Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
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http://ansinet.com

Journal of Applied Sciences 8 (5): 830-835, 2008
ISSN 1812-5654

A Comparative Study on the Visual Perceptions of Children with Attention Deficit Hyperactivity Disorder

[1]Emine Ahmetoğlu, [2]Neriman Aral and [2]Aynur Bütün Ayhan
[1]Department of Preschool Education, Faculty of Education, Trakya University, Turkey
[2]Department of Child Development and Education, School of Home Economics, Ankara University, Turkey

Abstract: This study was conducted in order to (a) compare the visual perceptions of seven-year-old children diagnosed with attention deficit hyperactivity disorder with those of normally developing children of the same age and development level and (b) determine whether the visual perceptions of children with attention deficit hyperactivity disorder vary with respect to gender, having received preschool education and parents' educational level. A total of 60 children, 30 with attention deficit hyperactivity disorder and 30 with normal development, were assigned to the study. Data about children with attention deficit hyperactivity disorder and their families was collected by using a General Information Form and the visual perception of children was examined through the Frostig Developmental Test of Visual Perception. The Mann-Whitney U-test and Kruskal-Wallis variance analysis was used to determine whether there was a difference of between the visual perceptions of children with normal development and those diagnosed with attention deficit hyperactivity disorder and to discover whether the variables of gender, preschool education and parents' educational status affected the visual perceptions of children with attention deficit hyperactivity disorder. The results showed that there was a statistically meaningful difference between the visual perceptions of the two groups and that the visual perceptions of children with attention deficit hyperactivity disorder were affected meaningfully by gender, preschool education and parents' educational status.

Key words: Children with normal development, attention deficit hyperactivity disorder, visual perceptions

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a condition which commonly presents itself in children under seven years of age; is characterized by inattention, hyperactive behavior and impulsivity and may lead to serious psychiatric and social problems throughout one's lifetime (American Psychiatric Association, 1994; Barkley, 1998; Öner *et al*., 2000; Johnston and Mash, 2001; Banaschewski *et al*., 2006). It is reported to be more common among males than females (Vitanza and Guarnaccia, 1999; Sonuga Barke *et al*., 2004) with a mean ratio of 4:1 in clinical samples (Maniadaki *et al*., 2006). It is estimated to affect approximately 4-6% of the world's child population (Johnston and Mash, 2001). Its diagnosis is based on medical, psychological and educational assessment of patients. Although the disorder usually emerges around the age of three, it is mostly diagnosed in child-adolescent mental health clinics during school years when attention and concentration become important (Şenol, 1997; Johnston and Mash, 2001; McCleary, 2002; Zimmerman, 2003). For a DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) diagnosis, ADHD needs to have been going on for more than six months, the symptoms need to recur in at least two different environments (such as home, school, work place), the disorder needs to have started before age 7 and it needs to adversely affect the child's academic and social functioning (American Psychiatric Association, 1994; Schneider and Eisenberg, 2006).

Unless the disorder is treated properly, the symptoms observed in children affect almost all areas of their education and life negatively. More precisely, untreated ADHD may lead to psychiatric problems such as anxiety and depression, aggressiveness, behavioral problems, low self-esteem, crime or substance abuse. It may also cause social and educational problems such as poor peer and family relationships or failure at school (Barkley, 1998; Brook *et al*., 2000; McCleary, 2002; Selikowitz, 2004; Hil and Van Haren, 2005). Studies on the topic report that children and youngsters with ADHD are usually behind their peers academically, socially and with respect to family functions (Power *et al*., 2002; McCleary, 2002; Selikowitz, 2004; Sonuga Barke *et al*., 2004; Hil and Var Haren, 2005). Visual perceptions, the basis of academic skills, are an important topic for children with ADHD who have academic problems.

Corresponding Author: Emine Ahmetoğlu, Department of Preschool Education, Faculty of Education, Trakya University, Turkey

Visual perception is defined as the ability to recognize, distinguish and interpret visual stimulants in relation to previous experiences. Visual perception is the result of an individual's attempt at understanding the visual information obtained through seeing by meaningfully organizing, classifying and generalizing visual stimulants (Morgan, 1984; Frostig, 1964). Visual perception is important because it supports children's reading, writing, spelling and arithmetic skills and also helps with concept acquisition. Children who have problems with their visual perception also have problems with perceiving information around them, which affects their school life negatively (Reinartz and Reinartz, 1975; Cengiz, 2002). With the help of visual perception, children learn to read, write, make mathematical calculations (Akçin, 1993) and combine sensory information. Visual perception comprises the stages of recognition, attention and making meaning, which appear in a certain order (Hogan, 1990; Tuğrul *et al*., 2001). Various studies have shown that preschool education supports higher visual perception in children with normal development (Mangır and Çağatay, 1987; Kaya, 1989; Ferah, 1996; Aral and Erturan, 1999; Kılıç and Ayhan, 2007). In such studies, the variable of gender did not lead to a meaningful difference in the visual perception of children with normal development (İbišoğlu, 1987; Mangır and Çağatay, 1987; Aral and Erturan, 1999; Koç, 2002; Aral and Ayhan, 2004). It is important to examine visual perception, which forms the basis of school success and failure of children with ADHD. The present study compares the visual perception of children with normal development and those diagnosed with ADHD to see possible differences and investigate the effects of gender, preschool education and parental educational levels on the visual perception of children with ADHD.

MATERIALS AND METHODS

The study which was carried out in 2006-2007 education year was conducted on seven-year-old ADHD children who were making use of the special education and counseling services of Trakya University Education, Research and Training Center for Mentally and Physically Disabled Children in Edirne and children with normal development from the same age group and development level who were attending the second grade of Yüksel Yeşil Primary School in Edirne. A total of 60 children were assigned to the study. The study is restricted with 60 students because only 30 students at the age of seven were diagnosed as ADHD at Trakya University Education, Research and Training Centre and 30 children at the same age with normal development at Yüksel Yeşil Primary School were chosen in order to compare both groups. The latter were chosen through random sampling and participated in the study voluntarily.

Data about children and their families were gathered by using a General Information Form and the children's visual perception skills were identified through the use of Frostig Developmental Test of Visual Perception. The latter was standardized through studies conducted on 2,116 children between the ages of 4-8. Sökmen (1994) tested the reliability of the test for use on five-year-old children and concluded that not only the general continuity coefficient but all continuity coefficients in the sub-dimensions were meaningful at 0.01. Frostig Developmental Test of Visual Perception is composed of five subtests involving eye-motor coordination, figure ground, constancy of shape, position in space and spatial relationships. Eye-motor coordination involves drawing continuous straight, curved or angular shapes within different sizes of boundaries without models and measures hand-eye coordination; figure ground perception involves detecting embedded figures on increasingly complex backgrounds; constancy of shape involves the perception and distinguishing of objects in different shapes, sizes, shadows and positions; position in space involves the identification of shapes in reversed position; and spatial relationships involve the analysis of simple form and patterns (Lockowandt, 1974).

Each subarea of Frostig Developmental Test of Visual Perception has standard scoring criteria. Raw scores obtained by children in each subarea are transformed into standard scores, which are obtained from the percentage tables developed for the test (Lockowandt, 1974).

Frostig Developmental Test of Visual Perception was implemented on children with ADHD in the family interview room of Trakya University Education, Research and Practice Center for Mentally and Physically Disabled Children. Those with normal development took the test in the family interview room of Edirne Yüksel Yeşil primary school.

In order to determine whether there is a difference between the Frostig Developmental Test of Visual Perception scores of children with normal development and those with ADHD and also to find whether the scores of children with ADHD vary with respect to the child's gender, preschool education experience and parents' educational level, Mann-Whitney U-test was conducted in independent groups with no normal distribution and consisting of two subgroups and Kruskal-Wallis variance analysis was conducted in groups with more than three subgroups and when the variance was not homogeneous. The group creating the difference was identified with Mann-Whitney U-test too.

RESULTS AND DISCUSSION

Of the participating children diagnosed with ADHD, 43.0% was girls and 57.0% was boys; 30.0% had received

preschool education and the remaining 70.0 % had not. Of the participating mothers who had children diagnosed with ADHD, 33.3% were primary school graduates, 40.0% were high school graduates and 26.7% were university graduates. For the fathers, these values were 23.3, 56.7 and 20.0%, respectively.

Table 1 shows that there is a meaningful difference between the Frostig Developmental Test of Visual Perception mean scores of the two groups of children (U = 223.00; p<0.001). Those with ADHD scored lower than those with normal development.

When the Frostig Developmental Test of Visual Perception scores were analyzed with respect to subtests, it was seen that the scores of children with ADHD were lower than those with normal development on eye-motor coordination (U = 293.00; p<0.01) and constancy of shape (U = 239.00; p<0.01) tests and that the difference between scores was meaningful. In other subtests, the scores obtained by children with ADHD were lower than those obtained by children with normal development but the difference was not found to be meaningful. It is mentioned that children with ADHD have difficulty focusing and holding their attention and recognizing details; have less attention than their peers; avert work and assignments requiring mental effort; fail to properly work on and finish a task: And appear not to be listening when talked to. They are reported to display poor academic success particularly in reading, attention (Power *et al*., 2002; McCleary, 2002; Sonuga Barke *et al*., 2004; Selikowitz, 2004; Hil and Van Haren, 2005). Additionally, these children are claimed to have difficulty organizing their learning and generally confuse the letters b, d, p. Such confusion also appears in the copying of geometric shapes. The motor coordination deficit in children with ADHD presents itself in tasks like using a hammer or cutlery, writing and painting (Cöngöloğlu, 2007) (http://www.gata.edu.tr/dahilibilimler/cocukruh/dehb_ders.htm). These and the developmental characteristics of children with ADHD imply that the lower scores obtained by these children on Frostig Developmental Test of Visual Perception, when compared to children with normal development, is an expected result.

Table 1: Mann-Whitney U-test results of participating children's scores on Frostig Developmental Test of Visual Perception

Subtests	Children with development normal (N = 30) Mean rank	Children with ADHD (N = 30) Mean rank	U	p
Eye-motor coordination	35.72	25.28	293.50	0.007**
Figure ground perception	34.37	26.63	334.00	0.082
Constancy of shape	37.53	23.47	239.00	0.002**
Position in space	31.50	29.50	420.00	0.647
Spatial relationships	31.48	29.52	420.50	0.652
Total	38.07	22.93	223.00	0.001***

*: p<0.05 **: p<0.01 ***: p<0.001

Table 2: Mann-Whitney U-test results of the Frostig Developmental Test of Visual Perception scores of children with ADHD with respect to their gender

	Subtests			
Gender	Girls (N = 13) Mean rank	Boys (N = 17) Mean rank	U	p
Eye-motor coordination	19.85	12.18	54.00	0.009**
Figure ground perception	19.92	12.12	53.00	0.013*
Constancy of shape	18.92	12.88	66.00	0.059
Position in space	19.00	12.82	65.00	0.050*
Spatial relationships	18.23	13.41	75.00	0.125
Total	23.46	9.41	7.00	0.000***

*: p<0.05 **: p<0.01 ***: p<0.001

Table 3: Mann-Whitney U-test results of the Frostig Developmental Test of Visual Perception scores of children with ADHD with respect to the variable of having received preschool education

Subtests	Preschool education (N = 9) Mean rank	No preschool education (N = 21) Mean rank	U	p
Eye-motor coordination	19.50	13.79	58.50	0.072
Figure ground perception	20.94	13.17	45.50	0.023*
Constancy of shape	21.06	13.12	44.50	0.022*
Position in space	18.78	14.10	65.00	0.170
Spatial relationships	15.67	15.43	93.00	0.944
Total	25.33	11.29	6.00	0.000***

*: p<0.05 ***: p<0.001

Table 2 shows that there was a meaningful difference between the scores of children with ADHD with respect to their gender (U = 7.00; p<0.001). Girls diagnosed with ADHD were seen to score higher on Frostig Developmental Test of Visual Perception than boys.

When Frostig Developmental Test of Visual Perception scores were analyzed with respect to subtests, it was seen that girls scored meaningfully higher than boys on eye-motor coordination (U = 54.00; p<0.01), figure ground perception (U = 53.00; p<0.05) and position in space (U = 65.00; p<0.05) subtests. While previous studies have shown that the variable of gender does not lead to a meaningful difference in the visual perception of children with normal development (İbişoğlu, 1987; Mangır and Çağatay, 1987; Aral and Erturan, 1999; Koç, 2002; Aral and Ayhan, 2004), it does so in the visual perception of children with ADHD. This may be resulting from the fact that boys diagnosed with ADHD outnumber girls (Maniadaki *et al*., 2005, 2006) and that girls are better than boys at focusing their attention. Similarly, Banaschewski *et al*. (2006) reported in their study that boys with ADHD experience lack of perception in naming colors.

Table 3 shows that having been to preschool creates a meaningful difference between the Frostig Developmental Test of Visual Perception mean scores of children diagnosed with ADHD (U = 6.00; p<0.001). The scores of those who received preschool education were higher than those who did not go to preschool.

Table 4: Kruskal Wallis Test results of the Frostig Developmental Test of Visual Perception scores of children with ADHD with respect to mother's and father's educational levels

	Educational level					
Subtests	Primary school graduate (N = 10) Mean rank	High school graduate (N = 12) Mean rank	University graduate (N = 8) Mean rank	Sd	X	P
	---------- Mother's ----------					
Eye-motor coordination	15.10	15.33	16.25	2	0.11	0.951
Figure ground perception	10.80	15.33	21.63	2	7.12	0.028*
Constancy of Shape	9.95	17.50	19.44	2	6.38	0.041*
Position in space	14.75	12.63	20.75	2	4.43	0.109
Spatial relationships	14.85	12.46	20.88	2	4.77	0.092
Total	12.45	13.67	22.06	2	6.27	0.043*
	---------- Father's ----------					
Eye-motor coordination	17.07	14.24	17.25	2	0.99	0.609
Figure ground perception	8.93	15.94	21.92	2	7.54	0.023*
Constancy of shape	9.57	16.09	20.75	2	5.55	0.062
Position in Space	15.71	13.71	20.33	2	2.66	0.265
Spatial relationships	15.93	13.79	19.83	2	2.25	0.324
Total	9.21	15.44	23.00	2	8.06	0.018*

*: $p<0.05$

When Frostig Developmental Test of Visual Perception scores were analyzed with respect to subtests, it was seen that the children with ADHD who received preschool education scored higher on figure ground perception ($U = 45.50$; $p<0.05$) and constancy of shape ($U = 44.50$; $p<0.05$) subtests and that the difference between scores were meaningful. Although the children with ADHD who went to preschool scored higher on other subtests as well, no meaningful difference was found between the scores. Higher scores on the part of children who received preschool education may be stemming from the fact that preschool education presents children with certain opportunities and conditions their families cannot provide them with, or that preschool education supports children's mental, social, emotional and physical development through various activities. Studies have also shown that preschool education leads to higher visual perception in children with normal development too (Mangır and Çağatay, 1987; Kaya, 1989; Ferah, 1996; Aral and Erturan, 1999; Kılıç and Ayhan, 2007).

It can be seen from Table 4 that the scores obtained by children with ADHD vary meaningfully with respect to mother's education level on the figure ground perception (χ^2 (2) = 7.12; $p<0.05$) and constancy of shape (χ^2 (2) = 6.38; $p<0.05$) subtests and total points (χ^2 (2) = 6.27; $p<0.05$). This shows that mother's educational level has different effects on increasing the scores obtained on Frostig Developmental Test of Visual Perception. According to Mann-Whitney U-test results, it was seen that children whose mothers were university graduates had higher total mean scores, figure ground perception scores and constancy of shape scores than others. It was determined that the difference was caused by mothers with a university degree.

As indicated in Table 4, father's educational level also caused a meaningful difference between the figure ground perception scores (χ^2 (2) = 7.54; $p<0.05$) and the total scores (χ^2 (2) = 8.06; $p<0.05$) of participating children who had been diagnosed with ADHD. This finding suggests that father's educational level has varying effects on increasing the scores obtained on Frostig Developmental Test of Visual Perception. According to Mann-Whitney U-test results, children whose fathers were university graduates had higher total scores and figure ground perception scores than other children and that the difference was caused by university graduate mothers. The favorable effect that university educated mothers and fathers have on children's visual perception may be because a higher educational level usually means more knowledge and more quality time with children. Parents with a higher education degree often display positive behavior which supports child development, such as obtaining information on their children, obtaining new resources, offering stimulating educational environments and making more use of written and visual sources in communicating with their children. These enable them to timely and frequently offer their children environments which help school preparation and support child development, as opposed to parents with lower educational degrees. These may be the reasons why children with ADHD whose parents were university graduates scored higher than others on Frostig Developmental Test of Visual Perception.

The differences between high educated mothers and fathers regarding the children's scores on Frostig Developmental Test may be due to the nature of mothers in the sense that mothers are more effective than fathers while educating and training their children.

CONCLUSIONS AND SUGGESTIONS

The results of the study seem to indicate that the visual perceptions of children with ADHD and those with normal development differ meaningfully and that the difference was caused by the variables of gender, having received preschool education and parents' educational level. Accordingly, children with ADHD were observed to have lower visual perception than those with normal development. These findings are significant as they give clues as to ADHD and children's visual perception levels. The study also revealed that certain variables affected children's visual perception, namely sex, having received preschool education and parents' educational level. Thus, work to be undertaken to support the visual perception of children with ADHD is believed to be important. Another finding has been that going to preschool affects the visual perception of children with ADHD positively. This asserts once again the importance of sending children to preschool before they start their basic education. Therefore, it is important that public and private institutions work in collaboration to encourage children with ADHD to be sent to preschool and that families are informed about the importance of this. Additionally, the findings seem to indicate that parents need to support their children's visual perception.

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