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The Effect of Self-Modeling with Mobile Phone on Overarm Throwing Skill in Children with Developmental Coordination Disorder

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Abstract

Background: One of the most important disorders in children is developmental coordination disorder. In this disorder, motor problems affect children's daily activities, academic achievement, and health in the absence of any known medical condition or neurological disorder.
Objective: This study aimed to investigate the effect of self-modeling with mobile phone on overarm throwing skill in 7-9 years old children with developmental coordination disorder.
Method: Twenty-four children with DCD were selected as purposeful sample and randomly divided into two experimental and one control group. Experimental groups conducted self-modeling with mobile phone under the supervision of a trainer and their parents. The control group trained overarm throwing skill without self-modeling. Training protocol consisted of 5 weeks, three sessions per week and each session included 40 minutes. The process and the product of overarm throwing were measured by the Ulrich test of gross motor development, the second edition, and the accuracy of the throw test.
Results: Covariance test and Bonferroni's post hoc test showed that there was a significant improvement in the process of overarm throwing skill in the two experimental groups ($P<0.05$). Comparison of the groups showed that there was no significant difference between the two groups in the throwing process ($P>0.05$), but both groups had a significant difference with the control group ($P<0.05$). Comparison of the groups in the product of the throwing skill showed that there was no significant difference between the groups ($P>0.05$).
Conclusion: In general, the results of this study showed that that self-modeling with mobile phone improves the process of overarm throwing skill in children with developmental coordination disorders. Self-modeling probably facilitates the process of performing and learning skill in these children by creating a representation of the task.

Introduction

One of the most important disorders in children is developmental coordination disorder, which in these children, has effect on motor problems, daily activities, academic achievement and health without any known medical condition or neurological disorder. The disorder affects about six percent of school-age children and impairs fine and gross motor coordination (American Psychological Association, 2013). Fundamental skills development is important for all children with disorders or without disorder. Because, fundamental movement skills are the basis of more complex motor skills which child uses them in recreational and daily activities (Gallahue, Ozmun, & Goodway, 2006).

The results of two decades of research in these children show that these children have more motor variability than typically developing children (Roche, Viswanathan, Clark, and Whitall, 2016).

These children, in most of daily activities, have difficulty in balance on one foot, directing hand to right position, catching ball, taking a glass of water without pouring it (Golenia et al. 2018). One of the hypotheses about these children is that they have less ability for using external models of motor control, meaning that they cannot provide a predicting model of a probable action. Based on this approach, variety in movement behavior can led to defect in internal model (Adams, Lust, Wilson, and Steenbergen, 2014). Another reason for high motor variability in these children is internal neuromotor disorder, which impairs the transmission of information in the motor-nervous system and this leads to motor problems (Sterand, 2018).

In teaching motor skills, modeling is one of the evidence-based teaching methods and can be useful in teaching different skills to healthy children and with developmental disorder as well (Bellini & Akullian, 2007). According to Bandura (1986), observing model implementation enables the viewer to create a representation of the observed task, and then performs it when task is required and use that representation to select and plan the required response. Representation also serves as a criterion for identifying and correcting errors during physical exercise. There are various methods such as live patterning (skilled or beginner pattern), video patterning (film and photo) and sometimes computer patterning (animation) to help the learner in acquiring any of the observational learning processes which leads to fixation of information in representation memory (Black, 2004).

There have been studies on the effect of self-modeling in children with the disorder, and most studies have evaluated the effect of self- modeling positively. In this regard, Edwards, Jeffry, May, Rinehart, and Barnett (2017), investigated the effect of playing a sports active video game on improving object control skills in children with autism spectrum disorder. For this purpose, 11 children between 6 to 10 years old with Autism spectrum disorder have been compared with 19 children with normal development. Results of this study showed that both groups were enhanced in these skills. Review studies on the effect of self-modeling in autistic children have shown that self-modeling is an effective intervention strategy in social communication skills, functional skills, skill acquisition and behavioral functions (Mac Coy and Hermansen, 2007). Also, Van Laarhoven, Zurita, Johnson, Grider, and Grider (2009), in a research, have studied effect of self-modeling, other modeling and mental modeling in teaching daily life skills to three children with developmental disorders. Results showed that self-modeling in every three methods has significant effect on response rate in daily activities.

On the other hand, in today's communication and information world, a great evolution has occurred. One of the most important innovations that changed communication world is mobile phone. During a ten years period, increasing mobile phone among people has been three times higher than other communication methods. One of the reasons for the popularity of mobile phones is its simple language and ease of use, which is a great advantage compared to other methods of communication (Allahyari, Heidari and Jian, 2015). Based on studies made, mobile phone has not been used in teaching motor skills and in some sources mobile phone has been seen as a tool for poverty of movement (Lepp, Barkley, Sanders, Rebold, & Gates, 2013). Therefore, due to the availability of this device, in this study, we tried to turn this threat into an opportunity and use mobile phones in teaching motor skills in children with developmental coordination disorders. In addition to the above, it is emphasized that in children, in addition to aerobic and anaerobic exercises and flexibility, strengthening basic motor skills such as running, jumping, being fast, throwing, hitting, and spinning have also been considered (Haywood, 2019).

Many studies have mentioned the role of parents in motor interventions in children. In most of these studies, parents have played an important role in motor interventions and it has been shown that parental involvement has an important effect on the effectiveness of motor interventions (Mahoony and Peerless, 2006). Therefore, in this study, we tried to get help from parents in teaching basic skills to children. A review of the research literature shows that no research has been done on the effect of self-modeling and video modeling on skills teaching in children with developmental coordination disorder, and researches which have been done have studied autistic children. Also, the number of participants in previous studies was very few. According to the above, the aim of this study was to investigate the effect of self- modeling with mobile phone on overarm throwing skill in children with developmental coordination disorders.

Method

Participants

The present study was a quasi-experimental study with a pre and post-test design with a control group. According to the study made in this research, the statistical population was 41 girls with developmental coordination disorders in Borkhar city of Isfahan, among them, 24 participants with a mean age of 8.4±0.92 years were selected by purposeful sampling. Inclusion criteria included having age range of 7 to 9 years, no cardiovascular disease, previous musculoskeletal injuries, and normal IQ. Exclusion criteria included not participating in more than two sessions in the training program and unwillingness or inability to properly perform the training protocol.

Research Tools

In this study, the Wilson, Kaplan, Crawford, Campbell and Dewey (2000) Developmental Coordination Disorder Questionnaire was used to identify children with developmental coordination disorder. The initial version of this questionnaire included 17 questions and was suggested to identify children aged 5 to 8 years. The revised version of this questionnaire has been developed for a wider age range from 5 to 15 years and includes 15 questions, which assess a total of three factors of control during movement, fine movements/ handwriting and general coordination. Then, the teachers' motor observation questionnaire (15 questions) was used in the identified statistical population, which examines the presence or absence of this disorder from the perspective of teachers. A high correlation between this test and the movement assessment set test has been reported (0.57), the test sensitivity for the diagnosis of these children was also reported to be 80.5% (Schumaker, Flapper, Reinders-Messelink, & kloet, 2008).

The second edition Ulrich's motor development test was used to assess the throwing process in children with developmental coordination disorder. This test is designed to estimate gross motor development in children 3 to 10 years old and consists of two sub-tests: locomotor (running, jumping, hopping, leaping, horizontal jump, sliding) and object control (striking a fixed ball, dribbling, kicking, overarm throwing and rolling (Ulrich, 2000). In this study, overarm throwing subtest was selected to measure the throwing process. The validity of this test is 0.96 and its reliability for subtests is 0.87 (Salehi and Zarezadeh, 2016). To perform the test, we stick a piece of glue on the floor at a distance of 20 feet from the wall. The child stands facing the wall on the 20-foot line and throws the ball to the wall strongly. Performance criteria include the following: movement of hand (arm) begins from bottom, shoulder and pelvis rotation up to the point which other part of body placed to the wall, body weight transfers by stepping opposite leg of throwing hand, and throwing hand movement continues to other part of body diagonally.

A method similar to that of Avila, Chiviacowsky, Wulf, Lewthwaite (2012) was used to measure the result of overarm throwing. Target was 10 concentric circles, with radius 10, 20, 30 … 100 centimeters. Considering that target was formed by 10 concentric circles, each circle from center has 100 scores and last and external circle has 10 scores. Numbering manner was so that if throwing landing to target center, score was 100, and if throwing landing on other regions, scores were 90, 80, 70, …, and if throwing did not collide to target, zero score was recorded for subject. For performing this task, participants had to throw by their dominant hands to the target. Participants were placed in a line with a 3 meter distance from target, and throwing to the target which was determined by concentric circles with a distance of 10 centimeter with each other. In each session, each subject did 10 overarm throwing with a yellow tennis ball.

Procedure

Firstly, 670 questionnaires of developmental coordination disorder were distributed among parents, from which 630 number were returned. After studying questionnaires, 41 girls diagnosed to have developmental coordination disorder, from which, 24 individuals were selected and randomly divided into two groups of experimental and one control with eight individuals. At first, in presence of physical education teacher, in a one-hour session, participants were trained for overarm throwing. In this way, the necessary verbal instructions were given to the participants and the throw was shown to them. The children were then asked to throw and were given the necessary feedback. At the end of the session, the pre-test was conducted. Then, in a one-hour session, parents were taught about overarm throwing and the necessary instructions were given to the parents. After selecting the participants and grouping them, the participants of both experimental groups were placed in their training environment. One group practiced self-modeling method under parental supervision and the other group practiced self-modeling method under the supervision of a trainer, and the control group did not observe a pattern. At home, the parent-supervised group observed a 2-minute pattern prepared from the previous session and then performed 20 overarm throws. In two front and side views and from a distance of 6 meters, a video was made of the last attempts of the participants of both experimental groups and it was shown in next session for training. The program was set for 15 sessions and its duration was 40 minutes per day and three training sessions per week. After 15 sessions, post-test was performed. Each session initially included warming up to begin the exercise program, which included walking with hand movements (rotation of right hand and left hand in different directions up, down, right and left) and total movements were performed in 10 minutes. Then, every participant in a distance of half meter, observed the two minutes film of his previous throwing which was prepared from 6 meters distance. In the following, every participant stands at the line of throwing and begins to throw. The child was then asked to perform relaxation movements individually and slowly for 10 minutes. (Jenings, Reaburn, and Rynne, 2013).

Statistical Analysis

Descriptive statistics including mean and standard deviation and inferential statistics including Shapiro-Wilk test to ensure normal distribution of data and covariance test and Bonferroni post hoc test were used to investigate the effects of self-modeling and compare group performance. Also, for data analysis, SPSS statistical software version 20 was used at a significance level of 0.05.

Results

Mean and standard deviation of participants divided in three groups of trainer, parents, and control in pre- and post-tests have been shown in table 1. Results show that in trainer and parents' groups, rather than the control group, average scores in post-test were increased rather than pre-test.

Table 1. Mean and standard deviation of variable scores by groups in the test stages.

Group	Variables	Pre-test		Post-test	
		mean	standard deviation	mean	standard deviation
Coach	skill process	3.5	1.414	5.63	0.744
	skill result	303.75	81.93	312.5	73.04
Parents	skill process	4.5	0.75	5.88	0.835
	skill result	312.5	58.73	318.75	62.66
Control	skill process	4.38	1.160	4.75	0.88
	skill result	312.5	82.83	313.75	42.06

In the following, for group comparison in pre and post-tests, covariance analysis has been used in throwing process. Firstly, hypothesis of this test including regression homogeneity, linear relation, variance homogeneity, have been studied and confirmed. As can be seen in Table 2, the effect of the covariate variable is significant (P <0.05). This shows that there is significant correlation between covariate variable (pre-test) and dependent variable (post-test). Results also show that group effect also is significant (P<0.05), which show, by elimination of pre-test effect, there is a significant difference between at least two groups of the three experimental groups.

Table 2. Covariance test between experimental groups in the process of overarm throwing skill.

Change source	Total squares	Degree of freedom	Mean squares	f	p	Effect size
Group	6.75	2	3.37	6.38	0.007	0.39
Covariate (pre-test)	3.67	1	3.67	6.94	0.016	0.25
Test error	10.75	20	0.52			

Results of mean comparison between groups with Bonferroni post-hoc test showed that there was a significant difference between the mean score of the throwing process in the two groups of coach and parents with the control group (P <0.05). While, there was no significant difference between self-modeling with mobile phone under supervision of coach and parents in overarm throwing skill process in children with developmental coordination disorder (P> 0.05). In the following, covariance analysis has been used for comparison of groups in pre and post-tests for throwing result.

Table 3. Covariance test between experimental groups in the result of overarm throwing skill.

Change source	Total squares	Degree of freedom	Mean squares	f	p	Effect size
Group	200.20	2	100.10	0.27	0.76	0.02
Covariate (pre-test)	69919.89	1	69919.89	191.42	0.001	0.90
Test Error	7305.11	20	365.25			

As it is seen from table 3, covariate variable effect is significant (P<0.05). This shows that there is significant correlation between covariate variable (pre-test) and dependent variable (post-test). Also, results show that group effect in variance analysis is not significant (P>0.05), which shows that by eliminating pre-test effect, there is no significant difference among three groups. Mean and standard deviation of adjusted post-test scores in process and result of the overarm throwing skill divided in three coach, parents, and control groups, have been shown in table 4.

Table 4. Mean and standard deviation of modified post-test scores of variables in the two analysis of covariance.

Group	Variables	Modified post-test	
		Mean	Standard deviation
Coach	skill process	5.86	1.13
	skill result	317.8	35.76
Parents	skill process	5.73	1.10
	skill result	316.05	29.89
Control	skill process	4.65	1.80
	skill result	311.05	29.76

Discussion and Conclusion

The aim of the present research was self-modeling effect by mobile phone on overarm throwing skill in female children aging 7 to 9 years with developmental coordination disorder. Results showed benefit of self-modeling method by mobile phone on throwing skill process from shoulder in children and using mobile phone in present research was effective for modeling in children who had developmental coordination disorder. Considering the result, we can understand that two groups of self-modeling with mobile phone under supervision of coach and parents in overarm throwing skill process have achieved the desired learning. In other words, as a result of practice and experience, children's skill has been changed. One of general features of learning is advancement, which notes to better performance of the task over time (Schmidt & Wrisberg, 2008) and it was seen in both groups in throwing process. When participants were in final sessions, they had better performance than first session, and their scores in both groups were significantly more than scores in pre- test stage.

Results in present research were aligned with previous researches which had studied video modeling in individuals with developmental disorder (Edwards et.al, 2017, Van Laarhoven et.al, 2009). These researches showed that use of modeling in individuals with developmental disorder usually caused quicker skill acquisition in some of the learners and in some others, caused generalization results to other situations (Mc Coy and Hermansen, 2007). It seems that video self-modeling is effective involvement, because, individuals can see themselves in successful performance of a difficult skill. It is supposed that subjects by seeing their successful performance become more interested in performing skill and are more confident in their abilities (Van Laarhoven et.al, 2009). Researches showed that with more probability, observers had better learning from familiar models, and where the model is similar with observer, this understanding is more happened (Hasford,1981). Thus, Bandura's theory of observational learning predicts that among video interventions, self- modeling is more useful than other modeling methods (Bandura, 1969). In addition, self-observation leads to increased attention and psychological arousal in the individual (Hasford, 1981). Bellini & Akullian (2007) have suggested that motivation may be one of the key factors in the success of video modeling and video self-modeling. Evidences and clinical findings show that film watching is one of the favorite activities of many children (normal children or those with developmental disorder) and increases motivation and attention to the model in the film. In self-modeling, this motivation may be more, because child views himself in successful performance.

In explanation these results, we can refer to dynamic systems point of view that consider the environment as important factor the development of motor skills and emphasizes to the point that factors affecting on motor development include the characteristics of motor tasks related to the individual and the environment, and these factors are effective in movement stability locomotion and manipulation skills (Payne and Isaacs, 2017). By creating factors affecting the development of motor skills through self-modeling with a mobile phone, this program was able to have a good effect on the development of the overarm throwing process in children with developmental coordination disorders. Therefore, it can be said that the influential factor on the subjects is creating training opportunities for the experimental group. It seems that self-modeling as a useful tool gives opportunity to children to enrich their motor skills and could achieve better motor development. One of the strengths of the present study was the use of mobile phones to teach motor skills, a tool that is available to most motor instructors and teachers. Due to the lack of necessary facilities in many schools and gyms to demonstrate skills, according to the results of the present study, mobile phones can be a good alternative to this issue.

The results also showed that the effect of self-modeling as a result of throwing between the experimental and control groups was not significant. Results from this research are consistent with the findings of Cannella-Malone et al. (2006). In a comparing research, they have studied effects of video prompting and video modeling in teaching daily living skills in adults with developmental disabilities and they understood that video modeling has not effects. It is difficult to adapt these data with many researches which all of them showed positive effect of video modeling. They have suggested some probable reasons for their works results, including numbers, duration or perspective which video clips were filmed. Likewise, Bellini and Akullian (2007) also have not shown any statistics significant difference between video self-modeling and video other modeling in keeping or generalizing target behaviors. One of probable reasons of self-modeling nonimpact as a result of overarm throwing can be noted five weeks training in present research. Perhaps, training rate in present research was not sufficient to effect on throwing results. The findings of this study on parental support and influence in the motor skills training process are consistent with previous studies (Sayers, Cowden, & Sherrill, 2002, Darrah, Law, & Pollock, 2001). These studies have shown that parents play an important role in children's motor interventions and parental involvement can have a positive effect on the effectiveness of the intervention. For example, Mahoney and Perales (2006) showed that the influence of parents in motor intervention sessions is surprising, although few suggestions were made by parents in their research; But less than half of those suggestions were about encouraging or supporting parents to move their children in the natural environment.

In general, it can be said that developmental coordination disorder is a common disorder among children, so that 5 to 6% of primary school children have this disorder. These children for These children, for sharing and active and effective presence, the possibility of using social and educational facilities, functional experience achievement, children and family stress reduction, and other accompanying problems that isolate and frustrate the child need effective physical activity and treatment program which prevents most of the previous problems. Therefore, it is recommended to use self-modeling to improve fundamental motor skills such as overarm throwing in children with developmental coordination disorders. The findings of the present study can be used in classrooms. Due to the need to teach fundamental motor skills in preschool, mobile phones can be used mobile phone can be used for self-modeling and teach learners' motor skills by parents and trainers. In the future direction of the present study, more participants in the groups, more sessions and gender variables can be considered. It is also suggested to study the effect of self-modeling to improve other motor abilities such as coordination and balance in these children. According to the results of this study, the use of mobile phones for self-modeling is effective in teaching fundamental throwing skills and improves the throwing process. Due to the availability of mobile phones for educators and parents, it is recommended to use this tool for self-modeling of fundamental motor skills.

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