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ORIGINAL ARTICLE

The effects of Psychomotor Intervention, on Visual-Motor Control as a Graphomotor aspect in preschool age.

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Abstract

The aim of the current research was to study the effects of a Psychomotor Intervention Program (PIP) targeting to the improvement of spatiotemporal awareness on visual-motor control. The sample consisted of 84 preschool children, aged 53-75 months (M=66.95 months, SD=1.31) divided into experimental group (EG, n=42) and control group (CG, n=42). The CG followed the typical physical activities program of the kindergarten, while the EG aside from that program, participated in the PIP, consisted of 51 sessions. The eight items of the 7th subtest of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP-Bruininks, 1978) were used for the assessment of the visual-motor control. A two–way MANOVA model for repeated measures was used for data analysis. Results showed that after the PIP, the children of the EG significantly improved both their total visual-motor control scores and their scores in the half of items tested. On the contrary, the children of the CG did not showed significant differences between the pre- and the post-measurement scores in any item or in the total visual-motor control score. Preschool educators should take into consideration that the implementation of PIP contributes not only to the improvement of children's general motor proficiency but also to the development of concepts essential for the school readiness.

Keywords: *Psychomotor Training, space awareness, temporal awareness, graphomotor development, handwriting*

Introduction

According to McHale and Cermak (1992), 30-60% of elementary school child's class time is spent in graphomotor activities, where writing itself is the dominant form of exercise. The acquisition of writing is depended on internal factors (Jongmans et al., 2003; Rudolf, 1986), such as visual-motor control, visual perception, motor planning, in-hand manipulation and kinesthetic awareness (Berninger & Rutberg, 1992; Feder et al., 2005; Maeland, 1992; Tseng & Murray, 1994; Ziviani, 1995). These factors are then evaluated and when they reach an acceptable, for the child's age, level it is assumed that the writing readiness has been achieved (Marr, Windsor & Cermak, 2001; Rimm-Kaufman & Pianta, 2000).

Visual-motor Control is the ability to match motor output with visual input. Although it is the non-visual or kinesthetic feedback that is crucial for handwriting, visual feedback is also important (Levine, 1987; Sudsawad et al., 2002). Visual feedback provides gross monitoring of writing rather than the fine-tuned monitoring provided by non visual feedback. It is this gross monitoring that prevents us from writing on the desk, and crossing over lines (Levine, 1987). The visual-motor control is also considered an important prerequisite for the achievement of the writing readiness (Beery, 1997). Visual-motor integration appears to be associated with handwriting legibility, which is not surprising considering that handwriting is a pencil and paper task (Weintraub & Graham, 2000).

However, besides visual-motor control, another important factor for the writing readiness is the children's understanding of spatiotemporal concepts (Marr et al., 2001; Sortor & Kupl, 2003). The improvement of children's ability to understand the spatiotemporal concepts is among the aims of the pre-writing skill development interventions that are applied in kindergartens and involve instructions like "on top of the line", "above the line", "between the lines" (Bendow, 1995; Daly, Kelley & Krauss, 2003), which are related with spatiotemporal concepts. These instructions are

given to the children during the performance of fine motor activities. However, it is well known that the understanding of the spatiotemporal concepts come after the integration of functioning in the final stages of the movement execution (fine motor control), which presuppose the experience, perception and awareness via the body (gross motor control) (Bart, Hajami & Bar-Haim, 2007; De Lièvre & Staes, 1992; Weintraub & Graham, 2000).

Although the importance of the children's understanding of spatiotemporal concepts is well documented, there are not many studies regarding the relationship between the spatiotemporal concepts and the writing readiness and some of them did not fully verify that relationship (Kambas et al., 1998; 1999; Rosenblum, Parush & Weiss, 2003; Weintraub & Graham, 2000). Additionally, while Marr, Windsor and Cermak (2001) did not find any significant relationship between spatiotemporal concepts and visual-motor skills other researchers state that there is a significant relationship between the spatial and temporal structure and the graphic ability (Howard, 2005; Rekalidou, 2001).

However, the above researchers studied just the relationship of spatiotemporal concepts with visual-motor skills, without involving any specific intervention program in their experimental design. Kambas et al (2005) found that an intervention program for the improvement of the neuromuscular coordination significantly improved the graphomotor skills in preschool aged children. Moreover, Kambas et al (2002) examined the effect of a psychomotor programme, emphasizing time and space, in 35 preschoolers' graphomotor skills. From the results it was revealed that the children who followed the intervention program showed significant improvement on the performance of tested graphomotor skills.

The Psychomotor Intervention Programs (PIP) are considered as the most appropriate educational method for the preschool age (Volkamer & Zimmer, 1986; Zimmer, 2006; Zimmer & Cicurs, 1993) and their efficacy for the motor proficiency improvement has been well established by several researchers (Kambas et al., 2005; Zimmer et al, 2008).

The purpose of the current research was to study the effects of a psychomotor intervention program (PIP), emphasizing on spatiotemporal awareness, on visual-motor control.

Method

Participants

Eighty four children aged between 53-75 months (Mean=66.95 months, SD=1,31months), voluntarily participated in the study. None of them had showed any evidence for developmental delays, prior to their participation in the study, according to their teachers and peers. Moreover, all children had developed the "dynamic tripod" of the hand i.e. they could hold the pencil with three fingers (thumb, index and middle finger) (Ziviani, 1983). Parents gave a written permission for their children's participation in the study.

Measurements

The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP- Bruininks, 1978) is one of the most commonly used battery tests, since it measures important skills of motor development (Burton & Miller, 1998). The complete form of the battery (BOTMP-LF) consists of 46 items that are grouped into 8 subtests "*providing a comprehensive index of motor proficiency as well as separate measures of both gross and fine motor skills*" (Bruininks, 1978, p. 11).

According to the manual, the 7th subtest (Visual - Motor Control) measures the ability to integrate visual responses with highly controlled motor responses (p. 89) and it has been used in studies that examine graphomotor skills of either preschoolers (Kambas et al., 2002) or school aged children (Spanaki et al., 2008). The aforementioned subtest comprises the following eight items: *Cutting out a circle*: the examinee cuts out a heavy circle embedded within six concentric circles, with the preferred hand. The number of errors made is recorded. *Drawing a line through a crooked path*. *Drawing a line through a straight path*. *Drawing a line through a curved path*. For the above three items, the examinee uses the preferred hand to draw a pencil line through a crooked, straight and curved path, respectively. The number of errors made is recorded. *Copying a circle*. *Copying a triangle*. *Copying a horizontal diamond*. *Copying overlapping pencils with preferred hand*. In the last four tests, the examinee uses the preferred hand to copy the corresponding geometric shape or figure. The accuracy of each drawing is evaluated and scored through a 0-2 point scale. A pilot study has been tested the test-retest reliability of the 7th subtest of BOTMP with a sample of 25 preschool children and was found r=.82. In the same study the internal consistency (correlation between items and total score) of the subtest was ranged between .79 to .87.

The item raw scores are converted into numerical point scores that are summed to give a subtest point score. That point score is then transformed to a standard score, for each age group. For the purposes of this study, both the total subtest point score and the point scores of the 8 items were used. For the administration of the test, the translation of the datasheets and the guidelines from English into the Greek language that has been tested for its precision and reliability in a previous study (Proviadaki, 2004) was used.

Procedures

Two measurements were taken place indoors in Kindergartens, where the subjects of the study were studying. Each child was tested individually and concluded all testing procedures on the same day and within the time limits of the Kindergarten's timetable. After the first measurement the participants were divided, according to their scores, into an experimental group (EG, n=42) and a control group (CG, n=42), with the method of stratified sampling. The children of the EG participated in a psychomotor intervention program (PIP) aside from the typical physical activities program of a public kindergarten. The children of the CG just followed the typical physical activities program of their kindergarten. During the experimental phase, both groups participated in the pre-writing skill acquisition program of their kindergarten.

Psychomotor Intervention Program (PIP)

The general purpose of the PIP was the development of the spatiotemporal awareness through gross motor activities for the improvement of movement coordination. The program, following the principles of Psychomotor Education, has as its basic axes the participial and individualization methods. That means that for the planning of the program took it was the individual differences that were taken into consideration and not the performance mean of the group. Moreover, the children play an important role in the progress of each PIP unit. In that way, the activities give to every child the opportunity to succeed and to choose the way of his/her own action leading to improvement of children's self-esteem and self-confidence (Zimmer, 2006; Zimmer & Cicurs, 1993). The PIP involved 51 sessions for a total period of three months. Each session, lasted approximately 25-35 minutes, consisted of the

introductory part (aiming to the development of team-esteem) the main part (including activities for the development of spatiotemporal kinesthesial differentiation, spatiotemporal orientation, static and dynamic balance, response ability and rhythmic ability) and the relaxation part.

Statistical Analysis

A two-way analysis of variance (MANOVA) for repeated measurements was employed for the statistical treatment of the data. The factorial model was 2x2 (2 groups x 2 measurements). Post-hoc comparisons were made with the Sidak test and the level of significance was set at α=.05.

Results

The results showed a statistically significant interaction between the "measurement" and the "group" factors, for the total visual-motor control score ($F_{1,82}$=5.15, p<.05) and the scores of the items: Cutting Out a Circle ($F_{1,82}$=7.60, p<.01), Drawing a Line through a Curved Path ($F_{1,82}$=6.53, p<.05) and Copying Overlapping Pencils ($F_{1,82}$=23.00, p<.001). Moreover, the "measurement" factor had a significant main effect on the total visual-motor control score ($F_{1,82}$=13.00, p<.005) and the scores of the items: Cutting out a Circle ($F_{1,82}$=5.55, p<.05), Drawing a Line through a Crooked Path ($F_{1,82}$=17.05, p<.001), Drawing a Line through a Curved Path ($F_{1,82}$=18.59, p<.001) and Copying Overlapping Pencils ($F_{1,82}$=27.83, p<.001). In addition, post-hoc comparisons showed that the children of the EG significantly improved their total visual-motor control score and the scores of the items: Cutting out a Circle, Drawing a Line through a Crooked Path, Drawing a Line through a Curved Path and Copying Overlapping Pencils (Table 1).

Table 1. Means and standard deviations of the children's pre- and post-measurement scores.

	Experimental Group (n=42)				Control Group (n=42)			
Test item	pre		post		pre		post	
	M	SD	M	SD	M	SD	M	SD
Cutting out a circle	1.88	1.62	3.09*	1.18	2.19	1.67	2.09	1.59
Drawing a line through a crooked path	2.07	1.22	3.19*	.92	2.12	1.06	2.52	1.58
Drawing a line through a straight path	2.5	.86	2.11	1.04	2.64	.79	2.52	1.11
Drawing a line through a curved path	.45	.83	1.47*	.77	.47	.83	.74	1.15
Copying a circle	1.57	.55	1.61	.49	1.55	.59	1.76	.43
Copying a triangle	1.5	.63	1.3	.81	1.4	.73	1.57	.77
Copying a horizontal diamond	.64	.73	.79	.87	.79	.84	.83	.93
Copying overlapping pencils	.24	.48	1.23*	.91	.21	.56	.26	.59
Total visual-motor control score	10.86	4.46	14.83*	3.67	11.41	4.47	12.31	5.57

*p<.05

On the contrary, for the children of the CG, no statistically significant differences were observed between the pre- and post-measurements, in the total visual-motor control score, nor in the score of any item (Table 1).

Discussion

The current research studied the effects of a psychomotor intervention program (PIP) that emphasized on spatiotemporal awareness, on visual-motor control of pre-school aged children. The results showed that the children that followed the PIP improved both their total visual-motor score and their scores in the half of the items tested. On the contrary, the children of the control group did not perform significantly better in the post-measurement than in the pre-measurement, in any item. That finding is consistent with previous studies that examined the effects of intervention programs on graphomotor skills (Kambas & Aggeloussis, 2004; Kambas et al., 2002). In contrast, Marr, Windsor and Cermak, (2001) did not find any significant relationship between the understanding of spatiotemporal concepts and the performance of graphomotor skills. However, they admitted that this was a non expected finding and assumed that it might be due to the effects of different social-economic factors in the subjects of their study (Marr, Windsor & Cermak, 2001; Marr & Cermak, 2002).

The improved performance of the children of the experimental group, in the post-measurements might be due to the instructions that were given to them during the PIP sessions, which were much related with spatiotemporal aspects of the movements. Because of these instructions, it is possible that the children of the experimental group could understand better the spatiotemporal information given for the execution of the test in the second measurements, which in turn might lead in better post-measurement scores. This aspect is supported by other studies that emphasize the importance of cognitive information in the performance of motor skills (Barnhardt et al. 2005; Case-Smith, 2002; Chu, 1997; Exner & Henderson, 1995; Graham, Harris & Fink, 2000; Jongmans et al. 2003; Sandler et al., 1992).

Another possible reason for the better performance of the children of the experimental group might be the large number of the visual-motor tasks involved in the games they played during the PIP. Although these were gross motor tasks, it is possible that they improved the graphomotor skills of the children, which are fine motor skills. This is because, according to Hattie and Edwards (1987), the gross and fine motor proficiency seem to be the output of a continuum and not separate forms of the motor proficiency (see also by Ratzon, Efraim & Bart, 2007). Moreover, Spanaki et al. (2008) found that graphomotor performance of preschool and primary school children can be significantly predicted from gross motor skills. Kambas et al. (1998, 1999, 2002) also found that certain visual-motor skills were significantly related with spatiotemporal perceptual motor abilities. In addition, Rekalidou, (2001), states that certain spatial parameters of perceptual motor development constitute important abilities for the direction of the graphic movements, the orientation of the graphic paths and graphisms, while certain temporal parameters contributed in the development of graphic abilities (Feder & Majnemer, 2007; Kurdek & Sinclair, 2000; Marr, Windsor & Cermak, 2001; Sortor & Kulp, 2003; Volman, van Schendel & Jongmans, 2006).

In conclusion, although both justifications about the positive effects of the psychomotor intervention program might be valid, it should be mentioned that a preschool age child might find it harder to understand complex spatiotemporal concepts than meet spatiotemporal relations through body experiences. For this reason, the second justification seems to be more possible. Based on the aforementioned findings, it seems important for the preschool educators to know that the implementation of Psychomotor Training Programs in Preschool contributes not

only to the improvement of children's general motor proficiency but also to the development of concepts essential for the school readiness. Taking into consideration both the effectiveness of the Psychomotor Training and its pedagogical worth, its importance as an educational means compared to other methodological approaches seems obvious.

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