



A Quasi-Experimental Study of a Sensorimotor Training on Pre-Writing and Pre-Reading Skills in an Italian Elementary School with Children Aged 5 to 7 Years

Scognamiglio Riccardo Marco^{1*}, Russo Simone Matteo² and Fumagalli Matteo³

¹Psychologist Psychotherapist, Scientific Director, Istituto di Psicosomatica Integrata, Milan, Italy

²Psychologist Psychotherapist, Istituto di Psicosomatica Integrata, Milan, Italy

³Clinical Psychologist, Istituto di Psicosomatica Integrata, Milan, Italy

***Corresponding Author:** Scognamiglio Riccardo Marco, Psychologist Psychotherapist, Scientific Director, Istituto di Psicosomatica Integrata, Milan, Italy.

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Abstract

Objective: Our study aimed to investigate the effect of a sensorimotor training on cognitive performance, especially on pre-writing and pre-reading skills, in an Italian elementary school children.

Methods: 463 elementary school children, aged 5 to 7 years (266 in the experimental group and 197 in the control group). In order to evaluate the effectiveness of the sensorimotor training, which lasted twice a week for 12 sessions, the psychometric evaluations were at before, after the training and at a follow-up after one month. We used two tests: VMI (Developmental Test of Visual-Motor Integration) that assesses the ability to coordinate body movements with visual perception; PRCR-2 (Prove di Prerequisito per la Diagnosi delle Difficoltà di Lettura e Scrittura; English translation: "Pre-writing and Pre-reading Deficits Assessment") that assesses prewriting and prereading deficits.

Results: The results of the specific sensorimotor training showed a significant effect of the training in improving performance at several PRCR-2 items, while no significant effect resulted on the performance at VMI.

Conclusion: Sensorimotor training showed an improving effect on pre-writing and pre-reading skills, with a significant reduction in writing and reading deficits. Instead, no significant effect resulted on visual motor integration.

Keywords: Pre-writing and Pre-reading Skills; Sensorimotor; Integrated Psychosomatic Model; PRCR-2; VMI

Introduction

The Integrated Psychosomatic Model [1,2] considers the body the first mediator in the therapeutic process. Like shown in a previous research on a single case treatment of a pervasive developmental disorder [3], the aim of the Integrated Psychosomatic Model is to prove the importance and the effectiveness of the involvement of the body for a range of clinical and subclinical conditions. In agreement with the paradigm of the embodiment, all psychological processes are influenced by body morphology, sensory systems, motor systems, and emotion [4]. Lakoff and Johnson [5] support that our thinking is embodied, that is abstract concepts result from interactions of the body with the environment.

In addition to Piaget [6], who highlights the importance of the sensorimotor stage for the acquisition of the first symbolic forms,

there is an increasing body of scientific evidence, for example the new view of the cerebellum's functions [7,8] supporting that perceptuomotor proficiency are not only at the basis of functional motor ability but also key element for the development of thought processes and academic learning. Perceptual-motor processes precede higher cognitive functions and are developmental precursors of various functions in school learning [9]. Reading largely depends on oculo-motor skill involving smooth eye movement, writing involves hand-eye coordination, sitting still and paying attention require postural control balance, motor coordination, in addition to the involvement of cortical centers. If there's a failure to develop these specific perceptual-motor skills, many aspects of learning can be affected negatively, even though the child has average or above average intelligence [10].

When there’s an integrated perceptual-motor response adequate to the requirements of the environments [11], the central nervous system can concentrate better on higher cognitive functions [12]. Moreover, difficulty in academic achievements can be improperly attributed to emotional or cognitive problems rather than a missed integration of sensory-motor aspects. On the other hand, promoting a sensorimotor integration can affect the emotional side, adjusting self-dysregulation condition [13].

Taking this into account, we hypothesized that structured motor activity can contribute to the acquisition of pre-reading and pre-writing skills and that a specific sensorimotor intervention can arrange mind-body system of a child for a better learning.

Materials and Methods

Methods

We recruited 463 elementary school children, aged 5 to 7 years (266 in the experimental group and 197 in the control group).

The design is a quasi-experimental study with one training group and one control group. Subjects were assessed at for before, after the training and at a follow-up after one month. Subjects of the experimental group participate to a sensorimotor training, while the control group received no treatment.

About the test we use:

- VMI (Developmental Test of Visual-Motor Integration) that assesses the ability to coordinate body movements with visual perception. Two supplemental tests (Visual Perception and Motor Coordination) that help compare an individual’s

VMI result with relatively pure visual and motor performances [14].

- PRCR-2 (Prove di Prerequisito per la Diagnosi delle Difficoltà di Lettura e Scrittura; English translation:” Pre-writing and Pre-reading Deficits Assessment) that assesses prewriting and reading deficits with tasks of words and letters identification in a visual and phonological form [15].

Administration of both tests took about 50 minutes.

Our sensorimotor training is based on a repetition of specific stereotypic infants’ movements (crossing over and homolateral patterns), followed by fine ocular-motor exercises. All these movements emphasize gross motor skills like balance, posture and a correct bilateral integration that foster inter-hemispheric functioning [16].

The training’s setting took place in the school gym with two clinical psychologists. The training program consisted of 12 sessions twice a week, each one lasting 30 minutes, carried out from October 2012 to November 2012, with a follow-up in January 2013.

Data analysis

Statistical analysis were carried out with SPSS or plus software. Generalized linear mixed-effects repeated measures model was employed for the analysis. Dependent variables were the VMI (linear) and PRCR-2 (binomial) scores. Time of assessment was inserted as repeated-measures factor while assignation to either training or control group was insert as between-subject factor. Gender and class attended by subjects were also inserted in the model as further factors. Classes attended by subjects was inserted as a random-effect.

Results

Tests		Training group			Control group			Timex Group effect
		Before treatment	After treatment	Follow up	Before treatment	After treatment	Follow up	p
PRCR-2	AV1/AV2	1,74	0,811	0,358	0,763	0,648	0,411	0,010
	AV3	1,169	0,653	0,266	0,457	0,341	0,09	0,820
	SD3	14,656	8,721	7,32	14,299	10,388	7,373	0,248
	SD4	17,307	12,292	10,609	16,331	14,356	10,446	0,046
	IVU1	2,533	1,514	1,053	2,08	1,734	1,406	0,201
	GV2	8,293	4,199	3,165	5,918	6,23	2,599	0,018
	GV3	15,004	11,583	7,808	12,237	10,957	8,346	0,091
	GV4/1	3,6	2,471	1,547	2,506	4,177	3,561	0,003
	GV4/2	7,347	4,702	3,581	8,169	6,406	7,786	0,106
VMI	VMI	84,976	86,122	87,858	84,196	85,314	86,566	0,201
	Visual Perception	98,451	107,604	118,297	98,742	104,072	110,842	0,843
	Motor Coordination	95,775	97,09	98,093	92,459	96,144	97,329	0,221

Discussion

Delacato talks about neurological organization like a basis for learning [17]. Ayres talks about Sensory Integration Theory [18] and Blythe [10] considers the connection between Neuro-developmental delay and specific learning difficulties. Especially, Neuro-developmental delay describes the persistence of a cluster of primitive reflexes in a child that influences the achievement of successful academic learning.

Many kinds of sensorimotor therapy are focused on clinical and pathological conditions [19-21]: sensorineural hearing loss, neurological disabilities, motor difficulties, developmental coordination disorder. In general, all these treatments obtain good results in postural control, balance and motor coordination.

Our sensorimotor training is addressed on a non-clinical sample, with the aim of consolidating pre-writing and pre-reading skills. The results of our sensorimotor training have shown that the training group showed a higher improvement than control group in four items of the PRCR-2 test: AV1/AV2, SD4, GV2 and GV4/1. Post-hoc analyses indicate that the training group had a significantly worst performance in AV1/AV2 than controls before the training ($p = 0.038$), while the two groups resulted no more significantly different both just after ($p = 0.404$) and at the follow-up ($p = 0.761$). For SD4 and GV2, post-hoc analyses couldn't identify any pairwise significant comparison. However, the training group showed a trend towards a higher increase in performance than the control group after the training, lost later at the follow up. For GV4/1, the training group showed a progressive improvement of performance along the three time of assessment (follow-up - before training: $p = 0.016$), while the control group a trend towards a progressive worsening of the performance.

Analysis showed a significant effect of the training in improving performance at several PRCR-2 items, while no significant effect resulted on the performance at VMI.

Conclusion

Integrated Psychosomatic Model bears that the body is a transformative instrument and the body precedes and concurs at the level of symbolic cognition.

This study is a first step of research project. Sensorimotor training showed an improving effect on pre-writing and pre-reading skills, with a significant reduction in writing and reading deficits. Instead, no significant effect resulted on visual motor integration. It is possible that VMI assesses skills that are already present in both groups, while pre-writing and pre-reading can be strengthened in

the first two years of primary school with a sensorimotor training. In a follow-up, VMI could be changed with another test more keys to our sensorimotor training like Movement ABC, which identifies motor development deficits.

Another interpretation for these results is that sensorimotor training improved attention and the level of energy (which are bodily factors that support cognitive performance), allowing experimental group a better performance.

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