The effect of a selected physical activity program using expert and novice modeling on acquisition and retention of gross motor skills in autistic children

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Abstract

Aim: This study investigated the efficacy of an exercise program on acquisition and retention of gross motor skills in two sections of Locomotor and object Control on autistic children.

Method: In this quasi-experimental study twelve autistic boys (average age 9.42 years, SD= 0.793) were assessed for developmental level of gross motor skills with Ulrich’s test and were then randomly assigned in to three groups of A, B and C. The number of samples in each group was N = 4 persons. SPARK motor program, for 12 sessions, each lasting 45 minutes, were applied using expert and novice modeling respectively to experimental groups A and B; while routine activities were followed in control group. Levine’s test for homogeneity of variance, analysis of score differences, Paired samples t-test, one-way ANOVA and at a significant level of (P≥0.05) were used to compare the means and analyze the data. Results: The results showed that the effect of selected program on acquisition of Lcomotor and object control skills using the expert modeling, and also acquisition of locomotor skills using novice modeling were significant (respectively P = 0.001, P = 0.009 and P = 0.001), but the acquisition of object control skills with novice modeling (P = 0.080), and the retention of locomotor and object control skills in experimental groups were not significant.

Interpretation: Given the significant differences in skill acquisition between the groups, it can be argued that the selected exercise program can bring about acquisition and improvement of gross motor skills in autistic children.

Keywords: expert modeling, novice modeling, gross motor skills, autistic children.

Introduction

During the development of human being some disorders may appear that influence the development of a child and divert it from its natural direction and prevent its normal development (Bardideh et al., 1998). Autism is a pervasive developmental disorder that brings about disability in various aspects such as social communication skills, cognitive skills, speech and also gross and fine motor skills (Amhiwood, 2004).

Autistic children due to disorder in social interaction cannot communicate with their peers and are often isolated. They also do not make a good eye contact with adults and other children. The way they play is different from normal children (Valizadeh, 2009). Recent diagnosis about the autistic people show that the disorder is increasing, its prevalence is one in one hundred and in boys 4 times as much as in girls (Rice et al., 2007).
Autistic children often due to proprioceptive problems, lack of motivation to participate in athletic activities, and being away from sports because of social nature of most sports, have a limited muscular strength and endurance, and a weak self-esteem and self-confidence which in turn cause these children to get less exercise (Valentin et al., 2004). Researchers have compared the path of physical activity of autistic children with natural developmental path and showed that lack of physical activity in these children increases with age (Pan et al., 2006). In terms of movement, autistic children are similar to normal and healthy children who are half their age. Results of research revealed deficit and delay in motor skills in autistic children (Staples et al., 2010). Also, researchers, using Test of Gross Motor Development-2 (TGMD-2), for evaluating gross motor skills in autistic and normal children showed that normal children have performed better and have gotten higher scores (Staples et al., 2010).

In the course of development, the period during which children are in pre-school to elementary school is an important period which needs more attention regarding training motor skills. Movement is an essential need of human being and accordingly, this need guarantees one’s health in different periods of life. The main element of motor development is fundamental motor skills which is one of gross motor (Reeves et al., 1999); i.e. movements that depend on the action of big muscles in the body [Ulrich D.A, 2000]. These skills which refer to purposeful motor modeling include locomotor and object control skills. Failure in the development of basic motor skills during the important childhood years may limit the capacity of acquiring more advanced motor skills in future (Galllaue et al., 1998).

Among factors affecting fundamental motor skills, providing a proper developmental training program can be regarded as one influential factor in development of these skills (Pan et al., 2006). An influential and vital method in cognitive, social and game development in autistic children is imitation (McKenzie et al., 1998; Farsi et al., 2011). Imitation has been recognized as an obvious factor in development process and learning in a lot of children (Meltzoff et al., 1997). Research has shown that autistic individuals, often, can interpret better and perform more effectively through looking than through listening instruction (Bryan et al., 2000; Broun, 2004; Welton, 2004; Tissot et al., 2003).

Given the highly significant role of imitation in cognitive and social development of children such as speech, game and social relations (Rogers et al., 1991) which appear to be limited in autistic children (Rogers et al., 2003; Charman et al., 1997; Stone et al., 1997), this has caused some researchers to investigate the role of imitation in development and learning of autistic children, although most research has been conducted on the fields of social relations and language (Rogers et al., 1997; Stone et al., 1997). Research has shown that imitative skills bring about a concentration increase in autistic children which in turn leads to enhancement learning. The findings suggest that imitation and concentration are interrelated and increase in one leads to improvement of the other (Ingersoll et al., 2006).

Some researchers emphasize on imitation as a prerequisite to learning intricate reactions (Igenmey et al., 1991). One of effective imitative methods in autistic children is using modeling, looking at which the child can learn the skill better and faster (Kaplan et al., 2000).

Trainers use an expert modeling usually for teaching new motor skills to novice learners. In recent years an educational policy called During-learning modeling has been developed which has questioned the trainers' use of the expert modeling (Barbara et al., 1992). Theoreticians of motor learning have posed this question that whether the expert modeling is the only beneficent modeling in observational learning (Pollock et al., 1992). Results of studies show that the observer’s involvement in cognitive activities of during-learning modeling ends in learning facilitation (Pollock et al., 1992).

The supporters of this view believe that the expert modeling improves imitation of the action, but the observer does not obtain any recognition of the way the skill has been performed because expert modeling provides the observer with less information about the processing of error. This gap made us use another modeling (novice) to perform the observation and as a result for the role of this connection in behavior and action of autistic children. According to what was stated, this research is aimed at evaluating a selected physical activity program using expert and novice modeling on acquisition and retention of gross motor skills in autistic children.

What this paper adds’:

- Investigates the effect of an exercise program on autistic children.
- Introduces new ways of improving Fundamental motor skills in autistic children.
- Shows the program is effective for autistic children.
Materials and Methods

In this quasi-experimental study, according to inclusion criteria, and based on demographical information, measurement conditions, and after obtaining written informed consent agreement of the parents, 12 children (6-10 years old) who have been diagnosed as autistic by specialists and child psychologists entered in the experiment. The subjects were in comparable anthropometric conditions. Then, the subjects, before intervention program, received a pretest by means of Ulrich’s (2000) gross motor skills development in two aspects of locomotor and object control. Next, the subjects were randomly and homogeneously assigned into two experimental groups of A (performing motor program by expert modeling) and B (performing motor program by novice modeling); and a control group of C (without intervention of motor program). In this study, expert modeling refers to a gifted peer performer who enjoys required capability for performing a skill without, or with the minimum, fault; and who receives no feedback from the trainer. The novice modeling, however, is a gifted peer who lacks this capability and needs feedback from the trainer.

Motor program was administered for experimental groups for 12 weeks. During the program, the control group was doing its regular daily activities.

The program of motor exercises in experimental groups was performed in different weekdays at the same time and place, by one person (the researcher) and away from any bias. During the exercises, the subjects were not experiencing any other motor exercises than the selected motor exercises. Also, they were not taking any medications during the exercises.

The selected exercise program used in this study is derived from SPARK that is related to basic skills of children and includes sports, games and creative activities. This program suggests some principles for physical activity of children that, with performing physical activities along with game and fun, improves healthy living in children. This program includes four sections during 45 minutes for each session: respectively, fifteen minutes is warm up; ten minutes doing locomotor skills; ten minutes object control skills; and ten minutes cooling down. At the end of the program the subjects received a posttest using Ulrich’s TGMD-2. Also, after two weeks, a retention test, again using the TGMD-2, was given with the aim of obtaining retention of the skills in autistic children.

TGMD-2 is a credited instrument for evaluating the development of gross motor skills, first prepared by Ulrich (1985) according to locomotor skills, validity and reliability of which was reported at respectively 0.96 and 0.87 (for subtests). It consists of two subtests of locomotor and objects control, each including six skills (Ulrich, 2000). Locomotor skills include running, galloping, hopping, Leaping, Horizontal Jump and Slide. Object control skills include striking a stationary ball, stationary dribbling, catching, kicking, overhand throwing and underhand rolling.

To analyze the data, inferential statistics (The analysis of differences; paired t-test to obtain the differences between pretest and posttest, and also differences between posttest and retention test; one-way ANOVA at a significant level of \( \alpha \leq 0.05 \)) were utilized. All the calculations were conducted using SPSS version 20 and Excel software.

Results

In this section demographic information of the participants are provided in Table 1. Tables 2, 3 and 4 show the results of score differences in ; paired t-test and one-way ANOVA. As it is clear, there is a significant difference between the acquisition of locomotor skill in the experimental groups and the control group (\( p=0.001 \)); however, in the average score of the acquisition of object control skill in the groups (\( p=0.013 \)), and also in the retention of locomotor and object control skills (respectively \( p=0.757 \) and \( p=0.288 \)) the differences are not significant.

| Table 1: Demographic information of the groups |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| IQ              | Average Height  | Weight average  | Age average    | Group Average   |
| 82.25           | 144.50          | 43.50           | 9.5            | Experimental A  |
| 79.75           | 139.25          | 42.25           | 9.25           | Experimental B  |
| 81.25           | 139.75          | 36.75           | 9.5            | Control         |

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Table 2: Results of score differences in acquisition and retention of locomotor skill in autistic children in experimental and control groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>MDF</th>
<th>t</th>
<th>Df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition and Retention of locomotor skill</td>
<td>Experimental A</td>
<td>Pre-test</td>
<td>11.75</td>
<td>10.046</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>26.25</td>
<td>0.575</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Experimental B</td>
<td>Pre-test</td>
<td>16.5</td>
<td>-43.301</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>29</td>
<td>-0.731</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Pre-test</td>
<td>20.75</td>
<td>-2.324</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>22.25</td>
<td>0.200</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 3: Results of score differences in experimental and control groups in acquisition and retention of object control skill in autistic children

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>MDF</th>
<th>t</th>
<th>Df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition and Retention of object control skill</td>
<td>Experimental A</td>
<td>Pre-test</td>
<td>16</td>
<td>-6.181</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>27</td>
<td>-1.464</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Experimental B</td>
<td>Pre-test</td>
<td>16.25</td>
<td>-2.605</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>21.50</td>
<td>-1.213</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Pre-test</td>
<td>27</td>
<td>-2.377</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>29.25</td>
<td>0.781</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4: Results of acquisition and retention of locomotor and object control tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>F</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of locomotor skill in the groups</td>
<td>Experimental A, Experimental B, Control</td>
<td>56.903</td>
<td>2-9</td>
<td>0.001</td>
</tr>
<tr>
<td>Retention of locomotor skill in the groups</td>
<td>Experimental A, Experimental B, Control</td>
<td>0.288</td>
<td>2-9</td>
<td>0.757</td>
</tr>
<tr>
<td>Acquisition of object control skill in the groups</td>
<td>Experimental A, Experimental B, Control</td>
<td>7.300</td>
<td>2-9</td>
<td>0.013</td>
</tr>
<tr>
<td>Retention of object control skill in the groups</td>
<td>Experimental A, Experimental B, Control</td>
<td>1.435</td>
<td>2-9</td>
<td>0.288</td>
</tr>
</tbody>
</table>
The aim of this study was investigating the effect of an exercise program using modeling on acquisition and retention of gross motor skills in autistic children. The findings regarding the effects of the selected physical activity program on autistic children showed that in the acquisition of locomotor and object control skills in group A (expert modeling) and group B (novice modeling) there was a significant difference with the control group; in other words, exercises regarding the locomotor skill such as Running, Gallop, hopping, Leaping, Horizontal Jump and Slide; and object control skills such as Striking a stationary ball, stationary dribbling, Catching, Kicking, Overhand Throw and Underhand Roll using expert and novice modeling have caused good progress and enhancement of the motor and object control. These findings are in line with the findings of (Scully et al., 1985). They believed that when the observer needs to learn a new motor skill, using expert modeling is more appropriate than when he/she is practicing a familiar motor skill.

Another Approach is observing a novice modeling (during-learning modeling) which is learned during practicing the learned skill. Lee et al. (1994) showed that observing a novice modeling is more effective than observing an expert modeling. They suggested two explanations in this regard: one is that if the learners observe a novice modeling and receive the feedback of implementing the modeling, participate more cognitively and more actively in problem solving process than when they observe an expert modeling or when they do not receive a feedback. The other explanation suggests that people can learn from observing the errors of others; especially if the feedback is provided during the problem solving process. It seems that an observer who is observing a novice modeling, simultaneous with his/her effort in discovering how to implement the skill gets involved in the problem solving activities by the modeling. In addition, using the expert modeling may end in weakness of the problem solving process; because the expert modeling provides the learners with less information about the error. This study has shown that the effect of the program on the experimental groups and the control group has a meaningful difference. Obviously, this difference does not exist in the comparison of the groups using expert and novice modeling.

(McCullagh et al., 1997) investigated the effects of modeling presentation and observed that the groups who had used the expert and novice modeling and had received the feedback of the modeling outperformed other groups under study. However, the program used in the present research has not been able to have a meaningful effect on retention of movement and object control skills probably because autistic children have abundant problems such as disorders in the senses, attention, memory, motivation and learning compared to normal children.

Kaplan et al. (2000) showed that autistic children have disorders in their memories. Based on the findings of these researchers, some deficiencies have also been observed in efficient memories of autistic people. According to (Kaplan et al., 2000) in memory tests, autistic patients show a consider degree of disorder in efficient memory compared to control group; but they do not have a problem relating the categories of short-term memory, long-term memory and remembering with a clue. Encoding as a valued emotional function in the efficient memory can be very effective in determining purposeful behavior.

Another element that is prerequisite to learning motor skills and may be effective in retention of gross motor skills in autistic children is motivation. Motivation causes constant participation in a number of activities and provides the condition for making willingness in doing an action. According to (Kaplan et al., 2000) there are severe cognitive deficiencies in autistic children; and they in addition to being unwilling to do an action they cannot perform it. Researchers have suggested methods such as rewarding for increasing the motivation of autistic children. Another method for increasing motivation in learning motor skills is modeling. Most autistic patients merely show excessive attention to answer a subset of environmental clues. In fact they exclusively avoid specific social stimuli and probably because they are not able to comprehend the meaning of those stimuli. Also, autistic children have disorder in their attention; and therefore some parts of the unusual processes in autism are accompanied by problems in comprehending the environmental stimuli and this in turn leads to weakness in selecting those clues in the environment which are presented unclearly (Kaplan et al., 2000).

Autism is a pervasive developmental disorder that brings about disability in various fields such as social relation skill, gross and fine motor skills and sometimes in mental skill. The main elements for motor development are fundamental motor skills which are a subset of gross and fine motors. One developmental disorder in autistic children is motor disorder which is believed to be related to brain problems and which makes autistic children weak in motor skills. Therefore, their motor skills are lower to their normal peers; these skills have not formed in them completely; and training is required for their enhancement (Staples and Reed, 2010).

One method that helps motor skill development of these children is presence in the community and imitation among the peers. Imitation has been known to have an obvious role in development and learning process of various children. As autistic children have disorders in cognitive, social and game development, an effective...
method on development of these factors is imitation (Farsi et al., 2011) and one of the effective imitation methods is using modeling in which the child can learn the skill faster after observing it (Kaplan et al., 2000). Considering the weakness of autistic children, exposing them with motor exercises strengthens their basic skills and enhances their motor skills.

According to Bandura’s social theory, most of the habits that we acquire during our lives are acquired by means of observation and imitation. Based on Bandura’s opinion, observation and imitation has an important role in human development because it is more efficient than trial and error. Observational learning gives the children the possibility to constantly learn desirable and undesirable reactions only letting their eyes and their ears open (Chufer, 2011).

(McCullagh et al., 1990) showed the effectiveness of during-learning modeling. Specifically, the researchers showed that observers who have observed a modeling that is learning a timed assignment, and receive information from the modeling about the accuracy of implementing the motor modeling, implement the skill as well as those who have practiced the skill physically and have received the information about their movement. This group of observers also implement better than those who observe an expert modeling before practicing the skill.

More importantly, participants who observed a novice modeling but were not made aware of the provided feedback about implementation of the modeling showed little progress in each step of the test. Providing the learner with feedback regarding the implementation of the modeling is important, especially when novice modeling is used (McCullagh et al., 1990).

Finally, the findings of this study imply that autistic children need a specific exercise program for development of their necessary motor skills and this issue should be considered in exceptional children schools and disabled children centers. If a proper and practical exercise program is designed for these children, they can reinforce their motor skills and perform better in locomotor and object control skills.

This study has also various implications. According to the findings, and owing to the weakness of autistic children in gross motor skills, the program used in this study is appropriate for improving the skills. Owing to the role of peers in motor development of children, it is proper to perform the program to improve motor skills of children together with their peers. It is suggested to found some physical activity centers to assist autistic children perform such activities. It would be also worthwhile to explore the effects of selected physical activity program on development of gross motor skills in autistic children with other modeling types such as video modeling. Another implication of the study is to investigate the effects of selected physical activity program on development of fine motor skills in autistic children. Still another implication of the study is to administer the selected physical activity program in more sessions to determine the effects of the higher number of sessions. In addition, it is recommended to conduct another study with on female autistic children.

Conflict of interest

The authors declare no conflict of interest

References


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