The effect of unilateral and bilateral perceptual motor exercises on visual-spatial memory and manual dexterity in NVLD children

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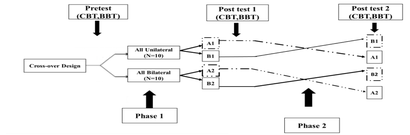
Introduction:

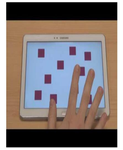
For the first time, the term "nonverbal learning disability" (NVLD) was used to characterize the difficulties experienced by individuals with higher verbal IQ index scores who also had statistically significant differences in their verbal and perceptual IQ scores (Rourke 1898). A particular group of kids with average or above verbal intelligence who struggle in nonverbal domains, especially visuospatial processing, has been repeatedly discovered by researchers (American Psychiatric Association, 2013). Nonverbal Learning Disorder is not what it sounds like. Children with NVLD frequently chatter nonstop. The right hemisphere of the brain, which handles nonverbal, performance-based information such as visual-spatial, intuitive, organizational, and evaluative processing capabilities, is said to malfunction in NVLD (Wilson K. C. 2022). According to Dr. Byron Rourke(Rourke 1898). NVLD affects 10% of children in communities with learning disorders. There does not appear to be a gender difference in incidence. This condition primarily affects three domains: motoric, visual-spatial, and social (Stewart 2002). To properly describe these kids, a variety of titles have been applied, such as nonverbal learning disabilities (Myklebust, 1975), nonverbal learning syndrome (Rourke,1995), visuospatial learning disability (Cornoldi, Venneri, Marconato, Molin, & Montinari, 2003), and right hemisphere developmental learning disability (Tranel, Hall, Olson, & Tranel, 1987). Additionally, inadequate motor abilities are a notable characteristic of kids with " specific learning disability" SLD. In order to participate in daily activities and achieve appropriate functional mobility, motor skills are crucial (Ibrahim et al., 2019). Comparing children with SLD to typically developing children, the former exhibit deficiencies in gross, fine, and postural motor skills (Westendorp et al., 2011). Among the most notable impairments in motor-related skills in children with SLD are visual-motor control, dynamic balance, and bilateral coordination (Bruininks & Bruininks, 1977). Inadequate motor abilities cause sedentary behavior (Stodden et al., 2008) as well as a decrease in engagement in games and physical activities. As such, inactivity restricts the sensorimotor inputs that are required during childhood and developmental stages (Soares et al., 2015; Son & Meisels, 2006). Additionally, sensory deprivation hinders normal brain growth and reduces the interactions between sensory systems, which could lead to cognitive and motor difficulties (Soares et al., 2015). Children with SLD would perform worse than their peers who are typically developing in terms of motor coordination and manual dexterity; (ii) academic achievement would be more strongly correlated with motor skills in SLD children than in typically developing children; and (iii) multivariable analysis would predict a deficit in motor skills in SLD and ADHD (Poyraz Findik, Burcu Erdogdu, Fadiloglu, 2022).

Method of research:



Box and Block test

Corsi Block test

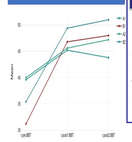


Wechsler test:
The Wechsler test for screening children with NVLD : Regarding the Wechsler test, the total IQ of these children should be above 80, with both VIQ and PIQ exceeding 70. Additionally, VIQ should be 10 to 15 points higher than PIQ. (All children in this research, N = 20). After administering the Wechsler test and evaluating NVLD children, we administered Pretest 1 measures.

Method of collecting data:

- **Phase 1**The study involved randomly dividing students into two groups, unilateral and bilateral groups, each further divided into two subgroups, unilateral A1,B1 and bilateral A2,B2. Groups A participated in six sessions of unplanned and intervention-free physical activity, with two sessions per week. Groups B, on the other hand, underwent 18 intervention sessions, with four sessions per week. After completing this initial phase1, all groups were retested using the CBT and BBT tests.
- **Phase 2**:In the second phase, the positions of groups A and B were reversed. Group A then underwent 18 intervention sessions, while Group B engaged in six sessions of physical activity. Subsequently, the CBT and BBT tests were administered again to assess the final post-test 2 results.
- **Pretest/ Post test 1/ Post test 2:**
- Corsi Block Test (CBT): Measurement for visuospatial short-term memory.
- Box and Blocks Test (BBT): Measurement for manual dexterity and gross motor skills.
- **EDINBURG HANDEDNESS INVENTORY:** For determining the dominance of the right hand in this child for stimulating by exercises on the brain's right hemisphere.

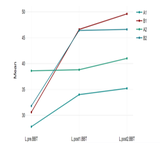
Right hand dexterity



Right hand Manual Dexterity

In relation to right-hand manual dexterity, the results show a significant difference between pre-test/post-test1 and pre-test/post-test2 phases. (*Wilcoxon's post hoc test*, $p \leq .05$).

Left hand dexterity



Visual-spatial memory

Visual-spatial memory

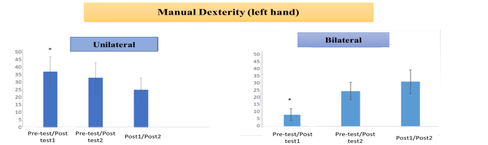
In relation to visual-spatial memory, the results show a significant difference between pre-test/post-test1 and pre-test/post-test2 phases. (*Wilcoxon's post hoc test*, $p \leq .05$).

Left hand Manual Dexterity

In relation to left-hand manual dexterity, the results show a significant difference between pre-test/post-test1, pre-test/post-test2, and post-test/post-test2 phases. (*Wilcoxon's post hoc test*, $p \leq .05$).

A1= Unilateral A
B1= Unilateral B
A2= Bilateral A
B2= Bilateral B

Result:



Left hand Manual dexterity

A statistically significant difference (*Mann-Whitney U test*, a $p = .05$) was observed in the pre-test/post-test 1 phase. It is important to note that the unilateral group (A1, B1) received specialized perceptual motor exercises for left-hand activities, while the bilateral group (A2, B2) received exercises that stimulated both hemispheres by controlling both sides of the body.

Phase1: A1 was control group, B1 was experimental group
Phase 2: A1 was experimental group, B1 was control group

Conclusion:

The findings of this study demonstrate and emphasize the effectiveness of perceptual motor exercises, both unilateral and bilateral, in improving manual dexterity and visual-spatial memory in children with NVLD.

Unilateral interventions	This targeted approach aligns with the idea of lateralization, emphasizing the specialized functions of each hemisphere.
Bilateral interventions	This type of exercise promotes communication and coordination between the right and left hemispheres - and can be an effective option.
Neuroplasticity	The exercises might facilitate engagement of alternative neural pathways, contributing to improvements in specific skills.

Implication:

By integrating these interventions into the educational and therapeutic system, children with NVLD can potentially demonstrate improvements in the manual dexterity of both hands and visual-spatial memory.

Limitation:

- This study focused solely on first-grade students, indicating a need for further research to investigate the effects of these exercises and interventions on older children and adults with NVLD.
- Future research on children with NVLD could include post-tests such as the WISC test to observe the effects of interventions on their learning and cognitive skills.
- It is possible that by providing interventions to children with NVLD and following up with them over a longer period with more exercise sessions, better results could be achieved.