International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

# Bridging Theory and Practice: A Holistic Psychological and INLM-Based Cognitive Rehabilitation Study Targeting Memory, Auditory Processing, and Receptive Language

**Ms. Radha Navnit Jajal[1], Ms. Badri Nirav Patel[2], Ms. Saanchi Umesh Bhatt[3]**

[1]Clinical Psychologist, Psychology, Healvibe
[2]Psychologist, Psychology, Healvibe
[3]Student, Psychology, Ahmedabad University

**ABSTRACT:**
This study investigates the effectiveness of the Integrated Neuropsychological Learning Model in enhancing learning in individuals through integrative cognitive and therapeutic techniques. This research administered cognitive rehabilitation therapy intervention on participants while focusing on various brain areas, and their consequent facets. The aim was to enhance receptive language, auditory perception, and memory, with their performance measured through the administration of the Learning Disability Test. The test design consisted of a homogeneous sample of 2 participants. A naturopathic regimen was administered adjunct to CRT for Participant 1, giving way to a comparative holistic study. The intervention consisted of guided cognitive remedial exercises focusing on the aforementioned facets. The analysis is drawn, showing significant improvement post-intervention, with a larger remedial scope and additive naturopathy. This result was consistent for both participants. These findings support the hypothesis that an individually tailored regimen guided by the INLM model integrating CRT can enhance learning when informed by the physiological, psychological, developmental, and social factors.

**Keywords:** Holistic Psychology, INLM Model, Neuroscience, Neuropsychology, Cognitive Rehabilitation Therapy, Receptive Language, Auditory Perception, Memory, Naturopathy, Pediatric Psychology

## INTRODUCTION

Several interconnected brain regions work together in an intricate and systematic neurological procedure to successfully produce certain behavioral functions, three of which are integral for this research: receptive language, auditory processing, and memory. They are intricately linked functions crucial for a child's early development and have resounding effects on his/her ability in various domains of his/her life, like academic performance, social communication, and professional success.

Wernicke's area, located in the posterior part of the superior temporal lobe, typically in the left hemisphere, is vital for the receptive language facet of neurological functioning. It helps process the

linguistic input to comprehend the written and spoken language. This comprehension is enhanced by the angular gyrus and the cingulate gyrus, found at the junction of the parietal, temporal, and occipital lobes, and above the corpus callosum within the brain, respectively. The angular gyrus plays a key role in language comprehension, reading by language and numerical processing, and integrating auditory input with pre-existing visual and semantic information. The cingulate gyrus, on the other hand, is the hub for attention and emotional regulation. It aids language reception and comprehension by emotional tonal detection and filtering sensory input accordingly.

However, a brain region is a precursor to these functional regions, and is a necessary factor for receiving and transferring the very information they process– Heschl's Gyrus. The primary auditory cortex, also called the transverse temporal gyrus, is the first cortical area that receives auditory signals as input. It is thus crucial for sound (audition) perception. Lastly, memory makes apprehension and prioritization of the auditory input, semantic processing, and comprehension of written or spoken language possible. A key brain region operating memory is the prefrontal cortex. Located in the anterior portion of the frontal lobe, it is responsible for working memory, decision making, and executive function by memory encoding and retrieval.

These structures allow for a symphonic execution of linguistic processing and memory encoding throughout an individual's developmental journey. Any damage or delay in the maturation of these regions can cause impaired auditory perception and consequently the output.

Receptive Language can be simply understood as the ability to comprehend spoken, written, or signed language. Interpreting the words, sentences, and gestures in this function is essential for effective social communication. This communication also has its implications for developing interpersonal relations and, in turn, self-concept. Receptive Language is facilitated by auditory perception. It is the perception of sound input. More descriptively, it involves processing sounds and their various facets, like the tone, pitch, content, and amplitude. These sounds comprise regular communication, environmental noises, and even music, and are essential to the accurate interpretation and, in turn, interaction with the environment as an active participant. The associative function of memory makes the interpretation aspect of these various functions possible. As a neurological function, it is the brain's process for encoding, storing, and retrieving information by forming new neural connections and strengthening or weakening the ones already present. This information, gathered from experiences over time, is used later while interpreting similar stimuli or actions.

## NATUROPATHIC INTERVENTION

With growing interest in cognitive health, Ayurvedic herbs like Ashwagandha, Brahmi, and Giloy are gaining scientific attention for their potential to enhance memory and brain function. Recent studies support their neuroprotective and cognitive benefits, aligning traditional use with modern findings.

In people with mild cognitive impairment, ashwagandha (Withania somnifera) has demonstrated notable cognitive advantages. After regular intake, standardized ashwagandha extracts like Sominone have been proven to improve memory, attention, and spatial reasoning (Xing et al., 2022). The neuroprotective and antioxidant properties of Bacopa monnieri (Brahmi) have also been shown to improve memory acquisition, learning, and recall, among other aspects of cognition (Chaudhari et al., 2017). Although primarily backed by research on animals, Tinospora cordifolia (Giloy) shows promise as a future treatment by improving memory and lowering anxiety-related behaviors (Bhandari, Sunkaria, & Kaur, 2022). While

Manganese is necessary for brain function, it has two roles: it is good in trace amounts, but too much can cause neurotoxicity and working memory problems, especially in older people (Guilarte, 2013).

## THE INLM MODEL

The integrated neuropsychological learning model (INLM), a comprehensive, holistic framework intended to direct therapeutic interventions for people with cognitive, linguistic, emotional, and behavioral difficulties, is a subset of the broader holistic intervention approaches. The INLM seeks to strengthen the intricate interactions between different neuropsychological domains to promote efficient learning and rehabilitation by combining several therapy methods. Specific therapeutic modalities, including emotion-focused, sensorimotor, CBT, and CRT (as in this paper), are employed to target each domain.

In accordance with this approach, CRT is an essential intervention. It is a treatment intended to enhance or restore cognitive function following brain damage, disease, or developmental delay (such as in children). It incorporates various techniques and strategies, such as individualized training, practice, and skill-building programmes. These exercises might be verbal (spoken or written), performance-based, or physical.

## PURPOSE

This research aims to evaluate the effectiveness of CRT (Cognitive Rehabilitation Therapy) in enhancing receptive language, auditory perception, and memory in children, primarily early adolescents. This research is informed by the INLM Model (Integrated Neuropsychological Learning Model) and seeks to provide empirical evidence supporting integrated therapeutic interventions that simultaneously address cognitive domains like memory, linguistics, auditory perception, etc.

## RELEVANCE

This research can prove to be relevant in areas of education to facilitate learning and in clinical settings by providing a tested methodology and evidence of effectiveness to ensure validity. It bridges an essential and little-explored gap in rehabilitation literature by providing a holistic framework that can be tailored to each individual's requirements.

## LITERATURE REVIEW

### WERNICKE'S AREA IS NOT THE ONLY HUB FOR RECEPTIVE LANGUAGE

Recent research suggests that a flexible, interacting network supports receptive language instead of separate brain areas. Wernicke's region, once seen as a fixed "language decoder", now appears to play a dynamic role in predicting incoming words based on context. This skill is crucial for learning and understanding language in real-life listening scenarios (Tremblay & Dick, 2016). Notably, early research by Selnes et al. (1983) found that deficits in receptive language following left hemisphere damage could vary greatly. This indicates that personal learning experiences and individual brain structure influence understanding.

The angular gyrus is closely connected and acts as a center for integrating different types of information, including semantic, visual, and auditory data. This region is important for language-related academic skills. It supports reading comprehension, abstract reasoning, and understanding metaphors (Seghier, 2013). The anterior cingulate cortex helps students maintain focus and adjust when they struggle with comprehension by managing attention and monitoring errors. The posterior cingulate aids in recalling

contextual meanings by linking language to past knowledge and learning experiences (Maguire et al., 1999).

These areas together illustrate the brain's collaborative and responsive approach to language. Understanding how targeted cognitive therapies can assist children and teenagers in recovering or improving their receptive language skills is vital.

## AUDITORY PERCEPTION AND HESCHL'S GYRUS

The primary auditory cortex is located in Heschl's gyrus. This area is essential for processing and receiving auditory information. It decodes basic acoustic features such as frequency, pitch, tone, and timing patterns. It serves as the brain's first cortical stop for sound (Liegeois-Chauvel et al., 1991). Researchers once thought Heschl's gyrus was only for sensory functions. However, recent studies have shown that it actively contributes to speech perception, especially in tracking rapid auditory changes if required for understanding language and differentiating between phonemes (Griffiths & Hall, 2012). Heschl's gyrus is the key hub in the auditory processing pathway. It connects to higher-level regions like Wernicke's area and the superior temporal sulcus. This connection helps turn raw auditory input into meaningful linguistic information. This growing understanding highlights its importance in treating auditory perception problems in children with language difficulties.

## PREFRONTAL CORTEX AND MEMORY

Higher-order memory functions, including working memory, retrieval, and strategic encoding, are essential for language development and learning. These functions are mainly controlled by the prefrontal cortex (PFC). Although the hippocampus has long been linked to long-term memory storage, the PFC is increasingly recognized for its role in organizing and manipulating information, maintaining attention, and recalling context-relevant memories (D'Esposito & Postle, 2015). The ventrolateral PFC helps select and hold on to important information, while the dorsolateral PFC supports the manipulation of information in working memory (Badre & Wagner, 2007). Furthermore, the anterior PFC assists in managing complex cognitive tasks, including combining memory with current goals. This is a critical step in educational and therapeutic practices (Burgess et al., 2007). The PFC is an important focus in cognitive therapies aimed at improving memory-based language performance. These areas are particularly active in children during learning tasks and support the flexible thinking and planning needed to engage with new information.

## METHODOLOGY

This study evaluated the efficacy of a cognitive rehabilitation program based on the Integrated Neuropsychological Learning Model (INLM) using a qualitative, exploratory pre-post intervention design. Evaluating gains in memory, auditory perception, and receptive language in kids with varying intelligence ranges. Socioeconomic background, baseline performance, and response to intervention were also investigated in this study.

## PARTICIPANTS

Two children aged **13 and 12 years** were selected through purposive sampling. They were not formally diagnosed with any learning disability or with any other debilitating neurodevelopmental or sensory disorder. Descriptive information about the participants was obtained from the parent/guardian and case study for each subject based on the interpretation of test scores.

## ASSESSMENT TOOL

The Learning Disability diagnostic tool developed in India was used for this test. The test has both non-verbal and verbal sub-parts, ensuring a fair assessment of linguistic and non-linguistic learning. Among the sub-tests measuring 10 facets (1 each), only three measuring Receptive Language, Auditory Processing, and Memory were considered for this test. It is to be noted that this tool was not used for diagnostic purposes but as a measure of performance in the pre-post single-subject study. The results shall not be used for any other purpose/ diagnosis.

## CONDUCTION OF TEST

The conduction of the test was done over a single session. The participant was appropriately briefed about the upcoming tasks, and necessary instructions were provided. All the required materials were provided, and the surroundings were controlled to adhere to laboratory conditions. Any doubts arising in the minds of the examiner and examinee were solved in real time, and constant supervision of the subject while performing the test was maintained. After the conclusion, the participant was assured that this test was in no way evidence of their intelligence on its own and was merely an instrument for the study. The completed test was then scored according to the prescribed manual, and the scores were noted down.

## INTERVENTION

The intervention consisted of a manual of targeted worksheets. Focusing on overall cognitive rehabilitation, the sets specifically enhancing facets of receptive language, auditory processing, and memory were given to the subjects. These worksheets were **structured, age-appropriate, and culturally relevant**, and their development was informed by INLM principles, including emphasis on repetition, multimodal learning, and increasingly complex cognitive tasks to deepen understanding, sustain engagement, and drive measurable long-term learning outcomes.

**Naturopathic Intervention:** Participant was prescribed certain levels of Ashwagandha, Brahmi, and Manganese with his diet. This treatment regimen was tailored with the CRT manual interventions to get faster and better results. Naturopathic methods may also be employed to gain better results in the same span of time for individuals with cognitive functioning below average.

## ETHICAL CONSIDERATIONS

**Informed consent** was obtained from parents, and verbal assent was taken from the children. Participation was **voluntary**, with the right to withdraw at any time. **Confidentiality** was ensured, and appropriate debriefing about the research was provided to the parent after the post-test administration to ensure objectivity. The intervention posed *minimal risk,* involving only age-appropriate cognitive worksheets. The study aimed to provide **potential cognitive benefits** to participants and was conducted with a commitment to not harm. It was strictly ensured that children in no way felt intimidated or forced into performance. *Appropriate rapport* was established, and their comfort and mental health were prioritised.

## CLIENT INFORMATION

### PARTICIPANT 1

Participant 1, a 13-year-old middle school student, was referred for psychological assessment due to language acquisition difficulties and overall academic concerns, despite strengths in mathematics. Early developmental milestones were typical. Evaluation revealed language-related challenges requiring

multidisciplinary intervention. As an only child with both parents working, limited interaction and neglect may have worsened developmental issues. His daily routine includes school, tuition, and excessive screen time, with no extracurricular involvement. He has average nutrition but prefers fast food. Socially introverted with limited friendships, his peer interactions are normal. Academically, he performs at an average level but struggles significantly with language-based subjects.

**PARTICIPANT 2**

Participant 2, a 12-year-old male, was referred for psychological evaluation due to ongoing academic challenges, particularly in language-related subjects. Despite showing average skills in math and related areas, he struggles significantly with reading, writing, and language comprehension. These difficulties impact his academic performance and require targeted support. He belongs to a lower socioeconomic, nuclear family of four and is the only male in the household. His parents are divorced, and there is minimal emotional interaction at home. Developmental milestones such as walking and babbling were achieved on time. However, the prenatal period involved complications, with the mother experiencing blood loss in the eighth month, requiring a transfusion. Participant 2 is generally easy-going, exhibits conditional reactions, and has strong preferences, especially for non-educational mobile usage. While he is social and forms selective friendships, his attachment with his mother is strained, potentially affecting his emotional development and learning engagement.

## SCORING AND INTERPRETATION

***PARTICIPANT 1: Learning Disability Test Scores***

| Sub-Test | Area | Before Intervention | After Intervention | Interpretation |
|---|---|---|---|---|
| **1** | **Eye-Hand-Coordination (EHC)** | 7 | 8 | *Moderate improvement in motor coordination was observed.* |
| **2** | **Figure Ground (FG)** | 2 | 7.5 | *Substantial gain in figure-ground discrimination skills.* |
| **3** | **Figure Constancy (FC)** | 6 | 10 | *Marked improvement in recognizing figures despite changes.* |
| **4** | **Point-in-Space (PS)** | 3 | 7 | *Clear enhancement in spatial orientation skills.* |
| **5** | **Spatial Relations (SR)** | 7 | 8 | *Slight progress in understanding spatial positioning.* |
| **6** | **Auditory Perception (AP)** | 4.5 | 8.5 | *Significant* |

| | | | | |
|---|---|---|---|---|
| | | | | *enhancement in auditory perception* |
| **7** | **Cognitive Ability (CA)** | 5 | 9 | *Significant growth in overall cognitive functioning.* |
| **8** | **Memory (M)** | 6 | 9 | *Noticeable improvement in memory function.* |
| **9** | **Receptive Language (RL)** | 3 | 8 | *Marked progress in language reception and comprehension.* |
| **10** | **Expressive Language (EL)** | 2 | 0 | *Decline observed in expressive language skills.* |

***PARTICIPANT 2: Learning Disability Test Scores***

| **Sub-Test** | **Area** | **Before Intervention** | **After Intervention** | **Interpretation** |
|---|---|---|---|---|
| **1** | **Eye-Hand-Coordination (EHC)** | 10 | 10 | *Maintained a high skill level.* |
| **2** | **Figure Ground (FG)** | 8 | 8 | *Stable figure-ground perception.* |
| **3** | **Figure Constancy (FC)** | 10 | 10 | *Maintained excellent ability in recognizing consistent figures.* |
| **4** | **Point-in-Space (PS)** | 9 | 10 | *High-level spatial orientation retained.* |
| **5** | **Spatial Relations (SR)** | 10 | 9 | *Slight decrease; overall spatial understanding remains strong.* |
| **6** | **Auditory Perception (AP)** | 6.5 | 7.5 | *Moderate improvement in auditory perception skills.* |
| **7** | **Cognitive Ability (CA)** | 10 | 9.5 | *Slight decrease;* |

| | | | | |
|---|---|---|---|---|
| | | | | *cognitive function remains strong overall.* |
| **8** | **Memory (M)** | 10 | 9 | *Minor decline in memory retention; still at a high level.* |
| **9** | **Receptive Language (RL)** | 7 | 8.5 | *Noticeable improvement in language reception and comprehension.* |
| **10** | **Expressive Language (EL)** | 0.5 | 2.5 | *Significant improvement in expressive language skills.* |

**Note: Language Barrier- Some verbal sub-tests of this assessment pose a language barrier for those children who study in state boards. Thus, the scores must be evaluated at the examiner's discretion, and varied non-linguistic/ culturally neutral tools must be used.*

**COGNITIVE OUTCOMES BY DOMAIN: INLM AND HOLISTIC OVERVIEW**

| Cognitive Domain | Neural Structure | Pre–Post Difference | Effect Valence | INLM Application | Holistic Interpretation |
|---|---|---|---|---|---|
| **Auditory Perception** | Heschl's Gyrus | P1: **+4**<br>P2: **+1** | Positive | Auditory sequencing, phoneme decoding, and attention modulation | **P1:** increased auditory vigilance<br><br>**P2:** limited sensory integration |
| **Receptive Language** | Wernicke's Area, Angular Gyrus, Cingulate Cortex | P1: **+5**<br>P2: **+1.5** | Positive | Multimodal semantic mapping, context prediction, and attention shifting | **P1:** enhanced comprehension and verbal fluency<br><br>**P2:** effortful gains under cognitive strain |

| | | | | | |
|---|---|---|---|---|---|
| **Memory** | Prefrontal Cortex | P1: **+3**<br>P2: **–1** | Positive / Negative | Working memory drills, executive control, and recall training | **P1:** improved encoding and flexibility<br><br>**P2:** retrieval disruption due to emotional interference |

## INTERPRETATION

Participant 1 showed significant improvements in all areas. Auditory perception increased exponentially from 4.5 to 8.5, Receptive Language improved from 3 to 8, and Memory increased from 6 to 9. In contrast, Participant 2 had slight to moderate improvement in Auditory Perception, moving from 6.5 to 7.5, and in Receptive Language, from 7 to 8.5. However, there was a mild decline in Memory, dropping from a centum score of 10 to a lower 9. This decline may be due to environmental or personal factors.

These results highlight the effectiveness of the Cognitive Rehabilitation Therapy intervention, especially when there is a larger scope for improvement. Additionally, Participant 1's progress may be partly due to a treatment plan that included Ashwagandha, Brahmi, and Manganese supplements. These natural elements are known for their positive effects on cognition and brain health. Ashwagandha helps reduce stress and promote nerve regeneration. Brahmi improves memory and learning, while Manganese is important for brain metabolism and protecting against oxidative stress. This combination likely boosted sensory processing, language understanding, and memory function. The comparison emphasizes the potential for integrative therapy as a helpful addition to standard cognitive treatments.

## CONCLUSION AND RECOMMENDATIONS

This study demonstrates the effectiveness of Cognitive Rehabilitation Therapy (CRT), within the Integrated Neuropsychological Learning Model (INLM), in enhancing receptive language, auditory perception, and memory in early adolescents. Participant 1 showed marked improvement across all domains, especially with the addition of naturopathic support, while Participant 2's moderate gains highlight how emotional and environmental factors can influence progress. These findings support the importance of tailored interventions that respond to individual needs and contexts.

To sustain and build upon these outcomes, participants should continue structured cognitive tasks, reduce screen time, and engage in more real-world verbal interaction. Emotional support at home, consistent routines, and supervised use of supplements like Ashwagandha and Brahmi can further strengthen cognitive outcomes. For future refinement of the INLM model, integrating emotional regulation tasks, involving caregivers, and dynamically adjusting task difficulty are recommended. Regular follow-ups will also be essential in tracking long-term benefits and refining intervention strategies. Together, these measures can enhance participant development and the practical application of the model.

## LIMITATIONS

While this study aims to explore how effective Cognitive Rehabilitation Therapy (CRT) is in improving receptive language, auditory perception, and memory in early adolescents through the INLM framework,

several limitations should be considered:

1. **Sample Size and Diversity:** The study had a small and mostly homogeneous group of participants. This may affect how the findings apply to larger populations with different linguistic, cultural, or neurodevelopmental backgrounds.
2. **Longitudinal Scope:** Due to time constraints, the research may not evaluate long-term effects and whether improvements last after the intervention.
3. **Control of External Variables:** It is challenging to fully control outside factors such as the home environment and quality of education, which can significantly impact language and cognitive results.
4. **Model-specific Constraints:** Although the INLM provides a holistic and integrative framework, its application in real-world settings is still emerging. This may limit the number of studies available to evaluate the reliability and applicability of the results.

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