



## Efficacy of sensory motor integration training on visual perceptual skills for children with handwriting difficulties

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### ABSTRACT

**Background:** Children with handwriting difficulties who struggle with forming letters often make mistakes that can hinder the legibility of their writing. Some children face challenges with their handwriting that impede their academic achievement.

**Objectives:** this study was to conducted to examine the impact of sensory motor training on visual perceptual skills in children with handwriting difficulties.

**Subjects and Methods:** Forty elementary school children with dysgraphia recruited in this study, aged from seven to ten years old. All of the children had been diagnosed with visual perceptual motor skills deficit, based on test of visual perceptual skills (TVPS) - 4<sup>th</sup> edition. These children were randomized into two groups (control as well as study groups). Control group (A) was received repetitive hand writing (occupational therapy) practice, whereas the study group (B) received repetitive hand writing practice in addition to multisensory intervention. Pre and post treatment program the children were examined for visual perceptual skills by TVPS-4. This study was conducted for almost 24 weeks.

**Results:** The results showed that post treatment, there was a statistical significant difference between groups ( $P < 0.05$ ). also, there were significant difference among the two groups favoring group (B) ( $P < 0.05$ ).

**Conclusion:** Multisensory motor training may had a great impact on improving visual perceptual skills in children with handwriting difficulties.

**Keywords:** Elementary school children, Handwriting difficulties, Sensory motor training.

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### INTRODUCTION

Handwriting difficulties refer to problems with letter formation that include characteristics associated with dyslexia and dysgraphia in children (Zainol et al., 2021). While the exact percentage varies from study to study, up to 27% of school-aged children have been shown to have handwriting problems (Van Hartingsveldt et al., 2011). Handwriting challenges encompass difficulties in acquiring writing skills, consequently impacting learners' educational and emotional growth (Mulanya, 2020).

In both primary as well as secondary schools, handwriting is still the main mode of writing used in the classroom and for assessment purposes because of its essential role in academic performance (McMaster and Roberts, 2016). Some of the abilities required to write well are fine motor control, bilateral as well as visual-motor integration, motor organizing, in-hand manipulation, proprioception, perception of vision,

sustained concentration, in addition to sensory awareness of the fingers (Lee, 2022).

Children with dysgraphia were investigated by Chang and Yu (2017), who examined into the effectiveness of a sensorimotor intervention that emphasized both visual as well as haptic perception. They discovered that the quality of handwriting significantly improved among the intervention group. The majority of rehabilitation treatments that focus on enhancing visual perceptual abilities consist of table-top exercises. Repetitive drills and exercises, like visual memory exercises, in addition to puzzles and games like pegboard games along with card games may fall into this category (Wuang et al., 2021). Limited research has been conducted to examine the impact of sensory motor intervention on visual perceptual skills in children with handwriting difficulties. Thus, the study was carried-out to investigate the impact of sensory motor training on visual perceptual skills of elementary children with handwriting difficulties. handwriting assessment - 2<sup>nd</sup> edition (Pollock et al., 2009), aged from 7 to 10 years old, participated in this study. All the children had deficits in visual perceptual motor skills, based on test of TVPS- 4<sup>th</sup>

### SUBJECTS and METHODS

#### • Subjects:

Forty elementary school children were diagnosed with dysgraphia according to McMaster

(Martin, 2017). The children were excluded if they had neurological, orthopedic disorders, receiving medical drugs that can cause confusion or make child less alert, visual or hearing impairment. They were selected from Governmental elementary schools in Alexandria, Egypt. The study was

#### Procedures:

##### • Outcomes measures

All children in both groups (control and study groups) were assessed prior and post the treatment program for visual perceptual skills by TVP4.

**1-Selection of children with handwriting difficulties:** The McMaster handwriting assessment protocol, 2<sup>nd</sup> edition, is a structured evaluation method employed to collect unbiased data regarding students' proficiency in performing practical handwriting tasks that are comparable to those needed in an educational setting (Ibana and Cacola, 2016). This protocol is specifically tailored for children in senior kindergarten through grade 6. Its purpose is to assess handwriting legibility by utilizing tasks such as writing from memory, dictation and copying sentences (Lee, 2014).

**2- Evaluation of visual perceptual skills:** The fourth edition of the Visual Perception test is a standardized test of visual perception designed for children, adolescents, as well as young adults (ages 5-21). The TVPS-4 measures analytical visual abilities associated with the visual information processing component. Seven different visual abilities are tested over the TVPS-4 battery: discrimination, memory, spatial connections, form constancy, sequential recall, figure ground, as well as closure (Martin, 2017). The therapist arranged the test plates in an upright position, ensuring that the front pages were conveniently visible and accessible to the child. The child had the option to provide the answer number verbally or indicate their choice by pointing to the corresponding image.

#### Results

##### Subject characteristics:

The differences between group (A) and group (B) subjects are detailed out in Table 1. No

conducted at Ahmed Maher hospital in Alexandria, Egypt. The children were enrolled and randomized into 2 groups; control group (A) and study group (B). Both groups received repetitive task practice, whereas the study group received an additional program which was sensory motor training.

##### • For treatment

**Control group (A):** The children in this group received repetitive task practice which contains imitation and copying activities. The treatment consists of practicing functional activities repeatedly, progressively, and often assimilating feedback while performing the tasks in varying task or environmental settings. The therapist provided encouragement to the child and occasionally offered verbal prompts. The study was conducted for 60 minutes three sessions a week for 24 weeks.

**Study group (B):** In this group the children received repetitive task practice in addition to sensory motor training. According to Jameel and Nabeel (2016) the child asked to engage in various activities to improve the visual perceptual skills such as visual exercises, games and problem-solving activities. The study was conducted for 60 minutes three sessions a week for 24 weeks.

#### STATISTICAL ANALYSIS

Subject characteristics were compared using an unpaired t-test to determine any significant differences between the groups. The Shapiro-Wilk test was used to ensure that the data followed a normal distribution. The homogeneity of the groups was tested using Levene's test for homogeneity of variances. A mixed MANOVA was used to examine whether or not therapy improved visual perception. All statistical tests were performed at the  $p < 0.05$  level of significance. IBM SPSS Statistics Version 25 for Windows (Chicago, Illinois, USA) was used for all statistical analysis.

statistically significant age difference ( $p > 0.05$ ) was seen among groups.

**Table (1):** Comparison of subject characteristics between the group (A) and (B):

	Group A	Group B	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	
Age (years)	8.21 $\pm$ 0.74	8.18 $\pm$ 0.64	0.13

SD, Standard deviation; MD, mean difference; p value, Probability value

- **Effect of treatment on visual perceptual skills:**

A significant interaction impact of treatment as well as time was found using Mixed MANOVA ( $F = 44.05$ ,  $p = 0.001$ ). The treatment main impact was statistically significant ( $F = 10.34$ ,  $p = 0.001$ ). The main impact of time was highly significant ( $F = 98.82$ ,  $p = 0.001$ ).

- **Within group comparison**

There was a significant increase in visual perceptual skills in both groups post treatment when compared to that pretreatment ( $p < 0.001$ ) (Table 2).

The percentage of increase in sum raw score and sum scaled score of TVPS-4 in group (A) was 31.6 and 15.4% respectively while that of group (B) was 132.04 and 89.32% respectively (Table 2).

- **Between group comparison**

There was a significant increase in sum raw score and sum scaled score of TVPS-4 of group (B) when compared to that of group (A) after treatment ( $p < 0.001$ ) (Table 2).

**Table (2): Mean test of visual perceptual 4<sup>th</sup> edition pre and post treatment of group (A) and (B):**

	Pre treatment	Post treatment	MD	% of change	p value
	Mean $\pm$ SD	Mean $\pm$ SD			
<b>Test of visual perceptual skills</b>					
<b>Sum raw score</b>					
<b>Group A</b>	31.65 $\pm$ 7.13	41.65 $\pm$ 10.69	-10	31.60	0.001
<b>Group B</b>	29.65 $\pm$ 9.72	68.8 $\pm$ 10.8	-39.15	132.04	0.001
<b>MD</b>	2	-27.15			
	<i>p = 0.46</i>	<i>p = 0.001</i>			
<b>Sum scaled score</b>					
<b>Group A</b>	36.7 $\pm$ 5.8	42.35 $\pm$ 6.64	-5.65	15.40	0.001
<b>Group B</b>	35.1 $\pm$ 6.86	66.45 $\pm$ 7.8	-31.35	89.32	0.001
<b>MD</b>	1.6	-24.1			
	<i>p = 0.43</i>	<i>p = 0.001</i>			

**SD, Standard deviation; MD, Mean difference; p value, Probability value**

## DISCUSSION

A lack of confidence and poor academic performance might result from chronic problems with handwriting as well as writing communications (Stevenson and Just, 2014). Perceptual-motor or sensory integration training are the cornerstones of evidence-based therapies for enhancing children's visual perceptual abilities (Waung et al., 2021). Therefore, the study was carried-out to examine the impact of sensory motor training on visual perceptual skills in children with hand writing difficulties.

In this study the pretreatment results declared a decline in visual perceptual skills for both groups. This finding comes in agreement with the study Mehta and Nandgaonkar, (2019) who stated that the children in their study showed visual perceptual deficits along with hand writing dysfunction.

Furthermore, several studies (Thomas et al., 2010; Lam et al., 2011; Schneck, 2013) reported that the children who had deficiencies in visual perception abilities, their handwriting may display inconsistencies in size, and/or difficulty recognizing letters and words. Additionally, they may struggle to recognize errors in their own handwriting.

The current study revealed that there was statistically significant enhancement in visual perceptual skills in the study group. These results are consistent with Alenizi's (2019) findings, which indicate that employing a multi-sensory approach is more effective than other intervention programs in improving the visual perception of children with learning disabilities, specifically those experiencing difficulties with handwriting. Moreover, Case et al., (2012) reported that the utilization of a multi-sensory approach was found

to be successful in enhancing skills that impact handwriting, specifically visual perception.

On the same line, **Li Tsang (2023)** conducted a study to examine the effect of sensory motor

#### **LIMITATION**

The study has a few limitations such as; the absence of follow up for the participants and the disruption caused by the COVID-19 pandemic,

#### **CONCLUSION**

From the gathered results of the existing study, it could be concluded that sensory motor training

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intervention on children experiencing difficulties with handwriting. The study findings indicated significant enhancements in visual perceptual skills, which were assessed using TVPS4.

which resulted in children being unable to attend the sessions.

may have a great impact on visual perceptual skills for children with handwriting difficulties.

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