Research in Autism Spectrum Disorders 9 (2015) 121–129

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

Journal homepage: http://ees.elsevier.com/RASD/default.asp

Teaching advance movement exploration skills in water to children with autism spectrum disorders

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ARTICLE INFO

Article history:
Received 7 October 2014
Accepted 17 October 2014
Available online 5 November 2014

Keywords:
Autism spectrum disorders
Aquatic skills
Physical activity
Most to least prompting

ABSTRACT

This study evaluated the effectiveness of the 'most to least' prompting (MLP) procedure on the teaching of advance movement exploration skills in water to children with autism spectrum disorders (ASD). Three 6-year old children with ASD, participated in the study and were taught 3 different aquatic skills, essential for movement exploration in water and swimming, in a one-to-one training format at three sessions per week. A multiple probe design across behaviors was used and was replicated across subjects to analyze the effects of MLP. The results of the study showed that MLP was effective in teaching advance movement exploration skills in water to children with ASD. Performing the exploration skills in water was continued after the training process during maintenance and generalization probe sessions. In addition, social validity results reflected that parents' opinions were positive on the learning skills in terms of functionality, beginning swimming and participation in other aquatic settings for their children. The enjoyable intervention and appealing setting are recommended to increase the repertoire of leisure skills and level of physical activity for children with ASD.

1. Introduction

The severity of autism spectrum disorders (ASD) in children is demonstrated by impaired social communication and restricted, repetitive patterns of behavior (American Psychiatric Association, 2013). Children with ASD also have difficulty in maintaining eye contact, participating in social games, making friends, turn-taking and reciprocal conversation, and engaging in physical activity (Pan & Frey, 2006; Reid, 2005). These failures and disadvantages of children with ASD could predispose them to a lower physical activity level and limited participation in leisure skills such as physical activity and sports programs (Lee & Porretta, 2013). According to the results of some studies, children with ASD have a lower physical activity level than peers without ASD during their weekly routine (Pan & Frey, 2006; Reid, 2005). This restricted participation in physical activity and sports programs could be due to various reasons for children with ASD, such as an insufficient repertoire and needing extra prompts for physical activity and sports skills, that the team and individual sports programs in

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http://dx.doi.org/10.1016/j.rasd.2014.10.016
1750-9467/

schools and community are competitive-based, and sedentary behaviors such as dependence on technology, and a lower consciousness of quality of life (Fragala-Pinkham, O'Neil, & Haley, 2010; Reid, 2005).

Regular physical activity participation is essential to reduce the mortality and morbidity risks of chronic disease such as cardiopulmonary disease, cancer, diabetes and obesity, which are seen in children and adolescents (Ortega, Ruiz, Castillo, & Sjöström, 2008). In addition, physical activity stimulates the improvement of physical fitness, motor performance, self-esteem, behavior, and social outcomes for children (Pan & Frey, 2006). These positive effects of physical activity interventions have been determined in several studies of children with ASD (Fragala-Pinkham et al., 2010; Huettig & Darden-Melton, 2004; Yılmaz, Yanardağ, Birkan, & Bumin, 2004). Children with ASD tend to choose the kinds of physical activities which do not involve great social cues or rules, such as walking, running, aquatic intervention, and individual sports such as swimming (Srinivasan, Pescatello, & Bhat, 2014; Yılmaz et al., 2004). Similarly, a review study revealed that jogging and swimming were the two most often utilized physical activity interventions for children with ASD (Sowa & Meulenbroek, 2012). Some authors have stated that many children with ASD enjoy and are successful in movement skills in aquatic settings (Huettig & Darden-Melton, 2004; Killian, Joyce-Petrovich, Menna, & Arena, 1984; Prupas, Harvey, & Benjamin, 2006; Yılmaz et al., 2004). A number of researchers have used an aquatic environment in order to develop physical performance (Fragala-Pinkham et al., 2010), learning (Rogers, Hemmeter, & Wolery, 2010; Yılmaz, Konukman, Birkan, & Yanardağ, 2010), behavior (Yılmaz et al., 2004) and social outcomes (Pan, 2010) for children with ASD. Aquatic programs and swimming provide some essential advantages. First, it is a lifetime activity and facilitates learning daily living skills such as social behaviors, dressing, bathing and hygiene skills. Second, it stimulates body and cognitive awareness aiding fitness, sensory–perceptual integration, orientation, and motivation. Third, these are functional skills which can be incorporated into family life. Finally, it is a safety skill which may prevent drowning during vacations in community-based settings such as a swimming pool, sea, or lake (Lepore, Gayle, & Stevens, 2007).

Children with ASD may have impairment in cognitive skills and display fluctuations in behaviors depending on the diagnostic features. Attention problems, intellectual delay, low orientation skills, repetitive behaviors, and poor eye contact have a negative effect on learning performance for both academic and leisure skills, which are essential to enhance social integration and to increase physical activity level (Bryson, Bradley, Thompson, & Wainwright, 2008; Srinivasan et al., 2014). Therefore, educators, therapists, and parents are needed to utilize evidence-based teaching strategies for the permanent learning of new skills for children with ASD (National Autism Center, 2009). Errorless teaching strategies and applied behavioral analysis are essential learning-based interventions for children with ASD, and several studies have applied these interventions to teach new skills such as work skills, self-care skills, leisure skills, independent living skills, hygiene skills, and feeding skills (Matson, Hattier, & Belva, 2012). One of the most common approaches to teach a new movement skill to children with ASD is the 'most to least' prompting (MLP) procedure into errorless teaching strategies (Fentress & Lerman, 2012; Lang et al., 2010). In MLP, decreasing assistance, prompts are provided hierarchically from the most intrusive to the least intrusive. The prompting hierarchy begins with physical prompts that gradually fade and the trainer delivers less intrusive prompts such as modeling or a verbal prompt (Duker, Didden, & Sigafos, 2004).

In current literature, MLP has been used in only two studies, which taught water exercises and backstroke skills for swimming to children with ASD in current literature (Best & Jones, 1974; Yılmaz et al., 2010). However, there are no studies on the effects of an MLP procedure to teach advance movement exploration skills in water to children with ASD. Therefore, the purpose of this study was to answer the following question: Will the use of MLP procedure be effective in teaching advance movement exploration skills in a swimming pool to three children with ASD? In addition, the maintenance and generalization effects of the procedure were evaluated. The advance movement exploration skills to be taught in the swimming pool were blowing bubbles, face submersion, and retrieving an object from the bottom of the pool.

2. Methods

2.1. Participants

The study comprised 3 boys with ASD, aged 6 years. Before the study, written informed parental consent and verbal assent were obtained from all the parents of the participants in compliance with the Declaration of Helsinki. The names of the participants have been substituted with pseudonyms for the study. To be able to teach the three advance movement exploration skills in the swimming pool using 'most to least' prompting, some prerequisite conditions were identified before the intervention: (a) ability to follow verbal prompts, (b) ability to imitate motor skills, (c) no physical dysfunction or health issue such as an open wound, (d) no hypersensitivity to water, and (e) ability to have toilet control. The 3 participants met all these criteria.

Sacit was a 6-year old boy with ASD. He had benefited from an early special education program, since he was 4 years old. He was receiving both individual special education (two sessions a week) and group based special education (five sessions a week). He had difficulty in social integration and displayed inappropriate behaviors such as crying and disobedience. He had learned the concepts of color, shapes and matching skills. He had participated in a group-based aquatic play program (one session a week) for three months. He learned some aquatic play skills such as snake, kangaroo, and train during the program, but he had a fear of water and needed to be given physical prompts.

Erdal was a 6-year old boy with ASD. He had benefited from an early special education program, since he was 3 years old. He had difficulty in social integration and expressing himself. He was receiving individual special education (two sessions a

week). He had learned the concepts of color, shapes, and basic daily living skills such as feeding and washing. He had participated in a group-based aquatic play program (one session a week) for six months. He enjoyed being in the water and the aquatic sessions.

Emek was a 6-year old boy with ASD. He had been receiving both individual special education (two sessions a week) and group-based special education (five sessions a week) for two years. He had difficulty in social integration and communication skills. He could not express himself. He displayed inappropriate behaviors such as crying, and disobedience. He had learned the concepts of color, shapes, and basic daily living skills such as feeding, and washing. He had participated in a group-based aquatic play program (one session a week) for six months. He enjoyed being in the water and the aquatic sessions.

None of the 3 participants had any experience or knowledge of advance movement exploration skills in the swimming pool before the study.

2.2. Trainers

One researcher, with specialist training in teaching swimming and physical education, conducted the intervention sessions. The other researchers carried out other tasks such as data collection, recording, analysis, and preparing the documentation. Three researchers have PhD degrees in special education and physiotherapy. They have research experience of errorless teaching procedures, single subject design, aquatic intervention, and autism spectrum disorders.

2.3. Setting

All instructional, probes, maintenance and generalization sessions were conducted in the indoor swimming pool on the campus of Anadolu University. All sessions were carried out as a one-to-one format in the pool, which was 15.5 m long, 6 m wide, and 1.0 m deep. All sessions were organized in a one-to-one format, as three sessions a week, between 12.30 and 13.30.

2.4. Materials

A digital camera (Sony XR155 Full HD), data collection forms, a writing pad, and pencil were used to collect data. Each participant wore swimming goggles (not a swimming mask) when learning the face submersion skill and retrieving an object from the bottom of the pool. The trainer used a plastic ring, which was collected from the bottom of the pool by participants for the last target skill.

2.5. Target behaviors

The main purpose of this study was to teach advance movement exploration skills in the swimming pool to children with ASD. These aquatic based skills are essential to begin swimming, and they were selected randomly from the Swimming Sherrill Model (Sherrill, 2004). These advance movement exploration skills in water are blowing bubbles, face submersion, and retrieving an object from the bottom of the pool. These target skills were described in detail (Table 1) to be able to reach a consensus on meeting the criteria and interobserver agreement.

2.6. Experimental design and procedure

A multiple probe design across the three behaviors (blowing bubbles, face submersion, and retrieving an object from the bottom of the pool) and replicated across the three participants was used to determine the effectiveness of the MLP procedure on teaching aquatic based skills (Alberto & Troutman, 2013). Before using MLP and providing intervention, experimental control was verified by a low level of correct behaviors, and the criteria level for proper behaviors after

Table 1
Description for target skills.

Skills	
Blow bubbles	1. Participant fills air to his mouth 2. Participant's lips touches to the water 3. Participant blows bubbles by exhaling air in mouth
Face submersion	1. Participant close his mouth 2. Participant bends his head forward 3. Participant immerses entirely his face and head into water
Retrieves object from bottom of pool	1. Participant immerses his body into water 2. Participant picks object from bottom of pool 3. Participant moves to the surface of the water with object

delivering the intervention of MLP. An independent variable was implemented to target behavior in a time lagging manner (Alberto & Troutman, 2013).

2.6.1. Probe sessions

A baseline condition was applied before the training of the target behavior; three baseline sessions were conducted on three consecutive days. A single opportunity procedure was used during the baseline sessions. The researcher provided task direction and recorded the response of the participants. The procedures for the baseline sessions were (a) delivering a verbal cue to gain the participant's attention, (b) the participant was then asked to perform a skill, (c) five seconds were allowed for the participants to initiate the skill, (d) If the participant displayed the correct behavior, the performance was recorded as plus (+) for that target behavior, (e) If the participant performed an incorrect response, the performance was recorded as a minus (−) for that target behavior, and the assessment was terminated (Brown & Snell, 2000). After the assessment procedure, the behavior of the participants was reinforced with verbal praise for their co-operation.

Similarly, full and intermittent probe sessions were regulated exactly like the baseline sessions. Full probe sessions were conducted before the intervention, and after reaching the criterion of the target behavior, and were continued until a stable response had been demonstrated in at least three consecutive sessions. One trial was performed for each target play skill during one probe session. When the criterion level for performance was obtained in the first aquatic skill, three more probe sessions were applied on all three target aquatic skills for the full probe session. Once criterion was met for the second skill, three probe sessions were conducted on all three targets aquatic skills. When the criterion was met for the third skill, the last three probe sessions were applied for all three aquatic skills for the full probe session.

An intermittent probe session was performed to determine the current performance of the participant to decide whether to stop the intervention process. This kind of probe session was useful to observe once the criterion of the target aquatic skill had been reached. If the participant showed 100% correct performance in three consecutive intermittent probe sessions for a skill, the researcher terminated the intervention sessions. One trial was performed for each target aquatic skill in the intermittent probe session as the full probe session.

2.6.2. Instructional sessions

The participants were taught three advance movement exploration skills in water. The teaching of the aquatic based skills was performed in a natural setting, a community based swimming pool. Since the MLP procedure was used to teach these skills, the instruction sessions progressed from physical prompts to independent response. The instruction sessions were performed as follows: (a) The researcher delivered an attentional cue to the participant, "are you ready to play?". (b) The controlling prompt for all the aquatic skills was a physical prompt. It was provided for the blowing bubbles skill by the researcher placing his hands on the participant's lower jaw, and the model prompt was provided simultaneously in view of the child in the swimming pool. The researcher used the controlling prompt for the face submersion skill by placing his hand on the back of the participant's head, and the model prompt was delivered simultaneously in view of the child. Similarly, a controlling prompt was used for retrieving an object from the bottom of the pool by the researcher placing his hand on the upper back of the participant, and the model prompt was provided simultaneously in view of the child. (c) When the skills instruction was completed, the researcher provided reinforcement with verbal praise. The behavior of the participants was reinforced using a fixed ratio reinforcement system during the probe and training sessions. There were three stages in the implementation of the MLP procedure to teach the advance movement exploration skills in water. The first stage was the physical prompt plus the model prompt for first six sessions. The second stage was only the model prompt for six sessions, and the last stage was a verbal prompt for six sessions. However, there was no need to use the model prompt during the second stage or the verbal prompt during the third stage, as all the participants performed the three advance movement exploration skills independently after the physical prompt plus the model prompt in the first stage. The researcher gave verbal praise ("bravo", "well done") for each participant's independent performance and collaboration during the probe and instructional sessions. Each instructional session covered five trials in this study.

2.6.3. Maintenance and generalization sessions

Maintenance sessions were implemented one, two, and four weeks after participants met the instructional criterion, which was to display independent performance for each target skill. Maintenance sessions were performed in a similar manner to the probe sessions except that reinforcement was provided after the session. Generalization across trainers was evaluated by pre-post test design. It was conducted as a probe session before the training process and after the participants had reached the criteria for the three advance movement exploration skills in water.

2.7. Reliability

Three types of data were collected during the study: effectiveness, reliability and social validity. The effectiveness data were collected by correct and incorrect performance being reported for each target skill, and the percentage of independent correct responses in the intermittent probe sessions was calculated. The reliability data was collected as interobserver agreement and procedural reliability during at least 30% of all the experimental sessions. Interobserver agreement was calculated using the point-by-point method with a formula of the number of agreements divided by the number of

agreements plus disagreements multiplied by 100 (Kennedy, 2005). Interobserver agreement data was collected in full probe, intermittent probe, training, maintenance and generalization sessions for each participant. Procedural reliability (independent variable) was calculated by dividing the number of observed researcher behaviors by the number of planned researcher behaviors multiplied by 100 (Billingsley, White, & Munson, 1980). The researcher's behaviors were observed as follows: (1) providing the attentional cue, (2) delivering task direction, (3) providing the controlling prompt, (3) waiting for the participant's response during the response interval, and (4) providing verbal reinforcement.

3. Results

3.1. Procedural reliability and interobserver agreement

Procedural reliability measures for Sacit revealed that the researcher performed procedures with 100% accuracy during the probe and training sessions. The researcher followed the procedural reliability items for Erdal and Emek during the probe and training sessions, and it resulted in 100% for both Erdal and Emek. Interobserver agreement data was revealed that both researchers agreed on the participants' performances during selected probe and training sessions, and it was calculated as 100% for all participants.

3.2. The effects of the 'most to least' prompting on advance movement exploration skills

Figs. 1–3 show the performance of the three participants for blowing bubbles, face submersion, and retrieving an object from the bottom of the pool during baseline, training, maintenance, and generalization sessions. Each data point showed the percentage of correct responses during the sessions.

As shown in Fig. 1, Sacit displayed 0% performance in the first three sessions for the three target skills during baseline sessions. He showed an increase in the percentage of correct skills when the MLP was delivered in session 4, and he reached the acquisition criterion of 100% after two sessions for blowing bubbles, four sessions for face submersion, and two sessions for retrieving an object from the bottom of the pool (Fig. 1). For Sacit to meet the criteria, 10 trials were conducted for blowing bubbles, 20 trials for face submersion, and 10 trials for retrieving an object from the bottom of the pool.

As shown in Fig. 2, Erdal showed 0% correct performance in the first three sessions for the three target skills before training. When the MLP was delivered in session 4, he displayed an increase in the percentage of correct skill performance, and he met the criteria of 100% after two sessions for blowing bubbles, four sessions for face submersion, and two sessions for retrieving an object from the bottom of the pool (Fig. 2). For Erdal to meet the criteria, 10 trials were conducted for blowing bubbles, 20 trials for face submersion, and 10 trials for retrieving an object from the bottom of the pool.

At baseline, Emek showed 0% correct performance in the first three sessions for the three target skills, as shown in Fig. 3. He showed an immediate increase in the percentage of correct skill performance when the MLP was delivered in session 4, and he reached the acquisition criterion of 100% after two sessions for all the advance movement exploration skills in water (Fig. 3). For Emek to meet the criteria, 10 trials were conducted for blowing bubbles, 10 trials for face submersion, and 10 trials for retrieving an object from the bottom of the pool.

Emek did not make any errors in any of the target skills. Sacit and Erdal made one error each in the face submersion skill, and no errors in the other 2 skills.

4. Discussion

The aim of this study was to evaluate the effectiveness of the MLP procedure in teaching advance movement exploration skills in water to children with ASD. The findings of the study showed that the MLP procedure was effective when teaching advance movement exploration skills to the three children with ASD. These results support a former study, which was conducted using the MLP procedure to teach basic swimming skills to children with ASD (Yılmaz et al., 2010). Similarly, that study found the MLP procedure to be effective in teaching basic swimming skills to three children with ASD and aquatic based skills originated from Halliwick's Method (Martin, 1981). In the present study, the target skills were selected from Swimming Sherrill Model (Sherrill, 2004). In addition, literature has shown that the MLP procedure is an effective method to teach other leisure skills such as Internet skills, pedestrian skills (Batu, Ergenekon, Erbas, & Akmanoglu, 2005; Jerome, Frantino, & Sturmey, 2007) and motor imitation (Fentress & Lerman, 2012). Parallel to these findings, this study has made a contribution to literature with an effective method to teach and maintain advance movement exploration skills in water to children with ASD. In addition, procedural reliability measures showed that the trainer applied the "most to least" prompting procedure consistently 100%. Literature recommended that procedural reliability which is minimally 80% and above 90% is highly considered (Wolery, Bailey, & Sugai, 1988). This study also reflected that procedural reliability and interobserver agreement was total agreement during the all stages.

According to the social validity data, which was obtained from parent questionnaires after the training, the participants' families had positive opinions about the findings of the study, especially with regard to increasing levels of physical activity, preparing for swimming, and having the opportunity to participate in another aquatic setting such as a pool or the sea, for

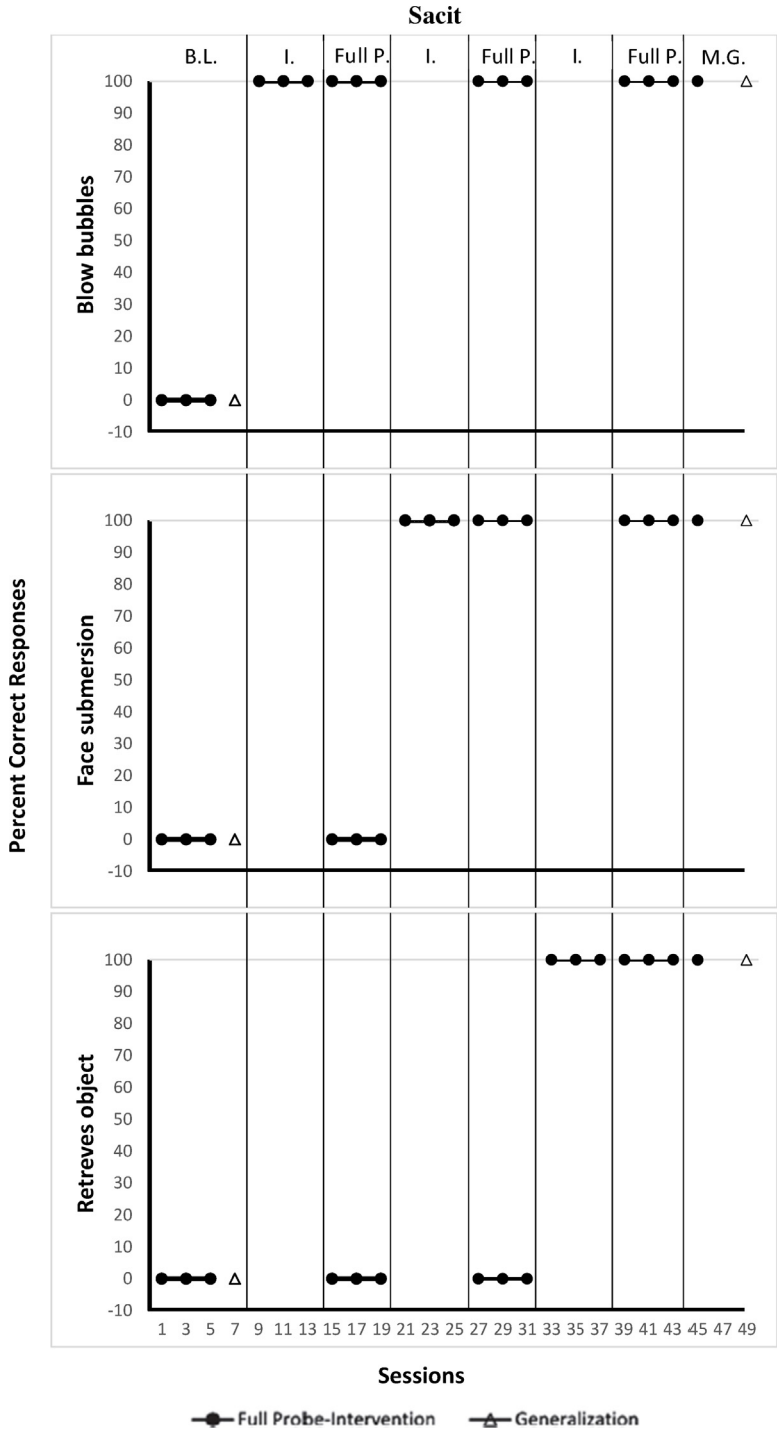

Fig. 1. Percent correct responses for Sacit during all sessions.

their children. In addition, the parents were willing to give permission for these children to participate in a new study, aimed at improving the ability of sport and leisure skills of their children. The affirmative view of the parents reflected the functionality of the selected target skills in this study.

The present study can be considered to make some contributions to literature: (1) it supports existing studies which state that MLP is an effective method to teach aquatic based skills for children with ASD. (2) It expands the body of literature on

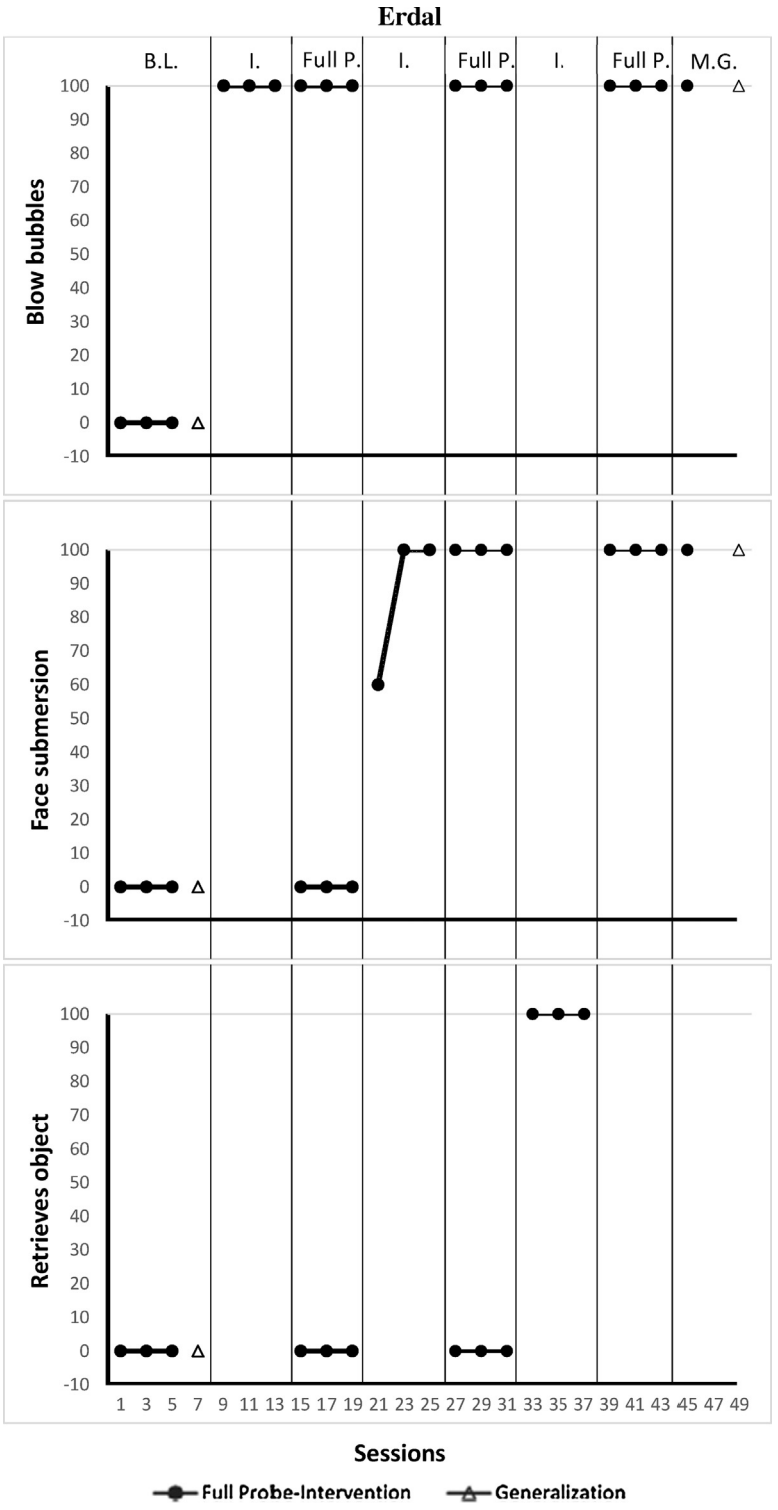

Fig. 2. Percent correct responses for Erdal during all sessions.

leisure and sport skills for the target population by MLP. (3) It is the first study to evaluate the effectiveness of MLP on teaching advance movement exploration skills in water to children with ASD.

There were some limitations of the present study. First, only three children with ASD were included in the study. Second, three target skills were used as the dependent variable. Future research should be conducted on the effects of MLP on several

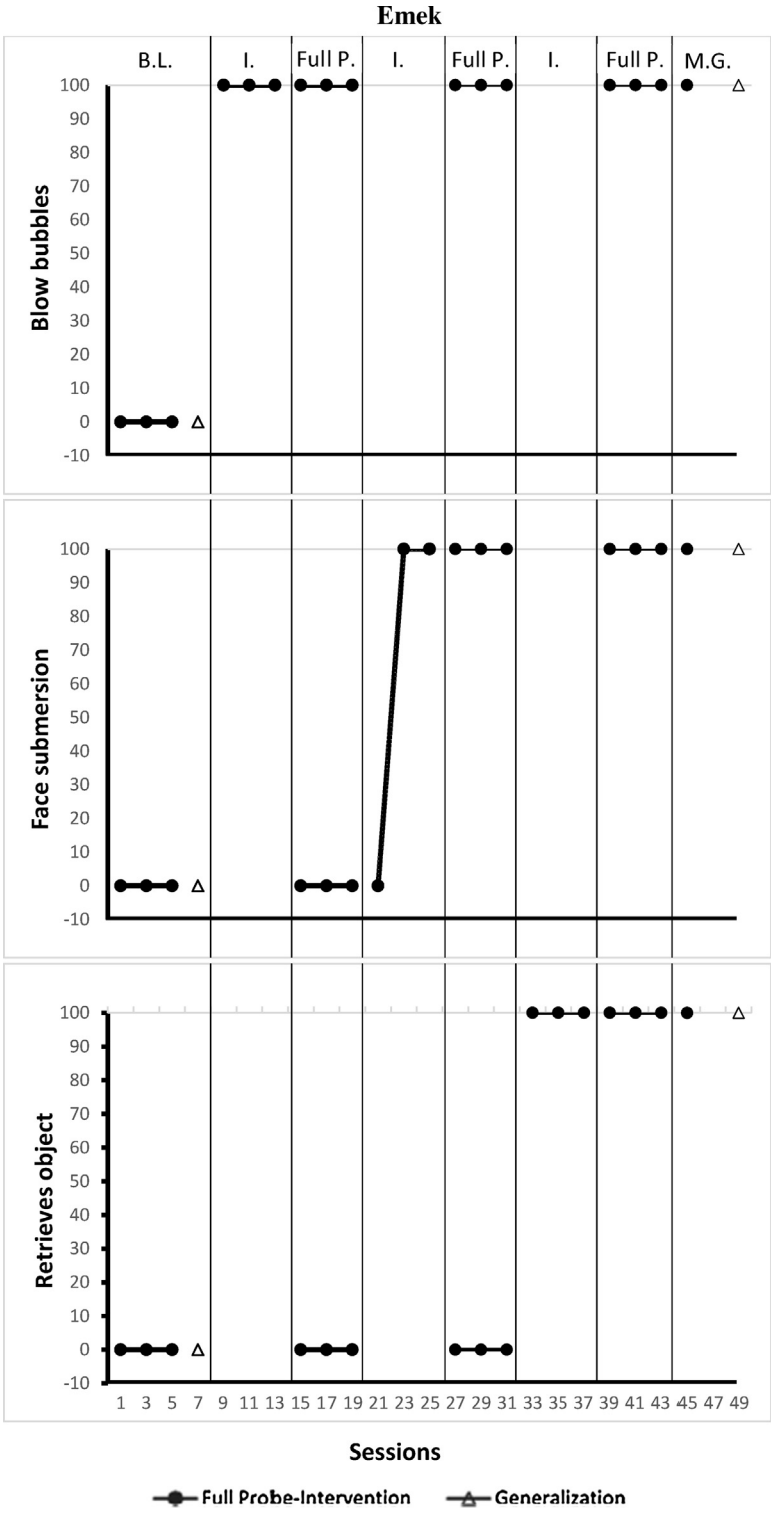

Fig. 3. Percent correct responses for Emek during all sessions.

swimming forms, such as free style. Finally, future studies should measure the level of physical activity before and after teaching sport-based leisure skills for children with ASD, and whether or not the learned leisure skill has been implemented into their weekly routine.

Conflict of interests

The author(s) declared no conflicts of interests with respect to the authorship and/or publication of this article.

Acknowledgments

The authors wish to thank all participants and their parents for engaging in this study. No financial support was received by any of the authors for the research of this article. The authors are grateful to Caroline Walker for proofreading the manuscript.

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