



The Comparison of Depth Perception in 7-9 Years Old Healthy Children with Developmental Coordination Disorder

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Abstract: *The visual perception is completely associated with successful performance of motor skills. Development of Children's perceptual abilities considerably improved motor function or weakens. So awareness of the developmental status of visual perception is essential. The purpose of this study was to compare depth perception of 7-9 years old children characterized by developmental coordination disorder (DCD) with healthy children. Participants were 80 male subjects, 40 subjects with developmental coordination disorder and 40 healthy peers that selected on available sampling. All have normal vision or were modified. Depth perception of subjects was evaluated in three times by the depth perception model D9009. The average error of depth perception was used as the depth perception score. Independent T-test results showed significant difference between healthy children and DCD. The average error in the healthy children was significantly lower (MD =9.45). From the results can be concluded that weaker motor functions and motor delay and consequently the DCD has negative impact on the visual perception of depth. Therefore, in dealing with these people due to the importance of depth perception in motor function, attention to this matter is essential.*

Keywords: Depth Perception, Developmental Coordination Disorder, Motor Delay.

Introduction

Developmental coordination disorder (DCD) is one of the most common disorders with a prevalence of 6% among primary school students (Wuang et al., 2012). This disorder involves gross and fine motor skills and motor coordination. According to DSM-V, DCD is an outstanding damage in motor coordination which remarkably affects academic achievement and daily activities such as wearing clothes, combing, and participating in games and sports. This disorder is characterized by low performance and poorer coordination than the expected level compared to the individual's age and intelligence in daily activities, Kaplan & Sadouk (2007). Theories of control and motor learning suggest involvement of basal

ganglia, cerebellum, and frontal lobe, Albaret et al., (2002). Many disabled children with poor motor coordination are referred to occupational therapists, and some of these children are diagnosed with DCD. It is estimated that 2-15% of children are suffering from this disorder, Hong. C.S et al., (2002).

Visual perception is complicatedly related to success in the function of motor skills. Therefore, it is necessary to be aware of the developmental nature of the children's visual perception capacity. Moreover, developments of perception abilities improves or weaken the children's motor function. A child with limited perception development is faced with problems in carrying out motor-perception tasks,

Gallahue DL et al., (2006). Defects in visual perceptual skills may have a negative effect on conducting simple daily activities which require delicate manipulation of objects, Rosenblum, S et al., (2006). Visual depth perception is a complicated system which is related with identification of an object and specification of its place in the space, and is closely related with the function motor, Sage, GH et al., (1984). The results of numerous studies have indicated the weakness of the children suffering from DCD in perceptual motor skills, Tsai et al., (2008). It is stated that perceptual abilities such as depth perception are among important characteristics of visual perception which affects motor function, Winnick (2005), Braddick (1996) and Kavsek et al., (2009). Therefore, Bruce et al., (2011) stated that when the harp is played with one eye, the fingers and the thumb open more than when two hands are used so that a safety margin can be created for the individual. As a result, one of the important participation of vision in complex tasks such as playing the harp is to provide initial estimation of the 3D characteristics of objects which is used for motor planning, Keefe Bruce et al., (2011). In this regard Houwen et al., (2007) indicated that children with visual disorder are outperformed in motor skills and manipulation of objects by their healthy peers, Houwen Suzanne et al., (2011). Moreover, the key role of depth perception is highlighted in motor skills and especially in the skills of catching, receiving, and throwing, Sage et al., (1984). The results of the studies carried out by Ashton et al (1955), Shick (1971), Sanderson and Whiting (1974), Isaacs (1981), and Gassman (1985) showed that different levels of skills and success in sports skills are directly correlated with depth perception, Ashton Craybiel (1995), Gassman (1985), Isaacs L D (1981), Sanderson (1974) and Shick J et al., (1974) In addition, Lenoir et al (1999) and Campos et al (2000) pointed out that displacement moves predict depth perception, Lenoir M (1999) and Campos J J et al., (2000). Skordilis et al (2004) showed that children who were classified based on gross motor development and were

poorer in displacement skills had a lower depth perception, Skordilis (2004). Gallahue and Ozmun (2006) stated that the level of the movement's role in visual perception is not clear. In the past, scholars used to consider the importance of movement in development and improvement of visual perceptual abilities. These studies were based on this assumption that automatic movement is necessary and enough to create visual-motor adjustments in a dynamic visual environment. They claimed that adjustments of visual perception would not occur without movement, and that muscles and the motor aspects of the nervous system are to large extent dependent on perception and are interrelated.

In addition, the concept of the relationship between motor activity and perceptual development has indirectly been confirmed through decrease in functioning in the experiments of motor and perceptual deprivation (Hebb, 1949; Riesen and Aarons, 1959) and the experiments carried out on perceptual-visual adjustments in reconstructed environments with visual regard (Gallahue,1982;held& blossom,1961;Mikaelian, Held, 1964;Haynes et al., 1965).

However, it is now affirmed that motor activity and depth perception are internally related. Preparing and implementing a motor activity, independent from sensory consequences, are usually enough to determine the perception of the observer and to represent the 3D space and the shape, Wexler et al., (2005). The strong relationship between transfer and the updated state if the spatial map will continue during adulthood. Results indicate that action has a solid internal relationship with depth perception, which affects even in the absence of external sensory feedback, Gibson (1950) and Findlay et al., (2003)Therefore, according to the importance of the role of depth perception and also the relationship between perception and action, it is necessary to investigate into the state of depth perception in children with DCD in order to design treatment and rehabilitation programs.

Materials and Methods

The present study was semi-experimental, and the subjects included 80 children aging 7-9 years old. Forty of them were suffering from DCD who were selected by a convenience sampling method, and the other 40 subjects were their healthy peers. All of the subjects were studying at ordinary schools of Mashhad's District 6.

Instrumentation

Motor Assessment battery test for children-2 (MABC-2) was utilized to measure the children's motor status in three subscales of manual dexterity, ball skills, and balance. This scale is designed for three age ranges; 3 to 6 years, 7 to 10 years, and 11 to 16 years, and it includes specific components based on the needs and prerequisites of each age range. This scale is employed to assess motor development and recognize motor disorders.

Other instruments used to collect the required data included Snellen Visual Acuity Test to ensure the visual health of the subjects, and the depth, hue, and shape perception apparatus. The subjects were selected from among individuals with visual health of 10/10 or had corrected vision. In so doing, Snellen Visual Acuity Chart was installed on the wall and the subjects were assessed from the distance of 6 meters from the chart. Afterwards, the

depth, color, and shape perception apparatus model D9009, with the capacity to measure depth perception with an accuracy of one ten-thousandth cm, was employed to measure the subjects' depth perception. The subjects stood at a distance of 4.5 m from the apparatus, facing the apparatus's monitor, and their depth perception was measured 3 times and the mean of those 3 times was recorded as the score of their depth perception. In the present study, each subject was tested three times in black hue with yellow background with light combination characteristics of red 234, green 234, and blue 0 degrees with hue saturation of 240, hue 40, and luminance 110, and the mean of the collected data was used for statistical analysis. The researcher-designed depth perception apparatus was designed in a way that it eliminates any effect of other senses including depth sense with the help of remote control in a wireless method and it can provide the researcher with precise measurements with minimum error. The validity of the apparatus was simultaneously examined in the Motor Behavior Laboratory of Shahid Beheshti University, Tehran by comparing the results of its performance for 30 subjects with those obtained from the Lafayette 1702 (14012) Depth Perception Apparatus. For both apparatuses, the subjects had 3 attempts in quite equal conditions, and the level of correlation of the two apparatuses was obtained through Pearson Correlation Coefficient which was

Table 1. Demographic Characteristics of the Subjects According to their Age Group

	Minimum (year)	Maximum (year)	Mean (year)	SD (year)
DCD	7	9	7.98	0.832
Healthy	7	9	7.98	0.832
Subjects	7	9	7.98	0.826

Table 2. The Mean Scores of the Subjects in the Two Groups

Groups	Mean	SD	Mean SD	t	df	p
DCD	18.20	2.97	0.47	16.52	78	0.0001
Healthy	8.75	2.05	0.32			

0.833. Moreover, reliability of the apparatus was also tested in the same laboratory by examining the performance of 30 subjects each of who had 3 attempts in quite equal conditions and in intervals of 3 days, and the results were analyzed using Pearson Correlation Coefficient which indicated a reliability of 0.879.

Statistical methods

In analyzing the collected data, descriptive statistics was employed so as to describe the data statistically and inferential statistics was used to examine whether the differences were significant or not. In the present study, Kolmogorov Smirnov Test confirmed the normality of the data. Moreover, independent t-test was used to compare the means in the two groups, and Levene’s test was employed to evaluate the equality of the data’s variance in the two groups.

Results and Discussion

The subjects’ demographic characteristics

Eighty subjects of the same age group were selected by a convenience sampling method and assigned into two groups of 40; a healthy group and a group with DCD. **Table 1** presents the subjects’ demographic characteristics.

In order to examine the assumption of equality of variances, Levene’s test was employed. The results of the Levene’s test proved the homogeneity of variance ($0.05 < p$). Independent t-test was used to compare the depth perception of the two groups. The mean and the standard deviation of the subjects’ depth perception are presented in **Table 2**.

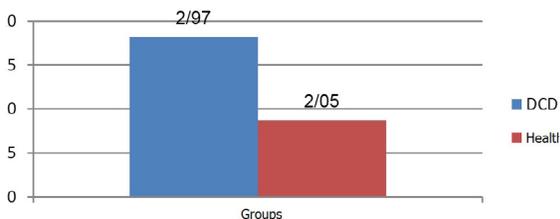


Fig. 1. The Mean of Depth Perception Error in the Two Groups

As observed in Table 2, there is a significant difference the scores of the two groups ($df=78$, $p \leq 0.001$, and t is 8.75 ± 2.05 mm and 18.20 ± 2.9 mm for respectively for the healthy group and the DCD group). Diagram 1 presents the mean scores of the two groups.

The main purpose of the present study was to compare the depth perception of children with DCD and healthy children. The results of independent t-test indicated that there was a significant difference between the two groups in terms of their depth perception scores, such that the healthy children had a significant lower level of errors in their depth perception. Since the results of different study indicate the positive effect of movement on visual acuity, which is attributed to an improvement in oxygen supply tanks to activity Sage et al., (1984) and because visual acuity plays an important role in depth perception, Gallahue (2006) and Sage et al., (1984) perhaps one of the reasons for decrease in depth perception in such individuals is chronic hypoxia. It is also possible that in this group, physical and psychosocial problems, Tsai (2008) and Winnick et al., (2005) cause decrease in their activity and exclusion from sports. According to the results of different studies, Campos (2000) and Skordilis et al., (2004) translational motions and gross motor skills, especially running and skipping, can improve depth perception, Isaacs (1981) and Sanderson et al., (1974) Furthermore, the results of the studies carried out by Lenoir et al (1999) and Campos et al (2000) displacement movements predict depth perception, Lenoir (1999) and Campos et al., (2000) Skordilis et al (2004) indicated that children that were classified based on gross motor development and were poorer in their movement skills had lower depth perception, Skordilis et al., (2004). Therefore, children with limited perceptual development are mostly faced with problems while carrying out perceptual-motor tasks, Gallahue et al., (2006). Results of some studies indicate that children with DCD are weak at motor-perceptual skills, Tsai (2008). It is stated that perceptual skills, such as depth perception,

are among important characteristics of visual perception which affects motor function, Winnick (2005), Braddick (1996) and Kavsek et al., (2009). Therefore, it is possible that weakness in transitional and displacement motions in this group of individuals is another reason for depth perception error, Skordilis et al., (2004). However, since motor activity and depth perception are essentially related, and preparing or implementing a motor activity, independent from sensory consequences, are usually enough to determine the perception of the observer and to represent the 3D space and the shape, Wexler et al., (2005) and because there is a solid internal relationship with depth perception, which affects even in the absence of external sensory feedback, Gibson (2005) and Findlay et al., (2003), these cases may be among the reasons for decrease in depth perception among these children. In the end, due to the highly significant role of depth perception in all aspects of life, especially in human motor behavior, and decrease in depth perception in children with DCD, it is necessary to carry out further studies on this issue.

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