

A Theoretical Analysis on Existing Child-Based Cognitive Rehabilitation Models

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ABSTRACT

Background: Cognitive Rehabilitation (CR) has been variously used in the research literature to represent non-pharmacological interventions. Along with adult cognitive impairments, the need to address neurodevelopmental impairments and acquired cognitive impairments among child populations is inevitable. The aim of this paper is to find out the existing CR models and to review the literature gap in the current area of child-based cognitive rehabilitation in India. **Methods:** Based on a systematic review of the literature from (1978 -2011), all published CR models targeting the cognitive domains of attention, memory, and/or executive function and behavioral aspects that could be identified were reviewed. **Results:** 15 papers, both Indian studies and foreign publications (Delhi psychiatry journal, APA PsyNet, Springer, Mount Sinai Journal of Medicine), were identified. **Conclusions:** A very limited number of studies in India have done research in the implementation of a structured module for CR, not established yet among children. Providing at this time is minimal conclusive evidence for, the efficacy of CR among children with neurodevelopmental impairments / acquired brain injury, has been studied. However, a clear need to address the concern of developing a child-based CR model is necessary for creating changes in clinical practice for the child's betterment.

Keywords: Cognitive Rehabilitation, Neuro-developmental impairments, Acquired Cognitive impairments and Neuroplasticity

A wide-ranging rehabilitation principle focuses on the enhancement of human functioning and quality of life. In contrast, other branches of health care focus totally on the prevention and treatment of disease. Rehabilitation accepts the complex correspondence between disease and thus the ability to function: a disease could even be eradicated while disability remains; disabilities are reduced within the face of permanent injury or chronic disease.

The terms cognitive rehabilitation, cognitive remediation, and cognitive re-training (CR) are invariably utilized in the research literature to represent non-pharmacological interventions that focus on the cognitive impairments with the goal of ameliorating the

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identical and more importantly, improving functional behaviors to optimize the standard of life. The genesis of cognitive intervention programs may be traced to the planet War I and II when soldiers suffered gunshot wounds leading to traumatic brain injuries (Shah, 2017).

Like Physical rehabilitation, CR may include interventions that aim to minimize cognitive impairments, or plan interventions that aim to minimize the disabling impact of these impairments. Interventions are applied mostly through technology and other compensatory strategies that will allow the individual with cognitive impairment to accomplish important life activities and more fully participate in society. Shoulson, Wilhel, & Koehler (2012). The intervention and support procedures include: Attention, Memory and Memory Problems, Retrieval, Organization, Problem Solving, Concrete Versus Abstract Thinking, Instructional Routines, Executive Function/Self-Regulatory Routines, Transfer of training, Cognitive and Learning Strategies, and others. Models of cognitive functioning like language, reading (Howard 2005, Mitchum & Berndt 1995), memory (Baddeley 1992, 2007), attention (Robertson 1999), and perception (Bruce & Young 1986) have proved useful in rehabilitation (Barbara, 2007). Different definitions are considered by many researchers on Cognitive Rehabilitation. Few favorable definitions have listed below:

- **Brain Injury Association of America:** “Cognitive rehabilitation is a systematically applied set of medical and therapeutic services designed to improve cognitive functioning and participation in activities that may be affected by difficulties in one or more cognitive domains.... Cognitive rehabilitation is often part of comprehensive interdisciplinary programs” (Katz et al. 2006).
- **U.S. Veterans Administration (VA):** “Cognitive rehabilitation is one component of a comprehensive brain injury rehabilitation program. It focuses not only on the specific cognitive deficits of the individual with brain injury, but also on their impact on social, communication, behavior, and academic/vocational performance. Some of the interventions used in cognitive rehabilitation include modeling, guided practice, distributed practice, errorless learning, direct instruction with feedback, paper-and-pencil tasks, communication skills, computer-assisted retraining programs, and use of memory aids. The interventions can be provided on a one-on-one basis or in a small group setting” (Benedict et al. 2010).

Applied CR

In multiple professional disciplines CR has been used, including, neuropsychology, clinical psychology, occupational therapy, speech-language pathology, physical therapy, and psychiatry i.e., rehabilitation medicine (Prigatano 2005). Collaboration with academic colleagues in other disciplines such as cognitive psychology also occurred. The various disciplines share a common goal of restoring function in a cognitive domain or set of domains or teaching compensatory strategies to overcome domain-specific problems, improving the performance of the specific activities of daily living. As adult rehabilitation is being focused more on the field of research and practice; the need to address neurodevelopmental impairments among child population (like ADHD – attention deficit hyperactive disorder, ADD - Attention deficit disorder, Specific learning disability & others) and acquired cognitive impairments (due to TBI, seizure disorders, cancer, congenital heart diseases & others) has been increased and it is inevitable.

Currently, in India such multi-disciplinary collaborative approaches have been initiated across the clinical settings but, most published research and current clinical practice are predominantly rehabilitating cases like acquired brain injuries (TBI, Stroke, dementia, neuropsychiatric disorders) among adults and very few among children. The reviews of the

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current evidence regarding the failures and successes of cognitive rehabilitation in adults (mostly in attention, memory and executive function enhancement) show that several promising approaches have been developed in the last 30 years.

Here the aim of the paper is to theoretically define the term CR, to review the existing models of CR being practiced (specifically in children) during the period of 1978 - 2011 and to find out the literature gap in the respective area. The current study recognizes the need to situate more research on applied CR among children. Consequently, the researcher sets out to collect and collate the above-mentioned information.

THEORETICAL MODELS OF COGNITIVE REHABILITATION/RETRAINING

Bracy et al. 2003, have emphasized that CR should be grounded in theory, which indicates that a firm foundation is necessary prior to the implementation of CR in practice. Different models of CR have been presented by Diamant & Hakkaart (1989) to enable the elaboration of an appropriate approach for the chronic psychiatric patient; to enhance their level of functioning and to bring out observable change in behavior within the limits given by the psychotic defect and/or cognitive impairments.

As the basis of CR model serves the *brain-behavior* frame of reference; they take baseline measurement of the actual level of cognitive functioning of the individual patient. From the test results of different cognitive functioning assessments, an individualized skills profile will be derived.

Many researchers, Bracy, 1986 & others; Diller, 1976; Reitan & Wolfson, 1985; Diamant & Hakkaart, 1989, Cicerone, 2004, 2005; Barbara, 2007 has operationalized the Models of Luria (syndrome analysis) and models of Reitan (model of neuropsychological functioning). They hold these models as a foundation for developing their school of models.

Further and much later, Malhotra, Bhatia, Gaurav, Vibha and T.B. Singh (2009) introduced and incorporated a part of the earlier proposed models by the previously above-mentioned researchers into their study along with their own different theoretical models to explain the process of CR and the mechanisms for change.

Researchers have tried to gather many different theoretical models from already existing literature reviews for this study. No specific child-based CR models were able to be found during this time. A few important adult CR models were reviewed and have enlisted below. These CR models can be utilized as a foundation for developing a child-based CR model. Six models are mentioned below, which include:

1. Descriptive (Procedure, Transcript) Models /DM

The following detail on the early connectionist research demonstrates that, when retrained after damage the simple networks trained on unstructured tasks can exhibit rapid recovery on treated items and generalization to untreated items. This rapid recovery is made possible through the process of neuroplasticity, which is psychologically conceptualized as the re-organization and re-establishment of cognitive functions. As such, retraining strategies focus upon ameliorating individual **test-specific deficits** and generalized cognitive/neuropsychological improvement is hypothesized to occur (e.g., Gudeman, Golden, & Craine, 1978). Here the basic approach to rehabilitation, centers around the patient's performance on neuro-cognitive measures and expecting the generalization to untreated items.

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In addition to Luria's "syndrome analysis" another similar descriptive model of CR was developed by Diller (1976,1981,1987) derived from the concepts of clinical neuropsychology. Diller starts with identifying test specific approaches and then specific tasks are used that appeal to the respective abilities of a patient and the stimulus reactions qualities to the task were analyzed.

Based on the activities of daily life (ADL) the ability and the task are evaluated, the achievements on other tasks that may reveal abilities associated with the trained ability and with neurological correlates. Consequently, a rehabilitation diagnosis is formulated which forms the base of the training process (Malhotra, Bhatia, Rajender, Sharma, & Singh, 2009).

2. Information Processing (Analytical) Models/IPM

Recently, Information theory has been considered as the basic model for CR. Thus, researchers have attempted to integrate information theory along with the frame of reference of Neuropsychology. Fundamental concepts of Clinical Psychology are used in the IPM and it has got resemblance with the work of Diller (1976) or Diller and Gordon (1981). Based on the 3-core principle (mentioned below), Reitan and Wolfson (1985,1988) put forward a model with 3 levels of information processing.

Core principles are:

(a) **Principle of functional specificity:** The first level implies attention, concentration and memory

(b) **Principle of functional hierarchy:** The second level reflects the lateralized processes, i.e., verbal and language skills in the left hemisphere and spatial and manipulative skills in the right hemisphere.

(c) **Principle of training circuits (tracks):** The highest level of information processing is considered as the central one, enhancing abstraction in the form of concept formation, reasoning and/or logical.

Luria, as a pioneer in cognitive psycho-physiological research, Luria's theoretical formulation has been influenced by many researchers, Bracy (1986) is one among them. Luria's 3 functional units was operationalized by Bracy in terms of locations and vivid cognitive processes; thus these 3 units are considered as prototypes for specific functional units. Bracy suggests, the basic processes must be first trained before, the specific and the then more complex processes can be trained for (Diamant, J. J., & Hakkaart, P. J. W.,1989).

3. Stimulus Organism Response Contingency Consequence (SORKCC) Model

A behavioral perspective of CR is operated through the SORKCC model. Model considers that behavioral approaches have a significant role in the process of CR because it allows the incorporation of bio-psycho-social aspects of individuals (i.e., along with physical and neurological facets, the motivational, behavioral and emotional status are also observed and analyzed). The abbreviation of SORKCC stands for:

Stimulus (S) refers to antecedent events, Organism (O) refers to person's biological conditions and individual differences resulting from previous experiences. Response (R) is for the behaviors (motor, cognitive or physiological) that are of concern, Contingency (K) refers to schedules of reinforcement in operation and Consequence (C) refers to events that follow behavior (physical, social or self-generated) (Malhotra, Bhatia, Rajender, Sharma, & Singh, 2009).

According to Diller & Gordon (1981), model of CR can best be characterized as behavioral engineering, where the patient's impairment is defined in terms of operationalized behavioral deficits inherently assumed to be maintained by environmental conditions. Therefore, the

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major objective in treatment is to identify and systematically modify the environmental “antecedents” that are assumed to underlie the *problem behavior*.

In the same period, Barth and Boll (1981) also emphasized on focusing upon groups or patterns of behaviors as a second basic approach to CR. Subsequently, Wilson & O’Leary (1980) utilized several common behavioral analytic techniques, while others like Reitan (1985) and Wolfson (1988) even introduced theoretical explanation based on the conceptual model of behavioral correlation with brain function.

To this end, unlike “psychometric” model of rehabilitation, behavioral deficits are treated as parts of a whole rather than as individual dysfunctions, with one of the major tasks of the therapist in this approach being to identify the specific components of a stimulus that contributes to the deficit. Moreover, proponents of this model of CR argue that these stimulus alterations may bring to the attention of the patient both the nature and extent of his or her disabilities as well as potential compensatory strategies.

For more than 40 years, such behavioral schools of models and theories have been employed in CR. These concepts are valuable in CR because they inform assessment, treatment, and the measurement of rehabilitation efficacy (Barbara, 2007).

4. Holistic Model (HM)

Ben-Yishay and Priganto (1990) has introduced a model of hierarchical stages in the holistic approach, where the client has an active role in rehabilitating themselves. Thus, the client has a great role in self-awareness, identity, engagement, mastery, control, and acceptance of current functioning (Malhotra, Bhatia, Rajender, Sharma, & Singh, 2009). HM emphasizes on the integration of socio-cognitive, emotional and functional facets of brain injury in CR rather than addressing each domain separately for rehabilitation. As holistic approach is concerned with enhancing the client’s awareness, bringing down cognitive impairments, developing compensatory skills, and to psycho-educate on vocational possibilities.

Ben-Yishay’s hierarchical stages include:

- i. Increasing the patient's awareness of the problems,
- ii. Increasing acceptance and understanding of the problems,
- iii. Providing strategies to improve cognitive functions,
- iv. develop compensatory skills, and
- v. Provide vocational counseling. Both individual and group sessions are also incorporated in HM (Ben-Yishay & Priganto,1990).

Later, Prigatano (1999) introduced a list of 13 principles of CR which were derived from the Holistic approach. His work had considerably influenced current rehabilitation practices. Cicerone et al. (2004, 2011 or 007) provides evidence for the effectiveness of comprehensive – holistic CR approaches and are probably the most effective clinically.

5. Integration Model:

Diamant, J.J. et al. (1989) tried to further develop the basic ideas of Reitan and Wolfson and to integrate this approach with that represented by Bracy based on Luria's model.

Reitan and Wolfson’s basic idea were grabbed by Diamant, J.J. et al. (1989) to develop a CR model and to blend the idea of Bracy based on Luria’s Model. The theoretical background for Diamant's thesis "*brain is the organ processing distance between subject and object in terms*

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of time, space and interpersonal relationships" is the "Closed Circuit Approach" (1980, 1982, and 1987).

The "Closed Circuit Approach" states the theoretical background for the IM. It is organized in a one-to-one approach, where the client is met individually and then a systematic training of specific cognitive functions and abilities is done in a multidisciplinary design, including neuropsychological screening, re-screening and continuous evaluation of results.

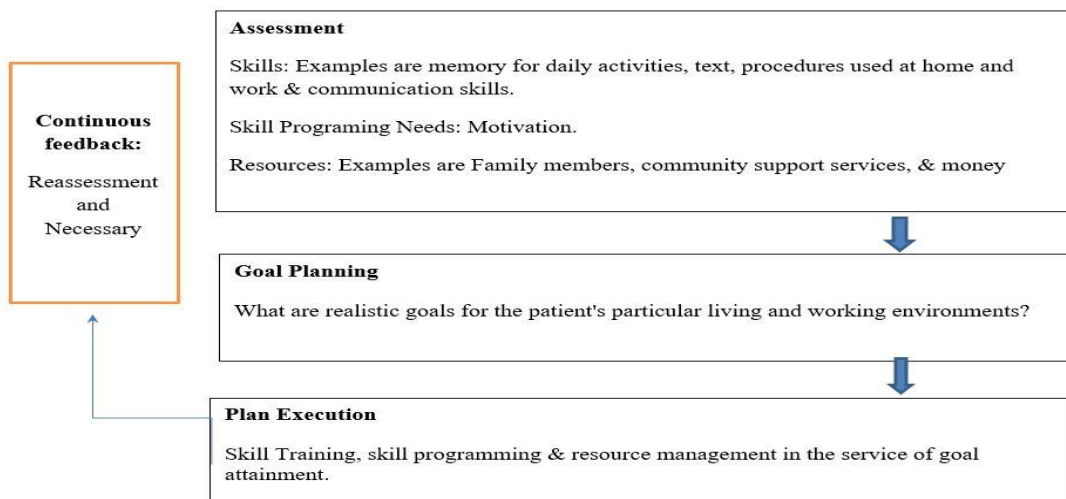
As the theoretical postulates are derived from "distance -regulation" of the brain, the primary aim is to regulate the distance between the subject and the environment. This fosters the adaptation skills of the individual. The phases of IM include:

- Initially, before entering the phase of fundamental level (i.e., attention/ concentration, and memory); a careful screening on the receptive level is made. This helps to understand the capability of the client to move on to the information processing phase.
- Information processing is analyzed in two distinct ways, i.e., spatial orientation and verbalization.
- After analyzing the basic information processing level, the next phase is the integration level, where the complex level of information processing (Abstraction function like concept-formation, reasoning and planning) take place.
- At the end, out-put level is analyzed, this gives an objective finding of verbal and psychomotor reactions.
- Diamant has tried to incorporate both the psychometric and non-psychometric CR approaches in the present model.

6. Anthony Comprehensive Rehabilitation Model (ACR): Later, Williams (1987) also surmised the importance of implementing applied CR techniques rather than solely depending on theoretical development alone.

The ACR model of Williams (1987), consists of six main components: Skill and Resource Assessment, Rehabilitation Goal Planning, Skill Training, Resource Management and Plan Execution (Figure 1). This comprehensive model is distinctive and helpful in the conceptualization of rehabilitation because it specifically defines these components of rehabilitation and attempts to explain how they interrelate.

Figure 1. Major Components of the Comprehensive Rehabilitation Model



CONCLUSION

This study attempts to bring an understanding based on current models and techniques on child-based CR, but reviewed studies during the 1978 - 2011 were mostly conducted among adults with acquired brain injuries succored. This indicates till recent years; no specific child CR model has been implemented for training the impaired cognitive domain. As there is no specific strategy for CR/Retraining, the rehabilitation professionals (Psychologist) are perplexed on how to start, when to start and who all should be considered for retraining. On the concept of brain plasticity, children are the group who has high possibility to enhance their level of cognitive functioning once trained during their critical developmental period. Hence, a more plausible approach of the CR distinctively among children is felt, that would be more conducive and have a far better outreach relative to an adult brain.

However, from these studies, and owing to the paucity of evidence on CR effects among children in India, the researcher here, suggests for a more rigorous scrutiny and approach, which needs to be tailored in terms of providing a generalized child-based CR model, as a foundation for customized CR process from culturally feasible, multi-centric and empirically evident based CR studies and techniques.

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Conflict of Interest

The author(s) declared no conflict of interest.

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