Also, results for toy engagement remained stable while an increasing trend in microswitch engagement for the caterpillar was observed across sessions. For the ring stacker, percentages for toy engagement continued to stay high (M = 93% of total session time) while lower percentages for microswitch engagement (M = 10% of total session time) were observed across sessions. For the training toy, the snake, Violet showed an increasing trend in toy engagement post skill training and a decreasing trend in microswitch engagement across sessions. Overall, the mean percentage of toy engagement was higher (M = 85% of total session time) than the mean percentage for microswitch engagement (M = 30% of total session time) for the snake. These data were different from baseline results as a shift in preference was observed. During baseline, levels of toy engagement were lower than microswitch engagement; however, during post skill training sessions, levels of toy engagement increased and were higher than levels of microswitch engagement.

Preference rankings based on post skill training preference assessment results for each toy across each condition are displayed in the second panel of Figure 2 for Violet. The results in the *Toys Only* condition indicated that the car, the ABC pad, and the caterpillar received a ranking of 1, as mean percentages of toy engagement were the same for all three toys (M = 99% of total session time). The ring stacker received a ranking of 4 (M = 93% of total session time), followed by the karaoke (M = 91% of total session time) and the snake (M = 85% of total session time). The results in the *Microswitch Plus Toy* indicated that the car received the highest ranking (M = 62% of total session time), followed by the karaoke (M = 49% of total session time), the ABC pad (M = 32% of total session time), the snake (M = 30% of total session time), the caterpillar (M = 26% of total session time), and the ring stacker (M = 10% of total session time)

Post skill training, Ariel consistently showed higher percentages of toy engagement (M = 83% of total session time) for the reward toy, the ABC pad, and lower percentages for microswitch engagement (M = 11% of total session time). Levels of toy and microswitch engagement for the ABC pad remained stable throughout post skill training preference assessment sessions. For the karaoke, the mean percentage for toy engagement (M = 43% of total session time) was higher than the mean percentage for microswitch engagement (M = 20% of total session time), although variability in toy engagement and a decreasing trend in microswitch engagement were observed across sessions. For the car, percentages of toy engagement were consistently higher (M = 60% of total session time) than percentages of microswitch engagement (M = 5% of total session time) across sessions. Similarly, higher percentages of toy engagement (M = 30% of total session time) were observed with the caterpillar when compared to percentages obtained for microswitch engagement (M = 8% of total session time) across sessions. For the training toy, the ring stacker, Ariel showed an increasing trend in toy engagement post skill training, and levels of microswitch engagement remained at zero or near zero across sessions except for one session during which microswitch engagement was at 72% of total session time. Overall, the mean percentage of toy engagement was higher (M = 81% of total session time) than the mean percentage for microswitch engagement (M = 9% of total session time) for the ring stacker. In addition, a shift in preference was observed post skill training relative to baseline sessions. During baseline, levels of toy engagement were lower than microswitch engagement; however, during post skill training sessions, levels of toy engagement increased and were higher than levels of microswitch engagement.

Preference rankings based on post skill training preference assessment results for each toy across each condition are displayed in the fourth panel of Figure 2 for Ariel. The results in the *Toys Only* condition indicated that the ABC pad (i.e., the reward toy) received the highest ranking (M = 85% of total session time), followed by the ring stacker (i.e., the training toy, M = 81% of total session time), the car (M = 60% of total session time), the karaoke (M = 43% of total session time), and the caterpillar (M = 30% of total session time). The results in the *Microswitch Plus Toy* condition indicate that the karaoke received the highest ranking (M = 20% of total session time), followed by the ABC pad (M = 11% of total session time), the ring stacker (M = 9% of total session time), the caterpillar (M = 8% of total session time), and the car (M = 5% of total session time)

Results of Preference Assessments for Training Toy

The results of toy/microswitch engagement for the training toy across both participants are displayed in Figure 3. The top panel shows toy engagement in the *Toys Only* condition and microswitch engagement in the *Microswitch Plus Toy* condition during baseline, skill training and post skill training for Violet. Results for Ariel are displayed in the same manner in the bottom panel. The y axis denotes the percentage of total session time for toy/microswitch engagement and the x axis denotes the number of sessions conducted.

Baseline Preference Assessments

Violet consistently showed high levels of microswitch engagement for the training toy (i.e., the snake) in the *Microswitch Plus Toy* condition, although a slight decreasing trend in engagement data was observed across baseline sessions. In comparison, lower levels of toy engagement were observed in the *Toys Only* condition and variability in engagement was observed across baseline sessions. Overall, the mean percentage of microswitch engagement was higher (M = 89% of total session time) than the mean percentage of toy engagement (M = 34% of total session time) for the training toy.

Ariel also consistently showed high levels of microswitch engagement for the training toy (i.e., the ring stacker) in the *Microswitch Plus Toy* condition, and an increasing trend in engagement data was observed across baseline sessions. When compared to toy engagement in the *Toys Only* condition, lower levels of engagement were observed across all sessions and percentage of toy engagement reached zero levels. Overall, the mean percentage of microswitch engagement was higher (M = 59% of total session time) than the mean percentage of toy engagement (M = 18% of total session time) for the training toy.

Preference Assessment Probes during Skill Training

During skill training, single preference assessment probes were conducted after every third skill training session for Violet. These results show a decreasing trend in microswitch engagement in the *Microswitch Plus Toy* condition during the first seven preference assessment probes and the percentage of microswitch engagement reached zero levels across these probes. However, during the last probe, a sudden increase in microswitch engagement to 60% of total session time was observed. In the *Toys Only* condition, variability in toy engagement was observed. As percentage of toy engagement reached criterion levels (i.e., above 80% or above toy engagement) during the last preference assessment probes, post skill training preference assessment probes were initiated. Overall, a shift in preference was observed as compared to baseline sessions, and the mean percentage of toy engagement (M = 42% of total session time) in the *Toys Only* condition was slightly higher than the mean percentage of microswitch engagement (M = 36% of total session time) in the *Microswitch Plus Toy* condition.

Ariel reached criterion levels for toy engagement (i.e., 80% or above toy engagement) after three skill training sessions, and hence post skill training preference assessment sessions were initiated. During these probes, an increasing trend in levels of toy engagement in the *Toys Only* condition and variability in levels of microswitch engagement in the *Microswitch Plus Toys* condition were observed. Overall, the mean percentage of toy engagement (M = 69% of total session time) was higher than the mean percentage of microswitch engagement (M = 49% of total session time) across preference assessment probes during skill training.

Preference Assessments: Post Skill Training

Post skill training, Violet consistently showed high levels of toy engagement in the *Toys Only* condition for the training toy, and an increasing trend in toy engagement was observed across preference assessment sessions. In comparison, lower levels of microswitch engagement in the *Microswitch Plus Toy* condition were observed. These results were maintained over a 6-week period following the last skill training session. Overall, the mean percentage for toy engagement (M = 83% of total session time) for the training toy was higher than the mean percentage for microswitch engagement (M = 30% of total session time) post skill training.

Similarly with Ariel, higher levels of toy engagement were consistently observed in the *Toys Only* condition when compared to microswitch engagement in the *Microswitch Plus Toys* condition during post skill training preference assessment sessions. An increasing trend in toy engagement and a decreasing trend in microswitch engagement to zero levels were observed. These results were maintained over a 7-week period following the last skill training session. Overall, the mean percentage of toy engagement (M = 81% of total session time) for the training toy was higher than the mean percentage of microswitch engagement (M = 9% of total session time) post skill training.

Results of Preference Assessments for Reward Toy

The results of toy/microswitch engagement for the reward toy across both participants are displayed in Figure 4. The top panel shows toy engagement in the *Toys Only* condition and microswitch engagement in the *Microswitch Plus Toy* condition during baseline, skill training, and post skill training for Violet. Results for Ariel are displayed in the same manner in the bottom panel. The y axis denotes the percentage of total session time for toy/microswitch engagement and the x axis denotes the number of sessions conducted.

Baseline Preference Assessments

During baseline, Violet showed high levels of toy engagement in the *Toys Only* condition for the reward toy (i.e. the ABC pad), and these levels continued to remain stable across all preference assessment sessions. In contrast, a decreasing trend in microswitch engagement to zero levels, in the *Microswitch Plus Toy* condition was observed across baseline sessions. These results indicate that mean percentage of toy engagement (M = 92% of total session time) for the reward toy was higher than the mean percentage of microswitch engagement (M = 44% of total session time) during baseline preference assessment sessions.

For Ariel, similar patterns in preference assessment results during baseline were observed for the reward toy (i.e., the ABC pad). Higher levels of toy engagement in the *Toys Only* condition were observed relative to lower levels of microswitch engagement in the *Microswitch Plus Toy* condition. These results indicate an increasing trend in toy engagement and variability in microswitch engagement across baseline preference assessment sessions. In addition, the mean percentage of toy engagement (M = 64% of total session time) for the reward toy was higher than mean percentage of microswitch engagement (M = 20% of total session time) during baseline preference assessment sessions.

Preference Assessment Probes during Skill Training

During skill training, Violet’s results for preference assessment probes conducted for the reward toy indicated high levels of toy engagement in the *Toys Only* condition and relatively lower levels of microswitch engagement in the *Microswitch Plus Toy* condition. These results were similar to the results observed during baseline for Violet. Also, these results show that toy engagement remained stable throughout all preference assessment probes. In contrast, variability in microswitch engagement was observed across sessions. Initially, a decreasing trend in percentage of microswitch engagement was observed; however, in the last session, a sudden increase in microswitch engagement was recorded (i.e., 84% of total session time). Overall, the mean percentage of toy engagement (M = 98% of total session time) for the reward toy was higher than the mean percentage of microswitch engagement (M = 21% of total session time) during these preference assessment probes.

For Ariel, similar patterns in preference assessment results during skill training were observed for the reward toy (i.e., the ABC pad). Higher levels of toy engagement in the *Toys Only* condition were observed relative to lower levels of microswitch engagement in the *Microswitch Plus Toy* condition. In addition, these results were similar to the results obtained during baseline. Overall, the mean percentage of toy engagement (M = 69% of total session time) for the reward toy was higher than the mean percentage of microswitch engagement (M = 9% of total session time) during these preference assessment probes.

Preference Assessments: Post Skill Training

Post skill training, Violet continued to maintain high levels of toy engagement for the reward toy in the *Toys Only* condition and low levels of microswitch engagement in the *Microswitch Plus Toy* condition. Similar to results obtained during baseline and skill training preference assessment sessions, the mean percentage of toy engagement (M = 99% of total session time) for the reward toy was higher than mean percentage of microswitch engagement (M = 32% of total session time) during these preference assessment sessions.

Ariel also continued to show high levels of toy engagement for the reward toy in the *Toys Only* condition and low levels of microswitch engagement in the *Microswitch Plus Toy* condition. These results were similar to the results achieved during preference assessment sessions at baseline and skill training. Levels of toy engagement were much higher relative to microswitch engagement, which reached near-zero levels across preference assessment sessions. Also, the mean percentage of toy engagement (M = 83% of total session time) for the reward toy was higher than the mean percentage of microswitch engagement (M = 10% of total session time) during these preference assessment sessions.

Results of Item Engagement for Microswitch Only

The results of microswitch engagement in the *Microswitch Only* condition across both participants are displayed in Figure 5. The top panel shows microswitch engagement in the *Microswitch Only* condition for Violet. Results for Ariel are displayed in the bottom panel. The y axis denotes the percentage of total session time for microswitch engagement and the x axis denotes the number of sessions conducted. The *Microswitch Only* condition served as a control condition to evaluate if repeated exposure to an item resulted in an increase in item engagement.

Baseline Preference Assessments

During baseline, Violet initially showed high levels of microswitch engagement; however, in later baseline sessions, microswitch engagement reduced to zero levels (M = 28% of total session time).

For Ariel, the percentage of microswitch engagement continued to stay low across all baseline sessions, and zero levels of microswitch engagement were observed in seven of the nine baseline sessions (M = 5% of total session time).

Preference Assessment Probes during Skill Training

During skill training, percentages of microswitch engagement during the *Microswitch Only* condition continued to stay low for Violet, except during the last preference assessment probe in which percentage of microswitch engagement was at 53%.

For Ariel, results of microswitch engagement showed a decreasing trend and continued to stay low during all preference assessment probes (M = 7% of total session time).

Preference Assessments: Post Skill Training

Post skill training, Violet continued to show low levels of microswitch engagement, and the percentage of microswitch engagement reached zero levels during the last two preference assessment sessions. The mean percentage of microswitch engagement across the four preference assessment sessions was lower (M = 7% of total session time) than the mean percentage of microswitch engagement obtained during baseline (M = 28% of total session time) and skill training (M = 12% of total session time).

For Ariel, percentages of microswitch engagement were at zero or near-zero levels across all post skill training preference assessment sessions. The mean percentage of microswitch engagement across all preference assessment sessions post skill training was lower (M = 1% of total session time) when compared to the mean percentage of microswitch engagement during baseline (M = 5% of total session time) and skill training (M = 7% of total session time).

Results of Independent Target Skills for the Training Toy and Reward Toy

The results of independent target skills for the training toy and reward toy during the *Toys Only* condition across both participants are shown in Figure 6. The top panel displays results of independent target skills for Violet and the bottom panel displays results for Ariel. The y axis denotes the number of target skills that could be emitted by the participants while operating each toy. A total of three target skills were specified for each toy, and a description of these skills for the training toys (i.e., the snake and the ring stacker) and the reward toy (i.e., the ABC pad) are provided in Table 4. The x axis denotes the number of sessions for each participant.

Baseline Preference Assessments

During baseline, Violet consistently exhibited one target skill (i.e., pushing the button) independently for the reward toy (i.e., the ABC pad) and zero target skills for the training toy (i.e., the snake) across all preference assessment sessions. Table 10 also provides information on the type of motor skills (i.e., target skills and other motor skills) that Violet performed with the training toy. These results indicate that Violet did not interact much with the toy and usually placed her hand on the toy during baseline sessions. On average, Violet displayed one motor skill per session to engage with the training toy across the five baseline preference assessment sessions.

Ariel also independently exhibited one target skill (i.e., pushing the button) for the reward toy (i.e., the ABC pad) in 8 of the 10 preference assessment sessions and zero target skills for the training toy (i.e., the ring stacker) across all preference assessment sessions. Table 11 provides information on the type of motor skills (i.e., target and other motor skills) that Ariel performed to interact with the training toy. These results show that Ariel on average performed 1.5 motor skills per session to engage with the training toy across the nine baseline preference assessment sessions. These included motor skills such as placing her hand on the toy, moving the rings on the stacker, and rocking the toy.

Preference Assessment Probes during Skill Training

During these sessions, skill training was initiated for the training toy for each participant, and preference assessment probes were conducted for the training toy and the reward toy after every third skill training session for each participant.

Violet continued to independently display one target skill (i.e., pushing the button) for the reward toy across all preference assessment probes. However with the training toy, zero target skills were observed during the first six skill training sessions (i.e., during skill training for Target Skills 1 and 2) and the first preference assessment probe. During the second preference assessment probe, Violet independently emitted Target Skill 1 (i.e., picking up the ball) and continued to independently display this skill across the next 12 skill training sessions (i.e., during modified skill training for Target Skill 1). For the next four preference assessment probes, Violet independently emitted target skill 1 in three of the four probes for the training toy. As Violet was able to independently exhibit Target Skill 1, skill training sessions for Target Skill 2 (i.e., modified skill training for Skills 1 and 2) were initiated. During these training sessions, Violet continued to independently exhibit Target Skill 1 in five of the six training sessions and also displayed this skill in one of the two preference assessment probes. However, Violet did not independently exhibit Target Skill 2 (i.e., pushing the ball down the snake's mouth) during these skill training sessions and subsequent preference assessment probes. In addition, Violet independently performed other motor skills (see Table 10) to interact with the training toy during the eight preference assessment probes. The results in Table 10 show that Violet on average performed 2.8 motor skills per session across the eight preference assessment probes indicating an increase in total motor skills (i.e., target and other motor skills) when compared to total motor skills observed during baseline preference assessment sessions. As Violet reached criterion of 80% or above toy engagement for the training toy during preference assessment probes, skill training was terminated and post skill training preference assessment sessions were initiated.

Ariel also continued to independently display one target skill for the reward toy (i.e., pushing buttons) across all three preference assessment probes during skill training. As zero target skills were observed during baseline preference assessment sessions for the training toy, skill training sessions for Target Skill 1were initiated. Ariel did not exhibit any independent target skills for the training toy during the three skill training sessions and during the first two preference assessment probes. However, she did independently exhibit Target Skill 1 (i.e., pushing the star button) for the training toy in the last preference assessment probe. In addition, similar to Violet, results in Table 11 indicate that Ariel performed more motor skills to operate the training toy during the three preference assessment probes. On average, Ariel performed 2.8 motor skills (i.e., total motor skills including target and other motor skills) per session across the three preference assessment probes. These motor skills included holding the toy, taking off rings, moving rings, and pushing the star button. As Ariel reached criterion of 80% or above toy engagement for the training toy during the preference assessment probes, skill training was terminated and post skill training preference assessment sessions were initiated.

Preference Assessments: Post Skill Training

Post skill training, Violet continued to independently exhibit one target skill (i.e., pushing buttons) for the reward toy across all sessions and one target skill (i.e. picking up the ball) for the training toy in three of the four preference assessment sessions. Table 10 shows that the number of total motor skills independently exhibited by Violet to operate the training toy continued to increase across post skill training preference assessment sessions. During these preference assessment sessions, on average, Violet engaged in three motor skills per session across the four preference assessment sessions. These motor skills included picking up the ball, hitting the ball in the tray against each other, shaking the ball, and rattling the snake's tail.

Ariel continued to independently perform one target skill (i.e., pushing buttons) for the reward toy and one target skill (i.e., pushing the star button) for the training toy across all preference assessment sessions post skill training. In addition, the number of total motor skills exhibited by Ariel with the training toy continued to increase across the 10 post skill training preference assessment sessions. On average, Ariel performed 3.7 motor skills per session across 10 preference assessment sessions. These skills included pushing the star button, taking off rings, placing hand on the toy, moving rings, rocking the toy, and holding the toy.

Figure 1: Results of Baseline and Post Skill Training Preference Assessments for All Toys across Both Participants

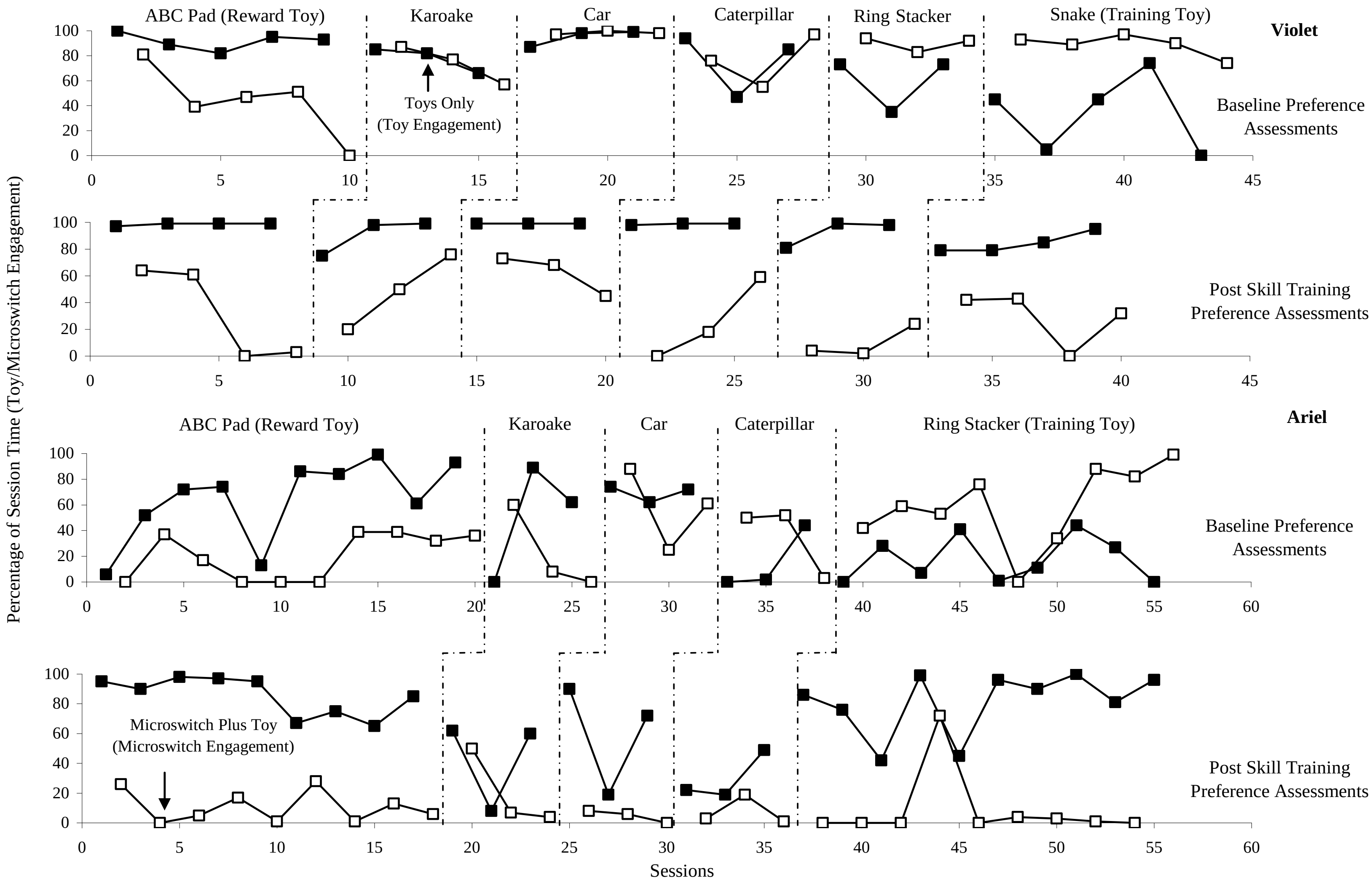

Figure 2: Results of Preference Rankings during Baseline and Post Skill Training Preference Assessments for All Toys across Both Participants

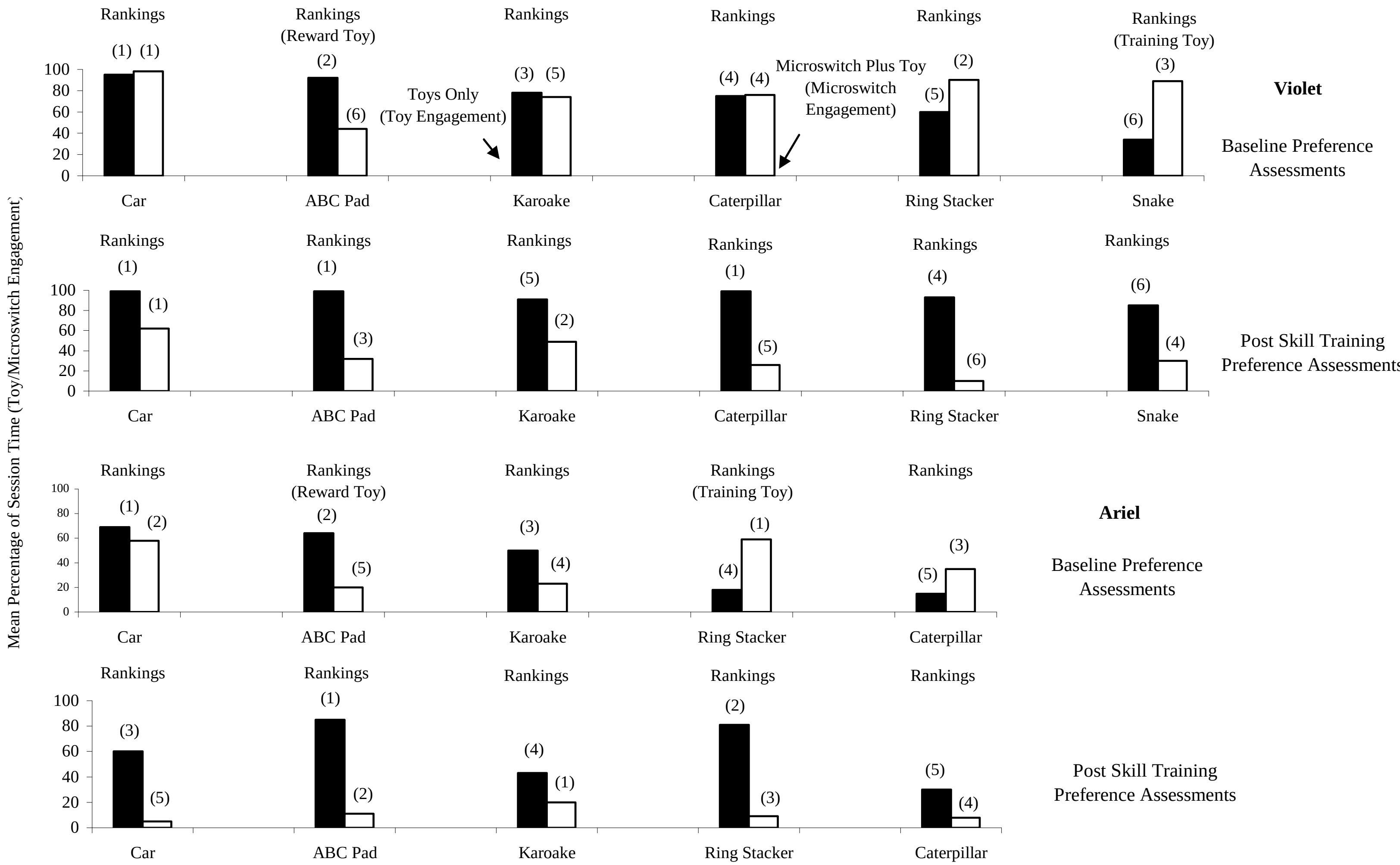

Figure 3: Results of Toy/Microswitch Engagement for Training Toy across Both Participants

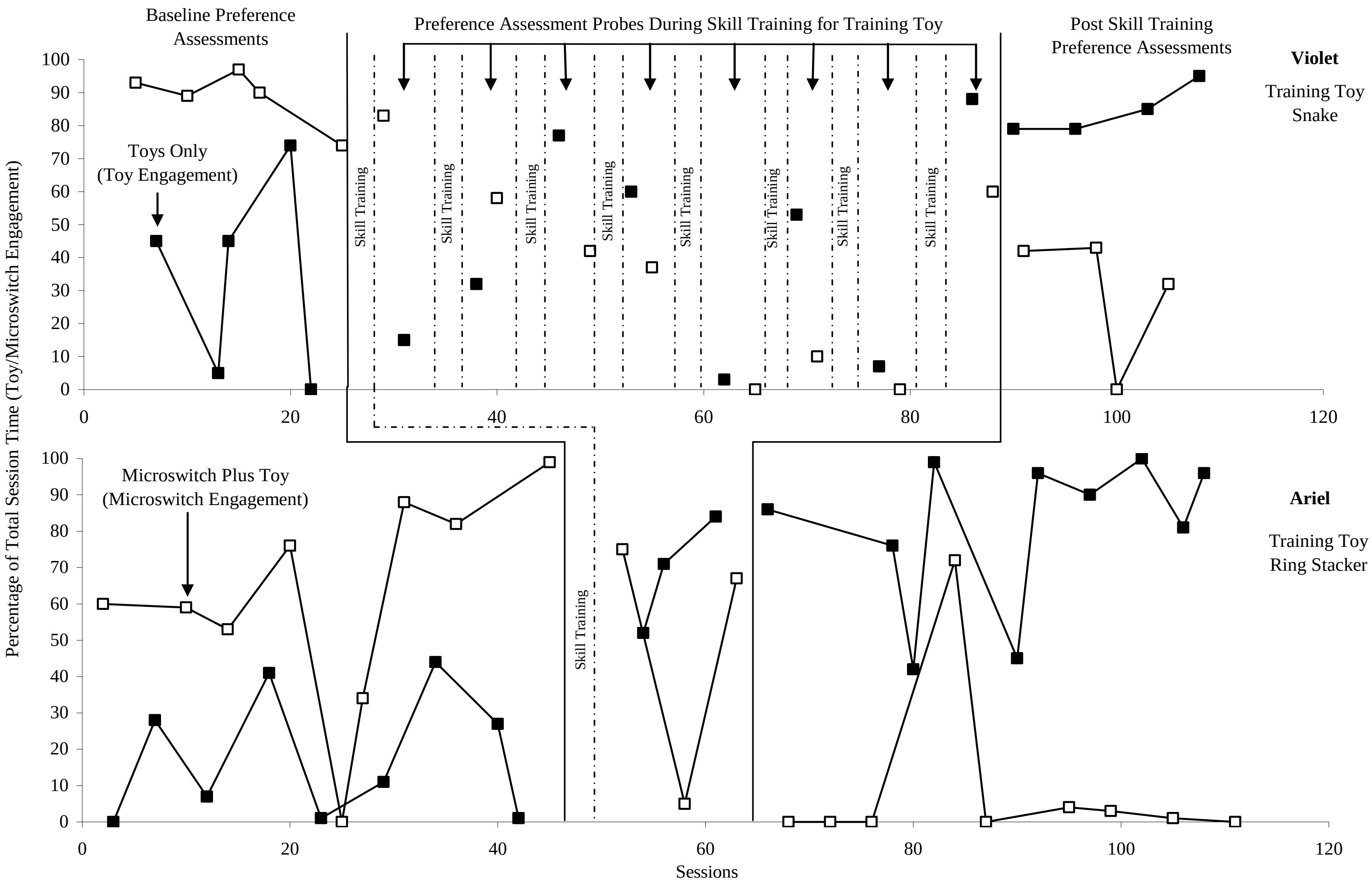

Figure 4: Results of Toy/Microswitch Engagement for Reward Toy across Both Participants

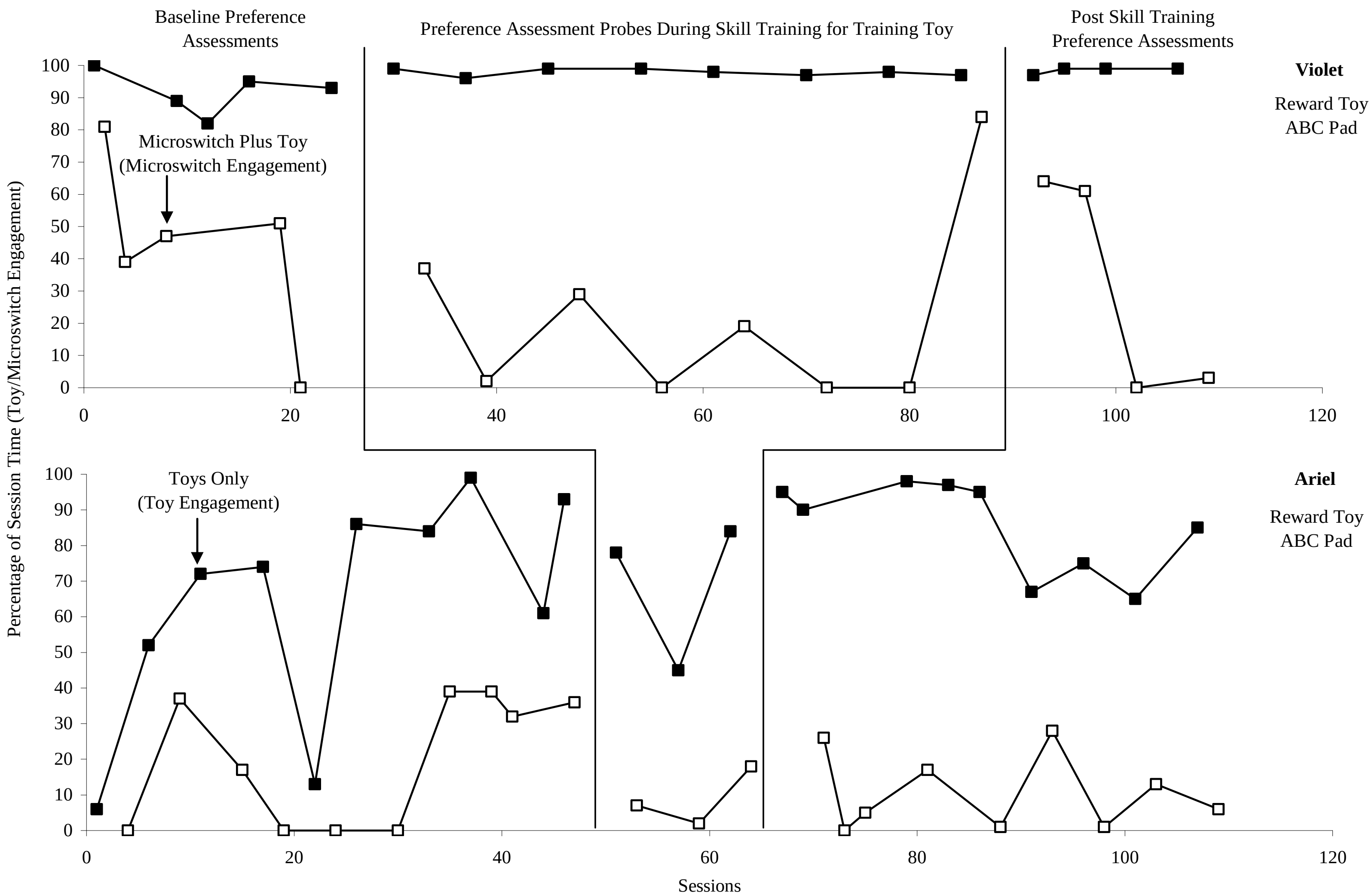

Figure 5: Results of Item Engagement for Microswitch Only across Both Participants

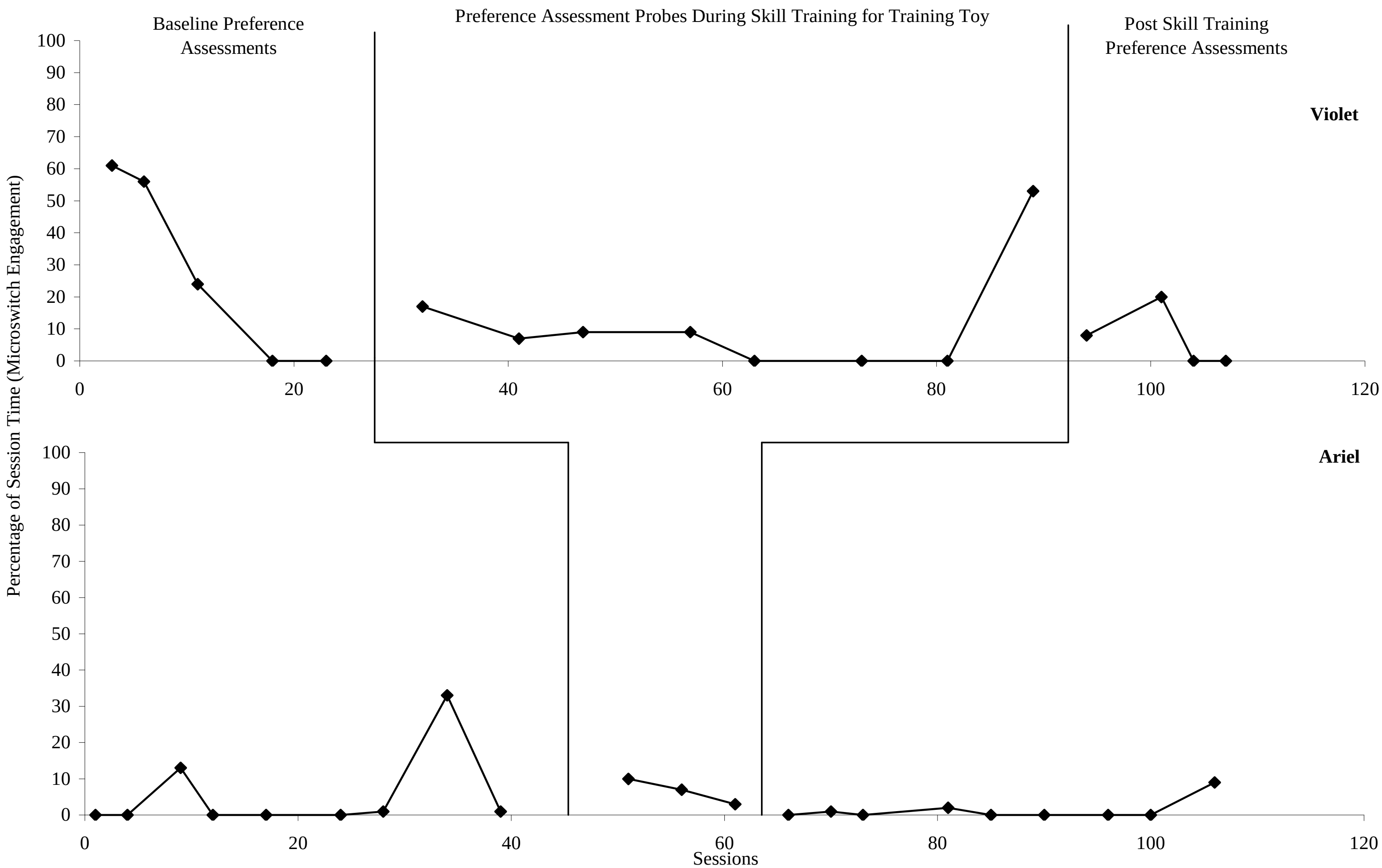

Figure 6: Results of Independent Target Skills for Training and Reward Toy across Both Participants

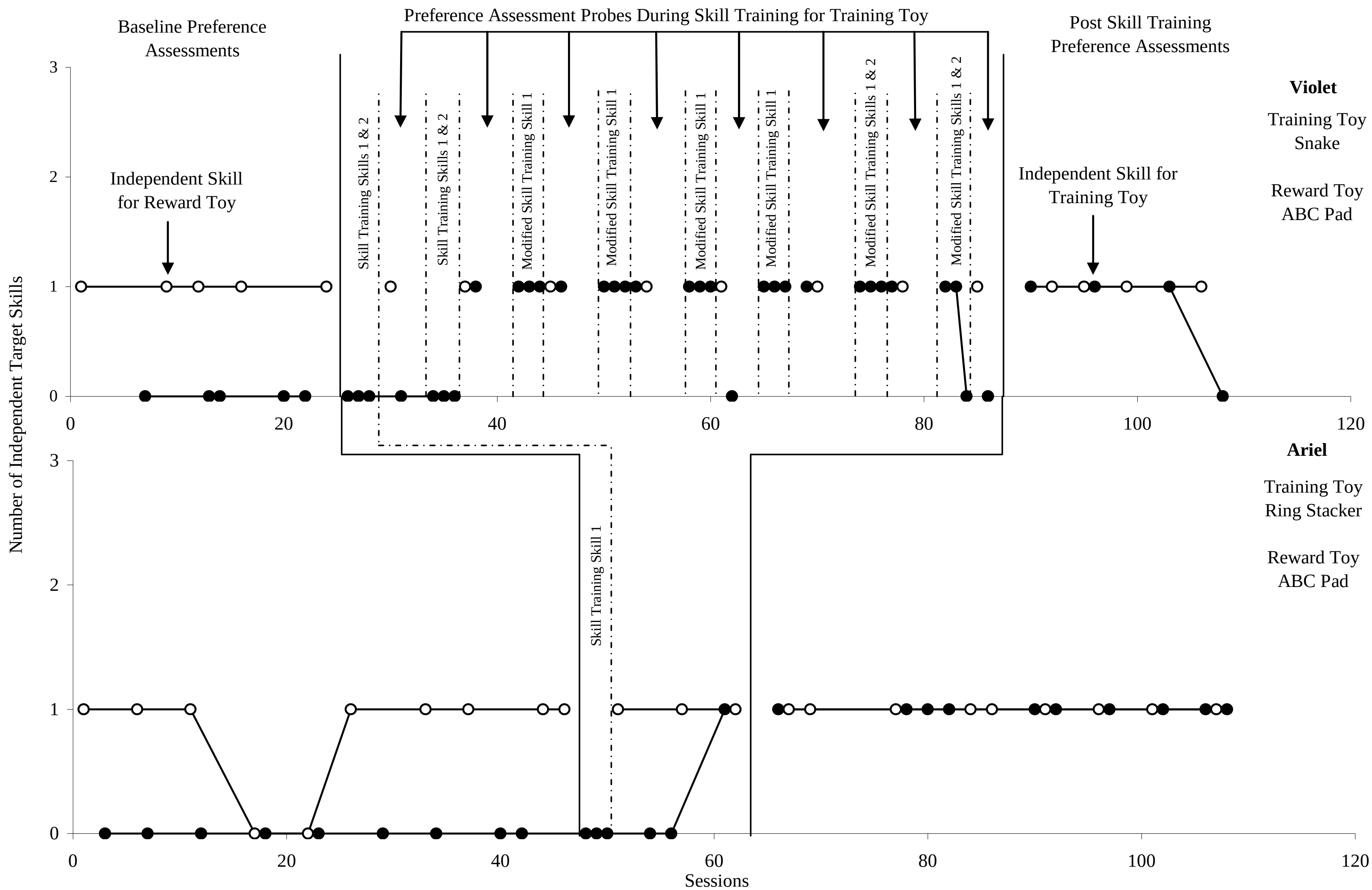

Table 10
Results of Target and Other Motor Skills Used by Violet to Operate the Training Toy (Snake)

Motor Skills	Preference Assessment Sessions for Training Toy (Snake) in Toys Only Condition															
	PA23	PA32	PA33	PA45	PA57	PA65	PA72	PA79	PA88	PA95	PA103	PA112	PA116	PA124	PA130	PA146
Target Skills																
Slide Knob from Left to Right																
Push Ball Down Snake's Mouth																
Picking Up Ball						X	X	X		X		X		X		
Other Skills																
Placing Hand on Toy	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Hitting Ball in Tray Against Each Other				X			X			X	X	X		X	X	X
Rattling Tail						X	X	X	X			X	X		X	X
Shaking the ball												X		X		

Table 11
Results of Target and Other Motor Skills Used by Ariel to Operate the Training Toy (Ring Stacker)

Motor Skills	Preference Assessment Sessions for Training Toy (Snake) in Toys Only Condition																					
	PA 63	PA 71	PA 83	PA 92	PA 97	PA 103	PA 108	PA 112	PA 116	PA 128	PA 131	PA 136	PA 141	PA 153	PA 155	PA 156	PA 165	PA 166	PA 171	PA 176	PA 181	PA 182
<u>Target Skills</u>																						
Putting On Rings																						
Taking Off Rings										X			X	X								X
Pushing Star Button												X	X	X	X	X	X	X	X	X	X	X
<u>Other Skills</u>																						
Placing Hand on Toy		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Moving Rings		X		X				X	X	X	X	X	X	X	X	X	X	X	X	X		X
Rocking Toy		X						X	X									X		X	X	X
Holding Toy												X							X	X		X

CHAPTER V

DISCUSSION

There were three purposes for conducting this study: (a) to determine if different patterns of preference were obtained when participants with SPMD were required to press a microswitch to access an item (i.e., the *Microswitch Plus Toy* condition) versus when they were required to directly operate an item (i.e., the *Toys Only* condition), (b) to evaluate if teaching specific skills to activate a toy resulted in increased toy engagement and a shift in preference towards the toy (i.e., the training toy) during the *Toys Only* condition, and (c) to evaluate if microswitch engagement in the *Microswitch Plus Toy* condition was affected after specific toy play skills were acquired.

Summary of Findings

Differences in Preference Patterns

Differences in preference were observed for both participants during baseline and post skill training. Preference within toys was represented in terms of differential responding observed in toy engagement during the *Toys Only* condition and microswitch engagement during the *Microswitch Plus Toy* condition. During baseline, different patterns of responding were observed during the *Toys Only* and *Microswitch Plus Toy* conditions for three of the six toys presented to Violet and for all five toys presented to Ariel. The ABC pad was identified as the reward toy for both participants because high levels of toy engagement occurred in the *Toys Only* condition and low levels of microswitch engagement occurred in the *Microswitch Plus Toy* condition. The snake and the ring stacker were identified as the training toys for Violet and Ariel, respectively, because high levels of microswitch engagement and low levels of toy engagement were observed in the two conditions. A possible explanation for these results is that participants were unable to activate some toys except by pressing the microswitch. Previous studies have used assistive technology to identify preferences for individuals with limited motor repertoires (Datillo, 1986; Lancioni et al., 2003; Lancioni et al., 2006;

Lancioni et al., 2009; Saunders et al., 2005; Shih & Shih, 2009; Wacker et al., 1985). Therefore, I hypothesized that microswitch engagement would be higher than toy engagement for toys that participants were unable to activate but that were preferred by the participants. In addition, participants would show preference toward activating toys by performing simple motor skills that were present within their current repertoire of motor responses (e.g., pressing the microswitch). This trend was observed for two toys for Violet (i.e., the ring stacker and the snake) and one toy for Ariel (i.e., the ring stacker) during baseline.

Differences in toy and microswitch engagement within toys resulted in differences in preference rankings across toys in the *Toys Only* and *Microswitch Plus Toy* condition during baseline. For example, with Violet, the ring stacker and the snake were the second and the third ranked toys in the *Toys Only* condition but were the fifth and sixth ranked toys in the *Microswitch Plus Toy* condition. The ABC pad was the second ranked toy in the Toys Only condition but the lowest ranked toy in the *Microswitch Plus Toy* condition. Similar results were obtained for Ariel. The ring stacker received the highest ranking in the *Microswitch Plus Toy* condition but the second to last rank in *Toys Only* condition. The ABC pad was the second ranked toy in the *Toys Only* condition but was lowest ranked in the *Microswitch Plus Toy* condition. If preference was based on results only from the *Toys Only* condition, preferences for some toys would have been missed. Therefore, these results suggest that differences in preference rankings were observed when different measures of assessing preferences were conducted

Skill Acquisition and Shift in Preference

The second purpose was to evaluate if teaching specific skills to activate a toy resulted in an increase in levels of toy engagement in the *Toys Only* condition during post skill training. Specifically, did acquisition of toy play skills result in a shift in preference for the training toy? This question was evaluated by conducting skill training sessions for the training toy and continuing preference assessment probes for the training toy during skill training and post skill training to evaluate if changes in preference patterns occurred. Preference assessment probes were also conducted for the reward toy to evaluate if levels of toy engagement continued to stay relatively high during skill training and post skill training. The *Microswitch only* condition served as the control condition and probes were conducted to evaluate if exposure to an item resulted in an increase in engagement.

Preference assessment results showed a shift in preference for the training toy in the *Toys Only* condition for both participants during skill training and changes in preference were maintained post skill training. For instance, with Ariel the training toy was ranked fourth during baseline but was ranked the second highest in the *Toys Only* condition during post skill training. Furthermore, participants showed a shift in preference towards operating the training toy directly instead of accessing the toy with a microswitch following skill training. Increases in levels of toy engagement relative to microswitch engagement during skill training were observed after both participants acquired one target skill. No changes in preference occurred with the reward toy for both participants and microswitch engagement in the *Microswitch Only* condition remained relatively low for Violet and consistently low for Ariel. Hence, these results suggest that skill acquisition resulted in a shift in preference for the training toys for both participants and that these results were maintained for both participants during post skill training.

Decreases in Microswitch Engagement for Toys

The third purpose was to evaluate if the participants' levels of microswitch engagement changed after they were taught a motor skill to directly operate the toys. Results indicated that decreases in microswitch engagement for the training toy were observed for both participants. Post skill training results indicated that percentage of microswitch engagement was consistently lower than percentage of toy engagement across all toys for both participants. These results were more pronounced for Violet who showed decreased microswitch engagement (*Microswitch Plus Toy* condition) and increased toy engagement (*Toys Only* condition) across all toys following skill training.

One possible explanation for the increase in toy engagement across all toys for Violet is that she may have developed new skills to operate the toys, even though they were not directly trained. Violet exhibited new skills with the ring stacker during post skill training that were not observed during baseline and this could have resulted in an increase in preference to manipulate this item directly. However, data on motor skills were not collected for toys other than the training toy and the reward toy and thus changes in motor skills for other toys were be directly analyzed.

Implications for Practice

These results extend the preference assessment literature on evaluating preferences for individuals with SPMD. Specifically, the results of the current study suggest that the motor response used to show item selection can affect the results of preference assessments. These results also indicate that assistive devices may be useful for identifying toys that participants prefer but do not have the motor skills to activate. With both participants, microswitches were used when they did not have pre-requisite skills in their current repertoire to operate certain toys. However after learning the target skills to operate the toy, direct toy contact was an appropriate means to assess preference.

The preference assessment literature has consistently documented challenges in identifying preferred stimuli and potential reinforcers for individuals with limited motor repertoires (Green et al., 1991; Ivancic & Bailey, 1996; Logan et al., 2001; Pace et al., 1985; Wacker et al., 1985). For instance, results obtained by Ivancic and Bailey (1996) indicated that preferred stimuli were identified for only 2 of 10 participants with severe orthopedic impairments. They suggested that alternative training programs be implemented with individuals who fail to demonstrate preferences. These training programs could include teaching approach responses such as reaching and grasping a toy, pressing a microswitch, and so on. Using assistive technology would be a starting point in assessing preferred stimuli for individuals with SPMD. The results of the current study suggest going a step further by conducting skill training programs documented in the toy play literature (DiCarlo et al., 2003; Haring, 1985; Schleien et al., 1981; Singh & Millichamp, 1987) to teach individuals with SPMD specific toy play skills. Following acquisition of toy play skills, single item preference assessments could then be conducted to further evaluate preference for various stimuli and to assess if skill training resulted in an increase in preference. This approach might be helpful in expanding the array of potential reinforcers available in teaching programs. In addition to identifying toy preferences among individuals with SPMD, increases in independent toy engagement might influence other forms of play such as social play (Schleien et al., 1981; Singh & Millichamp, 1987). Anecdotal information provided by school personnel suggested that increases in independent toy play and increases in social interactions with peers were observed with both participants when times allotted for toy play were scheduled as part of their daily routine.

Future Directions

In the current study, a toy identified as highly preferred in the *Microswitch Plus Toy* condition was selected as the training toy, and results showed that teaching toy play skills resulted in a shift in preference from using the switch to directly manipulating the toy. Thus, acquisition of toy play skills resulted in increased toy engagement in the absence of an assistive device. An extension of this study might evaluate if a similar shift in preference occurs with a low preferred toy (i.e., identified as low preferred in the *Toys Only* and *Microswitch Plus Toy* condition). Hence, would teaching specific motor skills to operate a low preferred toy result in an increase in toy engagement and a shift in preference?

Previous studies have shown that stimuli identified via a preference assessment did not function as effective reinforcers within a reinforcer assessment for individuals with SPMD (Green et al., 1991; Logan et al., 2001). In the current study, assessments to evaluate reinforcer effectiveness for toys identified as high preferred in the *Toys Only* and the *Microswitch Plus Toy* conditions were not conducted. Therefore, an extension of the current study is to conduct reinforcer assessments for the training toy and the reward toy to evaluate (a) the reinforcer effectiveness of these toys, and (b) if changes in preference were associated with alterations in the reinforcer value of both toys across participants.

Both participants engaged in low levels of problem behavior (e.g., head hitting and toy banging), and these behaviors were neutrally blocked during the study. Therefore we could not evaluate if acquisition of toy play skills and increased toy engagement affected rates of problem behavior. Hence an extension of this study is to assess if increases in toy engagement or acquisition of toy play skills are associated with reduced rates of problem behavior for individuals.

Limitations

One limitation of the current study is that the evaluations were conducted with only 2 participants. Evaluating more participants would further establish the generality of the findings.

A second limitation consisted of using the *Microswitch Only* condition as the control condition to evaluate if exposure to an item resulted in an increase in engagement. The microswitch did not provide any form of sensory stimulation to the participants and the absence of this stimulation may be responsible for the low levels of toy engagement. Identifying a second toy to function as the control toy might have better ruled out exposure or practice as an independent variable. A toy that was identified as highly preferred in the *Microswitch Plus Toy* condition but less preferred in the *Toys Only* condition could have been used as a control toy. With the control toy, skill training sessions would not be conducted but preference assessment probes would be conducted to evaluate if exposure to this toy resulted in increased toy engagement.

A third limitation of the study consisted of not collecting data on the occurrence of independent motor skills for the other toys presented to the participants. As the primary focus of the study was to evaluate if acquisition of motor skills resulted in a shift in preference for the training toy, data on independent motor skills were collected only for the reward toy and training toys. The lack of data on motor skills for other toys precluded an evaluation to explain the differences in toy and microswitch engagement between baseline and post skill training results.

Conclusion

Three major findings were suggested by the results of this study: (a) Differences in preference were observed when different measures of assessing preferences were conducted, (b) acquisition of specific motor skills resulted in changes in preference for items, and (c) acquisition of motor skills resulted in a decrease in preference for activating items via microswitches. These results extend the preference assessment literature by showing that the motor skills present within an individual's current repertoire affect toy preferences for individuals with SPMD.

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