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Cognitive Rehabilitation Through *the* Lens of Holistic Psychology: Applying the INLM Model to Perceptual-Motor Training

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Abstract

This study examines the efficacy of a Cognitive Remedial Therapy (CRT) integrated with the INLM neuropsychological account in ameliorating perceptual-motor deficits, especially deficits in eye-hand coordination and figure-ground perception for two adult female clients. Grounded in holistic psychology, the INLM framework views cognition-system interfaces as dynamic and functionally-motivated, thereby encouraging behavioral adaptation. A pre-post assessment single-subject experimental design was used, along with standardized techniques from the PGI Battery of Brain Dysfunction to evaluate changes in mental balance, attention, visual retention, and visual recognition. Inferential statistical values pointed to significant improvement in attention and concentration across both clients and in visual recognition for both also. This indicated enhancement in perceptual-motor integration along with executive function. Visual retention was an exception, which had no improvement at all, justifying the need for lengthening or modifying the intervention for memory-type dependent tasks. Qualitative data further showed increased engagement, initiation of tasks, and verbal elaboration, suggestive of cognitive flexibility and motivation.

Keywords: Holistic Psychology, INLM model, Eye-hand coordination, Figure-ground perception, Visual-motor integration, Cognitive-perceptual development, Neuroplasticity, Sensorimotor processing, Visual perception, Educational psychology

Introduction

In holistic psychology, the cognitive and physical domains are taken as closely interwoven in the development of perceptual-motor functions. The INLM model (Integrative Neuro- Learning Model) provides a comprehensive perspective within which the neurological, cognitive, and behavioural system interact in learning and adaptation. Within this framework, eye-hand coordination and figure ground perception are primary processes that underlie a variety of common activities, from reading and writing to athletic and artistic endeavours. These processes are sensorimotor plus cognitive, entailing complex loops between visual input, attention and motor output. Studying such perceptual motor functions develops insight into both normal and abnormal development, educational intervention, and neurorehabilitation. *The CRT intervention based on the INLM framework is effective in enhancing normally developed cognitive abilities, improving performance from average to above average by targeting perceptual-motor integration and executive functioning through structured, progressive, and holistic training.*

Purpose of the study

Eye-hand coordination and figure ground perception need to be investigated as integrals of perceptual and motor integration under the INLM framework with respect to their learning, behavioral, and functional independence aspects. Next, it aims to explore how these visual-perceptual skills interplay with attentional control, spatial awareness, and cognitive flexibility towards the understanding of holistic human psychology. Disruptions in the above different areas also must be identified as markers, albeit early, of developmental disorders, learning challenges, or neuropsychological disorders so that these interventions can be guided along the lines laid down in the INLM framework for neuro-adaptive learning.

Relevance

Eye-hand coordination and figure-ground perception are of paramount importance in various types of settings such as early childhood, education, and rehabilitative therapy-they are the basic forms of coordination that enable such actions as writing and drawing, catching things, assembling, and maneuvering through cluttered surroundings. Such abilities, however, are not isolated as an INLM framework, but are rather intertwined with executive function, emotional regulation, and body awareness: all pillars of holistic psychology. In fact, people with ADHD, autism spectrum disorders, and traumatic brain injuries often exhibit deficits in these areas and hold therefore diagnostic and therapeutic significance. In this respect, aligning neurology, psychology, and education, and thus becoming of special interest in interdisciplinary fields such as school, clinic, and cognitive training programs.

Literature review

Situated in the hindbrain under the cerebral hemispheres, the cerebellum has a densely organized structure with its anterior, posterior, and flocculonodular lobes. This region, having been studied extensively for its functions in voluntary movement, mental balance, and motor learning, has an extremely well-organized structure: the last sensory and motor information for fine-tuning motor execution.

Traditionally associated with motor control, when the cerebellum was considered to be involved with higher-order cognitive skills such as planning, decision-making, and emotional regulation. Bostan and Strick (2018) stress its connectivity through thalamic relays to the prefrontal cortex, proposing cerebellar dysfunction in the pathogenesis of ASD, schizophrenia, and ADHD.

The basal ganglia are involved in movement control, procedural learning, and reward-based behaviors that, through parallel circuits to the motor, pre-motor, and pre-frontal cortex, allow integration of motor and cognitive functions.

Temporal lobe holds importance for auditory input, memory, and language. It comprises the hippocampus, which is necessary for episodic memory and spatial navigation, and the perirhinal cortex for object recognition.

Further integration of sensory inputs occurs to support language and perception, whereas associations with the amygdala and prefrontal cortex have implications for social cognition and emotion. In contrast, the thalamus is involved in integration of sensorimotor, timing, and memory, holding extensive connections with the cerebellum, basal ganglia, prefrontal cortex, and hippocampus. Its dysfunction aberrantly impacts The poorly organized thalamus play

Methodology

The research utilize a pre-post single-subject experimental design to evaluate the effectiveness of Cognitive Rehabilitation Therapy (CRT) in enhancing cognitive abilities in enhancing cognitive abilities in a single participant. The intervention was based on the INLM model, targeting three primary areas : information processing, learning and memory.

The participant was selected based on average to borderline performance on standard cognitive measures, with no comorbid neurodevelopmental or psychiatric conditions. Their sensory functions were intact, and they demonstrated the ability to engage in task-based interventions with appropriate support.

Cognitive profiles at baseline were established with a detailed test battery that included a PGI Battery of Brain Dysfunction, specific tests such as the Digit Span Test, Word and Story Recall Tasks, and Paired Associate Learning were given to assess figure-ground and eye-hand coordination.

The intervention used materials that were inexpensive, easily obtainable, and could be printed so it could be replicated in either a similar clinical or internship setting. The worksheets were modified to the cognitive level of the participant and were made progressively harder based on performance feedback throughout the sessions. A reflection and feedback session took place at the end of each session to enhance cognitive awareness and further support an active cognitive process.

After the intervention phase, the same set of cognitive tests was administered under the same conditions. While results on the various cognitive domains were compared pre and post intervention, the emphasis was placed on improvements in eye-hand coordination and figure-ground perception. The quantitative results were later supported qualitatively with aspects like attention span, task initiation, response time and verbal elaboration..

This study throughout its duration adhered to ethical considerations, with informed consent; as well as anonymity of each person was maintained in the strictest sense, and all sessions were run under the supervision of a duly licensed clinical psychologist attached to the clinic. After the intervention, the participant was debriefed and their progress was conveyed in an age-appropriate and supportive manner.

Case History of the participants

There were two participants taken for the interventional study both taken from the middle class, both female and both housewives.

Participant A is a 43 year old who resides in Gandhinagar and has been married since 2006. She has a daughter of age 16 and has had a healthy pregnancy. Her developmental stages were all normal and reached all milestones at the correct age. She studied B.com in 2005 and worked for a year before getting married. Current medical problems faced by the participant are epilepsy and fits. She has no social contact and her daily routine consists of house chores and resting in the afternoon. She mentioned that she likes going out on weekends.

Participant B is a 35 year old who resides in Ahmedabad and has been married with two kids- one daughter and one son. There were some complications faced in the second pregnancy, causing a lot of problems both physically and mentally.Her early development was good but she faced a lot of social isolation. The subject has suffered through depression and has thalassemia minor. She mentioned that it was because she is an introvert. She currently has medical issues facing deficiency in vitamin D and iron. The participant has taken uprise D3 medication for the same. Her relationship with mother-in-law is rocky, stating that

she has a high ego. She also faces stress due to husband's unemployment. She mentions that she has an innate need for everything to be perfect and stresses a lot about the future.

Intervention

The emphasis was given to improving and applying perceptual-motor skills while carrying out real-life and cognitive tasks to maintain practical application and independence. These activities were task-sequencing drills wherein participants put daily tasks in order of priority to further executive functioning, and real-life scenarios involve practicing writing or assembling objects.

Dual-tasking challenges force participants to complete motor tasks such as sorting items while simultaneously completing a cognitively simple task like solving a puzzle to improve multitasking ability. Materials used in these activities include writing implements, daily planners, and very simple puzzles. Feedback occurs during reflection, where participants consider the problems they encountered and share strategies they used to foster self-awareness and adaptability. The need for several outcomes will enable the participants to apply multitasking efficiently, manage distraction, and apply learned skills into their daily activities toward achieving greater functional independence.

Results

PGI Battery of Brain Dysfunction

Tests Administered: mental balance, attention and concentration, visual retention and visual recognition

Tool Used:PGI battery of brain dysfunction

Phase: Pre and post CRT

Participant 1

Eye hand coordination	Name	Pre-test Scores	Post-test scores	Interpretation
	Mental balance	6	9	Improvement suggests enhanced stability and psychomotor control after CRT
	Attention and concentration	19	24	Enhancement in sustained attention and cognitive focus

Table 1. Scores of participant 1 for eye-hand coordination (pre and post test)

Figure ground perception	Name	Pre-test scores	Post-test scores	Interpretation
	Visual Retention	6	6	Retention ability remained stable
	Visual Recognition	8	10	Better ability to identify and distinguish visual stimuli after CRT

Table 2. Scores of participant 1 for figure ground perception (pre and post test)

Participant 2

Eye hand coordination	Name	Pre-test scores	Post-test scores	Interpretation
	Mental balance	7	9	Improved control over posture and psychomotor balance
	Attention and concentration	17	23	Significant improvement in focus and attention span

Table 3. Scores of participant 2 for eye-hand coordination (pre and post test)

Figure ground perception	Name	Pre-test scores	Post-test scores	Interpretation
	Visual retention	6	6	Retention ability remained stable
	Visual recognition	8	10	Indication of better ability to process and interpret visual stimuli

Table 4. Scores of participant 2 for figure ground perception (pre and post test)

Interpretation

From the data obtained, there is an observable increase in Eye-Hand Coordination in both participants post Cognitive Remedial Intervention, particularly in the areas of mental balance and attention and concentration.

Furthermore, both participants were consistently increasing in Visual Recognition scores with an increase in ability to properly discriminate and identify visual patterns and stimuli.This indicates that figure-ground perception is improved. Diagram perception is necessary for traversing complex visual environments, reading, and recognizing objects.

However, Visual Retention scores for each of them remained the same- i.e., no significant change in storing and recalling visual information could be observed. This lack of improvement speculates that the current approach of CRT might not be well targeted at memory-based visual tasks and might require further intensification through more repetition or longer periods to result in tangible gains. In summary, though CRT seems to have helped in many cognitive and perceptual areas, further fine-tuning may be necessary for areas such as visual memory

Domain	Cognitive gains	Holistic Intervention	INLM specific neuromapping
Attention and Executive Functioning	Improved vigilance, reduced distractibility, better task initiation	Shows better self regulation, purposeful action, and present-moment orientation	Prefrontal cortex and thalamus circuits sharpened; executive gatekeeping more efficient
Sensorimotor Integration	Increased motor precision, coordination, and readiness	Reflects improved embodied awareness central to real-world functionality	Cerebellum-basal ganglia-thalamic loops strengthened for adaptive motor behaviour
Visual Processing (Recognition)	Better identification of forms, edges, stimuli	Suggests stronger visual-motor coordination, and perception-action loop	Ventral visual stream and superior colliculus-frontal eye field systems more active
Visual Retention	No measurable change	Memory-related encoding may not be sufficiently engaged emotionally or semantically	Hippocampal involvement remains minimal without repetition; suggests incomplete neural learning loop
Engagement and Participation	More responsiveness, verbalization, and reflection in sessions	Signs of increased motivation, emotional resilience, and participation	Indicates activation of dopaminergic reward pathways (mesolimbic) linked to reinforcement and habit learning

Table 5. INLM Model and Holistic intervention and how it works on different domains.

Limitation

1. **Sample size:**

The study only includes two participants, which limits the generalizability of the findings to a broader population. A larger sample size would have provided more robust data to support the conclusions.

2. **Confounding variables:**

The study does not account for external factors such as participants' emotional state, fatigue , or environmental distractions during assessments, which could have influenced test performance.

3. **Absence of Longitudinal Follow-Up:**

The study does not include a follow-up phase to determine the long term retention of improvements or the sustainability of the intervention's effects on eye-hand coordination and figure-ground perception.

4. Interpersonal and Environmental Factors:

Participant B's family stressors, such as a rocky relationship with her mother-in-law and her husband's unemployment, might have influenced her cognitive performance, introducing confounding variables not accounted for in the analysis.

Conclusion and recommendations

This research examined the positive effects of a particular CRT based on the Integrative Neuro-Learning Model (INLM) viewpoint on developing perceptual-motor functions-primarily eye-hand coordination and figure-ground perception-in two adult female subjects. Results show that there were improvements during post-intervention in attention, concentration, and skills requiring visual recognition, hence performance in perceptual-motor integration and executive functioning.

This finding ties well with the INLM framework, which accentuates that the cognitive, sensory, and motor systems work together to perform human functions. In the final analysis, the study endorsed the utility of holistic treatment concepts, particularly in the transfer of cognitive gains into everyday functional spheres. Following the findings, it would be beneficial for future interventions to either increase the duration or intensity of training modules, particularly visual memory, thus leading to better and more general cognitive gains. The inclusion of *longitudinal follow-ups* would help understand the nature and sustainability of any gains observed, thus supporting adaptive changes to the program. Increasing sample size, while controlling for emotional and environmental variables, is also likely to contribute to the strength and applicability of the findings.

There should be continued interdisciplinary integration between the fields of psychology, neurology, and education in developing CRTs so as to best meet the needs of those with mild cognitive or functional deficits. Lastly, providing interventions similar to the one under study for other population groups, including children and senior citizens, should generate useful data concerning developmentally correlated perceptual-motor adaptability with that of a holistic human.

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