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Research Article

# 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

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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.

## Bibliography

1. Scognamiglio RM. "Il male in corpo. La prospettiva somatologica nella psicoterapia della sofferenza del corpo". Milano: FrancoAngeli (2008).
2. Scognamiglio RM. "Psicologia psicosomatica". L'atto psicologico tra codici del corpo e codici della parola. Milano: FrancoAngeli (2016).
3. Scognamiglio RM., *et al*. "A Sample Case of Treatment of a Preadolescent with Pervasive Developmental Disorder in Milan in 2013". *Acta Scientific Paediatrics* 3.3 (2020): 01-04.
4. Glenberg AM. "Embodiment as a unifying perspective for psychology". *Wiley Interdisciplinary Reviews: Cognitive Science* 1.4 (2010): 586-596.
5. Lakoff G and Johnson M. Methaphors we live by. Chicago-London: The Chicago university Press (1980).
6. Piaget J. "L'épistémologie génétique". Paris: PUF (1970).
7. Stoodley CJ. "The cerebellum and cognition: evidence from functional imaging studies". *The Cerebellum* 11.2 (2012): 352-365.
8. Diamond A. "Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex". *Child development* 71.1 (2000): 44-56.
9. Ayres JA. "Learning Disabilities and the Vestibular System". *Journal of Learning Disabilities* 11 (1978): 30-41.
10. Blythe SG. "Reflexes, learning and behavior". A window Into the Child's Mind. Eugene, Oregon: Fern Ridge Press (2005).
11. Berta B. Chartered Society of Physiotherapy (Great Britain). "Abnormal postural reflex activity caused by brain lesions". Aspen Publishers (1985).
12. Rider BA. "Relationship of postural reflexes to learning disabilities". *American Journal of Occupational Therapy* 26.2 (1972): 239-243..
13. Van der kolk BA. "The body keeps the score: Brain, mind, and body in the healing of trauma". Penguin Books (2015).

14. Cornoldi C., *et al*. "PRCR-2/2009. Prove di Prerequisito per la Diagnosi delle Difficoltà di Lettura e Scrittura". Firenze: Giunti O.S. (2009).

15. Beery KE VMI. "Developmental Test of Visual-Motor Integration". Firenze: Giunti O.S. (2010).

16. Clearfield MW. "The role of crawling and walking experience in infant spatial memory". *Journal of Experimental Child Psychology* 89.3 (2004): 214-241.

17. Delacato, CH. "Neurological organization and reading". Thomas (1966).

18. Bochner S. "Ayres, sensory integration and learning disorders: A question of theory and practice". *Australian Journal of Mental Retardation* 5.2 (1978): 41-45.

19. Niklasson M., *et al*. "Catching-up: Children with developmental coordination disorder compared to healthy children before and after sensorimotor therapy". *PloS one* 12.10 (2017): e0186126.

20. Niklasson M., *et al*. "Sensorimotor therapy: using stereotypic movements and vestibular stimulation to increase sensorimotor proficiency of children with attentional and motor difficulties". *Perceptual and Motor Skills* 108.3 (2009): 643-669.

21. Melo RS., *et al*. "Vestibular rehabilitation exercises programs to improve the postural control, balance and gait of children with sensorineural hearing loss: A systematic review". *International Journal of Pediatric Otorhinolaryngology* 127 (2019): 109650.