

2010

Teaching Aquatic Skills To Children with Autism Spectrum Disorders

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TEACHING AQUATIC SKILLS FOR CHILDREN WITH AUTISM SPECTRUM
DISORDERS

By

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A Research Paper

Submitted in Partial Fulfillment of the Requirements for the
Master's of Science Degree

Department of Rehabilitation Institute

In the Graduate School

Southern Illinois University Carbondale

December 2010

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INTRODUCTION

Children should be getting 60 minutes or more of physical activity everyday (“Physical Activity for Everyone”, 2010), including children with autism spectrum disorders (ASD). Daily, physical activity is an essential part of staying healthy. Exercise can improve mood, mental health, bone and muscle strength, and help with weight control. Being physically active can also decrease the risk for certain diseases, such as cardiovascular disease, diabetes, and cancer. Three types of physical activity can help achieve the daily recommendations: aerobic, muscle strengthening, and bone strengthening, with aerobic activity recommended as the dominant type within the proposed 60 minutes per day.

Aerobic exercise involves any movement that increases the heart rate and causes the lungs to demand more oxygen (“Physical Activity for Everyone”, 2010). The general belief is that aerobic exercise promotes a healthier longer life. Swimming is a popular form of aerobic exercise that appeals to all ages, provides cardiovascular benefits while working the entire body, yet creates less joint stress than other forms of exercise. For children, swimming is considered a fun activity and, therefore, a good way to provide the advantages of exercise and gaining skills without the appearance of work. The appeal of swimming transcends many groups and has been shown to be a popular recreation activity for children with ASD (Killian, Joyce-Petrovich, Menna, & Arena, 1984).

ASD is a developmental disorder that appears during the first three years of life ("Autism", 2010). The three main characteristics of ASD include impairments in social interaction, lack of communication skills, and signs of repetitive behaviors. Other characteristics may include the following: resistance to change, a preference to being alone, tantrums, inappropriate laughter, limited eye contact, unresponsiveness to normal teaching methods, obsessive attachment to objects, repetition of words or phrases, difficulty in expressing needs, use of gestures or pointing instead of words, difficulty mixing in with others, no real fear of danger, and uneven gross and/or fine motor skills ("About Autism", 2010). Children with ASD may also be at risk for inactivity because of their social and behavioral limitations (Pan & Frey, 2006) mentioned above. Therefore, it is important to address positive options and habits with these children so they can continue to participate daily in physical activity (Sandt & Frey, 2005).

One constructive physical habit to introduce and nurture in children with ASD is swimming and organized swim lessons, which will have multiple benefits for them. By gaining aquatic skills in a fun recreational outlet, children also learn significant water safety aptitude while participating in the recommended necessary exercise. Swimming and aquatic experiences, such as instructive lessons, can provide essential opportunities for children with ASD and help promote physical, motor, social, and emotional values (Huettig & Melton, 2004), community participation (Sandt & Frey, 2005), develop responses to stimuli in the environment, facilitate language development and

self-concept, and improve adaptive behavior (Yilmaz, Yanardag, Birkan, & Bumin, 2004).

There is limited research showing the benefits of swimming for children with ASD, and few recent studies. Past research has concentrated on measuring: physical fitness, aquatic play skills, water orientation, beginner swim skills, and social behaviors, but more research is needed. The current research will focus on how children with ASD can gain aquatic skills using behavioral procedures in an everyday learn-to-swim program. Even though there is limited research available on children with ASD and swimming, that research provides a building block for the present study.

Killian, Joyce-Petrovich, Menna, and Arena (1984) observed the responses of 37 children, 32 males and 5 females, with ASD as they orientated to the pool and to beginner swimming skills. There was no pre-test, just a post design with no controls. Participants attended a state developmental community recreation program; 33 had participated in weekly pool instruction at the developmental center pool, and 4 had not used the pool.

The Aquatic Orientation Checklist (AOC) was created and used as the main observational tool for this study. The AOC was designed to record water orientation and beginner swim skills, and a behavioral scale was used to rate performance on each AOC item. The AOC items consisted of four water orientation skills and two beginner swim skills that were taken from one of the American Red Cross (ARC) swim programs in 1981. The four water

orientation skills were: walks to pool, touches water, enters pool, and sits or attains a horizontal position in pool. The two beginner swim skills were: blows bubbles and face submersion. The definitions on the behavioral scale were taken from several leisure assessment journal articles. The five behavioral ratings were: spontaneous, voluntary, demonstration, manipulation, and objection.

Two graduate school students served as observers, and one swim instructor was acquainted with the participants. Sessions were held during the participant's weekly recreation program. There were six sessions over a 3-week period. A session began as soon as the instructor and participant entered the pool area and the instructor positioned the participant close to the pool edge. The instructor then went through all six swim skills while the observer took data using the AOC. Verbal reinforcement was used, but limited to three brief statements (e.g., "good boy, John") during a session. The participant was removed from the pool area by the instructor when the observation was over. The observations lasted between 5 and 10 minutes and 5-13 participants were observed on a given day.

Results showed that participant's responded in a predictable and typical manner to the hierarchy of water skills and displayed a low objection rate (i.e., 1.4%-6.7%) to water activities; only a few participants (i.e., 2.7%-13.6%) required manipulation. The least difficult task in the study was the first skill (i.e., walks to pool) and the most difficult was the last task (i.e., submerge face). The results also show that the participant's spontaneity

decreased and the noncompliance increased as the tasks became more difficult. Pearson correlations showed a strong relationship between prior experience and water orientation ($r=.95$, $p<.01$). Another strong relationship was shown between age and water orientation ($r=.95$, $p<.01$).

These results led the authors to conclude that children with ASD enjoy and respond well to water activities. The results also showed that water activities may also offer potential learning opportunities and further research should investigate this subject. It can also be noted that predictable and apparently normal patterns were shown in the results when presented with a hierarchy of water tasks, which is noteworthy considering that children with ASD are characterized as having unstable behavior. This study went beyond the case studies and subjective reports that dominated the literature and involved one of the largest samples of participant's with ASD on swimming pool activities and children with ASD.

The acquisition of aquatic skills in children with ASD was studied by Huettig and Darden-Melton (2004) using a pre- and post-test design over 4 year period. Participants were four boys diagnosed with ASD between the ages of 3 and 9 years old. The targeted aquatic skills were water orientation, breathing, floating, stroke, and water entry and exit. The Texan Women's University (TWU) Aquatic Skills Assessment, a curriculum-based assessment, was used to assess the aquatic skills during the pre- and post phases. An instructional program created by Armbruster (1968), was used between the tests. The Armbruster method provided a hierarchy of aquatic

skills based on the key movement element of the human stroke or dog paddle. Aquatic lessons were carefully prepared, individualized, and monitored during the study. Many different teaching methods were used during the instructional period because of the individualized approach. Some of the methods used were: the teacher mimicking the student's behaviors, using toys and pool items for visual aides, using games in the water, using prompts, fading prompts and pool equipment, teaching the skill as a whole, and providing reinforcement.

The first target skill of water orientation had 15 components that were assessed. Some of those components included playing with toys in the water, sitting on the edge of the pool, kicking feet in the water, and splashing. The results for water orientation showed various findings. Swimmer B did not change his performance from the pre- to posttest. He stayed at 14 skills throughout the water orientation period. Swimmer A gained 5 skills from the pre- to posttest and swimmer C gained 7 skills. Swimmer D did not show an interest in the water orientation skills for the pre- or posttest; therefore, his data were not recorded for this phase.

The second target, breathing skills, had 15 components that were assessed. Some of those components included pretending to wash face in the water, blowing a ping pong ball on the water, and blowing bubbles. The results for breathing skills showed an increase of skills for all except one participant. Swimmer B, once again, did not change his performance from the pre- to posttest. He performed 14 skills throughout the breathing skills

period. Swimmer A gained 2 skills from the pre- to posttest, swimmer C gained 4 skills, and swimmer D gained 1 skill. The third target, floating skills, had 15 components that were assessed. Some of those components included floating on back, floating on stomach, and recovering from both floating positions. The results showed an increase in floating skills for all except one participant. Swimmer B did not change his performance from the pre- to posttest. He remained at 14 skills throughout the floating skills period. Swimmer A gained 3 skills from the pre- to posttest, swimmer C gained 4 skills, and swimmer D gained 1 skill.

The fourth target, stroke skills, had 60 components that were assessed. Some of those components included gliding, kicking, treading water, and performance of specific strokes. The results for stroke skills showed an increase of skills by all of the participants. Swimmer A gained 11 skills from the pre- to posttest, swimmer B gained 15 skills, swimmer C gained 2 skills, and swimmer D gained 20 skills. The fifth and final target, water entry and exit skills, had 9 components that were being assessed. Some of those components included climbing up and down the ladder, walking up and down the stairs, stepping in the water from the side of the pool, and jumping into the pool. The results for breathing skills showed an increase by all except one participant. Swimmer A, did not change his performance from the pre- to posttest. He performed at 4 skills throughout the water entry and exit skills period. Swimmer B gained 1 skill from the pre- to posttest, swimmer C gained 2 skills, and swimmer D gained 4 skills.

Overall, this study, using a carefully designed pre-post design with no control aquatic intervention program, showed improvement in aquatic skills by children with ASD over a 4 year period. Swimmer A and B showed the most improvement with gaining an average of 60-70 total skills. Swimmer C and D averaged 30-40 total skills gained from the pre- to posttest.

Research by Yilmaz, Yanardag, Birkan, and Bumin (2004) had only one subject, but three purposes. The first was to determine the effects of water exercise and swimming on motor performance and physical fitness. The second purpose was to observe the behavior of the subject as he became familiar with the pool. The third purpose was to observe the development of beginner swim skills in a child with autism.

The subject, a 9 year old boy from Turkey, completed a 10-week program that involved three different swim components. The first component tested physical fitness with seven tests. The first was a 6 minute walking test to determine the subject's peak VO₂. The second test assessed balance. The subject has to stand and balance on his right and left foot with eyes open and then closed. The third was the thrust test to assess agility. The fourth test determined power by observation of a standing broad jump. The fifth test used a hand dynamometer to measure grip strength. The sixth test measured muscle strength with shoulder flexion and knee extension. The seventh and final test for physical fitness was a 22.86m running test to measure speed.

The second component tested the same water orientation and beginner swim skills using the Aquatic Orientation Checklist (AOC) and behavioral rating scale as the Killian et al. (1984) study. The third component tested the duration of four behaviors before and after 10 weeks of hydrotherapy using a 45 minute video camera recording. The three stereotypical behaviors assessed were: swinging, spinning, and delayed echolalia, and a fourth behavior of no or late reaction to stimulus within 5 seconds. The hydrotherapy used the Halliwick Method, based on scientific principles of hydrodynamics and body mechanics. The Halliwick Method is divided into four phases: adjustment to water, rotations, and control of movement in water. This program was conducted over 10 weeks, 3 times a week for 60 minutes.

The results of this study showed an increase in all measures of physical fitness: balance, speed, agility, power scores, hand grip, upper and lower extremity muscle strength, and flexibility and respiratory endurance. The results for the second component show that the subject oriented to the water after swimming training during the AOC component. The results were similar to the results of the Killian et al. (1984) study. The subject's spontaneous movements decreased and the objection responses increased as the water orientation skills became more difficult. The results of the third component show that the subject's autistic behaviors decreased after hydrotherapy. The duration of swinging went from 7 minutes to 5 minutes,

spinning went from 2 minutes to 0 minutes, and delayed echolalia went from 4 minutes to 2 minutes.

Overall, the results show that swimming training and water exercises were effective for the development of water orientation and physical fitness abilities of a child with ASD. The authors state that the subject's noticeable interest in water activities suggests that swimming can be a valuable addition to education programs. Swimming was shown to be enjoyable for the subject and contributes to motor development. This was the first known study to measure the effects of swimming on physical fitness in a child with ASD and the authors suggest that more studies of this nature should be completed using more than one subject.

The effects of a constant prompt delay procedure on aquatic play skills of children with ASD was investigated using a single-subject multiple probe design across behaviors with probe conditions by Yilmas, Birkan, Konukman, and Erkan (2005). Four boys with ASD, ages 7-9 years old, participated. They met the five prerequisite conditions established before the study began: responding to visual and audio stimuli for at least 7-10 minutes, imitating gross muscle skills, regular restroom habits, no open wounds on the body, and getting into water at waist level. All participants did not have any experience or systematic intervention with errorless teaching using constant prompt delay procedures. Four researchers applied the intervention phase.

All phases of the study (i.e., instructional, probe, maintenance, and generalization) were conducted in an indoor swimming pool, divided into two

parts with a rope. Students participated in fun water activities with instructors on the right side of the pool and completed the intervention on the left side of the pool. All pool sessions occurred in a one-to-one format between student and instructor for 10 weeks, three times a week, for one hour in the mornings. The target behaviors (i.e., aquatic play skills of kangaroo, snake, and cycling) were randomly selected for this study and the task analyses were developed by all authors.

The probe conditions occurred prior to training each target behavior and after the criteria were met for that target behavior for a minimum of three sessions. The teacher presented a single opportunity and recorded the subject's response to the steps of the task analysis. During the instructional conditions, aquatic play skills were taught by using a 4 second constant prompt delay. Two delay intervals (i.e., 0 second and 4 second) were used. There were six types of possible responses during the instructional sessions: correct response, anticipations, errors, nonwait, wait, and no response.

Maintenance sessions were conducted one, two, and four weeks after the final probe condition and in the same manner as the probe conditions, except for thinning the reinforcement. Generalization was conducted across persons and was examined by a pre-post test design. The first generalization measure occurred before training and the last occurred at the end of teaching each target skill.

The results showed that constant prompt delay was an effective and easy way of increasing aquatic play skills of children with ASD. All four

subjects met the criteria after the introduction of the 4 second prompt delay. Subject 1 and subject 2 required 13 training sessions and a total of 29 minutes to reach criterion on all three skills. Subject 3 took 12 training sessions and a total of 21 minutes to reach criterion on all three skills. Subject 4 needed 12 training sessions and a total of 24 minutes to reach criterion on all three skills. All four subjects also maintained the aquatic play skills during the maintenance phases of one, two, and four weeks and stimulus generalization occurred.

This study shows that constant prompt delay and a task analysis can be used successfully in a short time, to teach and maintain aquatic play skills to children with ASD. This was the first research attempt to teach aquatic play skills with a constant prompt delay procedure. All of the participants became ready to learn actual swimming skills after learning how to perform aquatic play skills.

A study to determine the effectiveness of a water exercise swimming program (WESP) on aquatic skills and social behaviors of children with ASD was concluded by Chien-Yu Pan (2010). The participants were 16 males with mild or high-functioning ASD (n=8) or Asperger syndrome (n=8), who were between 6-9 years old, able to follow instructions, and had parental commitment to the program. Two research groups were created of equal size, 8 participant's in each group, and disability type for this study. Six of the participants had prior swimming experience and they were evenly distributed between the two research groups as well. The study was a total of 21 weeks

in duration: 10 weeks of WESP, 10 weeks of control, and 1 week of transition. Group A went through WESP during the first 10 weeks, had a 1 week transition, and then 10 weeks of control (e.g., regular treatment/activity). Group B started with the 10 weeks of control, 1 week of transition, and then went through 10 weeks of WESP.

The WESP program was designed according to the foundations of the Halliwick Method, which involves the natural progression of the way humans acquire physical movement. This method is rooted in the biomechanical principles associated with the aquatic environment rather than a learn-to-swim progression. Structured teaching, a feature of the TEACCH model, was also used during the WESP program. Structured teaching included organization of the physical environment (e.g., boundary markings), visual schedules, and work systems (e.g., picture boards to describe daily activities).

There were 20 sessions, 2 sessions per week, in the 10 week WESP intervention. Sessions were held at a local indoor hydrotherapy and swimming pool and lasted 90 minutes each. Every session was divided into four categories. The first category was a social warm-up with floor activities and lasted 20 minutes. The second category consisted of a one-to-two small group instruction and lasted 40 minutes. The third category, which lasted 20 minutes, included whole group games and activities and the fourth category, which lasted 10 minutes, consisted of cool-down activities. During a WESP session, two subjects were paired with one swim instructor for each session, allowing for individual instruction and participation in a group setting.

The study was a within-participant repeated-measures design. There was one aquatic skills measure and one social behavior rating being collected at three separate times: at the study entry to serve as a baseline, after the 10 week program, and 10 weeks after the program was completed. The measurement used to assess participants' aquatic skills was the HAAR checklist, based on the Halliwick Method. The HAAR checklist has five stages and each stage has a certain number of items. The five stages are: mental adjustment (5 items), introduction to water environment (10 items), rotations (3 items), balance and control (8 items), and independent movement in water (6 items). Data were collected within the stages and recorded on the table as percentage scores for each participant. The School Social Behavior Scales was used by the child's classroom teacher to rate the social behaviors of the child. Behaviors rated included: social competence (i.e., peer relations, self-management/compliance, and academic behavior) and antisocial behavior (i.e. hostile/irritable, antisocial/aggressive, and defiant/disruptive). Higher scores for the social competence scale indicated greater levels of social adjustment and higher scores, for the antisocial behavior scale, indicated greater levels of social behavior problems.

The results showed improvements in aquatic skills and social improvement for both groups following participation in the WESP program. Participants sustained improvements for at least 10 weeks after participating in the program. Limitations of this study included small age range, lack of female participants, and a low number of participants.

Each of the previously cited studies used different approaches to teach children with ASD aquatic skills or aquatic fitness. Killian et al. (1984) was the only study to use some of the features of the ARC swim program. ARC was founded in 1881 as a premier emergency response organization and has continued over the years to expand services (“A Brief History of the American Red Cross”, 2010), including the Swimming and Water Safety program. The ARC now calls the swim program, the Learn-to-Swim program.

The purpose of this program is to teach people to swim and help them be safe when they are in, on, or around the water (American Red Cross, 2004). The program teaches aquatic skills in a logical progression using six learn-to-swim levels. Level one teaches the introduction to water skills, level two teaches fundamental aquatic skills, level three teaches stroke development, level four teaches stroke improvement, level five teaches stroke refinement, and level six teaches swimming and skill proficiency. An aquatic student must pass the completion requirements and exit skills of each level before moving up levels.

The purpose of this study was to contribute to the previous research on teaching aquatic skills to children with ASD by creating a training package using aspects of the Learn-to-Swim program with behavioral procedures. The target skills were the seven Learn-to-Swim Level 2 exit skills. After an initial assessment using the Learn-to-Swim Levels 1-6 checklist, all three participants needed training in five of the seven exit skills. The training package included using shaping steps (Horner and Keilitz, 1978), a most-to-

least prompting hierarchy (MacDuff, Krantz, and McClannahan, 2001) and differential reinforcement when training each aquatic skill. A multiple probe design across responses (Horner and Baer, 1978) with replication across participants was used to show the results of the training package.

Maintenance and generalization were also assessed.

METHOD

Participants

Participants were previous clients of the Southern Illinois University Center for Autism Spectrum Disorders (CASD). Inclusion criteria were four skills that participants had passed on the Assessment of Basic Language and Learning Skills – Revised (ABLLS-R) (Partington, 2006) ; data were acquired from the CASD. The skills were joint attention (ABLLS-R A5), responds to instructor controlled reinforcement (ABLLS-R A6), following simple instructions (ABLLS-R C8), and rote counts to 10 (ABLLS-R2). Participants were excluded if they did not meet these four inclusion skills, or if they did meet the four inclusion skills and also passed all of the exit skills of the American Red Cross Learn-to-Swim levels tested during the pretest phase.

Jonathan, 6 years old and twin brother of Charlie, attended a 1st grade classroom 5 days each week. He was a previous client of the CASD. Jonathan had 2 years of previous swim lessons. His mom reported no problems during the previous lessons but wanted him to gain more swim skills.

Charlie, 6 years old and twin brother of Jonathan, attended a resource room for academic skills and a 1st grade classroom for non-academic activities (i.e., physical education, art, music, lunch, and recess) 5 days each week. Charlie shared a personal aide with another student during the school day. Charlie was a previous client of the CASD. Charlie had 2 years of

previous swim lessons. His mom reported no problems during the previous lessons but wanted him to gain more swim skills.

Dylan, 6 years old, attended a resource room for academic skills and a 1st grade classroom for non-academic activities (i.e., physical education, art, music, lunch, and recess) 5 days each week. Dylan shared a personal aide with another student during the school year. Dylan was a previous client of the CASD. Dylan had 6 months of previous swim lessons. His mom reported some problems during the previous lessons such as not wanting to leave and being very loud at times during the lesson. She also reported an interest in Dylan gaining more swim skills.

Aquatics Instructor

The aquatics instructor, who was also the experimenter, conducted all aspects of the research. The instructor held the following certifications with the American Red Cross: Water Safety Instructor (WSI), Lifeguard, First Aid, Cardiopulmonary Resuscitation, and Automated External Defibrillation. The WSI certification allowed the instructor to teach aquatic skills using the American Red Cross Learn-to-Swim levels. The Lifeguard certification indicated the instructor was qualified to watch for signs of distress and react, if necessary, during all lessons. In addition, the instructor was also a Certified Therapeutic Recreation Specialist and a graduate student in behavior analysis and therapy.

Setting and Materials

All phases of the experiment took place in an indoor heated pool at Real Rehabilitation in Vienna, Illinois. The pool setting was located in the back of a physical therapy building and included a 10.67 m by 9.14 m pool, two locker rooms with bathrooms, a drinking fountain, and an area with chairs for observers. The pool had one stair entry located at the shallow end, and three ladder entries located on each side of the pool deck. The pool depth ranged from 1.01 m to 2.74 m and had an average temperature of 90°F.

Training equipment (e.g., noodles, kick boards, and dive sticks) was located on the pool deck during the research. These items were used only for specific skills, such as initial floating, kicking, and underwater skills. Preferred items, determined by a weekly preference assessment, also were present at the pool for all phases of the experiment. During the pretest, toys were in a pail next to the pool deck and available to the participant after the skills evaluation was completed. During training, toys also were in a pail next to the pool deck, but were only accessible to the participant contingent on a correct response.

Pre-Training Procedures

Parent Survey. Several weeks prior to the pretest, parents of the participants were given written information concerning the purpose and nature of the experiment, and informed that the research was approved by the University's Institutional Review Board. The parents or guardians signed permission to participate forms and completed survey questions before the experiment began. The survey included information about their children's

aquatic history, including their behavior in a swimming pool and during swim lessons. Additionally, information was obtained about potentially aversive stimuli associated with the pool environment, as well as the participant's stimulus preferences. The survey helped identify items for the preference assessment, guide the development of the training procedures, avoid aversive stimuli (e.g., loud sounds) that were not part of the experimental procedures, and allow the experimenter to gather preferred items before the experiment began.

Preference Assessment. Once a week during the experiment, the parent rank ordered items (e.g., beach ball, inner tube) or pool activities (e.g., jumping in the pool, going underwater) identified by the parent survey and also selected by the experimenter from most-to-least preferred. The top six items ranked by the parents were used in the child's preference assessment. A multiple stimulus without replacement preference assessment (DeLeon and Iwata, 1996) occurred at the pool to ensure that currently preferred items would be used as potential reinforcers.

The preference assessment was conducted by the experimenter who presented the six highest ranked items that session horizontally on the pool deck in front of the participant. The participant was instructed to select an item or picture of an activity, and allowed approximately 10 s to manipulate or perform it, after which it was removed from the array. This selection process was repeated until all items had been chosen. Selection was repeated five times, until a clear preference hierarchy was shown. The experimenter

recorded which items the participant selected, and those selected most frequently were used as potential reinforcers for that session.

Aquatic Skills Pre-test. All participants had an initial assessment based on an aquatic skills checklist taken verbatim from the American Red Cross Water Safety Instructor's Manual (American Red Cross, 2004). The checklist included six Learn-to-Swim Levels: a) Level 1 Introduction to Water Skills, b) Level 2 Fundamental Aquatic Skills, c) Level 3 Stroke Development, d) Level 4 Stroke Improvement, e) Level 5 Stroke Refinement, and f) Level 6 Swimming and Skill Proficiency. Each of the six levels have a specific number of exit skills to indicate proficiency. Testing began at Level 1 and continued until participants did not pass all of the exit skills for a given level. All participants passed the seven Level 1 exit skills, but only a few of the seven Level 2 exit skills; therefore, training began with the Level 2 exit skills. Table 1 shows the seven exit skills for Level 2.

Pretest instructions consisted only of the verbal request to perform the target skills (e.g., "Show me a back float and count to 5"). Response consequences for each aquatic skill consisted of descriptive praise contingent on appropriate responding; inappropriate responding or problem behavior resulted in the termination of the assessment for that skill. These natural contingencies were intended to replicate those that typically occur during an actual ARC aquatic assessment. Prompting was not used during the pretest.

Data Collection

The primary data collector was the experimenter (i.e., aquatics instructor). During baseline, maintenance, and generalization probes, the experimenter collected data on the occurrence or non-occurrence of target behaviors (i.e., aquatic exit skills) on the 10 trials within a trial block. A “+” was recorded if the participant complied with a request for a specified target behavior. A “-” was recorded if the participant did not comply with a request for a specified target behavior. During training, the experimenter collected data on the occurrence or non-occurrence of target behaviors (i.e., aquatic exit skills) on each training trial.

Trials

A discrete trial consisted of an instruction from the experimenter, a response by the participant, followed by the response consequence, and an inter trial interval. Individual trial duration ranged between 5-20 s, and were conducted in blocks of 10 trials.

Interobserver Agreement

Interobserver agreement (IOA) was taken between the experimenter and an undergraduate student who was a secondary observer. She was trained by verbal instruction, review of operational definitions with the experimenter, observation of aquatic skills demonstrated by the experimenter, scoring the experimenter’s performance, and performance feedback. The secondary observer was considered reliable when she scored three consecutive skill demonstrations by the experimenter with at least 80% agreement with the experimenter. After the observer was trained, she

collected data for 30% of the baseline and training trials. Interobserver agreement was calculated by dividing the percentage of trials that both observers agreed on scoring by the number of agreements plus disagreements and multiplying by 100%.

After the observer was trained, she collected data at the pool while the experimenter and participant were in the water. IOA was taken during baseline, training, and maintenance on the participant's compliance to perform an exit skill during these phases. Reliability on Jonathan's compliance was 97% during baseline, 93% during training, and 98% during maintenance. Reliability on Charlie's compliance was 92% during baseline, 96% during training, and 95% during maintenance. Reliability on Dylan's compliance was 95% during baseline, 97% during training, and 96% during maintenance.

Experimental Design

A multiple probe design across responses was replicated across three participants. Data collection for the seven exit skills for each participant began on the same day. Maintenance and generalization probe sessions followed training.

Baseline

After the pretest was completed, baseline began on each of the seven exit skills from Level 2. No prompts or response consequences were provided during baseline. The following is an example of baseline testing for the skill of stepping from side into chest-deep water. The experimenter

started with gaining the participant's attention by making eye contact. After the participant's attention was gained, the experimenter said, "It's time to get in the water using the side of the pool". If the participant did not comply or engaged in problem behavior, the experimenter stopped the demand and then repeated it nine more times to complete a trial block. After three consecutive trial blocks showing stable baseline performance, training began for this exit skill while baseline data was initiated on the next exit skill. If the participant responded correctly after three consecutive trial blocks of stable and correct baseline data, this exit skill entered the maintenance phase while baseline data was initiated on the next exit skill. This baseline testing procedure continued until all exit skills had three consecutive and stable, criterion trial blocks.

Training Procedures

After baseline data were taken on all exit skills, training on the first skill that did not meet maintenance criterion (i.e., three data points from three trial blocks at 0-80%) then began, while the other skills not meeting maintenance criterion continued in baseline. After the first exit skill showed a stable, criterion level of responding during training, training of the second skill began while the other skills continued in baseline. After the second skill showed stable, criterion level responding during training, training of the third skill began and so on until all skills were trained.

A most-to-least prompting hierarchy (e.g., verbal instruction with full physical guidance, partial physical guidance, modeling, gestural, and no-help)

was used to train each skill. The following is an example of training the back float for 5 s using a most-to-least prompting procedure and starting with the first shaping step. See table 2 for the shaping steps for each Level 2 exit skill. The prompts used for this skill included: full physical, partial physical, modeling, and no-help. The experimenter gained the participant's attention by making eye contact. Subsequently, the experimenter presented the instruction, "Show me a back float for 1 s" and physically supported the participant on top of the water. After three correct responses with full physical support, the experimenter repeated the verbal instruction and partially supported the participant on top of the water (e.g., the experimenter placed her hand under the participant's back and applied slight pressure to keep the participant floating on top of the water). After three correct responses with partial physical guidance, the experimenter repeated the verbal instruction and modeled the back float. After three correct responses with a modeling prompt, the experimenter gave the verbal instruction with no additional help and waited 5 s for an independent response.

After three correct and independent responses with verbal instruction only, the experimenter then moved on to the next shaping step (i.e., "show me a back float for 3 s") starting with a full physical prompt and continuing using most-to-least prompting until the participant completed all of the shaping steps. After the participant completed three correct and independent responses for the final shaping step, the skill was probed under baseline conditions for three consecutive trials blocks (i.e., 10 trials in one block) at

criterion level (i.e., three data points from three trial blocks at 90-100%). After the participant met the criterion level, the skill was placed on maintenance and the experimenter moved on to train the next exit skill.

Response Consequences. Correct responses during training resulted in descriptive verbal praise and brief access to preferred items or activities, determined during the weekly preference assessment. Reinforcement was provided for 10 s for prompted responses and 20 s for independent responses.

If the participant responded either incorrectly or failed to respond within 5 s to a prompt, the experimenter provided the previous prompt on which compliance occurred. For example, if the participant did not respond to the modeling prompt, the experimenter reinstated a partial physical prompt. If the participant responded correctly to the physical prompt for three consecutive trials, the experimenter then reattempted the modeling prompt. Problem behavior (i.e., yelling, hitting) was ignored and blocked.

Baseline Probes After Training

Baseline probes after training occurred after participants mastered an exit skill in training. This condition was procedurally the same as the baseline condition. After three consecutive trials blocks (i.e., 10 trials in one block) at criterion level (i.e., three data points from three trial blocks at 90-100%), the exit skill was placed on maintenance. If the participant did not achieve the criterion level (i.e., three consecutive trial blocks at 90% or higher), training was reinstated until the participant completed three consecutive, independent

training trials for the skill being trained and three consecutive trial blocks at 90-100% for the baseline probe during training condition.

Maintenance Probes

After participants had three completed baseline probes during training, baseline probes continued to test for skill maintenance. If the participant did not maintain an exit skill and required prompting, training was reinstated until the participant completed three consecutive, independent training trials for the skill being trained and at least one trial block at 90-100% for the maintenance probe.

Generalization Probes

Generalization probes were conducted after all exit skills were mastered. These probes were procedurally the same as the baseline, except the participant's parent conducted the probes instead of the experimenter. If an aquatic skill did not generalize from the experimenter to the parent, training with the latter occurred in the same manner as with the experimenter until the participant completed three consecutive, independent training trials at 90-100% for the skill being trained.

RESULTS

Jonathan

Pretest. Jonathan passed all 7 of the exit skills in the Learn-to-Swim Level 1 and passed 2 of the exit skills for Level 2. The two skills he independently completed in Level 2 were: step from side into chest-deep water and recover from a back float to a standing position. The five skills he did not complete were: front float for 5 s, back float for 5 s, roll over from front to back, push off and swim 15 ft using a combination of arm and leg actions on front, and push off and swim 15 ft using a combination of arm and leg actions on back. These five exit skills were trained. Table 3 shows data for Jonathan's compliance during training and Figure 1 shows data for Jonathan's compliance to the exit skills trained during the experimental probe conditions (i.e., baseline, maintenance, and generalization).

Front Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Jonathan 18 training trials to meet criterion for exit skill 2. After training, Jonathan maintained criterion in the maintenance phase and for generalization.

Back Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Jonathan 43 training trials to meet criterion for exit skill 3. After training, Jonathan maintained criterion in the maintenance phase and for generalization.

Roll Over from Front to Back. The figure shows a stable baseline for this exit skill before training. During training, it took Jonathan 27 training trials

to meet criterion for exit skill 5. After training, Jonathan maintained criterion in the maintenance phase and for generalization.

Swim on Front Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Jonathan 18 training trials to meet criterion for exit skill 6. After training, Jonathan maintained criterion in the maintenance phase and for generalization.

Swim on Back Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Jonathan 32 training trials to meet criterion for exit skill 7. After training, Jonathan maintained criterion in the maintenance phase and for generalization.

Charlie

Pretest. Charlie passed all 7 of the exit skills in the Learn-to-Swim Level 1 and passed 2 of the exit skills for Level 2. The two skills he independently completed in Level 2 were: step from side into chest-deep water and recover from a back float to a standing position. The five skills he did not complete were: front float for 5 s, back float for 5 s, roll over from front to back, push off and swim 15 ft using a combination of arm and leg actions on front, and push off and swim 15 ft using a combination of arm and leg actions on back. These five exit skills were trained. Table 4 shows data for Charlie's compliance during training and Figure 2 shows data for Charlie's

compliance to the exit skills trained during the experimental probe conditions (i.e., baseline, maintenance, and generalization).

Front Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Charlie 45 training trials to meet criterion for exit skill 2. After training, Charlie maintained criterion in the maintenance phase and for generalization.

Back Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Charlie 65 training trials to meet criterion for exit skill 3. After training, Charlie maintained criterion in the maintenance phase and for generalization.

Roll Over from Front to Back. The figure shows a stable baseline for this exit skill before training. During training, it took Charlie 47 training trials to meet criterion for exit skill 5. After training, Charlie maintained criterion in the maintenance phase and for generalization.

Swim on Front Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Charlie 39 training trials to meet criterion for exit skill 6. After training, Charlie maintained criterion in the maintenance phase and for generalization.

Swim on Back Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Charlie 58 training trials to meet criterion for exit skill 7. After training, Charlie maintained criterion in the maintenance phase and for generalization.

Dylan

Pretest. Dylan passed all 7 of the exit skills in the Learn-to-Swim Level 1 and passed 3 of the exit skills for Level 2. The three skills he independently completed in Level 2 were: step from side into chest-deep water, back float for 5 s, and recover from a back float to a standing position. The four skills he did not complete were: front float for 5 s, roll over from front to back, push off and swim 15 ft using a combination of arm and leg actions on front, and push off and swim 15 ft using a combination of arm and leg actions on back. These four exit skills were trained. Table 5 shows data for Dylan's compliance during training and Figure 3 shows data for Dylan's compliance to the exit skills trained during the experimental probe conditions (i.e., baseline, maintenance, and generalization).

Front Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Dylan 33 training trials to meet criterion for exit skill 2. After training, Dylan maintained criterion in the maintenance phase and for generalization.

Back Float for 5 s. The figure shows a stable baseline for this exit skill before training. During training, it took Dylan 27 training trials to meet criterion for exit skill 3. After training, Dylan maintained criterion in the maintenance phase and for generalization.

Roll Over from Front to Back. The figure shows a stable baseline for this exit skill before training. During training, it took Dylan 35 training trials to meet criterion for exit skill 5. After training, Dylan maintained criterion in the maintenance phase and for generalization.

Swim on Front Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Dylan 22 training trials to meet criterion for exit skill 6. After training, Dylan maintained criterion in the maintenance phase and for generalization.

Swim on Back Using Arms and Legs for 15 ft. The figure shows a stable baseline for this exit skill before training. During training, it took Dylan 24 training trials to meet criterion for exit skill 7. After training, Dylan maintained criterion in the maintenance phase and for generalization.

DISCUSSION

This experiment shows the training package is an effective way to teach ARC Learn-To-Swim exit skills to individuals with ASD. The training package included using shaping steps, a most-to-least prompting hierarchy, and differential reinforcement. The current research adds to the past literature on different aquatic programs by providing a new way to teach aquatic skills more efficiently to individuals with ASD, and to autism research in general. There is not a lot of autism research on teaching aquatic skills in comparison to research on more common topics regarding autism such as language skills (Esch, Carr & Grow, 2009), social skills (Betz, Higbee, & Reagon, 2008), play skills (MacDonald, Sacramone, Mansfield, Wiltz, & Ahearn, 2009), joint attention (Taylor & Hock, 2008), imitation (DeQuinzio, Buffington Townsend, Sturmey, & Poulson, 2007), eating issues (Anglesea, Hoch, & Taylor, 2008), phobias (Shabani & Fisher, 2006), and behavioral issues (Invarsson, Kahng, & Hausman, 2008). Even though research on the previous topics is imperative, there needs to be a balance. Individuals with ASD need to also have an outlet beyond instructional programs and stay physically active just like their typical peers. That is why adding to research on recreational type activities, such as swimming, is also important and should continue with other researchers.

Shaping, prompting hierarchies, and differential reinforcement, all used in the training package, are common and successful treatment options for many different skills and behaviors, other than teaching aquatic skills,

when working with individuals with ASD. Shaping has been used in treatment for phobias (Ricciardi, Luiselli, & Camare, 2006), food refusal (Ives, Harris, & Wolchik, 1978), increasing language skills (Ross & Greer, 2003) and in increasing social interactions (Grodin & Cautela, 1988). Prompting and prompting hierarchies have been used as treatments for acquisition of language (Carr, Binkoff, Kologinsky, & Eddy, 1978), increasing imitation skills (DeQuinzio et al., 2007), increasing social skills (Betz et al., 2008), and for teaching empathy skills (Schrandt, Buffington Townsend, & Poulson, 2009). Differential reinforcement has been used to treat phobias (Shabani & Fisher, 2006), for behaviors (Buckley & Newchok, 2005), and for skill acquisition (Karsten & Carr, 2009). Shaping, prompting, and differential reinforcement are also used as techniques in a popular intensive treatment for teaching individuals with ASD called discrete trial training (Crockett, Fleming, Doepke, & Stevens, 2007).

The research on teaching aquatic skills to individuals with ASD has also included the use of shaping, prompting, and reinforcement. The Yilmaz et al. (2005) study used shaping, prompting, and reinforcement in their treatment package for teaching aquatic play skills. The Huettig and Darden-Melton (2004) study incorporated prompting and reinforcement to teach basic aquatic skills to four participants with ASD. The Killian et al. (1984) study used verbal reinforcement while teaching orientation to the pool area and beginner aquatic skills. Only one of these studies used all three components of shaping, prompting, and reinforcement, as did the current study, but each

used the components in different ways. That is why more research needs to be completed on the techniques used in teaching aquatic skills to individuals with ASD. More research also needs to be completed on the use of other treatment options used in behavior analysis, such as video modeling.

Although the research was successful, there are several limitations to this study. The first limitation was the training package itself. By using several components as a package, the role of the individual components is not known. An analysis on the individual components should be considered for future research to determine the effectiveness of each. The second limitation involved the participant's age range, gender, and previous exposure to swim lessons. Future research on this study should involve different age groups, both male and female participants, and different backgrounds to swim lessons. The third limitation involving the participants included the fact that all the participants ended up in needing instructions for Level 2. Future research should evaluate procedures to teach participants different Learn-to-Swim levels. Another limitation is that only the ARC program was used in the research. Now that this experiment was successful, the training package should be considered for future research on other aquatic programs, such as the YMCA Swim Lessons program (YMCA of the USA, 1999). The fourth limitation was part of generalization phase, where the parents were asked to step in as the instructor, which was a success for all three participants. Future research should show generalization to different pools, to several different instructors (e.g., professional, non-professional, grandparents,

siblings), and to different environments (e.g., outdoor above ground pools, outdoor in-ground pools, lakes). The fifth limitation was the lack of a long-term maintenance phase. Future research should include weekly and monthly follow-ups. The final limitation of this experiment was limiting the target behaviors to the exit skills when the ARC provides many more aquatic skills to teach in their Learn-to-Swim levels. Future research should expand on the components of the ARC Learn-to-Swim program.

The training procedures were effective and found to be easy to implement in an aquatic setting and with an already established aquatic program. The procedures were also found to be easy to implement by the aquatic instructor and by parents with adequate training. All three participants were successfully taught the exit skills needed to pass the Learn-to-Swim Level 2 and now they will move on to Level 3, furthering their parent's desire to gain more aquatic skills.

Table 1

Level 2 Exit Skills

Skill	Description
1	Step from side into chest-deep water
2	Front float for 5 s
3	Back float for 5 s
4	Recover from a back float to a standing position
5	Roll over from front to back
6	Push off and swim using arm and leg actions on front for 15 ft
7	Push off and swim using arm and leg actions on back for 15 ft

Table 2

Shaping Steps for Level 2 Exit Skills

Skill	Step	Description
1	1	Step from side into knee
1	2	Step from side into waist
1	3	Step from side into chest
2	1	Front float for 1 s
2	2	Front float for 3 s
2	3	Front float for 5 s
3	1	Back float for 1 s
3	2	Back float for 3 s
3	3	Back float for 5 s
4	1	Return to standing position with support
4	2	Return to standing position with assistance
4	3	Return to standing position with no help
5	1	Front float for 5 s
5	2	Back float for 5 s
5	3	Roll over from a front float to a back float
6	1	Push off and swim using arm and leg actions on front for 5 ft
6	2	Push off and swim using arm and leg actions on front for 10 ft
6	3	Push off and swim using arm and leg actions on front for 15 ft
7	1	Push off and swim using arm and leg actions on back for 5 ft
7	2	Push off and swim using arm and leg actions on back for 10 ft
7	3	Push off and swim using arm and leg actions on back for 15 ft

Table 3

Training Results on Jonathan's Exit Skills

Exit Skill	No Help	Modeling	Partial Physical	Full Physical	Total for Criterion
2	6	6	6	N/A	18
3	9	10	15	9	43
5	9	9	9	N/A	27
6	6	6	6	N/A	18
7	6	8	12	6	32

Table 4

Training Results on Charlie's Exit Skills

Skill	No Help	Modeling	Partial Physical	Full Physical	Total for Criterion
2	9	18	18	N/A	45
3	10	14	23	18	65
5	11	18	18	N/A	47
6	10	14	15	N/A	39
7	12	19	15	12	58

Table 5

Training Results on Dylan's Exit Skills

Skill	No Help	Modeling	Partial Physical	Full Physical	Total for Criterion
2	9	15	9	N/A	33
3	6	9	6	6	27
5	11	15	9	N/A	35
6	7	9	6	N/A	22
7	6	6	6	6	24

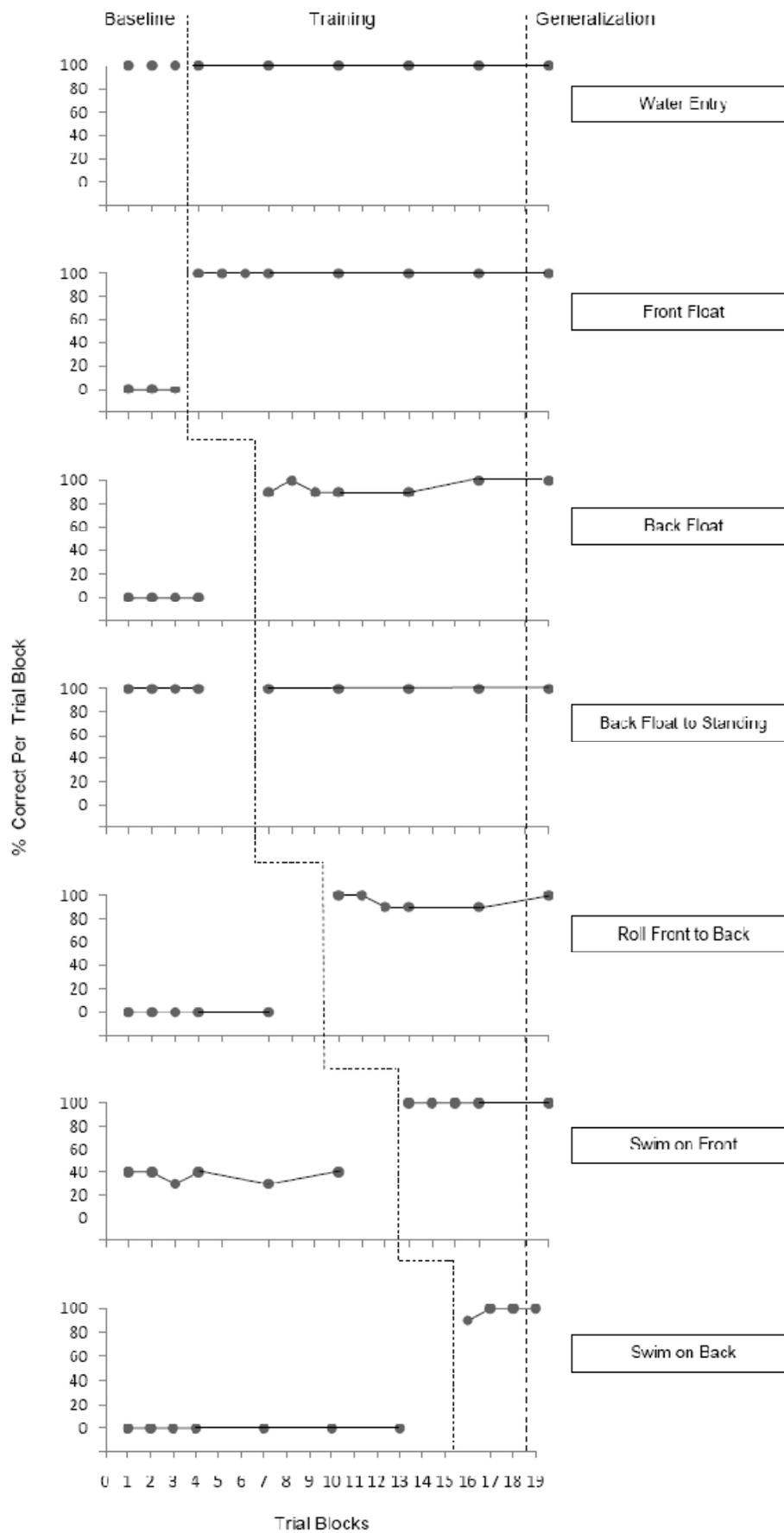


Figure 1. Effects of training on Jonathan's compliance to the aquatic skills.

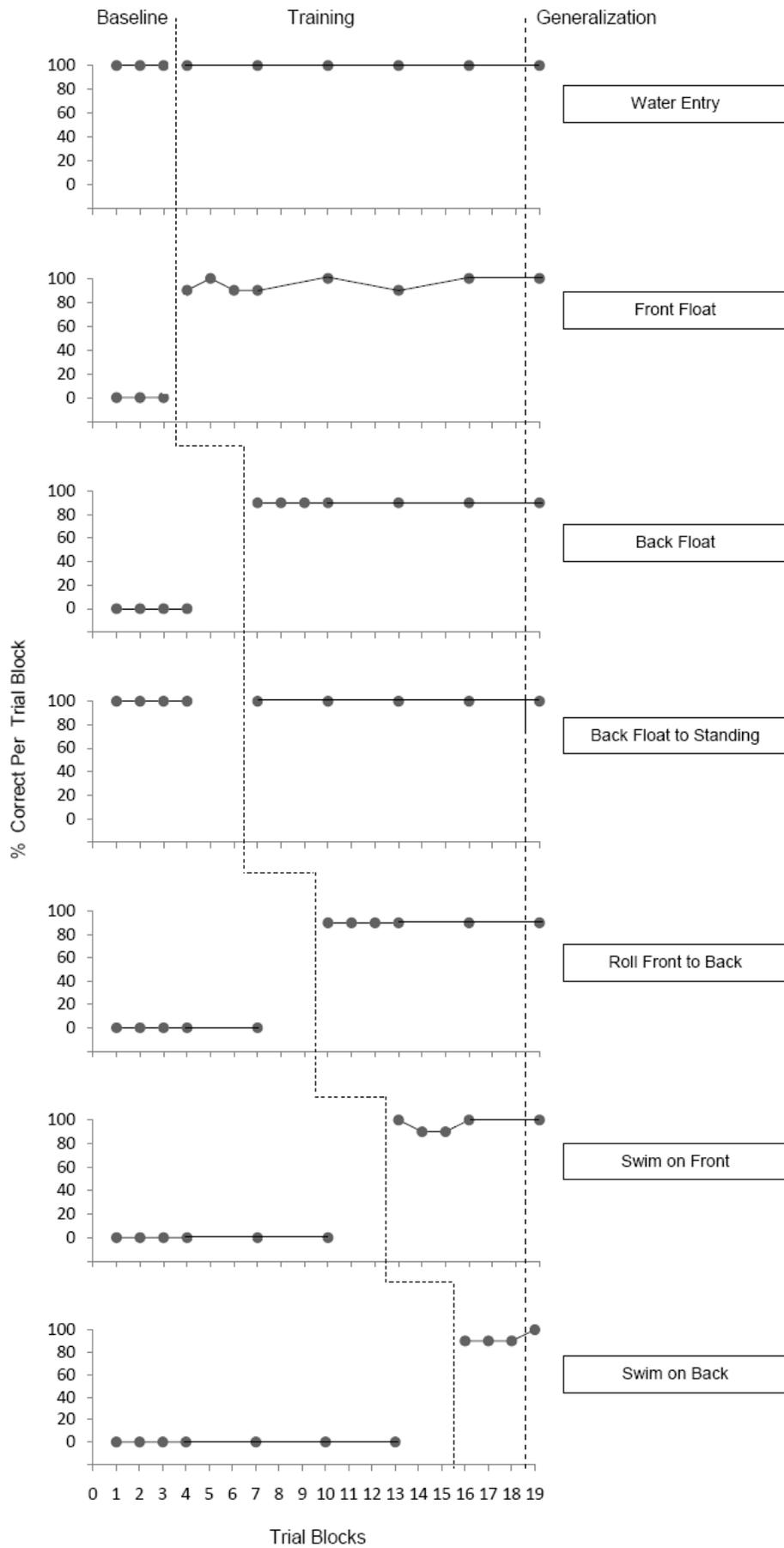


Figure 2. Effects of training on Charlie's compliance to the aquatic skills.

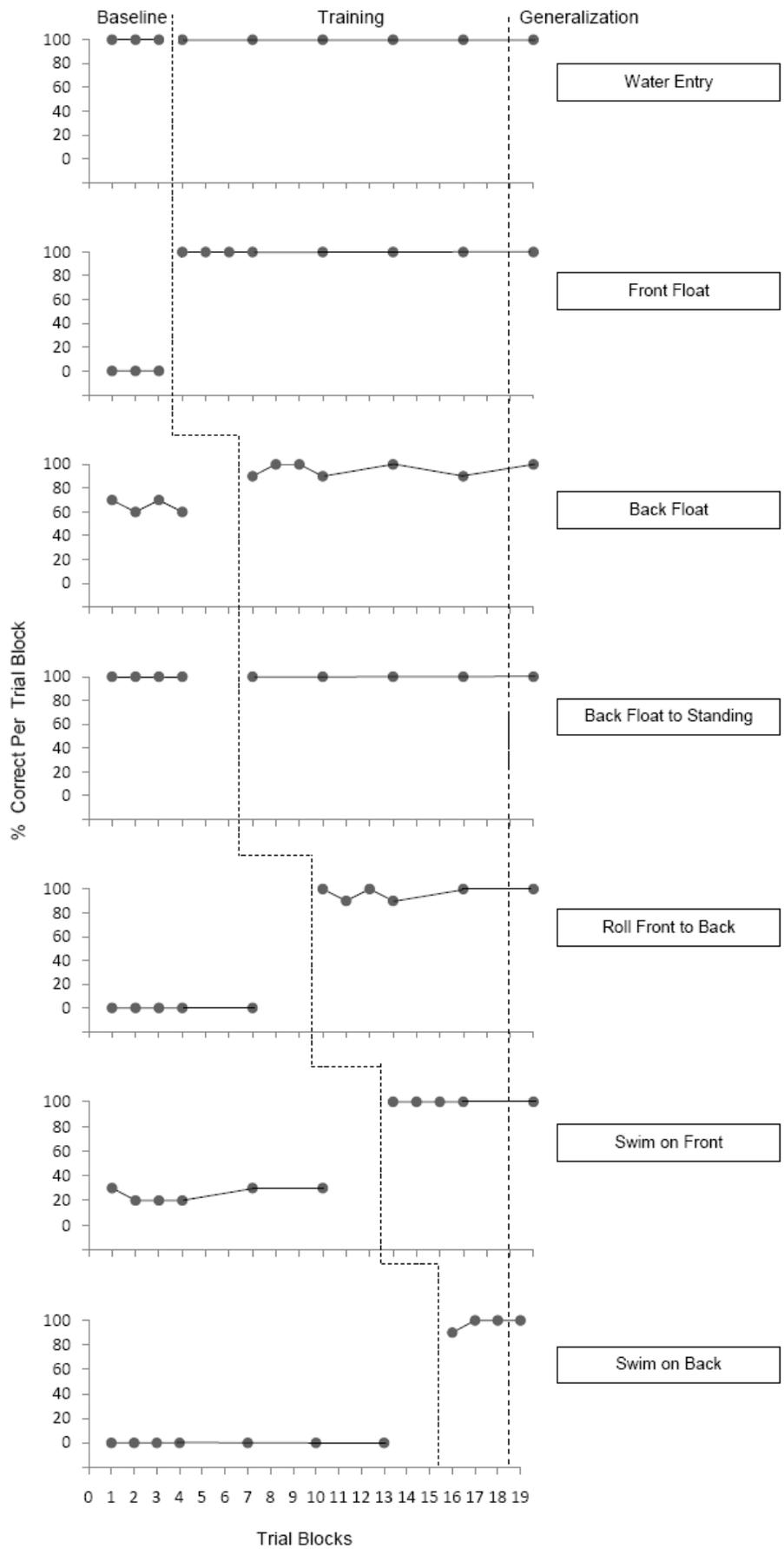


Figure 3. Effects of training on Dylan's compliance to the aquatic skills.

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