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Editorial

Discipline of Neuropsychology: It's Evolution, Present and Future

Vibha Sharma

Neuropsychology as a branch of broad fields of Psychology and Neurosciences, is an attempt to understand the relationships between brain, mind, and behaviour. The field has a long history. It was officially identified as an independent scientific discipline in 1963, when the publication of an international specialty journal titled 'Neuropsychologia' was started on the initiative of a small group of neurologists, psychologists, and psychiatrists. The scope and aims of the newly emerged field were spelled out in the first issue of the journal, which may be attributed to the first Editor – in- Chief of Neuropsychologia, a French Neurologist, Henry He'caen. But the lesser-known fact is that even much before this initiative, Donald Hebb gave this breakthrough idea that Psychology needed to integrate more closely with Neurology and Physiology in order to explain human behaviour. His idea was to merge the abstract "mind" with biological brain functions, so that Psychology can be viewed as a scientific discipline, rather than a study of 'abstract mind or soul'. He published his idea in 1949 as "The Organization of Behaviour: A Neuropsychological Theory", and that's how Donald Hebb is known as "Father of Neuropsychology". We can also trace back the understanding and study of brain behaviour relationships to Sigmund Freud in his initial work, where he tried to make the impossible possible, by understanding the human mind through his scientific psychology project, published in 1895. Freud explored the ramifications of unconscious mental processes for behaviour and therefore tried to adopt a neural model of behaviour in an attempt to develop a scientific psychology. But because of the limitations of neuroscience and in absence of neuroimaging techniques at the time, Freud abandoned his biological model in favour of developing psychoanalysis (Kandel, 1998).

Definitions of Neuropsychology and its Evolution

Scientists and researchers from various fields have contributed in the development of the field of Neuropsychology. Hence, in the scientific world, many synonyms for the field of neuropsychology have emerged, like cognitive neuropsychology, clinical neuropsychology, behavioural neurology, behavioural neuropsychology, experimental neuropsychology, physiological psychology and more. At the same time, neuropsychology also has close ties with the semantic field of neurosciences together with neuroimaging, neurophysiology, cognitive neurosciences, neuroanatomy, neurobiology, neurogenetics, neurochemistry and even neuro-economics. Therefore, many authors have proposed various definitions of Neuropsychology. The most popular among all is the definition by M. Meier (1974): "Neuropsychology is the scientific study of brain-behavior relationship" (cited by Horton and Puente, 1986). The definition by Meier is very close to the one given by A.R. Luria. He, being a founder of applied fields of neuropsychology added to this definition, and came out with a working definition: "a study of possibilities to use this knowledge for early and precise neuropsychological assessment and scientifically based rehabilitation of functions" (Luria, 1973).

Two major branches of Neuropsychology have been identified in the practical field. First, Clinical Neuropsychology, is concerned with assessment of and rehabilitation from brain injury that impairs an individual's ability to function, while the second, Cognitive Neuropsychology focuses on examining the effects of brain damage on thought processes, so as to construct models of normal cognitive functioning.

The evolution of neuropsychology can also be explained through three overlapping and coexisting phases of the field, different in the main emphasis for neuropsychologists, through the following model (see Figure 1). It explains how a static neuropsychology, relating the individual's behaviour to fixed cerebral lesions, is replaced by a dynamic neuropsychology, which analyzes the dynamics of brain-behaviour interactions (Glozman, 2020).

Broadly conceived as an attempt to understand the relationships between brain, mind, and behavior, neuropsychology has a long history, but it was only in the 1960s that an autonomous field of scientific inquiry with that name was formally established.

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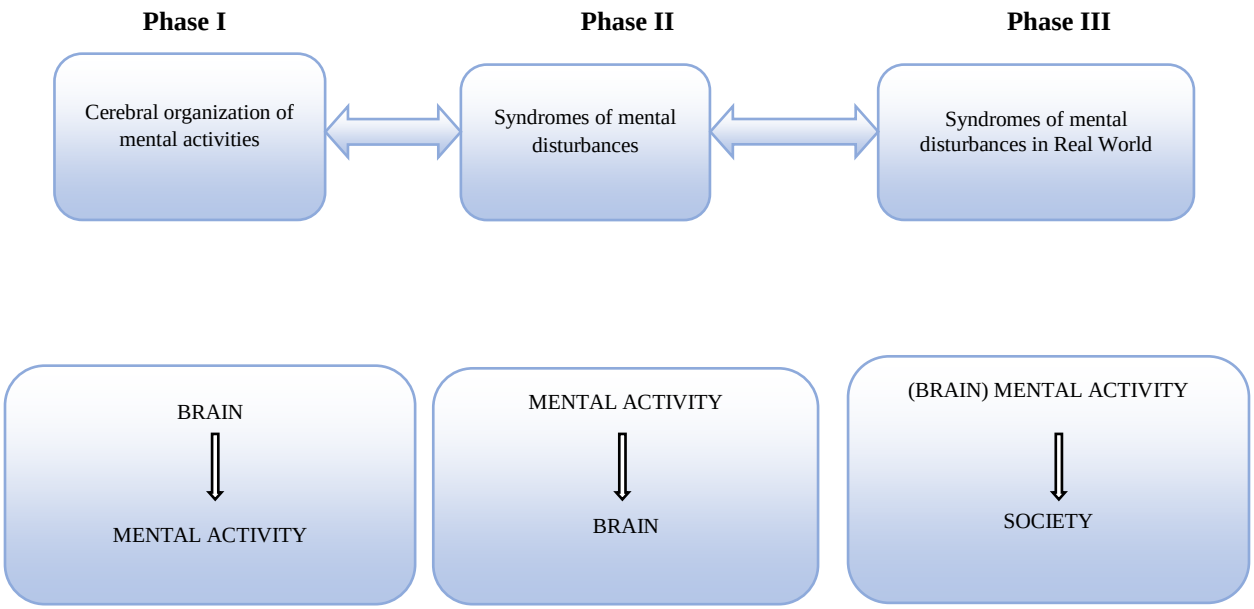

Figure 1: Model of Evolution in Neuropsychology

In the first phase, the emphasis for neuropsychologists was on the brain and its relationship to different behaviours. The above first definition of neuropsychology (brain-behaviour relationships) is relevant to this first phase in neuropsychology evolution. In the second phase of neuropsychology evolution, the structure of each mental activity has been the focus of attention and this was followed by its localization in the brain. The third and actually dominant phase of evolution in neuropsychology focuses on the interrelationship between a patient and his or her environment leading to integration of neuropsychological and real life data. It gave birth to new branches of neuropsychology, viz. ecological neuropsychology, behavioural neuropsychology, neuropsychology of everyday life, neuropsychology of personality and communication, neuropsychology of family etc. These ideas became predominant at the third phase of neuropsychology evolution; prepared by its transformation in social-historical or cultural-historical neuropsychology. Both terms are used as synonyms in the literature.

Cognitive processes descend from complex interaction and interdependence between biological factors (the individual mind), which is part of physical nature, and cultural factors, which appear in the evolution of a human being. This social-historical approach in neuropsychology looks for the origins of human conscience and mental activity neither inside the brain, nor in the mechanisms of nervous processes, rather in the context of human social life.

Another application of cultural-historical approach in neuropsychology are researches of social brain. The term social brain was introduced in neuropsychology by M. Gazzaniga (1985). Later this term was used to show how human brain processes the social information and determines the mind as a whole (Insel & Fernald, 2004). "Cultural-historical approach in neuropsychology, means a change in social brain; study orientation from localization to problems of social and cultural regulation of cerebral functions" (Glozman & Krukov, 2013). The cultural-historical approach in neuropsychology also influenced the neuroscience up to appearance of a new field of research -cultural neuroscience that is concerned with studying the influences of culture on brain anatomy and function (Chiao & Blizinsky, 2016).

Present Status- Technological Progress in the Aid of Neuropsychology

Neuropsychology has experienced a number of advances considerably by technological progress, mainly with the advent of Neuroimaging techniques starting from CT Scan to MRI, fMRI and PET scan. Further this has also developed from a primarily qualitative practice to a more objective and evidence-based approach, with expanded normative standards, performance validity testing, and cross-cultural considerations. Although these improvements have aided the investigation of neurocognitive functions, there are increasing discussions on the need to enhance the dimensionality of neuropsychological assessments and computational modelling (Casaletto & Heaton, 2017).

The technological and theoretical development of neuropsychological assessment till present times, can be understood in terms of dimensional waves of

technological adoption (Parsons, 2016). In Neuropsychology 1.0, neuropsychological assessments accentuate the development of low-dimensional and construct-driven (i.e., simple stimulus presentations of stimuli to test abstract concepts like working memory) paper-and-pencil measures. In Neuropsychology 2.0, there is a technological move to automated administration, scoring, and in some instances the interpretation of low-dimensional stimulus presentations using computerized approaches. Concurrently, technological developments in neuroimaging have changed the role of neuropsychological assessments, from lesion localization to predictions about a patient's ability to perform activities of daily living. Finally, Neuropsychology 3.0 reflects contemporary advances in high-dimensional (dynamic and ecologically valid simulation, logging, and modeling of everyday activities) tools.

To get an idea of where neuropsychology is today, basic searches were performed to tally the number of technology publications per discipline by Parsons & Duffield, 2020. Findings from these basic searches suggest that high-dimensional technologies have vastly greater representations in neurology and neurosciences. The inclusion of technologies is very recently increasing in neuropsychology but is explicitly not keeping pace with other neurosciences. A survey conducted by Rabin et al, 2014 in the US and Canada, of rates of neuropsychologists using computerized instruments also revealed the similar findings, that only 6% of the 693 neuropsychology assessments were computerized. The average respondent reported that they rarely used computerized tests. An increased likelihood of computerized assessment use was apparent for early career neuropsychologists.

Similar is the condition in India till date. There are only a few laboratories and departments where computerized neuropsychological assessments are being used. Otherwise, old verbal and performance (Paper Pencil) tests and batteries are used at most of the centres, due to lack of resources. It shows that we in India are still following the second wave (as mentioned above), and very slowly moving towards the third wave of high technological advancements in the field of Neuropsychological assessments.

The Future of Neuropsychology

For the future development of the field, there is a need for Integrating Neuroscience Advances into Clinical Neuropsychology and Adoption of Advances in Measurement Science to Neuropsychological Assessments, globally as well as; in India. In their article, Unai Diaz-Orueta et al (2020) have advocated implementing computerization of neuropsychological tests using a Process-Based Approach (PBA) to the technology-based adaptations and to work towards developments in this area by linking it to future technological developments that may be possible in the area of neuropsychological assessment.

We know that the coming era is an era of Artificial Intelligence. So, an interface of Neuropsychological tools and techniques with current advancements in the fields of computer and electronics are highly required. There are ongoing demands of development of different Apps for the measurement of Brain activities, including various cognitive domains. Now the computer scientists wish to develop Apps to measure simple and complex cognitive functions like, attention and memory, and to have simple programmes for remediation, as this is the demand of the present times. In the fast-pacing world students, parents and teachers are looking for such devices to provide better results in their studies. Similarly, App based tools for early detection of common psychological and neurological problems, like high anxiety, SLD, migraine, etc are in high demand and professionals from computer and electronic sciences are in the process of development of such tools. Now there is also an increasing demand for AI (Artificial Intelligence) based Interventions for common psychological problems, which is going to be the next step of Tele-Therapy.

With the various advancements of the field, yet, there is poorly understood neuropsychology of complex cognitive and emotional derangements as they occur in major psychoses (e.g., bipolar disorder, schizophrenia, clinical depression, obsessive–compulsive disorder). Hopefully the understanding will progress to a point where the already blurred border toward neuropsychiatry will eventually vanish. There is still a long, effortful way to go, but the endeavour is worth the effort. To know how the human brain furnishes the medium through which all members of our species cognize, emote, and act would be tantamount to solve the perennial mind–brain problem, an achievement which, in William James' words, would make all previous achievements pale (Berlucchi, 2009).

The developments in High-dimensional Neuropsychology also requires substantial reform in the way the profession conducts training. Advanced level training should be added to current training programmes that emphasizes primarily on low-dimensional neuropsychological tests (eg, paper-and-pencil tests) and methods of cognitive rehabilitation. Increased emphasis should be placed on technical skill development with high-dimensional technologies and data-driven inferential reasoning. Curricula in Clinical Psychology and Neuropsychology programs in our country should be expanded to adapt to the recent

technological advances that have led to exponential growth in the other sciences. This would require reframing the training in clinical psychology programs across the country. Increased emphasis on training basic technical and computational skills will improve the ability of future Neuropsychologists to participate in science. There is also a need for training of Neuro-ethics. We also need to enhance our pace of growth in this fast -growing field, which is now moving from old Neuropsychology towards new advancements in Cognitive Neurosciences.

The Present Special Issue of IJCP on Neuropsychology is an effort to rethink and rejuvenate our efforts in the field, by evaluating our current position and preparation towards future endeavours to be able to withstand the advancements in the field which are taking place at global level. There is an increasing interest in the younger generation to take up the studies in the field of Neuropsychology and Cognitive Neurosciences, as these are the promises for future with the increasing demands in the fields beyond Clinical Psychology, like in Forensics, Electronics and Computers, AI, and many more.

The current issue includes an Invited article from Prof. S P K Jena, on the future advancements. It also includes original and review articles from various senior as well as younger researchers from the field. There is also an effort to acknowledge the work of Prof. C R Mukundan, who is a legendary figure in the field of Neuropsychology and practically started it in India, through a letter to editor.

I am thankful to the Hon. Chief Editor of IJCP, entire Journal team, and also to the EC of Indian Association of Clinical Psychologists for providing me the opportunity to serve as Guest Editor for this special issue. I also acknowledge the help provided by my colleagues at IHBAS, the reviewers, and Dr. Manoj Kumar Bajaj for helping me in bringing this issue out in the final printable form. I am also thankful to the publishing team. I hope I have been able to do justice with this special issue in a very short time allotted to me. I still would like to put forth my apologies in advance for any inadvertent errors on my part. Lastly, thanks to Almighty God and my teacher Prof. S P Sinha for guiding me towards the field during my initial career.

Vibha Sharma

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Invited Research Article

Brain-Computer Interface in Neuropsychological Rehabilitation

S. P. K. Jena[1]

ABSTRACT

Brain-computer interface (BCI) is a new frontier of neuropsychological rehabilitation. Neuroscientists have long visualized the possibility of using brain signals to control artificial devices. There are promises as well as challenges involved in it. The present article examines the concept of BCI through its function-based classification and its various operational paradigms such as P300, steady state evoked potentials, sensorimotor rhythms, and slow cortical potentials, which are used as means of BCI. In this context, Hebb's theorem of long-term potentiation (LTP) was discussed to explain the mechanism of behaviour change. While describing the stages of signal acquisition, this article describes procedures for artifact reduction. It provides a kaleidoscopic view evidence-based practice of BCIs various clinical conditions, with hope that in coming years BCI will provide new avenues of applied research and insight for neuropsychological intervention.

Keywords *Brain-Computer Interface, P300, Steady State Evoked Potential, Sensorimotor Rhythm, Slow Cortical Potentials, Long-Term Potentiation*

INTRODUCTION

Brain is an immensely complex, self-organizing and self-modifying 'super organ', that has always remained an enigma. Its learning, memory and categorization capabilities make it possible to self-recruit the sensory and motor systems to identify patterns and features in the real world, which in turn, helps it in modeling and modifying the external world for its best use. Its capability to directly alter its own circuitry and neural activity even offers promises for treatment of brain damage. However, this capacity for self-recovery (plasticity) is limited. Therefore, the existing functions need to be augmented through assistive technology—neuroprosthesis, the devices, which are linked to the peripheral or central nervous system to enhance the cognitive, motor or sensory abilities (Medical Dictionary, 2009). In a broader sense, such devices—most often computers, used for restoring and enhancing the functions lost due to brain damage is called the brain-computer interface (BCI). Vidal coined this term in 1973 describing it as "utilization of the brain signals in a man-computer dialogue" (Vidal, 1973). BCI is primarily a communication system in which an individual sends messages or commands to the external world without passing through the brain's normal output pathways of peripheral nerves and muscles (Wolpaw et al, 2002). The CBI system uses devices that enable their users to interact with computers and machines by using brain activity (Nam, Nijholt, & Lotte, 2018). Nicolelis (2001) predicted that real-time interfaces between the brain and electronic and mechanical devices could one day be used to restore human sensory and motor functions. The present article attempts to track some of the significant developments in the field that has created convergences in closer inter- and cross-disciplinary approach and expanded the field of neuroscience enormously.

The earliest development of BCI came with Hans Berger's path-breaking discovery of electroencephalogram (Berger, 1929), which translated the brain signals into electrical signals to study cognitive functions and their neural correlates. The technology opened floodgates for research and applications. Joseph Kamiya (1968) on the other hand used alpha waves in neurofeedback training and demonstrated that human action can control the brain waves such as alpha is possible by receiving real time feedback, based on the principle of operant learning. Another remarkable innovation was Farwell and Donchin's (1988) 'P300 Speller' a form of mental prosthesis, based on event-related potential (ERP). It was a 6 x 6 grid of letters and digits, from which the user can select letters as well as digits to spell. It became possible to detect and predict which row and which column contains the letter that the user would select to spell. Although, designed for healthy users, could be used successfully for people with brain injury. Childers and associates (1989) developed a 'cortical mouse', based on event-related potentials, which enabled the user to select one command among the two. This was based on the N400 response to a congruent or incongruent stimulus sentence (Konger et al. 1990, Principe, 2013). Thereafter, researchers developed BCI-based parameters such as sensorimotor rhythms (SMR) (Wolpaw et al. 1991). Since end of the last century there has been a bloom of research in the field, as a result of which BCI has become a distinct field itself. For comprehensive and detailed review of the historical development, readers may refer to Nam, Nijholt, & Lotte, (2018).

Types and Paradigms of BCI

The BCIs are classified under three different categories (Zander, et al, 2008): active, reactive and passive. *Active BCIs* are based on brain electrical patterns of activities, identified in terms of specific frequency bands at a

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specific electrode location. The user actively generates the electrical changes by use of limbs movements or through cognitive performance (e.g. mental arithmetic, speech imagery, visualization or mental rotation). *Reactive BCIs* are the brain responses to certain stimuli (cues that the user uses and the ones he/she ignores). Apart from discrimination and feature detection, it also reveals the emotional state of the individual user such as frustration, attention, workload, and drowsiness. which are measured through event-related potentials (ERPs) of Steady State Evoked Potentials (SSEP). The third group, *Passive BCIs* use information about the user's cognitive or emotional states as neural correlates of cognitive and affective states in order to improve performance. These are further explained through its paradigms.

Few paradigms of research have been discusses in the next section, which focuses on some of the major paradigms of BCI.

P300 based BCI Paradigm

P300 is a positive deflection in human event-related potential (ERP), most commonly elicited by "oddball" paradigm in which an occasional "target" stimulus appears in a regular train of standard stimuli. The peak P300 is generally seen in adults while making a simple discrimination at 300 ms. and its amplitude varies with the chance of occurrence of a target (infrequent) stimulus, whereas the latency varies with difficulty in distinguishing a target stimulus from the standard ones (i. e simple discrimination). People, with decreased cognitive abilities (as in epilepsy) tend to have smaller and later waves than in age-matched normal participants. It reflects the amount of attentional resources allocated to a task as well as degree of information processing of an individual. Although the origin and role of P300 is not adequately understood, the wave is expected to occur only if an individual is actively engaged in detecting the target. It is generated naturally without any conscious effort in response to target trial, therefore, unlike many rhythm-based neurofeedback tools, the ability to control the proposed P300-based neurofeedback training is obtained after a short calibration, without undergoing tedious trial and error sessions. This can be the basis for input for performance-enhancing assistive devices for patients suffering from brain damage or impaired neurological functioning for improving their quality of life (Arvaneh, Robertson, & Ward, 2019).

Steady State Visual Evoked Potentials (SSVEP) based BCI Paradigm VEPs are elicited by changes in the visual field, which are strongly generated in the occipital area of the brain and there are two types of visual evoked VEPs: Steady State Visual Evoked Potential (SSVEP) and Transient State Visual Evoked Potential (TSVEP). The former is elicited by the change in the visual field, which is higher than 6 Hz (Wu, He & Tian, 2012) and the later is lower than 6 Hz, and can be caused by events such as visual stimulus applied to the subject via a computer screen. 'Steady state' is vibratory in nature. When a participant is presented with a steady state stimulus (visual, auditory or vibrotactile), rhythmic brain activity associated with cortical areas will be generated similar to the frequency of the stimuli. Currently, the most popular one is Steady-State Visual Evoked Potentials (SSVEP) in BCI operations. This is elicited by visual stimuli, whereas, auditory stimuli elicit Steady-State Auditory Evoked Potentials (SSAEPs)(Hill, et al. 2012). These evoke potential are useful for training patients suffering from brain damage that affects their communication significantly and those who are in 'lock-in' condition.

Sensorimotor Rhythms (SMR) Paradigm

SMR the rhythm is typically picked up from sensorimotor part of the cortex, notably, the Mu band or Mu rhythm (~7-13 Hz, alpha band) mostly picked up at sensorimotor part of the cortex (somatosensory and motor cortices) and also the Beta band 14-30 Hz). The participants are trained to control the amplitude of the SMR, so that they can self-regulate in order to activate an assistive device (e.g. 1D cursor). These wave patterns may change due to either actual or imagined movements, which create event related desynchronization (ERD) i. e increase in the frequency band amplitude immediately in the sensorimotor area (Graimann et al. 2010). The event-related synchronization (ERS) is significant for BCI studies on patients who have neurological disorders affecting motor co-ordination. Pfurtscheller, Flotzinger, and Kalcher (1993) developed an imagery-based BCI in which the user had to explicitly imagine left- or right-hand movements. The SMR generated from this motor imagination was translated into command for a computer by using machine learning that focuses on the use of data and algorithm to improve its own performance, which is similar to human learning that improves gradually by accuracy. It allows making accurate prediction of the outcomes. Tariq and his associates (Tariq, et al., 2018) studied the use of SMR for improving the gait disturbance of people suffering from spinal cord injuries (SCI) and found that the action imageries obtained through SMR could improve the functioning of an individual. In other words BCI could be used to build new communication channel between the brain and other output devices.

Slow Cortical Potentials (SCP) Paradigm

Slow Cortical Potentials (SCP) is the third type of paradigm, which refers to very slow shifts in electrical activity of the brain lasting from several milliseconds to several seconds. SCP takes anywhere from 1 second to several seconds to develop. It suggests that the information transfer rate is quite slow compared to

SSVEP and visual P300. A change of the direction of negative polarity is associated with increased cortical activity or movement and a change in the positive polarity is associated with decreased cortical activity and calm (Nam, Choi, Wadeson, & Whang, 2018). These changes in neural activity are assumed to be related with excitability of the neural network that is linked with mental functioning such as executive functions, especially attention (Banaschewski and Brandeis, 2007, Calderone et al., 2014). These negative or positive polarizations, can be externally triggered or self-induced. The amplitude of this low frequency variation of can be voluntarily increased or decreased through neurofeedback training. For instance, among the neurofeedback protocols applied for Attention Deficit-Hyperactivity, SCP-training is considered as the best validated approach (Mayer et al, 2013). SCPs have moderating impact on information processing. This has been demonstrated in a number of studies (e.g. Bauer & Nirnberger, 1981; Birbaumer, et al., 1992; Schupp et al. 1994). Similar to SMR BCIs, SCP BCIs do not rely on external stimuli, such as visual stimuli of SSVEP in order to generate brain wave patterns. Instead of which users control their thought processes in order to interact with BCI. SCPs are generally analysed through Thought Translation. It can select one group of commands or another to increase or decrease the SCP. All the above paradigms of BCI heavily rely on the principles of operant conditioning. Extensive and intensive training is required using individualized cognitive and behavioural strategies (Studer et al., 2014).

Hwang et al. (2013), who conducted a survey of the neurotechnologies used for BCI studies, reported that, according to the published work during 2007-11, EEGs (i. e. P300, SSVEP, SMR) are the most commonly used BCI technologies. At least 68% research articles are based on these technologies, followed by invasive technologies (32%), IMRI (3%), Functional Near Infrared Spectroscopy (fNIRS) (3%) and MEG (2%).

CBI and Neuroplasticity

Neuroplasticity refers to capacity of the brain to self (re) organize after trauma or environmental changes (Gross-Wentru et al. 2011). This innate capacity makes BCIs successful in restoration of brain function. CBI is now designed for neuromdulation that induces plasticity in neural structures. It is suggested that experience–dependent activation of two or more converging inputs strengthens the connectivity of neurons, whereas the connectivity is weakened by uncorrelated activities due to "neural pruning".

In this context, it is important to understand Hebb's theorem of long-term potentiation (LTP), the cellular mechanism for memory and learning storage. Hebb (1949) suggested that relearning motor tasks because of motor impairments requires correlated activation of neural cells. Accordingly, relearning of motor tasks in people suffering from motor impairment requires correlated activation of neural cells. Other investigators have extensively investigated this. For instance in one of the *in vitro* experiments this was observed following stimulation of the prefrontal path. LTP was observed in dentate area of the anesthetized rabbit (Bliss & Lomo, 1973). This phenomenon has been extensively studied in hippocampus of rats. The *mu* rhythm changes are quantified in terms of event-related. However, Stefan and colleagues (Stefan, et al., 2000) provided the first proof of LPT-like plasticity in a human experiment. Although LPT is dependent on the extent of brain damage, these observations suggest that BCI designed for neuromodulation, based on known theories of memory storage and learning can benefit the patients who have lost certain adaptive functions due to brain damage.

Stages in BCI

In the previous section, I discussed the most widely used parameters of signals used for BCI. There is always a need for improving signal quality and extract important features. Therefore, the computers have to be designed in a manner to accurately detect and amplify the signals in order to make them perceptible for the user.

There are several stages of implementation of BCI for securing high level of competence, which starts with recording, designing and application in real settings. It involves various stages of processing for effective use in neuropsychological rehabilitation, such as signal acquisition, improving signal quality, feature extraction, classification and application

The raw signals picked up from the targeted cites of the body (e.g. scalp, brain, skin or muscles) whether invasive or non-invasive are inherently "noisy" or contaminated with "artifacts", which could be endogenous (e.g. eye blink, heart rate, sweating, bodily movements) or exogenous (e. g. power line interference, affecting flow of the current, poor impedance due to electrode contact and electrode drift). A notch filter is applied at 50 Hz to 60 Hz to remove artifacts due to power line data from the incoming signals (Nam, Choi, Wadeson, & Whang, 2018). A good number of artifacts are reduced manually just by organizing the setting by giving appropriate instruction to the participant and others by use of technology. For instance the eye blink, heart rate have certain patterns of electrical activity, which goes unnoticed, and contaminating the data. High correlation of these biosignals (e.g. ECG, EOG, or EMG) with the index signals (e.g. EEG or ERP) reveals the extent of data contamination. Statistical analyses and visual monitoring are used to overcome irrelevant signals from issues with EEG cap. Under circumstance, when the correlation between these sources and the EEG is still high the data is not considered for controlling BCI. Spatial filtering is conducted in order to enhance the

sensitivity to a particular cite (brain sources) from which the data is acquired. It improves source localization and suppresses certain artifacts (Krusienski, et al. 2012). Referencing of one of the principal measures of spatial filtering and the simplest measure of bipolar reference, which is a measure of difference between two electrodes placed anteriorly, posteriorly, to left or right of the target position. Spatial filtering can be derived from user's data using statistical methods such as principal component analysis (PCA), independent component analysis (ICA) and common spatial pattern (Nam, Choi, Wadeson, & Whang, 2018). Apart from amplification and filtering original signals there is a need for performing analog to digital conversion to facilitate further processing and storage of data, which is often programmed with the computer.

In order to understand the acquired data in terms of their functionality, the data features are classified according to the nature of activation. For instance, Hidden Markov Model is being used extensively to classify EEG-based BCIs (see Cincotti et al. 2003). Other feature classifiers include, linear classifiers, and artificial neural network classifiers. These classifiers aim at determining the user's intention by extracted brain features.

Application

If EEG and ERP can be obtained reliably in real-time, it is logical to ask how to make use of it in neuropsychological intervention? While the technology has generated considerable interest as a potential tool for rehabilitation, there are critical questions too about which signal to be used in which context or training paradigms.

Neurofeedback

(a) Neurofeedback involves providing feedback in the form of some visual or auditory stimulus, based on some predetermined EEG feature (Micouland-Franchi et al. 2015) and normalize the EEG. This has been used successful treatment in wide range of behaviours including mental health problems, such as treatment resistant obsessive-compulsive disorder (Mantione, et al, 2010), intractable major depression (Mayberg et al., 2005) and other mood disorders (Downar, & Daskalaakis, 2013), anorexia nervosa, (Lipsman, et al., 2013), learning disability (Kaushik, & Jena, 2022); autism (Friedrich et al., 2015), attention-deficit /hyperactivity disorder (ADHD) (Lubar & Shouse, 1976), depression (Hammond, 2005). This is also used extensively in the filed of disability such as sound perception (Eisen, 2003), word recognition (Henkel, 2013), word recognition (McGee, 1965) in deaf, cognitive restoration and augmentation (Serruya, & Kahana, 2008), and substance use disorder (Trudeau, 2005). In neurorehabilitation, epilepsy is one such condition where this is used effectively in many cases who simply do not benefit from anti-epileptic drugs. They have distinct pattern of neurological activity associated with the initiation and establishment of seizure attacks. Recently, few labs have introduced automatic seizure-production algorithms that can be applied to intracranial and scalp recording to forecast the occurrence of seizures.

Imagery Enhancement

Imagery-based BCI helps in use of mental imagery, and the purpose being reinforcing mental imagery in order to enhance performance of the individual client. A majority of researches have been conducted in this area of restoration of motor control. The fundamental parameters of motor control emerge by collective activation of population of motor neurons in primary motor cortex (M1). These neurons are broadly turned to the direction of force required to generate a reaching arm movement (Georgopoulos, Schwartz, & Kettner, 1986). Even if these neurons fire maximally, before the onset and execution and of the arm of a movement (activity). They also fire significantly before the movement in broad ranges of other directions. It suggests that one can design algorithms capable of extracting motor control signals from these ensembles, for their clinical use. Hundreds and thousands of people suffer from motor impairment in which intact movement-related areas of the brain cannot generate movement because of damage to the spinal cord, nerves and nerves to the muscles. They can benefit from BCI-based muscle activation.

Close Sensorimotor Loop

The ability to learn, adapt, and refine motor skills are the key features of sensorimotor control. Cognitive control employs cognitive processes such as prediction, learning and multisensory integration. The neural processes behind these cognitive processes even in one of the simplest acts like arm reaching, is quite intricate. The action involves a nonlinear dynamics and multiple modalities. A BCI is a well-defined sensorimotor loop with key simplifying advantages that address each of these challenges, while engaging similar cognitive processes. As a result, it is becoming recognized as a powerful tool for basic scientific studies of sensorimotor control (Golub, Chase, Batista, & Yu, 2016).

The key aspect of this approach is re-establishing the disrupted sensorimotor feedback loop. This is about determining the intended movement using a BCI and helping the individual with impaired motor function (Gomez-Rodriguez, et al., 2010). This is a valuable tool for neuro-rehabilitation and has been used in cases with severe hemiparetic syndromes due to stroke (crebrovacular brain damage) and other conditions. Haptic feedback helps to improve motor coordination.

Close sensorimotor loop is also used in the context of control of orthosis. The purpose was to associate intention with haptic feedback control of orthosis. Badakva and associates (2016) suggested that BCIs have to be based on bidirectional system involving tactile, proprioceptive and other useful feedback.

Neuroergonomics

A key aspect of this approach is re-establishing the disrupted sensorimotor feedback loop, i.e., determining the intended movement using a BCI and helping a human with impaired motor function to move the arm using a robot.

Neuroergonomics applications

BCI also has a neuroergonomics applications, that is use of brain signals to control external devices without need for motor output. Neuronal ensemble control of prosthetic devices by patients, in other words called 'neuromotor prostheses' (NMPs) is a challenging area. The aim is to replace or restore motor functions in paralyzed patients. This is made possible by routing movement-related signals from brain, around damaged areas of the neural systems, to external affectors (Hochberg, 2006). This would help individuals who have limited or no need for motor output, as in case of 'locked-in' patients who are confined to their beds with amyotrophic lateral sclerosis (ALS) who have virtually no motor control (Kramer, & Parasuraman, 2007). Noninvasive BCIs have been used successfully with a wide range of clinical population such as chronic pin (Coffey, 2001), Ischemic stroke (Bearden et al., 2003; Buttaro, 2012), Tourette's syndrome (Kaido et al, 2011; Wardell, et al., 2015), hypertension (Das, 2010).

CONCLUSION

To sum up, undoubtedly, the field of BCI is expanding rapidly and the achievements are remarkable. Looking at the advances in neuroscience, we expect that, could one day we shall allow our patients to use their brain activity to control sophisticated electronic, mechanical and even virtual devices to their fullest extent? Although, this has remained a very distant dream, the success stories are many. There is accumulating evidence that BCI has been quite useful with patients suffering from a wide range of neurological, psychological and behavioural disorders. In recent years, sensitivity of the instruments used for this purpose have been remarkably enhanced, making them more sophisticated and sensitive to neural activity in the brain. For instance, when repeated or continuous monitoring of brain activity obtained from surface scalp electrodes, it is found to be contaminated with increased artifacts due to muscle and electronic artifacts, therefore now subdermal electrodes are used as non-invasive alternatives, particularly for low frequency waves (8-30 Hz) (Smith, Olson, Darvas, & Rao, 1928). There has been revolutionary change in biomedical engineering, particularly in acquisition, classification and processing of neural signals. In view of these developments, now BCIs can facilitate much more natural, seamless and intuitive interaction. This has opened up several modalities including Virtual Reality (VR) and Augmented Reality (AR) to explore its use further.

However, there are still methodological questions. The researches are plagued with methodological issues such as small sample size, unavailability of control group, and lack up long-term generalization beyond the hospital settings (very few follow-up studies). Randomized control designs considered as 'gold standards' of intervention research, are rare to find. Unlike pharmacological studies on drugs, the process of research is slow. Some of these difficulties are due to the cost of the instrument, training time and other logistic issues. Future searchers should look into these limitations of methods and improvisation of the technology in use.

While conceptualizing the complex movements of a classical dancer or a gymnast, we always admire the amazing co-ordination that results in such exquisite accomplishment. Can this again happen to a performer paralyzed by traumatic brain injury? Although the question is too difficult to answer at the moment, possibilities and promises of BCI are immense.

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Original Research Article

Clinical Factors as Predictors of Neuropsychological Dysfunctions in Obsessive Compulsive Disorder

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ABSTRACT

The aim of the study was to determine the clinical factors such as medication, duration, compliance, severity of illness, co-morbidity, onset, insight, family history, subtypes of OCD predictors of neuropsychological dysfunctions in persons with obsessive compulsive disorder. **Material and Methods:** An exploratory, single group and cross-sectional design was employed. Participants were selected consecutively from the outpatient department of psychiatry of a tertiary care government hospital from north region of India. Total 32 participants diagnosed as OCD as per WHO ICD-10 DCR criteria, educated minimum 10th class, of any gender, between age of onset 15 years to 55 years with minimum illness duration of 3 months were recruited. Participants those who have co-morbidity of any other psychiatric, neurological and physical/ medical illness, history of long term cognitive retraining were excluded except mental and behavioural disorder due to use of tobacco, and secondary depression due to OCD. A brief face to face interview was conducted to record the clinical profile of OCD like name of medication, doses of medicine, time, response to treatment, duration of illness,, onset, subtype of OCD, co-morbidity, course, severity of illness (OCD), level of depression, insight and family history of psychiatry illness or other. Further, Yale – Brown Obsessive Compulsive Scale (Y – BOCS) and Symptom Checklist; Hamilton Rating Scale for Depression (HAM–D); Medication Compliance Scale; Medication Adherence Rating Scale (MARS); Clinician Rating Scale (CRS). Subtests of Mental speed, Attention, Memory, Executive functions from NIMHANS Neuropsychological Battery for Adults-2004 were administered. **Results:** Severity of depression and onset of illness were significant predictors of mental speed. Insight was significant predictor of sustained, focused attention and set shifting. Co-morbidity was also significant predictor for set shifting. Medicine type was significant predictor for verbal fluency. Severity of illness, family history and response of treatment were significant predictor of working memory. **Conclusions:** Clinical Factors plays an important role in the development or maintenance of the neuropsychological dysfunctions in OCD, therefore management of OCD requires understanding for the clinical factors contributing to Neuropsychological dysfunctions, so that these can be prevented or managed simultaneously with cognitive retraining.

Key Words: *Obsessive Compulsive disorder, Clinical Factors, Neuropsychological Dysfunctions, Predictors*

INTRODUCTION

With a lifetime prevalence of between 2 and 3% in the general population, obsessive-compulsive disorder (OCD), which consists of obsessions and compulsions, is the fourth most prevalent psychological disorder. Patients with OCD experience frequent anxiety attacks and disability as a result of their repetitive thoughts and actions (Rauda et al., 2010). OCD symptoms are often associated with marked impairment of neuropsychological function. Depressive symptoms and Disorder are common clinical features of OCD (Catapano et al., 2001), which affects the neuropsychological functioning in OCD. Several studies examined the effects of clinical factors on neuropsychological impairments in OCD patients. Individual with OCD have been found to feel difficulties in inhibiting tasks of motor and cognition, attention shifting, executive functioning and memory. Inconsiistent neuropsychological dysfunctions may be due to the socio demographic and clinical factors and the available data is conflicting (Shin et al., 2014). The recent neuropsychological studies of OCD have found a close relationship between neuropsychological functions, Clinical factors and brain functions. Neuroimaging studies using PET, SPECT or fMRI have identified abnormally in the brain (Nakao et al., 2014).

Findings suggest that attention processes might be differentially impaired in sub-types of OCD with relevance to the age at onset (Hashimoto et al., 2011, Overbeek, et al., 2002).

Executive function performance difficulties seen in patients with OCD in other cognitive domains ((Nelson et al., 1993; Abbruzzese et al., 1995; Veale et al., 1996). Deficits in visual constructional area (Irle et al., 1990; Lawrence et al., 2000) and correlation between OCD and spatial working memory dysfunction have been found (Hashimoto et al., 2011). Memory for

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actions is better reported by the OCD patients in a Meta analysis by Woods et al., (2002) demonstrated memory deficit in recall but not in recognition of verbal materials. Recall is impaired on complex figure test of visual memory (Lezak et al., 2004).

It is evident from the review of literature that neuropsychological dysfunctions exists in obsessive compulsive disorder in attention, verbal fluency and category fluency, visual memory and working memory, set shifting, response inhibition, and verbal and learning memory. In, many of the studies, relationship between neuropsychological functions and clinical factors such as medication and other clinical variables had significantly affected the cognitive functioning in individuals with OCD, whereas in several other studies the relationship between clinical factors and cognitive functions has not been significantly related. So, present investigation is an attempt to confirm the impact of clinical factors on neuropsychological functioning in persons with OCD. The impact of clinical factors on neuropsychological functioning in OCD patients is being less studied in India. There are no consistent findings that clinical factors influence the neuropsychological functioning in OCD; therefore it needs to be further clarifying and confirm the contribution of various clinical factors can predict in the progression and development of neuropsychological dysfunctions.

The aim of the study was to determine the clinical factors such as medication, duration, compliance, severity of illness, co-morbidity, onset, insight, family history, subtypes of OCD predictors of neuropsychological dysfunctions in persons with obsessive compulsive disorder.

Material and Methods: An exploratory, single group and cross-sectional design was employed. Participants were selected consecutively from the outpatient department of psychiatry of a tertiary care government hospital from north region of India. Total 32 participants diagnosed as OCD as per WHO ICD-10 DCR criteria, educated minimum 10^{th} class, of any gender, between age of onset 15 years to 55 years with minimum illness duration of 3 months. Participants those who have co-morbidity of any other psychiatric, neurological and physical/ medical illness, history of long term cognitive retraining were excluded except mental and behavioural disorder due to use of tobacco, and secondary depression due to OCD.

The recruited participants were interviewed for the socio-demographics & clinical details on specifically developed socio demographic and Clinical Performa sheet. A semi structured Performa developed for the purpose of present study. It contains information about socio – demographic variable like age, sex, education, occupation, marital status, address & contact, total monthly income and social class. A brief face to face interview was conducted to record the clinical profile of OCD like name of medication, doses of medicine, time, response to treatment, duration of illness,, onset, subtype of OCD, co-morbidity, course, severity of illness (OCD), level of depression, insight and family history of psychiatry illness or other. Further, Yale – Brown Obsessive Compulsive Scale (Y – BOCS) and Symptom Checklist; Hamilton Rating Scale for Depression (HAM – D); Medication Compliance Scale; Medication Adherence Rating Scale (MARS); Clinician Rating Scale (CRS); Subtests of NIMHANS Neuropsychological Battery: Mental Speed by Digit symbol Substitution test (DSST); Attention by Color Trails Test (D' Elia, 1996); Digit Vigilance Test (DVT) (Lezak, 1995). Verbal Fluency by Controlled Oral World Association Test (COWA) (Benton & Hamsher, 1989), Category Fluency by Animal Names test (Lezak,1995). Executive Functioning was assessed using N- Back test (Smith & Jonides, 1999), Wisconsin Card Sorting Tests (Milner, 1963) and Stroop test, (Alexander, Benson & Struss, 1989). Memory: Rey's Auditory Verbal Learning test (Schmidt, 1996), Rey Complex Figure Test (Lezak, 1995) were administered.

The participants in the present study were referred by psychiatry consultants with the primary diagnosis of OCD as per ICD 10 DCR criteria to the investigator. A total no. of 84 patients with OCD was referred by the expert psychiatrists in the OPD. Then the investigator interviewed the patient to screen the patient for the suitability of the present study on the basis of exclusion or inclusion criteria specified for the study. After screening and informed consent a total of 32 participants were recruited in the study. The rest 52 patient were excluded because of various reasons. The majority of patients (n = 15) were referred back as they were not fulfilling the inclusion and exclusion criteria. Twelve patients have not given consent, and 12 patients were having a history of co morbid psychiatric illness. Thirteen participants met the criteria of the present study but did not come on appointment hence considered as dropout of the study.

Finally (n = 32) patients comprised the sample of the study. Socio-demographic and clinical details were recorded with the help of socio-demographic and clinical datasheet. Thereafter tools were administered. No interference was done by the investigator in treatment and no advice was provided regarding the treatment. These cases were referred back to respective consultant after data collection. Data collected from the assessment was scored according to the standardized manual. The assessment procedure with each individual took about 3 to 4 hours. The obtained data was entered into SPSS for statistical analysis. Background

information was explained using descriptive statistics technique, frequency/ percentage for the participants with the help of Statistical Package for Social Science (SPSS) version 22. Pearson's correlation and regression analysis method used in the current study. Pearson correlation used for the knowing relationship between the clinical factors and neuropsychological functions of the participants. The linear regression analysis was computed to predict the actual contribution of specific clinical factors in Neuropsychological dysfunction in participants with OCD.

RESULTS

Table 1 Socio-demographic details of participant

Variable	Frequency (Percentage)
Gender	
Male	23(71.9%)
Female	9 (28.1%)
Education	
Matric	3(9.4%)
Inter / Diploma	6(18.8%)
Graduate	17(53.1%)
Postgraduate	6 (18.8%)
Marital Status	
Single	19 (59.4%)
Married	13 (40.6%)
Occupation	
Professional	1 (3.1%)
Clerical/ Shop- Owner/ Farmer	6 (18.8%)
Skilled / semi skilled	4 (12.5%)
Housewife	6 (18.8%)
Unemployed/ student	15 (46.9%)
Social Class	
Lower class	8 (25%)
Lower middle class	11 (34.4%)
Upper middle class	8 (25%)
Upper class	5 (15.6%)

Table 2 Clinical factors of persons with obsessive compulsive disorder

Variable	Frequency (Percentage)
Onset	
Within 3 months	10 (31.3%)
Stable on treatment for around 6 months	22 (68.8%)
Course	
Episodic	1 (3.1%)
Continuous	14 (43.8%)
Deteriorating	2 (6.3%)
Fluctuating	3 (9.4%)
Static	1 (3.1%)
Improving	9 (28.1%)
Remission	2 (6.3%)
Sub type of OCD	
Predominantly Obsession thoughts	15(46.9%)
Predominantly compulsive acts	9 (28.1%)
Mixed Obsession thoughts and acts	8 (25%)
Co morbidity	
OCD with depression	24 (75%)
OCD without depression	8 (25%)
Severity of illness	
Mild	11(34.4%)
Moderate	11(34.4%)
Severe	8 (25%)
Extreme	2 (6.2%)
Severity of depression	
Normal	7 (21.9%)
Mild depression	5 (15.6%)
Moderate depression	11(34.4%)
Severe depression	6 (18.8%)
Extreme	3 (9.4%)
Insight	
Good insight	12(37.5%)
Fair insight	20 (62.5%)
Family History	
Similar illness	7 (21.9%)
Other illness	3 (9.4%)
No	22 (68.8%)
Name of Medicine	
Fluoxetine plus Lonazep / Etirest / Etizolam	6 (18.8%)
Sertaline plus Olenzapine / Respridone	3 (9.4%)
Fluoxetine only	5 (15.6%)
Clofrnafil plus Paxidep	8 (25%)
Fluoxetine plus Clofrnail	4 (12.5%)
Dose of Medicine	
Fluoxetine plus Lonazep / Etirest / Etizolam	6 (18.8%)
Sertaline plus Olenzapine / Respridone	3 (9.4%)
Fluoxetine only	5 (15.6%)
Clofrnafil plus Paxidep	8 (25%)
Fluoxetine plus Clofrnail	4 (12.5%)
Response of treatment	
Good	7 (21.9%)

Average	17 (53.1%)
Poor	8 (25.1%)

Table 3 Clinical factors as predictors and neuropsychological functions of the OCD

Clinical factors as Predictors	Cognitive Functions	Beta value	Significant
Severity of depression	Mental Speed	.371	.024*
Onset	Sustained Attention	.440	.011*
Insight		-.397	.020*
Response of treatment		.345	.042*
Insight	Focused Attention	.394	.026*
Name of medicine	Verbal Fluency	.351	.049*
Severity of illness	Working Memory	.387	.010**
Family History		-.306	.038*
Response of treatment		-.534	.000**
Insight	Set Shifting	.383	.031*
Co morbidity		.373	.036*

Significance: * P < 0.05, ** P < 0.01

DISCUSSION

The present study was conducted with the aim to determine the clinical factors such as medication, duration, compliance, severity of illness, co-morbidity, onset, insight, family history, subtypes of OCD predictors of neuropsychological dysfunctions in persons with obsessive compulsive disorder. Measurement of neuropsychological functions provides an intermediate or middle path between clinical assessment and highly sophisticated functional imaging studies.

Description of the socio demographic details is presented in Table 1. Majority of the patient were male, single and belong to lower middle background population and all participants were educated. The clinical factors showed in table 2, majority of OCD patients onset of illness was stable on treatment around 6 months; course was continuous; predominantly obsession thoughts and co morbidity with depression. The maximum of OCD patient had fair insight and no family history. The severity of illness on Y – BOCS were mild. The more frequently medicine, i.e, Fluoxtenine used or without with other combination of anti-anxiety or antidepressants. Overall response to the treatment in patients was average.

Result table 3 depicting the significance of clinical factors in neuropsychological dysfunction of the OCD patient. Severity of depression and onset of illness were significant predictors of mental speed. Insight was significant predictor of sustained, focused attention and set shifting. Co-morbidity was also significant predictor for set shifting. Medicine type was significant predictor for verbal fluency. Severity of illness, family history and response of treatment were significant predictor of working memory.

The findings in this present study indicative of the significance of clinical factors in the development of neuropsychological dysfunctions in patients with OCD. Findings of this study are consistent with the findings of previous researches. Further, findings of current study are discussed in the following headings:

Onset

Onset of illness was classified into two categories to recruit the participants in the study to have the new onset patients one was within 3 months the other was stable on treatment for 6 months. Onset was significantly positively correlated with the scores of mental speed, sustained and focused attention, stroop effect and learning across trial 5. The findings revealed that onset of illness increases as well as impairment of mental speed and delayed information processing, difficulty to maintaining their attention on particular tasks for long period of time, easily distractible, unable to change of perceptual set from one stimulus to other stimulus as per environmental demands and inability to encoding of the new information also increases in OCD patients. The findings also revealed that Onset was also significant predictors in contribution of the neuropsychological dysfunction in OCD patients. These findings were similar to earlier researches. Christensen et al (1992) and Purcell et al (1998) mentioned that OCD patients slowest on motor initiation and speed tasks.

Course

Course of illness was classified into seven categories: episodic, continuous, deteriorating, fluctuating, static, improving and remission respectively. Course of illness are not significantly correlated with the other neuropsychological functions. The previous researches have not examined the relationship between course of the illness and neuropsychological functioning of the OCD patients.

Sub type of OCD

In the present study, sub type of OCD was classified into three categories: predominantly obsessional thoughts, predominantly compulsive acts and mixed obsessional thoughts and acts according to the classification of ICD – 10. There was no significantly relationship between the sub type of OCD and cognitive functioning. In contradictory, the previous studies were not classified the OCD according to ICD -10. They are taking the sample of OCD patients as per diagnosis of

DSM – IV TR. Hartston and Swerdlow et al, reported in their studies that OCD aggressions obsessions or checking had more greater interference effect.

Co morbidity

In the present study, co morbidity of OCD was classified into two categories: OCD with depression and OCD without depression. Co morbidity was statistically negatively correlated with the score of mental speed, sustained attention and failure to maintain set (set shifting) and statistically positively correlated with the score of no. of categories completed (set shifting). Finding are similar to that reported by Christensen et al. (1992) that slow motor performance and information processing in OCD patients who had co morbid depressive psychopathology.

Duration of illness

There was no significant relationship between duration of illness and neuropsychological functioning of the OCD patients in the present study. The previous researches were not examined the relationship between duration of the illness and neuropsychological functioning of the OCD patients.

Severity of illness

In the present study, severity of illness was assessed through Y – BOCS. Severity of illness was negatively correlated with category fluency (animal name test). Severity of illness was the significant predictor in cognitive dysfunction of the OCD. This finding was contradictory of earlier researches. Schmidtke et al.,(1998) reported in their studies that OCD patient were impaired on fluency test but impairment not related to severity of OCD symptoms.

Severity of depression

Severity of depression was assessed through Hamilton Depression rating scales. Severity of depression was statistically positively correlated with the score of mental speed and sustained attention. It is an important significant predictor in development and progression of neurocognitive dysfunction of the OCD patient. OCD patients continued to show significant impairments in mental speed and sustained attention. This finding are similar to that reported by Christensen et al who reported slow motor performance and information processing in OCD patients who had co morbid depressive psychopathology.

Insight

Insight was assessed through Y – BOCS on 11^{th} item. The majority of OCD patient had good or fair insight due to regular compliance of medicine and therapeutic interventions. There was significantly positively correlated insight among focused attention, no. of preservative responses and no. of categories completed in set shifting, and stroop effect. Insight is significant predictors in cognitive dysfunction. It indicates that the OCD patients had inability to organize the things and more interference effect.

Family History

In the present study, Family history was classified into three categories: similar illness; other psychiatric illness or no illness. Family history was negatively correlated with mental speed, and focused attention.

Name and dose of medicine

In the present study, Name and dose of medicine were positively correlated with the score of controlled oral word association test. Name of medicine were significant predictor in the dysfunction of verbal fluency.

Response of treatment

In the present study, response of treatment was negatively correlated with the score of sustained attention, and working memory. Response of treatment was significant predictor for the neuropsychological dysfunctions.

CONCLUSION

Overall findings of the study suggest that patient with OCD showed impairment in information processing, slow motor performance, easily distract by the external stimulus, inability to maintained and sustaining attention for a long period of time due to may be anxious state, inability to attending and encoding of the new information, cognitive inflexibility, inability to change the responses as per environmental stimulus and more interference effects on particular tasks. The findings of current study revealed that clinical factors, i.e., onset, severity of illness and severity of depression, co morbidity, insight, name of medicine and response of treatment were significant predictors in the development and progression of neuropsychological dysfunction in patient with OCD. The present study needs to be replicated with large sample size with control groups as the findings are very interesting and needs to be done longitudinally to further determine the impact of clinical factors in progression of the neuropsychological dysfunctions. Clinical factors plays an important role in the development or maintenance of the neuropsychological dysfunctions in OCD, therefore management of OCD requires understanding for the clinical factors contributing to Neuropsychological dysfunctions, so that these can be prevented or managed simultaneously with cognitive retraining.

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Neuropsychotherapy to Improve Cognition of Patients with Cannabis Dependence Syndrome

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ABSTRACT

Objective: Neuropsychotherapy is a novel integrative treatment approach based on recent advances in neuroscience, neuropsychological rehabilitation, and models of psychotherapy. Published reports on management of patients having cannabis dependence using neuropsychotherapy is limited. The present study examined the effectiveness of a six-week-long inpatient Neuropsychotherapy treatment program and treatment as usual (TAU; psychoeducation and drug therapy) on neuropsychological functions of patients with Cannabis Dependence Syndrome. **Materials and Methods:** Participants (n=20) with an ICD-10 diagnosis of Mental and Behavioural disorders due to the use of cannabinoids- dependence syndrome were randomly allotted to receive Neuropsychotherapy plus treatment as usual or treatment as usual only. The participants were obtained through purposive sampling from the inpatient unit of Ranchi Institute of NeuroPsychiatry and Allied Sciences. The study groups were assessed on various cognitive functions using neuropsychological tests at baseline and post-treatment. The neuropsychological tests employed are Digital Symbol Substitution Test, Indian Adult Trail Making Test, Wechsler Memory Scale- Indian Edition, Wisconsin Card sorting test, and Rey-Osterrith Complex Figure Test. **Results:** All the twenty patients recruited completed the intervention and assessments at baseline and post-intervention. Statistical Package for Social Sciences (SPSS) software - version 21.0 (SPSS, Chicago, IL, USA) was employed to analyse the obtained data from baseline assessment and post-intervention assessment of the study participants. Descriptive statistics were used to describe the demographic, clinical and other psychosocial variables. Mann Whitney U test was used to compare the participants of the study groups across the scores obtained in the neurocognitive parameters of the study at baseline and post-intervention. Participants receiving Neuropsychotherapy showed more significant improvement in cognitive functions than participants who received treatment as usual only. **Conclusion:** Neuropsychotherapy combined with treatment as usual effectively enhances the cognitive functions of patients with prolonged cannabis use attending psychiatric treatment. However, further studies examining this treatment package on a larger cohort with a rigorous design involving independent raters are suggested.

Keywords: *Cannabis Dependence Syndrome, Neuropsychotherapy, Cognitive functions*

INTRODUCTION

Cannabis is one of the most widely consumed drugs in the world. According to the National Survey on Extent and Pattern of Substance Use in India conducted by the National Drug Dependence Treatment Centre (NDDTC) in 2019, Cannabis is the highest consumed psychoactive substance in India, next to alcohol, with an estimated prevalence rate of 2.83 %. The most commonly used forms of recreational Cannabis in India are Ganja' and 'Bhang'. Ganja, elsewhere called Marijuana, is prepared by drying leaves, stems, and flower buds of the Cannabis plant, whereas bang is prepared by crushing cannabis leaves. (Sarkar et al., 2020) The sticky resin of the cannabis plant has numerous chemical components with psychoactive properties collectively called Cannabinoids. Of the 144 listed cannabinoids to date, delta 9 - tetrahydrocannabinol (Δ9_ THC) contributes to the behavioural toxicity of Cannabis. Those who consume Cannabis regularly, daily or on a near-daily basis experience various forms of adverse physical, psychosocial, and mental health outcomes. (Medina et., al. 2018; Jenkins & Khokhar, 2021). These adverse outcomes are resulting from the functional alterations of the brain brought about by cannabinoids. One of the most undesirable effects of long-term cannabis use is dependency. The latest version of the international classification of disorders (ICD11) describes cannabis dependence as a syndrome consisting of a cluster of physiological, behavioural and cognitive phenomena in which the use of Cannabis or a class of cannabis-like substances takes on a much higher priority for a given individual than other behaviours that once had greater value accompanied by features indicative of neuroadaptation which includes tolerance and withdrawal. (WHO, 2022).

The alterations in the brain functioning produced by cannabinoids are also likely to impact cognitive

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functions. Cognitive functions of memory and attention are found to be impaired in most studies. ((Bourque & Potvin, 2021). Higher-order cognitive functions like abstraction, decision-making and executive functioning are also found to be compromised (Medina et al., 2007; Dellazizzo et al., 2022). Most researchers who studied the nature of cognitive impairment during consumption and at the early period of abstinence have reported that the impairment appears to be more severe during consumption and tends to improve over protracted periods of abstinence. (Pope et al. 2001; Becker et al., 2018). Further, all cannabis users need not necessarily follow same pattern of cognitive impairment as the nature and severity of deficits depend upon the dosage and frequency of substance use and other neurophysiological parameters. (Hooper et al., 2014) Regarding reversibility of these deficits throughout abstinence, the findings are inconsistent. Attention and concentration deficits are usually found to be getting resolved within a month of abstinence. Deficits in verbal memory, learning, mental speed and executive functions persist during abstinence (Behan et al., 2014), causing difficulties in occupational and social functioning to dependent users. Impairment in psychosocial functioning and behavioural regulation resulting from these cognitive deficits are likely to keep individuals in the trap of addiction. (Hooper et al., 2014) Individuals suffering from prolonged cognitive deficits are less likely to benefit from interventions oriented to enhance motivation towards abstinence from substance use, as the deficits act as a veil, preventing them from developing awareness and directing their activities. (Le Berre et al. 2017). Such individuals with executive function deficits are prone to drop out from psychological management program (Aharonovich et al., 2008). Thus, the cognitive difficulties of dependent usersneed be attended to and remediated to facilitate better participation in therapy and maximise the benefit of psychosocial management.

With Neuroscience advancements, our understanding of the brain and its relationship with addictive behaviours and psychiatric conditions is deepening. Experts have now concluded that almost all form of abnormal behaviours and experiences of humankind can be traced to the alterations in brain structure and functioning. (Herpertz & Fuchs, 2014; Opel et al., 2020) Neuropsychotherapy is a modern outlook to psychotherapy that visualises psychotherapy in this direction. The approach evolved as an outcome of thought of a group of researchers in Australia two decades ago and is being adopted by several researchers worldwide (Garwe, 2007). Although the term Neuropsychotherapy is understood differently by experts who uses it, the common thread is that psychotherapy can bring demonstrable changes in the brain. (Laaksonen & Ranta, 2013; Gallese, 2014). By way of thinking and doing things differently, humans can create and strengthen synaptic connections and weaken or prune unused ones. (Perkins et al., 2019) The resultant changes in the brain can bring in a drastic change in human conscious and unconscious activities and skills. Neuropsychotherapy is a treatment approach that focuses on capitulating these brain features to create a positive change in persons suffering from mental ailments. For this reason, Neuropsychotherapy has received wide recognition in the scientific community and is expected to revolutionise psychotherapy in the future.

Considering the multifaceted impact of cannabis dependence, there is a logical need to have an integrated therapy that addresses the psychological aspects which foster dependency and cognitive deficits. As per the researcher's best knowledge, no published research is available so far where strategies to address neurocognitive deficits are integrated along with the management programme of cannabis use disorders. To address the treatment gap, we developed the Neuropsychotherapy treatment module combining psychosocial management and cognitive retraining strategies. The present research is to assess the effectiveness of the Neuropsychotherapy module on the cognition of patients with cannabis dependence syndrome.

METHODS

Sample

Twenty individuals with cannabis dependence syndrome attending inpatient psychiatric treatment of Ranchi Institute of Neuropsychiatry and Allied Sciences, Kanke, Ranchi during the study period were chosen as participants of the study. All the participants were diagnosed to have cannabis dependence syndrome as per ICD10 DCR criteria. Those with severe comorbid substance use other than tobacco and caffeine, experiencing severe psychotic and mood disorders and chronic medical conditions were excluded. The mean age of the participants of the experimental group was 25.70 ±5.10 yearsand those of control group was 24.40 ± 5.85 years. Most of the participants had a minimum education qualification of Std. 10. All the participants met the criteria for Cannabis dependence on the screening test. All the participants were consuming Cannabis continuously for a minimum period of 2 years, the most extended duration of consumption being 12 years. A quarter of the participants in the study groups had multiple relapses. All the participants were receiving psychiatric treatment during the intervention phase. The participants were free of severe mood and psychotic symptoms during the intervention.

TOOLS

Socio-demographic and clinical data sheet

A socio-demographic and clinical data sheet prepared by the researcher was used to collect information regarding socio-demographic variables and substance use-related variables. Socio-demographic variables included were age, gender, religion, education and marital status. Substance use-related information variables include the age of onset, course, duration, treatment, abstinence, and relapse.

Cannabis Users Disorders Identification Test (CUDIT-R)

The revised version of the Cannabis Users Disorders Identification Test (CUDIT-R), developed by Adamson et al. (2010), was used to detect problematic cannabis use**.** The items capture essential features of consumption patterns, cannabis problems (abuse), dependence symptoms, and psychological features.

Indian Adult Trail Making Test (IATMT)

The Indian Adult Trail Making Test (IATMT) was used to assess the attention and executive functions of the patient. The test comprises of a standardised set of four visual search and sequencing tasks. The trail-making's primary task is to connect a series of stimuli (numbers, expressed as numerals and letters) in a particular order as rapidly as possible. (Jahan et al., 2015)

Wechsler Memory Scale - 3rd Edition (WMS-III)

Wechsler Memory Scale is a comprehensive neuropsychological assessment which examines several aspects of memory of a person. The primary subtests of Indian adaptation of Wechsler Memory Scale - 3rd Edition (WMS-III) was used for assessing participants in the present study. (Gurappa and Rao, 2009)The primary subtests included Logical Memory, Verbal Paired Associates, Letter Number Sequencing, Faces test, Spatial Span, and Family Pictures.

Wisconsin Card Sorting Test (WCST)

Wisconsin Card Sorting Test (WCST) was employed to measure executive functions. The test requires strategic planning, organisation ability, the ability to use environmental feedback to shift cognitive set and the ability to modulate impulsive responding. The participant is presented with a series of stimulus cards with shapes on them. The cards differ in the colour, number and form of the shapes printed on them. The task of the participant is to sort these cards. The participant is not told what stimulus dimension to use to sort the cards, but the administrator tells the participant if a particular match is correct. During the test, the sorting rules are changed, and the participant must discover the new sorting rule to be successful. WCST-128 item version was used in the present study. (Anderson et al., 1991)

Rey Complex Figure Test (RCFT)

Rey Complex Figure Test (RCFT) was administered to assess the patient's visual-spatial constructional ability and visual memory. The administration and scoring system developed by Meyers and Meyers (1994) is used for the present study. The complex figure is presented before the subject first to be copied, and then the immediate recall trial is taken after three minutes and delayed recall after 30 minutes. Following this, a recognition trial is administered immediately after the recall. The scoring of drawings was based on the widely used 36-point scoring system, and the same scoring criteria apply to all three drawing trials.

The Neuropsychotherapy module

The treatment module of Neuropsychotherapy designed and developed by us was used to provide intervention to the experimental participants. The therapeutic package included psychosocial management strategies and cognitive retraining. The intervention was designed to be provided simultaneously with sessions combining psychosocial management strategies and cognitive retraining exercises or cognitive retraining alone, targeting altering substance intake behaviour and improving cognitive functions. The integrated intervention module comprised face-to-face patient-therapist contact sessions, take-home exercises and family sessions. Psychosocial management strategies and cognitive retraining were delivered through twenty, one to one contact sessions and two-family sessions. Each face-to-face session was of 60 to 90 minutes duration. Therapeutic management comprised of motivation enhancement strategies and coping skills training. A self-help manual developed as a part of the intervention was used for the purpose. The self-help manual had content designed to provide information to the client regarding the substance use and its ill effects, enhancing their motivation towards abstinence and offer functional tips to deal with situations demanding coping skills. (Table 1) Cognitive retraining exercises comprise specific techniques and practice exercises employed to improve cognitive functions like attention, memory, planning, problem-solving, decision making, set-shifting, and organisational capacities. The module had 30 such retraining activities of which the therapist could select needed activities to make a retraining plan, depending upon the nature and extent of cognitive deficits of the patient. (Table 2) Each of the activities was designed to be progressive, such that the patient attending these sessions get the opportunity to improve their cognition on the hierarchical order of deficit in cognitive functions. The practice exercises included letter cancellation, letter-number sequencing, solving

jumbled sentences, mazes, category matching, ordering task, problem-solving puzzles etc.

PROCEDURE

Patients who were admitted in inpatient unit of Ranchi Institute of Neuro-Psychiatry and Allied Sciences, Kanke, Ranchi and were receiving medical treatment after detoxification period, diagnosed with mental and behaviour disorders due to the use of cannabinoids - dependence syndrome according to the ICD-10 DCR criteria werescreened. Detailed information regarding the research intervention program was provided initially, and those who express willingness were purposively recruited for the study following a screening interview based on inclusion and exclusion criteria. A total of twenty such patients were selected, and prior informed consent was obtained from them. The selected patients were randomly distributed to the experimental and treatment as usual groups such that both groups have ten participants each. Participants of both groups were assessed on the neurocognitive assessments of the study. The experimental group was provided with neuropsychotherapy treatment, whereas no additional treatment other than what is routinely available in the treatment facility was provided to the treatment as usual group. Provision of routine pharmacotherapy was ensured for both groups of patients with cannabis dependence. Each of the participants underwent treatment for one month and had attended a minimum of 20 sessions, with four to five sessions per week. The intervention started with psychoeducation sessions which informed the participants about the nature and impact of cannabis dependence. Subsequently, motivational counselling and coping skills training was conducted alongside cognitive retraining activities with the aid of a self-help manual. The participants were encouraged to read and reflect upon various topics in the manual between the sessions and fill up the worksheets provided. During therapy sessions, the client and therapist hold discussions on the read material and reflections. Cognitive retraining was provided for 45 min to 60 minutes per day for 15 to 17 days spanning over three weeks, ensuring that each of the participants receives a total of 12 hours of training. Each session began with a review of the previous session and ended with homework assignments. Patients were assessed at baseline and post-treatment using above-mentioned tools. To assess the effectiveness of the treatment, pre and post treatment data were compared with the aid of statistical methods.

STATISTICAL ANALYSIS

Statistical Package for Social Sciences (SPSS) software - version 21.0 (SPSS, Chicago, IL, USA) was employed to analyse the obtained data from baseline assessment and post-intervention assessment of the study participants. Descriptive statistics were used to describe the demographic, clinical and other psychosocial variables. Mann Whitney U test was used to compare the participants of the study groups across the scores obtained in the neurocognitive parameters of the study at baseline and post-intervention. P-value of <0.05 was taken as the level of significance.

RESULTS

Experimental and control group were compared at baseline. Table 3 shows that there was no significant difference between both groups on variables assessed suggesting that both groups were comparable at baseline.

Comparison of both groups at post-treatment is given in Table 4. Findings suggest that participants of experimental group made significantly fewer errors at the first, third and fourth trials of IATMT during post-assessment. The experimental group participants also showed significant improvement in scores on several subtests of WMS (Logical memory, faces test, family pictures and spatial span) both in the immediate recall and delayed recall phases compared with the control group after intervention. Similar improvement in scores was observed in RCFT and WCST tests as well. In RCFT, the scores obtained by participants of the experimental group on recall and recognition tasks were significantly higher compared to scores obtained by participants of the control group after intervention. In WCST, the experimental group participants made a significantly lower percentage of errors, perseverative responses, and perseverative errors compared to scores obtained by participants of the control group at post-assessment. The experimental group participants required fewer trials to complete the first category and had completed more number of categories at post-assessment.

Table 1: Neuropsychotherapy: Psychological management strategies

Psychological management strategies and components
Psychoeducation
Physical and psychological effects of Cannabis use
Symptoms of dependency and withdrawal
Effects of substance use on cognition, behaviour, occupation and relationships
Motivation Enhancement
Contemplating change weighing pros and cons of substance use
Planning for a change
Coping skills training
Scheduling daily life
Rebuilding disturbed family relationships and strengthening friendships
Coping with cravings
Assertiveness and substance refusing skills
Developing an occupational plan
Managing stress and negative thinking
Managing Anger

Table 2: Neuropsychotherapy: Cognitive retraining activities

Cognitive retraining activities		
Attention	**Memory**	**Executive functions**
Number Cancellation	Word list recall	Code Maths
Beading	Paired association	Tangrams
Pulses Sorting	Positioned visual object recall	Construction Puzzle
Connect dots and complete the picture	Memorizing stories	Colour sudoku
Card sorting and sequencing	Locate the card	Matchstick puzzle
Colour flash	Matchstick design from memory	Colour area estimation
Colour box counts	Reversagrams	Jumbled alphabets
Stacking	Paired card recall and recognition	Word Categorizing
Design using blocks		Mazes
		Metal wire Puzzles

Table 3: Comparison of scores obtained by participants of the study groups on study variables at baseline

		Treatment group (N=10)		**Control group (N=10)**		**Mean Rank**		**U**	**Z**
		Mean	**SD**	**Mean**	**SD**	**Treatment Group**	**Control Group**		
IATMT	***Trial 1 - No. of errors***	.20	.63	.50	.71	9.15	11.85	36.500	-1.346 NS
	Trial 2 - No. of errors	1.20	1.93	.90	1.10	10.50	10.50	50.000	.000NS
	Trial 3 - No. of errors	4.20	5.12	5.80	5.18	9.40	11.60	39.000	-.840 NS
	Trial 4 - No. of errors	5.90	6.79	6.30	4.79	9.75	11.25	42.500	-.575 NS
WMS	***Logical Memory - Immediate Recall***	40.10	15.77	31.60	8.14	12.40	8.60	31.000	-1.438 NS
	Faces Test - Immediate Recognition	33.60	3.92	32.40	4.40	11.45	9.55	40.500	-.722 NS
	Verbal Pair Associates – Immediate recall	11.50	4.25	11.10	3.54	10.45	10.55	49.500	-.038 NS
	Family pictures - Immediate Recall	39.60	7.17	34.90	7.80	12.35	8.65	31.500	-1.402 NS
	Letter Number Sequencing	4.60	1.58	4.80	1.75	10.10	10.90	46.000	-.308 NS
	Spatial Span	13.90	2.77	12.40	3.41	11.50	9.50	40.000	-.763 NS
	Logical Memory Delayed Recall	23.20	12.59	19.00	6.46	11.15	9.85	43.500	-.492 NS
	Faces Test Delayed Recognition	34.20	5.71	30.60	5.30	12.40	8.60	31.000	-1.444 NS
	Verbal Pair Associates -Delayed Recall	3.50	1.72	4.00	1.94	10.00	11.00	45.000	-.390 NS
	Family pictures Delayed Recall	36.00	6.94	32.00	6.99	12.30	8.70	32.000	-1.366 NS
	Logical memory Recognition	19.90	6.47	19.50	3.03	12.15	8.85	33.500	-1.257 NS
	Verbal Pair Associates Immediate	23.60	.52	23.40	.84	10.90	10.10	46.000	-.347 NS
	Auditory Recognition Delayed	43.50	6.69	42.90	3.25	11.90	9.10	36.000	-1.069 NS
RCFT	**Copy score**	24.50	4.57	21.65	4.92	11.95	9.05	35.500	-1.101 NS
	Immediate Recall score	10.55	6.19	9.90	5.72	10.70	10.30	48.000	-.152 NS
	Delayed Recall score	9.15	6.47	8.30	4.48	10.60	10.40	49.000	-.076 NS
	Recognition Total correct	19.10	1.60	18.30	2.11	11.35	9.65	41.500	-.660 NS
	Time to copy (in seconds)	440.50	118.36	508.00	136.52	9.10	11.90	36.000	-1.059 NS
WCST	**Number of trials administered**	125.30	7.54	128.00	.00	9.50	11.50	40.000	-1.451 NS
	Percentage of errors	48.19	15.14	47.50	14.46	10.90	10.10	46.000	-.302 NS
	Percentage of perseverative errors	25.47	7.63	27.70	13.08	10.10	10.90	46.000	-.302 NS
	Percentage of nonperseverative errors	22.72	11.36	19.70	7.59	11.00	10.00	45.000	-.378 NS
	Percent of conceptual level responses	36.53	18.73	37.30	18.10	10.10	10.90	46.000	-.302 NS
	Number of categories completed	2.80	1.93	2.80	1.48	10.00	11.00	45.000	-.389 NS

NS- Not significant

IATMT – Indian Adult Trail Making Test, WMS- Wechsler Memory Scale- IIIrd edition, RCFT- Rey Complex Figure Test, WCST – Wisconsin Card Sorting Test

Table 4: Comparison of scores obtained by participants of the study groups on study variables at post-assessment

		Treatment group (N=10)		Control group (N=10)		Mean Rank		U	Z
		Mean	SD	Mean	SD	Treatment Group	Control Group		
IATMT	Trial 1 - No. of errors	.00	.00	.40	.52	8.50	12.50	30.000	-2.179*
	Trial 2 - No. of errors	.30	.67	.80	.79	8.60	12.40	31.000	1.640
	Trial 3 - No. of errors	1.00	1.89	6.50	4.50	7.15	13.85	16.500	-2.621**
	Trial 4 - No. of errors	2.10	2.28	5.80	3.77	7.50	13.50	20.000	-2.304*
WMS	Logical Memory - Immediate Recall	46.60	16.45	33.50	7.53	13.70	7.30	18.000	-2.425*
	Faces Test - Immediate Recognition	40.20	4.34	34.70	4.50	13.50	7.50	20.000	-2.275*
	Verbal Pair Associates – Immediate	14.10	6.10	11.80	4.34	11.80	9.20	37.000	-.986
	Family pictures - Immediate Recall	46.00	7.90	36.80	6.39	13.80	7.20	17.000	-2.501*
	Letter Number Sequencing	6.50	2.17	5.40	1.71	12.05	8.95	34.500	-1.193
	Spatial Span	15.80	2.35	12.10	2.73	13.95	7.05	15.500	-2.619**
	Logical Memory Delayed Recall	28.50	10.19	20.20	6.11	13.10	7.90	24.000	-1.970*
	Faces Test Delayed Recognition	39.40	5.06	32.80	4.21	13.85	7.15	16.500	-2.547**
	Verbal Pair Associates -Delayed Recall	5.50	1.72	4.30	1.57	12.65	8.35	28.500	-1.677
	Family pictures Delayed Recall	42.90	8.49	33.30	6.36	13.65	7.35	18.500	-2.387*
	Logical memory Recognition	21.00	4.67	20.00	2.71	12.25	8.75	32.500	-1.331
	Verbal Pair Associates Immediate	23.70	.48	23.20	.79	12.30	8.70	32.000	-1.529
	Auditory Recognition Delayed	44.70	4.90	43.20	3.16	12.30	8.70	32.000	-1.370
RCFT	Copy score	32.30	2.35	23.55	6.97	13.80	7.20	17.000	-2.502*
	Immediate Recall score	23.95	5.48	12.75	6.80	14.50	6.50	10.000	-3.035**
	Delayed Recall score	23.90	6.77	11.70	7.00	14.40	6.60	11.000	-2.950**
	Recognition Total correct	21.60	1.35	17.80	3.12	15.00	6.00	5.000	-3.485**
	Time to copy (in seconds)	237.20	73.28	346.80	143.48	8.10	12.90	26.000	-1.815
WCST	Number of trials administered	116.50	13.31	127.80	.63	7.70	13.30	22.000	-2.484*
	Percentage of errors	32.10	12.91	45.71	13.58	7.65	13.35	21.500	-2.155*
	Percentage of perseverative errors	17.09	9.16	28.61	11.84	7.65	13.35	21.500	-2.158*
	Percentage of nonperseverative errors	14.40	6.75	17.10	6.72	9.40	11.60	39.000	-.832
	Percent of conceptual level responses	57.43	14.24	39.15	15.26	13.50	7.50	20.000	-2.268*
	Number of categories completed	5.20	1.14	2.60	1.65	14.45	6.55	10.500	-3.073**

**P<0.05 – Significant, ** P<0.01 – Highly significant*

IATMT – Indian Adult Trail Making Test, WMS- Wechsler Memory Scale- IIIrd edition, RCFT- Rey Complex Figure Test, WCST – Wisconsin Card Sorting Test

DISCUSSION

In the present study, an attempt was made to assess the effectiveness of Neuropsychotherapy in managing cognitive deficits in patients with Cannabis Dependence Syndrome in a managed care facility for cannabis dependence in India. The study groups were compared in selected neurocognitive tests at baseline and post-intervention to examine the effectiveness of the intervention. The results indicated that those who received neuropsychotherapy had shown significant improvement in cognitive functions at post-intervention. The improvement was observed as a significant change in scores in the outcome variables post-intervention. Published literature on efficacy of neuropsychotherapy on cognitive rehabilitation of dependent cannabis users could not be traced, however, numerous scientific studies on the efficacy of cognitive retraining are conducted on alcohol, opium and cocaine dependence. In the present study, those who attended intervention had enhanced attention, which resulted in a significant reduction in time and errors in IATMT. The intervention group participants also were able to enhance their memory significantly, which resulted in

significantly higher scores in most of the subtests of WMS. They showed superior performance in the visual and auditory recall and recognition tasks at both immediate recall and delayed recall phases of the test. Verbal working memory ability did not yield any significant improvement. Organisational and planning ability was also found to be significantly improved after the intervention. The participants took lesser time and had a smaller number of errors post-intervention in RCFT. A significantly lesser number of perseverations, perseverative errors and a higher rate of successful completion of sorting categories and increased conceptual responses in a lesser number of trials at post-intervention reflected the improvement of cognitive flexibility in the intervention group. Studies employing cognitive retraining suggested that patients with alcohol dependence experienced improved in their cognition after cognitive rehabilitation treatment (Bell, 2009; Bates et al., 2013). Rupp et al. (2012) examined the added outcome of cognitive remediation in recovering patients who were dependent on alcohol. The researchers found that the remediation treatment, which involved the use of computerised cognitive retraining, helped bring significant improvement in attention, recall and executive functions evidenced through performance in neuropsychological tests. Further, they also found that those who had better cognitive recovery showed more significant improvements in psychological well-being and the compulsion aspect of craving. Goldstein et al. (2005) study showed that cognitive training helps enhance the attention and cognitive flexibility in patients with alcohol dependence in their detoxification phase. Thusneuro psychotherapy is effective in improving cognitive deficits in patients having cannabis dependence.

CONCLUSION

The preliminary study findings indicate that Neuropsychotherapy is a promising intervention for patients with Cannabis Dependence Syndrome. The treatment is found to help improve cognition. However, further studies examining this program on a larger cohort with a rigorous design involving independent raters are required to establish its efficacy.

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Examining the Importance of Literacy in Neuropsychological Research: Insights from Indian Adults Living in the Community

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ABSTRACT

Literacy is widely explored topic in cross cultural neuropsychology research. Indian culture is unique in terms of literacy and related cultural belief systems. There is paucity of research on Illiterate participants as majority of the Indian studies focus on educated participants including low and high educated participants with inadequate representation of illiterate participants. **Aim/ Objective:** The main purpose of this study was to investigate the impact of literacy on neuropsychological test performance in an educationally diverse population. **Method:** Total sample consisted of 140 healthy participants with heterogeneous educational backgrounds. Illiterate and literate participants between the age range from 18 to 50 years were selected in this study. They were screened using the Modified MINI Screen, HMSE and Edinburgh Handedness Inventory, and followed by detailed neuropsychological assessment. **Results:** The results of this study revealed that the participants not having formal education or having less years of education performed poorly on tests of attention, construction ability, memory, phonemic fluency, naming and global cognitive screening (HMSE). On the other hand, participants having higher or more years of education performed better than them on similar tests. Literacy has a significant impact on neurocognitive functions and ability to read and write few words can enhance cognitive functioning. Further, results revealed that the impact of education on neuropsychological test performance is nonlinear. **Conclusion:** The findings clearly demonstrates the role of literacy on Neurocognitive functions. Further considering education as proxy measure for level of literacy in Indian context might not be appropriate method especially in low educated participants. Therefore, there is urgent need to examine literacy related influence on cognition using contextualized approach and we recommend developing sensitive and culturally valid tools to assess neurocognitive functions for Indian participants.

Keywords: *Literacy, Neuropsychological test, cognitive impairment, indigenous test*

INTRODUCTION

Literacy is regarded as an important skill for effective functioning in the community. Literacy includes reading, writing and numeracy skills that can be acquired through intensive tuition and practice (Carreiras, 2009). When a person can read, write, and comprehend a brief statement about his or her daily life, it is frequently deemed that individual to be literate(UNESCO, 2008). Years of education is often used as a proxy for level of literacy in neuroscientific research (Noroozian et al., 2014).

Literacy has a beneficial role in our mundane life and known to enhance our cognitive well-being. Learning to read or literacy reinforces and facilitates better phonological awareness, visuospatial awareness, visuomotor skills, remembering strategies and working memory(Ardila et al., 2010) provides protection against dementia and is associated with ontogenic structural brain changes (Carreiras, 2009). There is mounting evidence suggesting that literacy could strongly influence neuro-cognitive performance. Participants with higher education perform significantly better on several neurocognitive tests including working memory, executive functioning, learning and memory, fluency and construction (Tripathi et al., 2014; Ardila et al.,2010; Rao et al., 2004; Mathuranath et al., 2007; Ganguli et al., 1996;Ostrosky-Solis et al., 1998). Lower literacy is considered to be a significant risk factor for dementia and other associated disorders. (Brucki, 2010). However, the impact of literacy on neurocognitive tests is not systematically explored in Indian context.

Higher illiteracy rates have been recorded in developing nations, particularly among women and in rural areas (UNESCO, 2008) and 35% of the world's illiterate population resides in India. Assessment of cognitive functions among illiterates and low educated is a major concern due to poor adaptation of neuropsychological tests (Brucki, 2010), culture specific belief system and lack of indigenous tests (Tripathi et al., 2014). Most of the neurocognitive tests being used in India are developed in the West and attempt has been made to adopt these tests in Indian context (Tripathi et al., 2014; Rao et al., 2004; Mathuranath et al., 2007; Ganguli et

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al., 1996) and this is consistently observed that educated participant scored higher on Trail Making Test (Rao et al., 2004; Ganguli et al., 1996; Bhatia et al., 2007), Category Fluency (Tripathi et al., 2014; Rao et al., 2004; Mathuranath et al., 2007; Ganguli et al., 1996), Episodic Memory Test (Tripathi et al., 2014; Rao et al., 2004; Ganguli et al., 1996), Complex Figure Test (Rao et al., 2004), and Picture Naming Test (Tripathi et al., 2014; Ganguli et al., 1996). Surprisingly, Low educated participants' score remains at base level and they often refuse to participate. Lower scores on neuropsychological test may be caused by a variety of things, such as different learning opportunities, exposure to psychological testing scenarios, and the suitability and utility of the items in the particular cultural environment. It is argued that several measures of cognitive functions are biased by our current schooling systems.

It has been observed that the majority of the neuropsychological studies conducted in India are on educated participants including low and high educated participants with inadequate representation of illiterate participants. Indian socio-political culture has a unique influence on the literacy levels of its citizens. Moreover, several attempts have been made since independence to eradicate illiteracy including social education, Gram Shikshan Mohim, formers functional literacy project and national literacy mission etc. Such efforts have significantly changed the rate of literacy in India. Those who benefited may read and write in the local language. This could have been rewarding experience and might facilitates better adjustment in the society. However, there is limited data to suggest its impact on functional outcome and cognition. Neuropsychological assessment with a low educated group is quite challenging and yields confusing results (Tripathi et al., 2014; Ganguli et al., 1996). Therefore, there is an urgent need to understand neuropsychology of low educated participants using culturally appropriate tools.

METHOD

The total sample consisted of 140 healthy participants with heterogeneous educational backgrounds. Illiterate and literate participants, aged from 18 to 50 years were included in this study. The participants were healthy adults from Ahmedabad, Gandhinagar and other nearby rural areas. Each participant received information about the study and gave their consent to take part. Participants in this study were excluded if they had a known history of a serious psychiatric or neurological condition, had visual or auditory impairment, or had an HMSE score below 24.

Sample was distributed in a total five groups on the basis of their years of education. Participants who had not attended school or had not formal education (Illiterate) been included in Group 1 (N=27), participants with 1 to 5 years of education were included in Group 2 (N=13), participants with 6 to 8 years of education were included in Group 3 (N=25), participants with 9 to 12 years of education were included in Group 4 (N=36) and participants with 13 and above years of education were included in the Group 5 (N=39).

Screening tools

Socio-demographic data sheet: It comprised of name, age, date of birth, gender, education, address, socio-economic status, mother tongue, languages known, occupation, family type, religion, domicile, handedness, with history of physical illness and any form of medication taken, head injury or accident in past, known history of mental disorder and neurological disorders.

Edinburgh Handedness Questionnaire (old field, 1971): This test was used to determine handedness. It has 10 items and often used in neuropsychiatric research.

Hindi Mental Status Examination: HMSE was used to screen cognitive impairment in participants. It consists of 23 items which screens cognitive functions like orientation, registration and recall, attention, naming, repetition, three step task, sentence writing and copying a figure. The possible scores can ranged between 0 to 31.

Modified MINI (Mini International Neuropsychiatric Interview) Screen: This test was used to screen psychiatric symptoms or illness. MMS is a screening measure for major psychiatric disorders.

Neuropsychological tests

Several tests were included to assess attention, working memory, learning and memory, language functions and constructional abilities.

Word List: This test was used to assess episodic memory, developed specially for the elderly persons to assess verbal learning, delayed recall and recognition.

Paired Association Test: This test was used to assess verbal learning memory. This test is an episodic memory paradigm in which pairs of words (e.g. lotus - silver) are presented during four learning trials. The maximum score of all trials with delayed recall is 50 and minimum score is 0.

Stick Construction Test: This test was used to assess construction ability, visual learning and memory. The participants have to make presented designs using sticks. The maximum score is 24 and minimum score is 0 for construction and recall.

Digit Span: This test was used to assess attention and verbal working memory or short-term verbal memory (Richardson, 2007). The maximum score 8, and minimum score is 3 for forward sequence. The maximum score is 7, and minimum score is 2 for backward sequence.

Corsi Block Tapping Test: This test is majorly used to assess visuospatial working memory and attention. The maximum score is 8, and minimum score is 3 for forward sequence. The maximum score is 7, and minimum score is 2 for backward sequence.

Category Fluency: In categorical fluency participants were presented with a category and had to generate as many names in one minute per category that he/she knew belong to the category. In this study three widely used categories "Fruit", "Animal" and "Vegetables" were used. The total number of accurate names produced in each category consideredas a score.

Phonemic Fluency: This test was used to assess phonemic fluency. Participants have to generate words starting with Ka, Ma, Pa in one minute per category.

Picture Memory Test: Visual-spatial memory test examines spatial memory for visually presented, meaning material while allowing verbal responding. In the present test, individuals were shown a scene of a park. The picture is exposed for 10 seconds. After which the client is asked to describe what is happening in the picture. Later the picture is taken away and the participant is to recall it again. The task consists of delayed recall phase taken after 20 minutes. The maximum score of the entire test is 15 and minimum score is 0.

Picture Naming: This test was used to assess semantic memory and language abilities (Tripathi et al., 2014). Picture naming test includes 24 pictures belonging to different semantic categories that is relevant to daily life. The total number of correctly reported answers is considered as a total score. The maximum score is 24 and minimum score is 0.

Administration of all the neuropsychological tests takes around 45 minutes to administer. All the screened participants were tested individually. The data were examined using the Statistical Package for Social Sciences (SPSS 16.0). The effect of literacy on particular neuropsychological test were examined by using one-way analysis of variance.

RESULTS

A total of 140 participants were assessed with screening and neuropsychological tests. Mean age of the participants was 34 years (SD=11) and mean education was 9 years (SD=6.00). Each group was categorized on the basis of different levels of education. To examine the impact of education on neuropsychological test performance one way analysis of variance was used.

Figure 1: Mean values on Word List Test by education

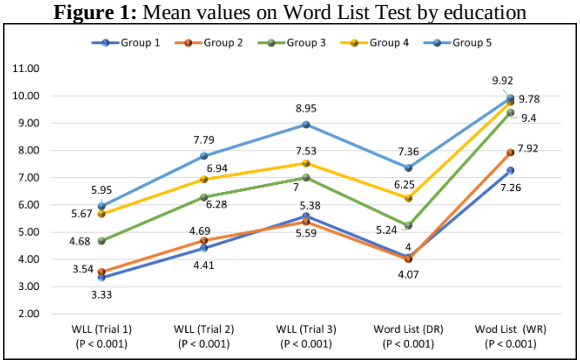

Figure 2: Mean values on Stick Construction Test by education

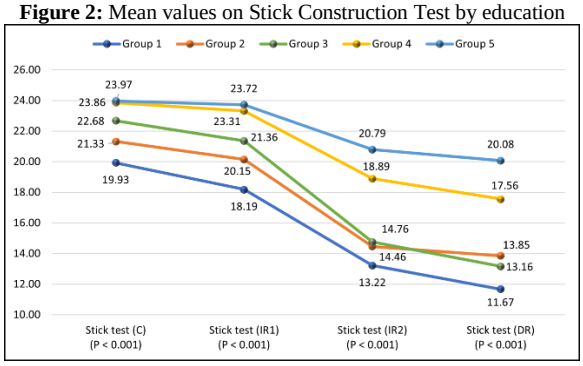

Figure 3: Mean values on Digit Span and Corsi Span by education

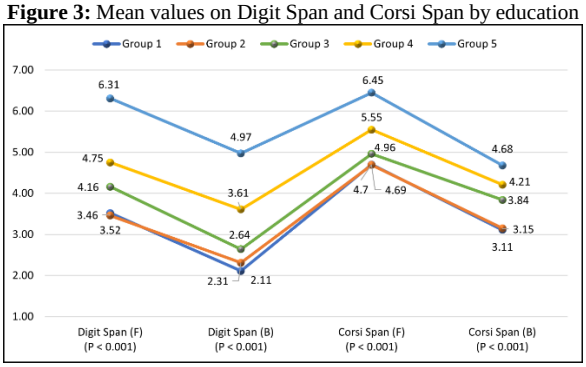

Figure 4: Mean values on Paired Association Test by education

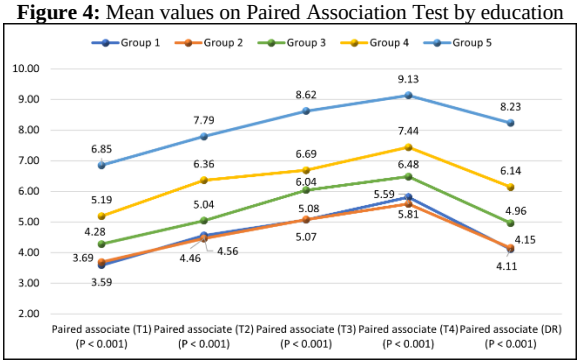

Figure 5: Mean values on Category Fluency by education

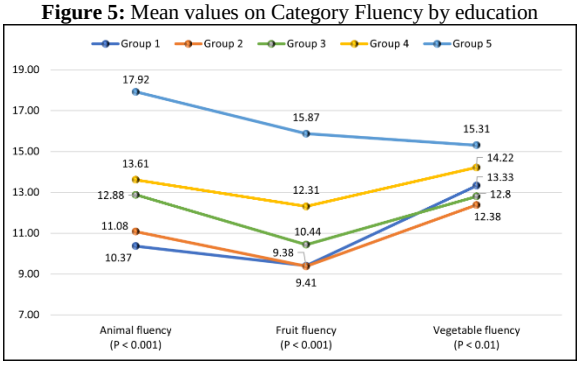

Figure 6: Mean values on Phonemic Fluency by education

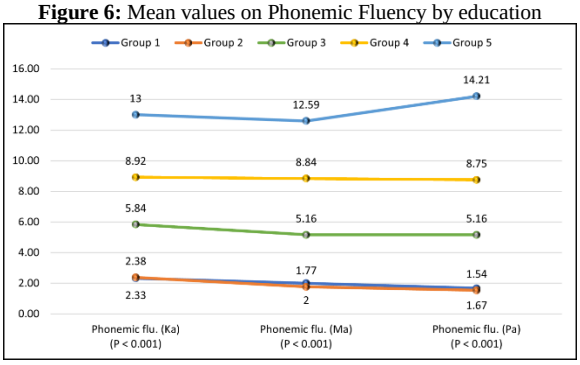

Figure 7: Mean values on Picture Memory Test by education

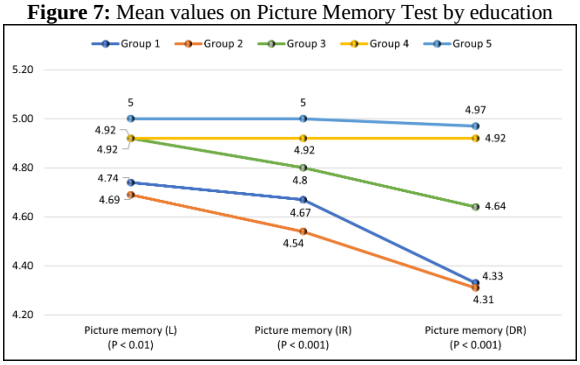

Figure 8: Mean values on Picture Naming and HMSE by education

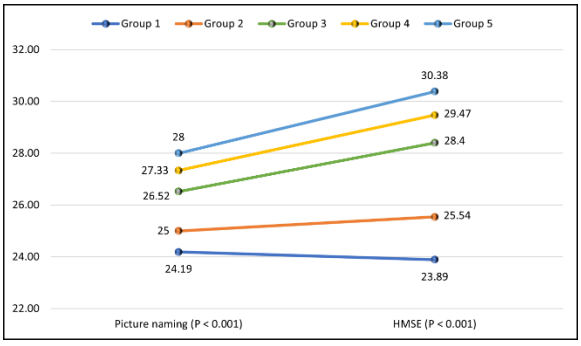

Figure 1 to 8 depicts mean, and significance level of participants with different educational experiences on different neuropsychological tests. As depicted in the figures, participants with higher education performed better on all the neuropsychological tests than their low educated counterparts i.e., Group 1 and group 2.

Findings of post-hoc analysis revealed that Group 5 performed significantly better on each neuropsychological measure than Group 4 and Group 3, Group 2 and Group 1. In Word list recognition and HMSE statistically significant difference between illiterate and low educated group (G2) were noted. Otherwise, G1 and G2 performed similarly on all the neuropsychological tests except word list recognition and HMSE total score, G1 & G3 on stick construction delayed recall, digit span test forward and backward, corsi block tapping test forward, paired association test trial 1, trial 2, trial 4, delayed recall, animal naming, fruit naming, vegetable naming, picture memory learning, G1 & G4 on vegetable naming, picture memory learning and immediate recall, G2 & G3 on stick construction learning, SC immediate recall 1, SC immediate recall 2, digit span forward & backward, corsi block forward & backward, paired association test trial1, trial2, trial3, trial4, delayed recall, animal naming, fruit naming, vegetable naming, picture memory test learning and delayed recall, G2 & G4 on animal naming, vegetable naming and picture memory test learning and immediate recall, G2 & G5 on picture memory test immediate recall, G3 & G4 on word list trial 2, trial 3, word recognition, stick construction learning, corsi block backward, paired association test trial 3, animal naming, fruit naming, picture memory learning, delayed recall and HMSE score, G3 & G5 on picture memory test learning, and G4 & G5 on word list test trial 1, word recognition, stick construction learning, SC immediate recall 1, SC immediate recall 2, corsi block backward, picture memory learning, delayed recall, picture naming and HMSE score.

DISCUSSION

Results of our study clearly showed that education plays an important role in determining neuropsychological test performance. Participants with higher education perform significantly better on selected tasks including attention and working memory (span tasks), learning and recall (Word list, Stick construction test, Picture memory test, Paired association test), fluency (Phonemic and semantic), naming (Picture naming) and construction (stick construction). Educated participants perform better than their low educated counterparts (Ardila et al.,2010; Tripathi et al., 2014; Rao et al., 2004; Mathuranath et al., 2003; Ganguli et al., 1996; Ostrosky-Solis et al., 1998) is well established finding. The organization and functioning of the brain are altered by reading and writing. (Stern, 2009) that might result in better performance on neuropsychological tests.

Our finding further supports the previous observation that the association between the education and neuropsychological test performance is nonlinear with

diminishing returns as education increases (Ostrosky-Solis et al., 1998). Said differently, the impact of education is seen significantly higher when comparison is made between high and low educated participants. However, a similar effect of education could not be observed while comparing educated participants (middle educated and higher educated). This could be due to the ceiling effect (Ostrosky-Solis et al., 1998), opportunity and stimulation related to test, test taking attitude and item validity in cultural context.

Interestingly, our study revealed that illiterate and low educated participants (educated up to 5 years) perform similar on several tests including attention and working memory (span tasks), learning and recall (Word list, Stick construction test, Picture memory test, Paired association test), fluency (Phonemic and semantic), naming (Picture naming) and construction (Stick construction). There are several reasons that could explain such findings. In this study, most of the illiterate and low educated participants are engaged in either the agricultural or informal sector that could provide similar cognitive stimulation. Several efforts have been initiated since independence to eradicate illiteracy among adults in India including social education and national literacy mission. Such efforts from the government are known to be proven beneficial as most of the uneducated participants could read and write their names in local language. In this study too, it was noted that several uneducated participants could read and write their name. Owing to the fact that illiterate and low educated participants have similar occupational and work environments and therefore perform similarly on cognitive tests. However, future studies are required to explore neurocognitive function in low educated participants. Our study clearly demonstrates that considering education as a proxy measure for level of literacy in our culture might be misleading especially in low educated participants.

Participants with low education (Group 2) and illiterate participants (Group 1) performed equally poor on most of the tests, especially on digit span, corsi block tapping test and phonemic fluency. We would like to recommend to avoid using span tasks and phonemic fluency with low educated participants. There is an urgent need to develop robust normative data on these tasks in future. Kosmidis et al. (2011) found that illiterate and functionally illiterate participants performed equally worse and similarly on digit span, spatial span, and sentence span. These findings support the findings of the present study. Tripathi et al. (2015) found that healthy older adults with lower education level performed poorly on corsi block tapping test, digit span and other neuropsychological tests. This is in line with the findings of the present study. It is interesting to note that our illiterate participants performed better on spatial span task than on digit span. It needs to be further examined in future studies. Those having attained some level of education may have been accustomed to recognizing stimulus on paper, whereas not having attained any education may mean that the person may heavily rely on environmental exposure in making calculations. Providing physical stimulus may improve the performance of the illiterate group due to familiarity. In our study, illiterate and low educated participants performed poorly on all neuropsychological tests. The possible reason behind poor performance could be lack of stimulating opportunities, tasks exposure and context inappropriate items.

Our study has certain constraints that should be considered. The sample size is very small and future study is required to examine impact of literacy on neurocognitive functions using larger populations. We have used years of education as a proxy to determine literacy levels. However standardized measures of literacy was not used in this study. In this study we have used HMSE and self-report to rule out presence of neurologic deficits that could not be sensitive enough to identify psychopathology, especially in low educated participants.

In conclusion, our findings extend the investigation of neurocognition and literacy in Indian participants. This study confirmed previous results indicating education can affect neuropsychological test performance. Our study clearly showed low education could adversely affect performance on several neuropsychological tests that may not necessarily imply neurocognitive impairment. There is urgent need to develop indigenous tools to assess neurocognitive functions for Indian population.

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Original Research Article

A Comparative Study of Neuro-Cognitive Correlates in Patients Diagnosed with Schizophrenia and Normal Controls

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ABSTRACT

In the present study, a neuro-cognitive comparison was carried out among -Visual-Motor Functioning, Memory Functioning, Visuo-Constructional Ability, Response Inhibition and Perceptual Acuity between individuals with Schizophrenia and their approximately matched control. 30 individuals participated in the study. 20 belonged to Normal Population and 10 matched the criteria for Clinical Population.GHQ-28 was used to screen Normal Population and PANSS was used to screen the population diagnosed with Schizophrenia. Tools used for the present study included Bender Visual Motor Gestalt Test -I, PGI-Memory Scale, Clock Drawing Test, Stroop Test and Nahor-Benson Test. Product Moment Correlation was calculated for both Normal and Clinical groups. For both the groups, Memory and Response Inhibition was correlated with Visual-Motor Functioning, Visuo-Constructional Ability and Perceptual Acuity. Within the Normal Group, Delayed Recall significantly correlated with Visual-Motor Functioning and Visuo-Constructional Ability. Within Clinical Group, Perceptual Acuity significantly correlated with Visuo-Constructional Ability.

Key Words: *Schizophrenia, Florid symptoms, Partial Remission, Visual-Motor Functioning, Memory Functioning, Visuo-Constructional Ability*

INTRODUCTION

Schizophrenia is a disorder characterized by extreme distortions in perception, thinking, speech, sense of self, and social contact with a significant loss of contact and orientation with reality, referred to as psychosis. Schizophrenia spectrum and other psychotic disorders are characterized by positive and negative symptoms. Positive symptoms refer to pathological excess or addition to behavior. Delusions, hallucinations, disorganized thinking and speech, grossly disorganized or abnormal motor behavior (catatonia) are the positive symptoms that characterize schizophrenia. On the other hand, negative symptoms, which refer to pathological deficits in behavior, consist of flat, blunted affect, social withdrawal, alogia and anhedonia.

Neuroimaging, neuropsychological, and neurophysiological assessments have significantly shown differences between groups of individuals with Schizophrenia and appropriately matched control subjects. Structural neuroimaging literature implicates enlargement of the lateral ventricles. There is decrease in volume of brain tissue by widening of cortical sulci and decreased volumes of gray and white matter. Significant decrease in volume of temporal lobe has been found. Focal abnormalities have been found in medial temporal structures namely hippocampus, amygdale and entorhinal cortex. The superior temporal gyrus is found to be smaller in volume. Decreased thalamic volume has also been observed in not only individuals with Schizophrenia, but also their unaffected first-degree relatives. Hence it can be understood that genetic loading is significant over here. Another interesting finding is that of an increase in the size of basal ganglia. An increased incidence of large cavum septum pellucidi has also been demonstrated in individuals with Schizophrenia. This may carry important implications, because it is suggestive of an early i.e., prenatal developmental brain abnormality.

Functional brain imaging studies implicate hypofrontality (i.e., a relative decrease in cerebral blood flow metabolism) to be the most consistently replicated finding. These functional abnormalities are unlikely to be limited to any one brain region as there are more widespread abnormalities involving the cortical and subcortical circuit of the brain.

Cognition is the sum total of mental processes that helps us to acquire knowledge and keeps us aware of our surroundings. Thus it enables us to arrive at appropriate judgments. Cognitive deficits in schizophrenia last throughout, thereby worsening the prognosis of the illness. They can be neuro-cognitive and relate to social cognition. Neurocognitive deficits are deficits in speed of processing, attention / vigilance, memory, perception, psycho-motor abilities, visuo-motor functioning, difficulty in changing response set along with reasoning, problem solving and social cognition. Such cognitive deficits are present at the onset of illness. Such deficits inevitably produce substantial functional impairment. Though Psychotic symptoms remit with treatment, functional impairments remain stable over time.

As we can understand neuropsychological deficits are a consistent aberration in groups of individuals with Schizophrenia. Evidence points out that that many of

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these deficits are found among individuals, during their first psychotic episode, prior to treatment with antipsychotic medication. Such deficits are also found in individuals with Schizophrenia who are in clinical remission, as well as in unaffected first-degree relatives. For these reasons, some of the neuropsychological deficits are thought to reveal how such deficits make individuals with Schizophrenia more vulnerable and functionally impaired to the course of the illness. These deficits carry clinically meaningful implications. They are related to the degree of difficulty that some individuals with Schizophrenia have with activities of daily living. They are also crucial for the ability of the affected individuals to acquire skills in psychosocial rehabilitation. Accordingly, the severity of neuropsychological deficits is a relatively strong predictor of psycho-social, vocational and cognitive outcome of the illness.

There are problems with Working Memory which can be thought of as our mental "blackboard." Patients with schizophrenia showed less prefrontal brain activity on tasks involving Working Memory in comparison to healthy controls (Cannon et.al. 2005). The medial temporal lobe in particular the hippocampus, associated with memory function (Squire, 1987), is implicated in schizophrenia (Suddath et al., 1989). There is evidence of marked deficits in procedural memory as well as implicit memory functioning in individuals diagnosed with Schizophrenia. Thus Schizophrenic patients have a global deficit in all aspects of memory (Elliott and Sahakian, 2010).

Research literature highlights the difficulties encountered by patients with schizophrenia in active, functional allocation of attentional resources, meaning that they are unable to attend well on demand. Attentional problems described in schizophrenia (Venables and Wing, 1962) can be attributed to poor frontal or executive function control (Damasio and Anderson, 1993).At the pathophysiological level, abnormal neural arousal mechanisms, associated with amygdala, hippocampus, and reticular formation have been replicated (Wing, 1962).

Tasks measuring higher order cognitive functions like conceptualization, planning, cognitive flexibility, verbal fluency, ability to solve complex problems inevitably gets compromised in Schizophrenia.

Executive Functioning encompasses set-shifting abilities, selective attention, and inhibition of inappropriate responses. In the year, 2010, Kalkstein, Hurford and Gur have shown that Schizophrenics suffer from executive impairments. Tasks sensitive to executive functioning like the Wisconsin Card Sorting Test (WCST) are poorly performed by schizophrenics (Stuss and Levine, 2002). Schizophrenic patients tend to perseverate on their responses. They encounter difficulties in shifting their response sets to new solutions when task demands change.

Visuomotor functions unlike pure motor function involve the occipital, parietal-spatial, frontal-motor cortex and other brain areas. Visual constructional ability depends on the integration of several higher order brain functions including perception, planning and motor coordination. It is compromised in schizophrenia. Schizophrenics come up with difficulties in building, assembling and drawing objects.

The right parietal lobe forms the underlying biological basis for Visuospatial functions. The role of posterior frontal lobes in visuo-constructive and praxic functions cannot be ruled out as they work in unity. Studies show moderate level of deficits in all these functions (Tracy et al. 2001; Goldberg et al., 1993) Constructional and visuospatial functions are more severely affected than other functions in schizophrenia.

A study was conducted by Bozikas et al (2004) to compare performance on Clock Drawing Test in patients with Schizophrenia with that of normal controls. Qualitative analysis of the clocks drawing performance of the patients with Schizophrenia revealed that they had difficulty placing numbers in the correct position, failure to indicate the minute targets, displacement of the minute hand from the minute number, and failure to draw a longer minute hand. Such errors were related to frontal lobe dysfunctions.

Perceptual acuity in the Visual modality is mostly compromised (Butler, Silverstein and Dakin, 2008). Schizophrenics encounter difficulties in visual processing and visual perception. Contrast, contour, form and motion processing in schizophrenia gets highly compromised. Such deficits directly implicate deficits in object recognition, grouping, perceptual closure, phase processing and reading.

In 2017, Edward et al conducted a comparative study on Visual-Motor Perceptual Dysfunction between individuals exhibiting Positive and Negative Symptoms of Schizophrenia. They came to the conclusion that Negative Schizophrenia had more deficits than Positive Schizophrenia. Rotation was seen more often in patients exhibiting Negative symptoms of Schizophrenia than patients in florid phase of Schizophrenia.

METHOD

Participants

30 adults participated in the study, out of whom20 belonged to the Normal Control Group (Screened through GHQ-28). The remaining 10 belonged to the Clinical Population. Their symptoms were screened through PANSS.

PROCEDURE

The Normal Population was provided with Information Schedule and Informed Consent Forms which they filled in themselves. The basic socio-demographic information for the Psychiatric Population was collected from the patients' family members and/or caregivers. It was a comparative study with a between-group design. It took around 1 to 1.5 hours to completely administer all the tools. Specific instructions and required stationery was provided to the participants for each specific test .30 individuals agreed to participate in the study. GHQ = 28 was administered to screen the 20 Normal Controls and the 10 Clinical Patients underwent screening through PANSS to confirm diagnosis of their symptomatology. After the data were properly scrutinized, they were scored according to the different scoring systems / keys available for the different Performance Tests used for the present study. All the scores were arranged on excel sheets. They were statistically analyzed with the help of SPSS (Version 16).Pearson Product Moment Correlation was calculated for both Normal and Clinical group. For both the groups, correlation was found out between Memory and Response Inhibition with Visual-Motor Functioning, Visuo-Constructional Ability and Perceptual Acuity. Graphical representations of Correlation were provided for the Normal and Clinical Group. Results were discussed. Necessary conclusions were drawn.

MEASURES

Detailed Information Schedule

The Detailed Information Schedule for Normal Controls consisted of basic socio-demographic details along with History of individual and family Physical and Mental Illness. For Individuals with Schizophrenia, other than the basic socio-demographic details, the detailed information schedule included Chief Complaints, Diagnosis, Medication, Duration of Illness, Family history of Psychiatric Illness etc.

Bender Visual Motor Gestalt Test

Famous Child Psychiatrist Lauretta Bender originally developed the Bender Visual Motor Gestalt Test (abbreviated as Bender Gestalt Test), in 1938 to assess visual – motor functioning, developmental disorders and neurological impairments, by extensively covering the age range from 3 years to old age in humans. The eight B – G designs scored by Pascal-Suttell and Koppitz system proved to be highly inter – correlated with a very significant positive correlation (r=0.92).

PGI – Memory Scale

The PGI Memory Scale was constructed and standardized in 1977. It is one of the sub-tests included in the PGI-Battery of Organic Dysfunction (PGI-BBD) developed by Pershad, 1977; Pershad and WIgg in 1988. It attempts to measure verbal and non – verbal memories from the neurological perspective; very short term, short term and long term memories on the basis of empirical evidences and remote, recent and immediate memories to facilitate clinical practice of evaluation of memory. PGI Memory scale was found to share a significant positive correlation with both Boston Memory Scale and Wechsler memory scale. Its test – retest Reliability over a period of 1 week and Split-Half reliability indicated significant positive correlations for both ten subtests and for the total test respectively.

Clock Drawing Test

The Clock Drawing Test (CDT) is a simple and ecological neuropsychological instrument that is used to assess visuospatial abilities and praxis. In order to correctly draw a clock, patients have to follow directions, comprehend language, visualize the proper orientation of an object, and execute normal movements along with having proper numerical knowledge. The inter-rater reliabilities of the CDT were determined in elderly people in Brazil by scoring their CDT Performance using Shulman and Sunderland methods of scoring CDT. Out of these, one scored the tests using Shulman's method, while the others compared the accuracy of Shulman and Sunderland scoring system and determined the inter-rater reliability of CDT performance. Good inter-rater reliabilities were reported from the findings. The Shulman score had the highest correlation with the MMSE scores of elderly population from Brazil. The Shulman Method also significantly correlated with and Sunderland methods of scoring the CDT performances.

Stroop Color and Word Test

The Stroop Color and Word Test (SCWT) is a neuropsychological test extensively used to assess executive dysfunctions with a special focus on response inhibition and shift in response set. It was developed by Golden and Freshwater in the year 2012. Stroop Effect is a phenomenon that was described by Stroop, after whom the test is named in the year 1935. It refers to the ability to inhibit cognitive interference arising from the processing the characteristic of a specific stimulus which impedes and competes with the simultaneous processing of that of a second stimulus. Golden (1975) reported that the Stroop Scores were found to be highly reliable and consistent when the test was administered both at the individual and group level.

Nahor Benson Test

It is a sub test included in the PGI Battery of Brain Dysfunction (PGI-BBD)(Persad and Verma, 1978) developed by Nahor and Benson in 1970. There are 8

card in this test, Five cards contain a design that each that the participant is required to copy. The remaining three cards contain instructions to be followed. In those three cards, subjects are required to draw shapes of objects .According to Pershad and Verma, (1978) participants diagnosed with having brain dysfunction reproduced and made more incorrect drawings when compared to their matched healthy counterparts. These findings implicate the clinical utility of this test in the context of neurocognitive measures.

General Health Questionnaire – 28

Developed by Goldberg and Hillier in 1979, the GHQ-28 is mainly used as a screening tool to detect people who are likely to have or to be at the risk of developing psychiatric disorders in the 4 domains namely Anxiety, Depression, Insomnia and Somatic Complaints. It consists of 28 items, scored on a 4-point rating scale. It is an easy and convenient way to measure emotional distress in medical settings. From the psychometric point of view, Test – retest reliability has been reported to be high (0.78 – 0.9) with significant Inter – rater and Intra – rater reliability (Cronbach's α = 0.9 – 0.95). High internal consistency of the items in GHQ-28 has also been reported.

Positive and Negative Syndrome Scale

The PANSS was developed by Stanley Kay, Lewis Opler and Abraham Fiszbein in the year 1987. It serves to be a valid instrument for screening and assessing the severity of schizophrenia symptoms As far as the psychometric properties of PANSS is concerned, Kay, 1990; Kay et al 1987, 1988 have reported significant Test – retest Reliability for the total score and the 3 subscales of PANSS.

RESULTS AND DISCUSSION

Result Table 1: Showing Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual – Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Normal Control Group

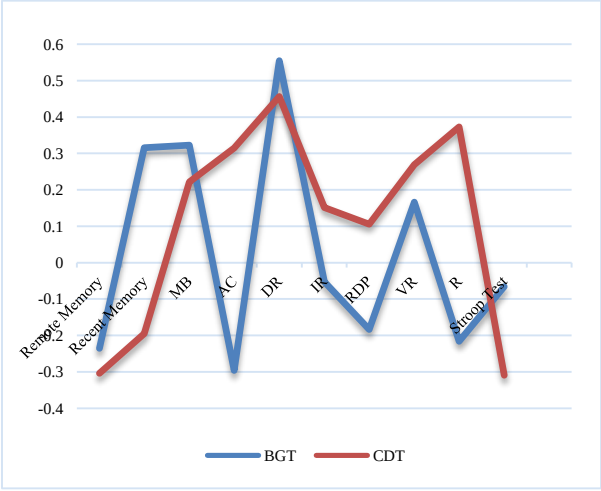
Varia-bles	Remote Memory	Recent Memory	MB	AC	DR	IR	RSP	RDP	VR	R	Stroop Test
BGT	-0.235	-0.316	-0.32	-0.29	0.555*	-0.05	a	-0.18	0.166	-0.216	-0.066
CDT	-0.304	-0.195	0.222	0.315	0.456*	0.151	a	0.106	0.269	0.373	-0.309
NB	a	a	a	a	a	a	a	a	a	a	a

*Correlation is significant at the 0.05 level (2 – tailed)
a. At least one of the variables being constant, Correlation could not be computed

The correlational matrix shows that there is a significant positive correlation between Visual-Motor Functioning and Visuo-Constructional Ability with Delayed Recall ($p<0.05$ level) within Normal Control Group. Positive correlation was found between Visual-Motor Functioning and Visual Retention, Visuo-Constructional Ability with Mental Balance and Attention and Concentration, Immediate Recall, Retention of Dissimilar Pair, Visual Retention and Recognition. Visual-Motor Functioning was found to negatively correlate with Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Retention of Dissimilar Pair, Recognition and Response Inhibition. Visuo-Constructional Ability was found to negatively correlate with Remote Memory, Recent Memory and Response Inhibition

There is evidence to support that visuo-motor adaptation is a cognitively demanding task **(**Eversheim and Bock, 2001; Taylor and Bond, 2015).One cognitive process that may play a role in visuo-motor adaptation is Spatial Working Memory. The computed values of correlation between Visuo-Constructional Ability and Delayed Recall domain of Memory Functioning was found out to be 0.456, indicating a significant positive correlation between Visuo-Constructional Ability and Delayed Recall domain of Memory Functioning at 0.05 level of significance. Three important components of visuospatial construction have been identified by cognitive psychologists, namely spatial working memory, flexibility in the use of spatial reference systems and object organization. These components are crucial for defining spatial properties and flexibility and organization of objects and configurations. All these component abilities are likely to be important for performing adequately on pattern-construction tasks**.** **(**Just and Carpenter, 1985; Pani et al, 1994, 1999)

Fig 1(a): Graph Showing Correlation of Variables within Normal Control Group



Graphical Representation of Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual- Motor Functioning and Visuo – Constructional Ability within Normal Control Group

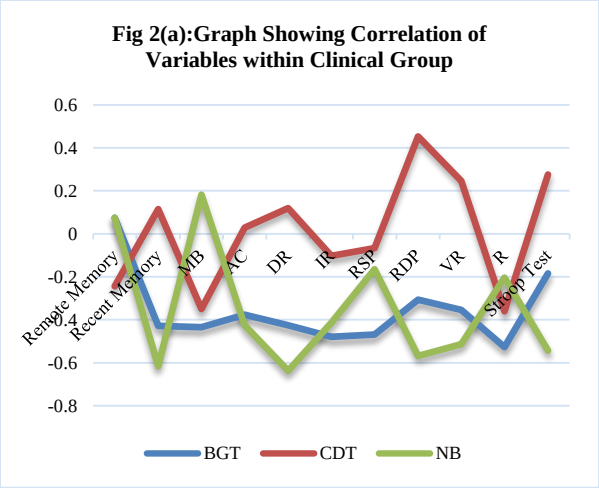
Result Table 2: Showing Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual – Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Clinical Group

Varia-bles	Remote Memory	Recent Memory	MB	AC	DR	IR	RSP	RDP	VR	R	Stroop Test
BGT	0.074	-0.428	-0.434	-0.377	-0.425	-0.479	-0.469	-0.307	-0.254	-0.527	-0.185
CDT	-0.244	0.115	-0.35	0.028	0.119	-0.102	-0.066	0.453	0.246	-0.36	0.275
NB	0.074	-0.616	0.182	-0.425	-0.637*	0.414	-0.165	-0.569	-0.513	-0.204	-0.543

*Correlation is significant at the 0.05 level (2 - tailed)

The correlational matrix shows that there is a significant negative correlation between Perceptual Acuity and Delayed Recall ($p<0.05$ level) within Clinical Group. Visual-Motor Functioning was found to positively correlate with and Remote Memory. Similarly, Visuo-Constructional Ability positively correlated with Recent Memory, Attention and Concentration, Delayed Recall, Retention of Dissimilar Pair, Visual Retention and Response Inhibition. Positive correlation was also found between Perceptual Acuity and Remote Memory, Mental Balance, Immediate Recall. However there was negative correlation between Visual-Motor Functioning, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Retention of Similar Pair, Retention of Dissimilar Pair, Visual Retention, Recognition and Response Inhibition. Visuo-Constructional Ability was found to negatively correlate with Remote Memory, Mental Balance, Immediate Recall, Retention of Similar Pair, and Recognition. Perceptual Acuity was found to negatively correlate with Recent Memory, Attention and Concentration, Retention of Similar Pair, Retention of Dissimilar Pair, Visual Retention, Recognition and Response Inhibition.

After analyzing the results, significant negative correlation was found to exist between Perceptual Acuity and Delayed Recall (r=-0.637) at 0.05 level of significance. Performance on tasks pertaining to object and spatial visual perceptual discrimination was more impaired for the clinical population in comparison to that of the Normal Control. The posterior brain areas that mediate visual-perceptual processing and the Pre-Frontal areas involved in the active maintenance of information during delay intervals are compromised in Schizophrenia, as implicated by findings.



Graphical Representation of Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual-Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Clinical Group

CONCLUSION

Significant association of neurocognitive deficits in visual-motor functioning, memory functioning, executive functioning, visual-constructional abilities and perceptual functioning were found in persons with Schizophrenia after conducting the present study. As far as the present study was concerned, the schizophrenics who were in Partial Remission Phase exhibited greater deviations in the dimensions assessed in the current study.

Certain limitations such as limited sample size, gender differences, and limited age range of participants could not be completely overruled. A formal Neuropsychological assessment in individuals with psychosis is recommended to determine the level of severity of functional impairment.

Cognitive deficits may serve as identifiers and early predictors for individuals who are at risk for the disease. They can help in monitoring the clinical course of the illness, and in determining the prognosis of the disease. The cognitive deficits worsen the functional status of the individuals more directly than their psychotic symptoms. Therefore Clinical Psychologists and Neuropsychologists should work together to improve the cognitive functioning. Better quality of life of patients, less dependence on psychiatric care and fewer hospital admissions can be achieved (Wykes et al 1999). Cognitive Remediation Therapy should be introduced in this context.

Future work should be focused on a larger sample size. Gender differences should be explored. Cognitive impairments in other types of psychotic disorders like

Mood Disorders (Major Depression, Bipolar Disorders) should be explored and compared with that in Schizophrenia. How Cognitive deficits compromise Planning, goal-directed behavior and Insight in Schizophrenia, should be researched upon. Finally the effect of cognitive dysfunction on social functioning and social skill acquisition also needs to be explored. The area of Cognitive Remediation Therapy is required to be explored more. The benefits of it should be made customizable and equitable to the specific needs of patients with cognitive dysfunctions.

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Original Research Article

Development of Affective and Cognitive Decision Making Inventory in Indian work Setting

Aayushi Sharma[1] and Anand P. Singh[2]

ABSTRACT

Objective/Aim: The purpose of this study was to construct a decision making inventory to assess the level of decisional ability at work and to validate its psychometric properties respectively. The inventory was designed to measure two core indices i.e. Cognitive, which foresee the logical aspects of decision making and Affective, which foresee the emotional aspects of decision making at workplace. **Method:** Purposive sampling was used to gather data. For standardization of the items the scale was distributed amongst eminent scholars and OB practitioners. 504 working professionals completed the ACDMI. **Result:** Face validity, Content Validity and Construct Validity were found to be significant. ACDMI had good internal consistency. **Conclusion:** ACDMI is a 5 - point likert scale which consists of 28 items, 15 items in cognitive index and 13 items in affective index with positive and reversed scoring.

Keywords: *Cognitive Decision Making, Affective Decision Making, Inventory, Indian Work Setting*

INTRODUCTION

Modern organizations operate in a dynamic, multifaceted and unprecedented environment. To survive and grow in conditions of intense competition, businesses must exhibit characteristics that enable them to swiftly recognize and capitalize on market opportunities and to adapt effectively to changes in their immediate and distant environments(Meredith & Francis, 2000). Therefore, it stands to reason that companies' capacity to adapt to changes in the business environment and, more specifically, their capacity to satisfy the demands of individual clients, is a necessary condition for both survival and, in the long term, competitive advantage. Moreover, to sail in this fierce market organizations should be proactive in enhancing their capabilities and must possess the necessary skills to adapt & adjust.

It is evident through literature that in today's complex and dynamic knowledge-based society, decision-making is one of the most essential competencies for organizational echelons(Bavol'ár & Orosová, 2015; Gehani, 2002). In particular, complicated decision-making with several diverse players and stakeholders frequently occurs in leadership. Based on their beliefs and interests, organizational echelons must recognize and select optimal options.

Making a choice involves selecting from a range of options. The human mind is unquestionably the most intricate structure known, with billions of people indulging in multifaceted decision-making every day (Trafton, 2019). Many of our decisions are prosaic and are the result of habitual behaviour; some are hasty judgments' made quickly and without much thinking, while others—the most imperative ones—are made after thorough consideration of all pertinent information and its implications (Fischhoff & Broomell, 2020; Mellers et al., 1998). It is true that there is a thin line separating a good decision from a bad one, indeed the effectiveness of a decision can only be inferred once the outcome is revealed.

As quoted by the authors of the entitled paper Decision making is defined as an individual and social phenomenon which entails the selection of one behavioral action from among two or more possibilities. It requires deliberate processing of both cognitive and affective component of human functioning to efficiently progress towards desired state of affairs. In other words, the process of Decision-Making is termed as the culmination of deliberation and the initiation of action. It is grounded upon factual and value premises of the decision maker.

Individual and organizational performance & success are contingent on effective and efficient decision-making. If we do not judiciously detect and handle problems, the cost to our time, health, customers, or economic well-being will be indeed very high and counterproductive. At every decisional level decision making is a crucial work competency. To sustain in this cutting-edge environment it is imperative for every organization specially those that are knowledge intensive to provide training and re-training of such skill to their employees.

Paradigms of Decision Making

The Literature offers several perspectives and theories on decision-making. From a managerial perspective, the decision- theory is categorized on three school of thoughts Reductionist, Pluralist, and Contextualist (Tetlock, 1990). Realistic principles underlie the Reductionist school of philosophy. This viewpoint evaluates any variance from rationality; it entails the philosophy of 'the economic-man'. All aberrations are

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viewed as cognitive biases when it comes to making judgments. Reductionist school of thought views a decision through mathematical, laboratory lens(Edward 1954; Edward 1961; Tversky and Kahneman 1974; Kahneman and Tversky 1979; Nisbett & Ross, 1980) Pragmatism is central to the Pluralist philosophical system. The effects of bounded rationality, interpersonal conflict, and executive decision-making at workplaces are studied through pluralist research (March G. & Simon A., 1958). The contextualist paradigm employs phenomenology. The emphasis is not on normative idealism. According to this school of thought subjective views, common ideologies, and cognitive frameworks are much imperative than ex ante decisions. This approach has a process-oriented viewpoint. It indicates that the process of decision-making is more imperative than the result.

Primarily, research on decision-making centered on normative models. Such models suggested how individuals should make judgments and projected the effectiveness of those decisions based on whether or not real-world behaviour mirrored laboratory behaviour (Beresford & Sloper, 2008). Recently, naturalistic descriptive models have been created that place equal emphasis on the role of experience and human skill in decision making and the characteristics of the context in which decisions are formed because the ideology behind the earlier theories were too primitive and static to account for the way individuals make choices in the real world. (Cannon-Bowers, Salas, & Pruitt, 1996; Zsambok & Klein Gary, 1997 ; Patel, Kaufman, & Arocha, 2002; Beresford & Sloper, 2008)

1. Rational Decision-making Model This paradigm accommodates logical approaches to decision-making. This is in accordance with Economic Theory and Utilitarianism. It is assumed that a "Economic Man" makes decisions logically and considers the decision's highest utility. For individuals in organizations looking to gain the most, this approach might be regarded as the ideal one. Under the classical model, each alternative is given a numerical value or utility during the "choice" phase. The alternative with the greatest utility (or the greatest subjective predicted utility) is preferred (Turpin & Marais, 2004).

2. Bounded rationality decision-making model Herbert Simon's Bounded Rationality paradigms of decision making (1955) acknowledged the limitations of the rational model. The prevalent misconception that being economical was similar to being reasonable is acknowledged by the decision-making paradigm of bounded rationality. This paradigm is based on the understanding that human knowledge & abilities are constrained and lack in certain important ways. The idea of bounded rationality indicates that decision-makers must be adaptable in their rational approach. According to this approach, individuals consciously restrict their choices to a manageable number and select the first acceptable option without completing a comprehensive search of alternatives. Bounded rationality is characterized by the search and satiation processes. An option is said to "satisfice" and the search is regarded to be finished if it satisfies some implicitly or explicitly given minimal criterion.

3. Intuitive Decision-making Model As an alternative to conventional decision-making models, the intuitive decision-making paradigm has emerged. This approach relates to decisions made without conscious deliberation. 89% of managers who responded to the survey reported employing intuition at least occasionally, and 59% claimed they did it frequently (Plessner, Betsch, & Betsch, 2007).

The intuitive decision-making model posits that in a certain circumstance, decision-makers rely on the surroundings for clues to identify patterns. Once a pattern is identified, they can simulate a potential course of action to its conclusion based on their existing knowledge. From a neuroscience perspective, this paradigm follows to the right brain approach. This approach employs intuitive tactics and frequently prioritizes sentiments over facts. Even when knowledge is insufficient, right-brained decision-makers employ an unstructured and impulsive process to examine the whole rather than its components (Sauter, 1999).

Affective Cognitive Dominance in Decision Making

There have been several attempts to cast light on the link between affect and cognition in managerial decision-making. For instance, Blanchette & Richards, 2009 analyzed a plethora of studies to determine if and how affective systems impact cognitive mechanism. These researchers concluded, in particular, that cognitive biases are mostly associated with anxiety and that (high/low) perception of risk is also impacted by affective states. Furthermore, according to them, affect can impede normatively accurate reasoning, while in other instances they enhance it. In a similar line, Lochner, 2016 inferred that negative and positive emotional states had a substantial influence on reasoning skills. Conversely to the above opinion, another set of researchers asserted that cognitive systems are superior to affective systems. Grecucci et al., 2020 postulated and confirmed that cognitive methods are capable of altering emotional states However, a third group of scholars held the notion that emotions and cognition could not be assessed independently and that the debate over affect and cognition should instead be viewed through the lens of dynamic interaction, with the cognitive and affective

domains being seen as two sides of the same coin. (Gosling et al., 2020)

In an expanding number of contexts, psychological research on decision making has proven that dual process models are more effective at describing behaviour than unitary models (e.g., (Chaiken & Trope, 1999) (Kahneman, 2003) (Sanfey et al., 2006) (Scherbaum et al., 2022) In addition, the neuroscience literature demonstrates a growing number of distinct neuronal systems in the brain that contribute to decision-making and behaviour. Moreover, Economics literature also infers the increasing impact of multi-system approach to decision making (Sanfey et al., 2006, Lee, 2013, Grecucci et al., 2020).

Cognitive Decision-Making (CDM) As quoted by the authors of the entitled paper Cognitive decision-making is a technique in which decisions are drawn on logical algorithm, refraining from influence of sentiments or non-logical factors to arrive at solution. CDM entails comparing several possibilities or alternatives with the aid of objective research, facts, and other data. When making decisions, rational decision-making prioritizes logic over affect. Decision makers who predominantly evaluate a problem through a cognitive lens rely on methods of deductive reasoning.

Affective Decision-Making (ADM) As quoted by the authors of the entitled paper Affective decision-making (ADM) involves making decisions based on instinct, incidental & integral emotions. Affective decision-making is selecting among alternatives without using logic or analysis. It entails making judgments based on emotions or inadvertently recalling a memory. In contrast to CDM, Affective approach expedites decision-making because it eliminates time-consuming algorithmic processes.

Upon analyzing the classical, neoclassical and modern paradigms of decision making and related literature we observed the dearth of measurement instruments in this field in Indian work settings. Despite significant shortcomings in its assessment, numerous scholars believe that decision-making is at an intriguing turning point. In light of the fact that individuals often have very little knowledge about the variables that influence their decisions (Bordley, 2001), it appeared crucial to construct and evaluate a questionnaire to gather data for two purposes: (1) to identify the primary factors that contribute to and inhibit decision making. (2) To assess the individuals predominant approach to decision-making. But because real decisions are complicated and made by people from all walks of life and professions—such as those in healthcare, corporate, education, and government—it is believed that it would be more beneficial to develop a questionnaire that could be used in the Indian workplace, specifically among corporate.

Theoretical Model of ACDMI

Organizations are considered as decision-making systems, with an emphasis on how they choose among possible courses of action. Decision-making and problem-solving are required of by members' at all organizational tiers. These responsibilities are an integral element of a employees' job. Decision making serves to orient human behaviour and commitment toward a future objective. There are two types of decisions made at work: programmed decisions and non-programmed decisions (Fig. 1). Decisions that are programmed are recurrent in nature. These choices address straightforward, typical, and commonly occurring issues that are addressed by established processes. Non-programmed decisions are not certainly routine. They pertain to exceptional circumstances for which no set processes exist. An individual can rationally or emotionally assess programmed and non-programmed decisions depending on the nature of the problem, the circumstance, the time constraints, and the individual's abilities. Through the aforementioned model representation, it is demonstrated that a predominant cognitive approach to decision making is employed when a programmed or non-programmed work decision is based mostly on logical algorithm, refraining from the effect of feelings or non-logical variables to arrive at solution. On the other hand, predominant affective approach to decision-making is utilized when an individual bases their choice on emotion, sentiments, and personal preferences without considering any logical considerations.

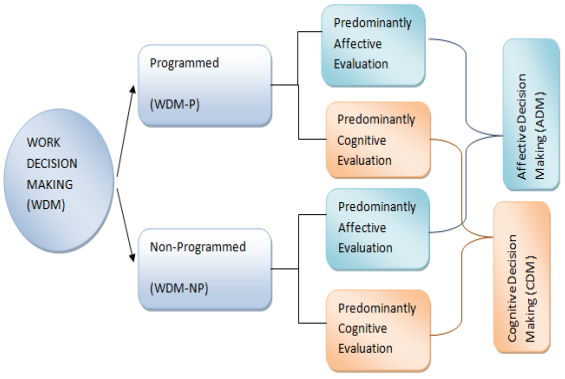

Figure 1: Showing the theoretical model of Affective Cognitive Decision Making Inventory

METHOD

AIM

The present research describes the conceptualization, construction and validation of Affective Cognitive Decision –making.

DESIGN

A mixed method research design, was considered appropriate for a study of this kind, it encompassed both qualitative and quantitative facets. Figure 2 depicts the phases of ACDMI development as a whole. The final ACDMI scale, which has 28 items, was developed by following an integrative version that underwent numerous iterations of improvement.

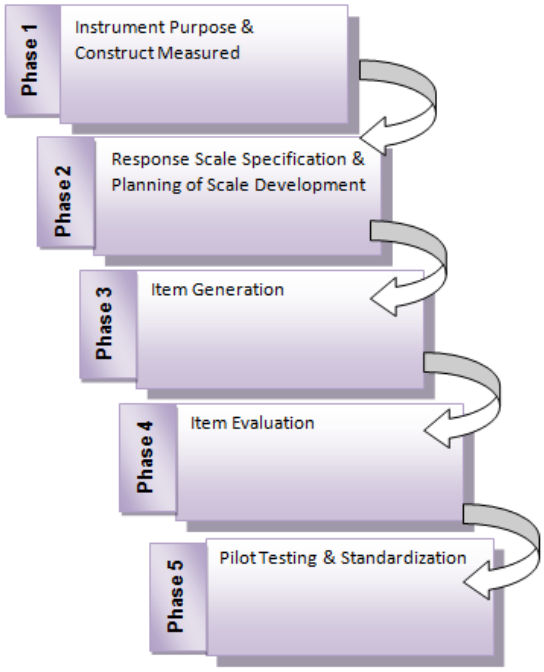

Figure 2: Showing the phase manner development of Affective Cognitive Decision Making Inventory (ACDMI)

SAMPLE

This study aimed to develop a decision making questionnaire to measure the level of decisional competence at work and validate its psychometric features. HR Personnel were the targeted population for this study. Purposive sampling was used to choose the sample. The questionnaire on decision-making was completed by 504 HR managers. The selected sample has at least a bachelor's degree and falls between the ages of 25 and 60. There were no racial, social, or gender-based barriers.

MEASURES

The Affective Cognitive Decision Making Inventory (ACDMI) is a self-report scale that attempts to measure two key indicators, namely cognitive and affective, which predict the logical and emotional components of individual decision-making. It has 28 items that uses a 5-point likert response scale, where 1 represents very infrequently, 2 seldom, 3 neutral, 4 often, 5 very frequently. Out of twenty eight items 9 items are reversed score. Statements like 'while making decision at work I think clearly and precisely at eleventh hour', 'I am governed by my own feelings of right and wrong' are included.

PROCEDURE

The questionnaire was produced over five distinct phases. The goal of the first step was to specify the construct being measured as well as the intent behind the instrument. As a result, a thorough assessment of the scientific literature on the concept of decision making was conducted using the ERIC, Scopus, Pubmed, and Jstor databases. Based on the findings of this analysis, we were able to get a thorough understanding of the variables that have the greatest effect on decisions as well as gained information on the decision-making scales that are now in use. The second phase began with the planning of scale development and the specification of the response scale. Questions about the planning of scale development were addressed after examining the evaluation of relevant material and advice provided by a subject-matter expert. (1) What number of items is required? (2)Which response scale is suitable? (3) The type of statements, such as closed-ended or open-ended inquiries. (4) The method of test administration (eg. Self report scale). The third and fourth phases were item generation and item evaluation. We intended to generate an initial item pool with many more items than the anticipated final scale. This phase allowed us flexibility with regard to the psychometric standard of the components that made it to the final scale. Regarding item generation, the five processes outlined in Handbook of Survey Research were adhered to. Following that, a thorough list of possible indicators of the target construct was created (n=60). The produced items were evaluated for quality and relevance by a panel of experts from the psychology and management fields as well as by upper organizational echelons (HR Managers). The 60 items were reviewed by five experts to eliminate redundancy, identify unclear or awkwardly phrased questions, discover phrases that would be difficult to comprehend and address any general questionnaire issues with regard to presentation, etc. We modified certain phrases, dropped some items, and adjusted the response interval range based on the quantitative and qualitative suggestions made by the experts. These two phases combined to produce a decision-making questionnaire with 28 items that were divided into two indices or subsets: the affective index and the cognitive index. The questionnaire's items are graded on a Likert scale of 1 to 5, with 1 denoting very infrequently and 5 denoting very frequently. The questionnaire has both negative and positive worded statements with different scoring patterns. In the fifth phase, pilot testing and data analysis were used to determine the psychometric

parameters. Samples of 504 working professionals, ranging in age from 25 to 60, were preferred for the pilot test. The information was acquired through a Google form link and by giving out paper forms to HR managers. Three individuals' responses were withheld from the final analysis after data collection. We then determined reliability, means, correlations, and executed a factor analysis. In the result section, the outcome of this statistical study is further explained.

RESULT

The Affective Cognitive Decision Making Inventory (ACDMI) which consists of 28 items in its final version was administered on a sample of five hundred (n=504) employees, those who were working on managerial level to collect the responses. Out of sample size of 504, two hundred eighty five represented male and two hundred fifteen represented female gender. All the sample which were included in the study were ensured to be having at least graduation level of education with equal number of representation of age group 25-35, 36-46, 47-60, hence the sample with matched aged and education level from both the gender was included in the study.

To establish the psychometric properties of the Affective Cognitive Decision Making Inventory pertinent reliability and validity measures were applied. Reliability analyses were examined through cronbach alpha for internal consistency. The Alpha Coefficient varies between 0 and 1. Cronbach's Alpha based on standardized items was determined to be 0.81 for the current scale. George , 2003 stated that the coefficient alpha of the scale is rated as inadequate if it is below 0.50, doubtful if it is between 0.50 and 0.60 acceptable if it is greater than 0.70, good if it is greater than 0.80 and extremely reliable if it is greater than 0.90. The reliability of the entire scale is within the good range, according to the aforementioned interpretation.

Table 1: Showing the Cronbach's Alpha Reliability Statistics for ACDMI

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.777	.808	28

Followed by reliability analysis, validity analysis was done by the measure of face and content validity (Expert Judgment) for the data and tool as a whole. As a result of the experts' and respondents' assessment, it was inferred that the scale had good face validity. Both face validity and content validity was analyzed statistically through Fleiss Kappa method. Fleiss Kappa method is utilized in case where there are more than 2 raters. The Kappa value for the scale if less than 0.20 denotes strength of agreement as poor, between 0.21 - 0.40 fair agreement, 0.41 – 0.60 moderate agreement, 0.61 – 0.80 good agreement and 0.81 – 1 is denoted as excellent strength of agreement (Landis and Koch, 1977) . Because Affective Cognitive Decision Making Inventory kappa coefficient value was calculated to be 0.78, it can be concluded that the scale has good strength of agreement among raters.

Furthermore Factor Analysis (FA) was used to reflect upon the construct validity of the scale. FA is a statistical method where items are clustered into common factors on the basis of loadings crossing a certain threshold. To examine the items and details of assumed factor structure principal component analysis method with varimax rotation is carried out.

The Kaiser- Meyer- Olkin (KMO) is used to examine the partial correlation between variables. If KMO value is closer to 1 it indicates strong partial correlation, factor analysis can therefore be justified. In other word KMO and Bartlett's test of sphericity are prerequisite to Factor Analysis. For the present scale KMO was calculated to be 0.887, which is above the threshold limit of 0.6. Bartlett's test of sphericity $X^2 = 5876.230$ is greater than the critical value; hence there is a significant difference in the variance among items. In addition to this the p value is less than 0.05 which too indicates significant difference (shown in table 2).

Table 2: Showing the KMO and Bartlett's Test statistics to measure sampling adequacy of ACDMI

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.887
Bartlett's Test of Sphericity	Approx. Chi-Square	5876.230
	Df	378
	Sig.	.000

The preceding table illustrates enough association between the items/variables to perform a factor analysis. The anti-image correlation matrix also demonstrated that each individual item's measure of sampling adequacy is much more than the threshold value of 0.5, which supports the use of factor analysis for the data. Likewise, it was discovered that communalities had a mean value greater than.6, which is considered to be a sufficient indicator of sample adequacy.

Factor Analysis with varimax rotation was used. The items in the scale were grouped into five factors. The variation explained by that component is taken into consideration by the Eigenvalue, which is actually the sum of the squares of the factor loadings for each factor. The greater the overall variance value, which is the factor's Eigenvalue or characteristics root, the more variance the component explains. In this study, five components with Eigen values over one were retrieved

and arranged in accordance with the maximum variance explained (table 3). Further analyzing the above factor it was observed that items under factor 1 and factor 4 shares same characteristics in nature which is integrated into 1st category i.e. affective component. Similarly factor 2, 3 and 5 possess comparable qualities thus, these factors are merged into 2nd category i.e. cognitive component. In conclusion to the above the items of the scale are divided into two major indices that is affective index and cognitive index.

Table 3: Showing the total extracted factors and variance explained by each factor

Extraction Sum of Square Loadings			
Components	**Total**	**% of Variance**	**Cumulative %**
1	7.311	26.112	26.112
2	4.732	16.901	43.014
3	1.276	4.559	47.573
4	1.192	4.256	51.828
5	1.069	3.819	55.647

DISCUSSION

The present paper describes the conceptualization, development and validation of a relatively new instrument intended to measure affective and cognitive decision making at managerial level in Indian work setting. This questionnaire was developed considering the theoretical definitions of both the indices and after an intensive literature review in this field (Epstein, 1994; Turpin & Marais, 2004). Decision making is defined as an individual and social phenomenon which entails the selection of one behavioral action from among two or more possibilities (Bruch & Feinberg, 2017). It requires deliberate processing of both cognitive and affective component of human functioning to efficiently progress towards desired state of affairs. The questionnaire was developed and its validity and reliability were analyzed.

The study aimed to test the internal consistency, content validity and construct validity for the items of affective cognitive decision making inventory. The reliability of the entire scale was found to be within the good range through cronbach's alpha statistics. The validity analysis was asessed by the measure of face and content validity (Expert Judgment) for the data and tool as a whole. As a result of the experts' and respondents' assessment, it was inferred that the scale had good face validity. Both face validity and content validity was analyzed statistically through Fleiss Kappa method. It was inferred that the scale has good strength of agreement among raters. The result obtained using kappa suggested that modifying some statements in the scale would enhance the validity. Furthermore, construct validity was assessed through factor analysis. The questionnaire's structure was well defined by the exploratory factor analyses, which also supported the findings of other writers (Gomez et al., 2022; Rattray et al., 2007). Following that, and in the sequence of their occurrence in the questionnaire framework, we shall discuss two key factors of the questionnaire that is, the affective component and cognitive component. If an individual's work decisions are predominantly cognitive then it means that the decisions are drawn on logical algorithm, refraining from influence of sentiments or non-logical factors to arrive at solution. Alternatively, individuals whose decisions are predominantly affective in nature usually involve making decisions based on instinct, incidental & integral emotions. Affective decision-making is selecting among alternatives without using logic or analysis.

In an expanding number of contexts, psychological research on decision making has proven that dual process models are more effective at describing behaviour than unitary models (e.g., Chaiken & Trope, 1999, Kahneman, 2003, Sanfey et al., 2006, Scherbaum et al., 2022) In addition, the neuroscience literature demonstrates a growing number of distinct neuronal systems in the brain that contribute to decision-making and behaviour. Moreover, Economics literature also infers the increasing impact of multi-system approach to decision making (Sanfey et al., 2006, Lee, 2013, Grecucci et al., 2020).

After analyzing the psychometric properties of the scale and extensive literature review the final version of the scale consist of 28 items that were divided into two indices or subsets: the affective index and the cognitive index. The questionnaire's items are graded on a 5 point rating scale where 1 denotes very infrequently and 5 very frequently. The questionnaire has both negative and positive worded statements with different scoring patterns.

The Affective Cognitive Decision Making Inventory has its application in Indian work setting and for research purpose at academic and professional level. The scale can be used to simply measure the level of decisional competency of HR managers; it can be used as one of the entry level assessment of managers; it can be used as a learning tool to train decision makers about various factors affecting decision making. It can used to determine the aspects that professionals in positions of responsibility give weight to and are continually making judgments upon. It can be used to assess the predominant factors of decision making for different types of business and work sectors.

CONCLUSION

According to the empirical data it is inferred that ACDMI has demonstrated itself to be a relatively valid and reliable instrument to examine the aspects connected to decision making. Despite this, new data must be obtained to demonstrate its technical features using larger criteria. For instance, the questionnaire's predictive validity, concurrent and divergent validity should be examined using actual decisions, along with comparisons to other existing instruments that assess related or unrelated attributes. The questionnaire also has certain constraints generated from the samples, such as the number of respondents, selection procedure, etc. Therefore, further research in this area should attempt to replicate the findings of this study using samples from different contexts. Similarly, a thorough examination of the age and sex disparities in decision-making in particular fields would be intriguing. Furthermore, the scale only evaluates managers' decision-making skills at this time. Future versions of the scale should evaluate the decision-making skills of all organizational echelons (lower, medium, and upper).

Conflict of Interest: The authors of this study state that there are no conflicts of interest that might possibly hinder the research process or the interpretation of its findings. Furthermore, we have not accepted any financing, grants, or other types of assistance from institutions or people that may have an impact on the impartiality or integrity of the study.

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Effectiveness of Thought Speed Manipulation among Young Adults

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ABSTRACT

Background: Thought speed is defined as number of thoughts one has for per unit of time. Fast Thought speed has been associated with elated mood, increased energy, arousal compared to slow thought speed. **Objective:** To study the effectives of thought speed manipulation technique in Indian Context. **Method:** Paced reading of Velten Mood Induction was used, 3 types of different statements (elation, depressive and neutral) were given to the participants in the fast and slow pace. Totally six different conditions were created. Stimulus were presented using Microsoft Power point. Perceived thought speed questionnaire and PANAS were to administered (Pre and Post Test). **Results:** Showed no significant differences when comparing pre and post test in all six conditions. **Conclusion:** Further improvement were to made in methodology when the stimulus is presented in non-native language.

Keywords: *Thought Speed, Manipulation*

INTRODUCTION

Thought speed is defined as the number of thoughts, one has per unit of time (Yang & Pronin, 2018). There is enough evidence in the literature to state the link between various psychiatric disorders and thought speed.

People with mania experience racing thoughts (Hanwella & de Silva, 2011; Mansell & Pedley, 2008) and become less concentrated on a particular thing (Camelo et al., 2013) rather they have multiple ideas popping up. Racing thoughts can also predict the manic episode (Correll et al, 2014). People with depression experience the other end of the thought speed spectrum, where sluggishness is seen in their thinking, to put in other words, their thoughts are slowed down (Caligiuri & Ellwanger, 2000). Thought speed is not always associated with Psychiatric conditions. When people consume substances like cocaine, amphetamines (Asghar et al., 2003) or even coffee (Childs & de Wit, 2006) they feel their thoughts are racing fast. When you are asked to generate ideas in a stipulated time, you may think at a faster pace (Pronin, 2008). Through systematic mood induction procedures, human mood can be altered but not everyone is susceptible to mood induction. There is a growing body of evidence showing the influence of mood on cognitive domains (Storbeck & Clore, 2005). Likewise, the effects of thought speed on the cognitive domain has been investigated.

Researchers (Pronin & Jocobs, 2008) proposed the concept of Mental Motion to address the effects of thought speed. According to the mental motion model, there are the two components are– thought speed and thought variability, where it can have independent as well combined effects. Thought speed is referred to the speed of your thoughts and variability refers to repetition or varied content. This model predicts condition-specific symptoms. For instance: Repetition of the same thought at a fast pace may lead to anxiety (Pronin & Jacobs, 2018). Experimental manipulation of people's thought speed led to producing different psychological states.

Researchers (Pronin & Wegner, 2006) manipulated people's to participant`s thought speed through paced reading and found accelerated thought speed produced a high level of elated mood, feeling of power, positive emotion and high energy compared to participants in the decelerated thought speed condition. Varies studies have reported the same findings and consistent results have been found in understanding the relationship between thought speed and mood (Pronin et al. 2008; Duff & Sar, 2015). The effects of thought speed have been seen in other cognitive domains as well, individuals showed increased purchasing interest to buy when their thoughts were accelerating (Duff & Sar, 2015). When participants were made to undergo thought speed manipulation, participants in the fast thought speed reported to have increased risk-taking behaviour, (Chandler & Pronin, 2012), they have scored high in Remote Associates Test (Insight Creativity Task) when compared to neutral condition faster compared to the slow thought speed condition (Yang & Pronin, 2018) and differences in arousal level were also seen. Thought acceleration was linked with a higher level of physiological arousal. Repetitive thoughts led to produce depression or it can maintain depression (Watkins, 2008).

The combinational effects of thought speed and variability were explained by the mental motion model, whereas slow, repetitive thought leads to depression and fast, non-repetitive (variability) leads to mania.

Adaptive theory (Yang & Pronin, 2018) states as faster thought speed leads to increased positive mood, arousal, and creative problem-solving ability which indeed acts as an action needed for survival (Pronin, 2013) and this is termed an "activation state". And decreased thought speed would oppositely produce effects. Like the fight or fight response, the adaptive theory states that the

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activation of accelerated thought leads to myriad cognitive, affective and physiological processes (Pronin, 2013; Yang & Pronin, 2018). Fast thinking leads to the firing of the dopaminergic system which leads to motivation to attain the goal and faster internal clock. speed are a few associated with increased dopamine activation. The ability to become in sync with the external cause is associated with physiological arousal and psychological processing, whereas increased thought speed is associated with this and causes changes in us, research evidence shows us that increased respiration rate and arousal were seen when the participants were made to listen to faster music (Khalfa et al., 2008). Even EEG recordings have shown us changes in different thought speeds (Duff et al., 2015). Emotional and cognitive changes were seen after thought speed manipulation.

Thought speed manipulation techniques were also used to treat individuals with depression (Kaite Yang et al., 2014). Whereas when researchers made individuals with mild to moderate levels of depression read Elation statements at a faster pace, they reported a more positive mood compared to the state before manipulation.

Because of increased interest in understanding the effects of thought speed on various psychological constructs. It is important to test the effectiveness of the thought speed manipulation technique in the Indian context to go further in the area of understanding the effects of thought speed.

The present research tries to evaluate the effectiveness of thought speed manipulation technique, this research utilizes one of the widely used manipulation tool, paced reading of Velten Mood Induction Statements. A 2 X 3 (Thought Speed vs Valence) was used. All 3 types of statements – Elation, Depressive and Neutral were taken into this research and all 3 were presented in fast and slow manner. So, there are totally 6 conditions. Example – Elation statements in fast and slow pace. The study utilized validated self-reported measures.

METHOD

The aim of the study is to see the effectiveness of thought speed manipulation. Data was collected from young adults who were currently residing in India within the age group of 18 to 25 Years. Participants were from Non-Psychology background. Participants who are physically challenged and participants with Psychiatric Illness – recently got diagnosed (for past 6 months) were not considered for this study. As, the present study's area of interest is on non-clinical population. Research shows us that difficulties in cognitive processes are seen in Psychiatric illness (Kang et al., 2014). Convenience Sampling was used for the study. Research Ethics Committee of Kristu Jayanti College has approved this study. And every participant gave their acceptance through written informed consent. A sample of 78 were collected, after analyzing the data only 55 (29 Males and 26 Females) were found to be eligible for the study. Data from 23 participants were excluded as they had made some errors they missed few responses in data sheet in data sheet (Ex. Missing one or two columns in PANAS (or) choosing two options for same questions). Between subject group design was used for the study.

The hypotheses of the study were:

H_1 – There is significant differences in pre and post test scores for thought speed and mood (All conditions).

a. There are significant differences in pre and post test scores in thought speed and mood in fast elation condition.
b. There are significant differences in pre and post test scores in thought speed and mood in slow elation condition.
c. There are significant differences in pre and post test scores in thought speed and mood in fast depressive condition.
d. There are significant differences in pre and post test scores in thought speed and mood in slow depressive condition.
e. There are significant differences in pre and post test scores in thought speed and mood in fast neutral condition.
f. There are significant differences in pre and post test scores in thought speed and mood in slow neutral condition.

The tools used for the study were i.) **Velten Mood Induction Statements:** These statements are given by Emmett C.Velten, there are totally three sets of statements– Elation, depression and neutral. Each set of statements are used to evoke mood states and in each mood statements there are totally 60 statements. ii.) **Perceived Thought Speed:** "Sometimes people have the feeling that their thoughts are coming slowly, and other times people feel that their thoughts are 'racing'. What did you feel was the speed of your thoughts, as you were reading the statements on the computer screen? This question was answered on a 9 – point scale, anchored at 1(Very slow), 5 (moderate speed), and 9 (very fast). iii.) **PANAS:** This is a self-report questionnaire, which is used to assess affect level. The questionnaire consists of 20 different emotions, the subject has to respond how they are feeling now in 5-point Likert scale it has two sub domains in it – positive and negative. Internal consistency was reported between 0.86 - 0.90 for positive affect and 0.84 -0.87 for negative affect. Test-

retest reliability was reported as 0.79 for positive affect and .81 for negative affect (Watson et al., 1988).

Descriptive statistics was used to view the data in simpler form and for easy understanding. In descriptive statistics – mean, median, range and standard deviation were taken into consideration.

Inferential statistics was used to get more precise of the data and to find conclusion about the data used. In Inferential statistics – Wilcoxon Signed Rank Test was used. Analysis was done using IBM SPSS.

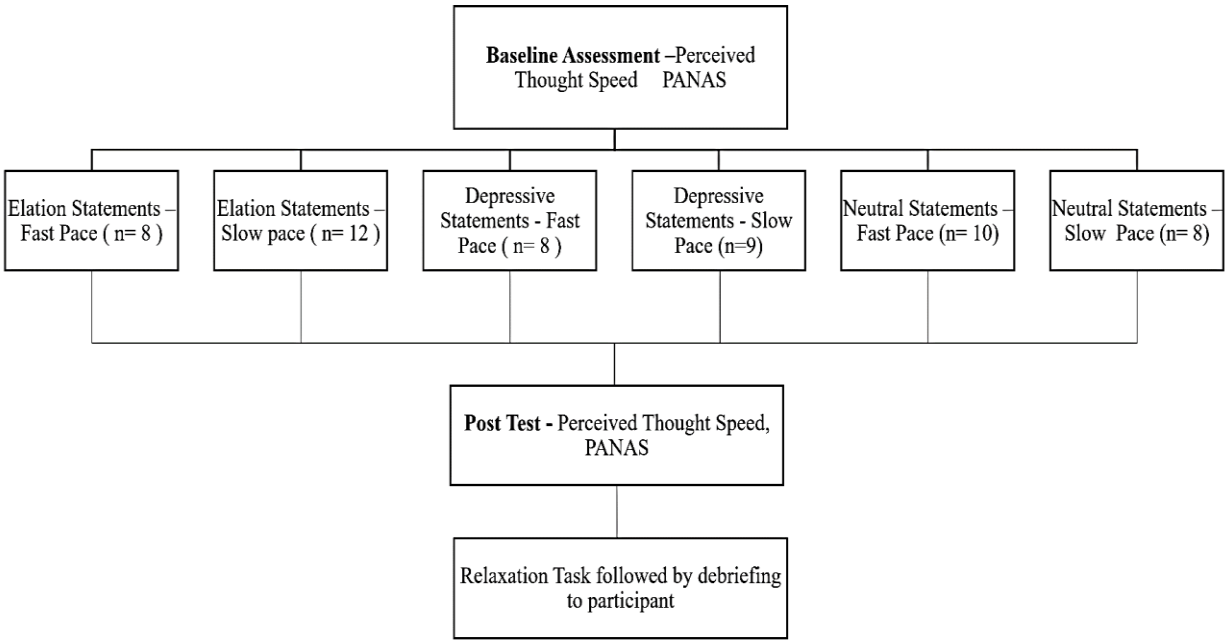
PROCEDURE

Structure of the experiment

In order to see the effects, first from the participants: consent to participant in the study was taken, then basic demographic details were collected and their base line mood and thought speed was assessed via PANAS and perceived thoughts speed subjective rating scale. After the completion of base line assessment (Pretest) , participants were made to seat in front a laptop and following instruction were given for Mood and thought speed induction,

"Once you get started, you will see a series of statements presented one word at a time on the screen. Read each word of each sentence aloud as it appears. Don't worry if it takes you a few sentences before you get used to it. If it's okay with you, I'm also going to tape record this for our records. Okay, I'll stay here until you get the hang of it, and then I'll come back when you're done with this part of the study. When you're ready to begin, click the mouse once, and the study will begin. And remember, as soon as words start to come up on the screen, you should be reading them". (Pronin & Wegner, 2006)

There are totally six different conditions – Elation Mood (Fast and Slow), Depressive Mood (Fast and Slow) and a Neutral Mood (Fast and Slow). Each participant was made to go through one of them.



Content Manipulation

The statements that were given to participants were adopted from Velten's (1968) procedure for mood induction. It consists of three sets of different mood induction statements – Elation, Depressive and Neutral Statements. Each particular mood induction consists of 60 statements. In this present study, we have used 59 statements in elation and depressive. One statements that talks about thought speed was deleted for the study (Pronin & Wegner, 2006). Each mood induction condition starts with neutral statements and slowly gets into respective mood induction and participants were not informed about the particular mood condition they are going to get.

Speed Manipulation

These statements were presented to participants in Microsoft PowerPoint and the statements were presented in timed manner. This study utilizes the method used by Pronin & Wegner (2006) with some modification, adding one second after completion of appearance of a statement in screen in fast condition the statements were presented in large size (Arial 44), each letter was made to appear one by one and for this particular speed was set – each letter move at the speed for 40ms (fast condition) and

170ms (slow condition). Between slides speed was fixed by taking the longest sentences in the particular mood condition and adding a one seconds for fast condition and for slow condition four seconds. Then, posttest assessment was given – PANAS and Perceived Thought Speed.

RESULTS

Table 1: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Neutral Fast using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	35.10	5.38	38.00	7.18	-1.78	0.07
Negative Affect	15.90	3.24	16.80	3.79	-0.83	0.40
Thought Speed	6.20	1.31	5.70	1.82	-0.68	0.49

As the table above shows, that pre and post-test effects of positive , negative affect and thought speed are not significant (p = 0.07, 0.4, 0.49) . Hence, the manipulation technique didn't show any statistically significant results.

Table 2: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Neutral Slow using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	31.50	6.27	28.50	5.34	-1.36	0.17
Negative Affect	20.00	5.63	17.25	4.97	-1.55	0.12
Thought Speed	5.50	2.39	4.50	1.51	-1.23	0.21

The table above shows, that pre and post-test effects of positive , negative affect and thought speed are not significant (p = 0.17 , 0.12 , 0.21) . Hence, the manipulation technique didn't show statistically significant results.

Table 3: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Elation Slow using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	35.83	6.01	36.83	7.13	-0.42	0.67
Negative Affect	18	3.56	15.50	4.38	-2.23	0.02
Thought Speed	6.42	1.31	6.08	2.50	-0.36	0.71

The above table shows, that pre and post-test effects of positive , negative affect and thought speed are not significant (p = 0.67 , 0.02 , 0.71). Hence, the manipulation technique didn't show statistically significant results.

Table 4: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Elation Fast using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	36	7.61	38.5	7.44	-0.84	0.39
Negative Affect	20.75	7.68	19.13	9.49	-0.91	0.36
Thought Speed	5.38	0.74	7	1.77	-2.23	0.26

The above table shows, that pre and post-test effects of positive, negative affect and thought speed are not significant (p = 0.39, 0.36, 0.26). Hence, the manipulation technique didn't show statistically significant results.

Table 5: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Depressive Fast using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	38.25	5.06	36.87	7.88	-0.85	0.39
Negative Affect	18	7.01	19.75	7.34	-1.02	0.30
Thought Speed	5.88	2.41	7.75	1.58	-1.68	0.09

The above table shows, that pre and post-test effects of positive, negative affect and thought speed are not significant (p = 0.39 , 0.3 ,0.92). Hence, the manipulation technique didn't show statistically significant results.

Table 6: *Shows comparison of scores between Pre and Post treatment on Positive Affect, Negative Affect and Thought Speed in Depressive Slow using Wilcoxon Signed Rank Test*

Variables	Pre Test		Post Test		Z	Asymp.Sig
	M	SD	M	SD		
Positive Affect	35.67	6.51	34.44	10.33	-0.59	0.55
Negative Affect	20.56	5.19	21.78	9.56	-0.29	0.76
Thought Speed	5.89	1.05	6.44	1.81	-1.06	0.28

The above table shows, that pre and posttest effects of positive , negative affect and thought speed are not significant (p = 0.55 , 0.76 , 0.28) . Hence, the manipulation technique didn't show statistically significant results.

DISCUSSION

The present study's aim was to see the efficiency of new manipulation technique. In this section we will highlight the potential reasons that led to that led to non-production of significant results in manipulation of the induction procedure to cause change in post-test. The non effectiveness to induction technique can be attributed to methodological weakness and other issues. The present used (Pronin., 2006) MIP, with certain modification, which didn't work as we expected and this could be due to small sample size. As, higher the sample

size increases the accuracy of the research (Andrade., 2020). Whereas the current study has a total of 55 participants and approximately 10 ± 2 in each six conditions. For some individual's mood induction technique won't response (Rottenberg., 2018), it can due to personality factors, they may have trait which is high in resisting negative experiences (Kashdan et.al., 2006) and can be due to response bias, they may be unwilling to report their sad mood. (Rottenberg et al., 2018).

Differences in affect level processing leads to non-response to MIP (Brenner et.al, 2000). Some researchers have altered the manipulation time for participant till they reach the mood induction criteria (Liotti et al. 2000), this present study didn't utilize this method.

In the present study, the research used Velten Mood Induction Procedure in fast and slow pace (Pronin, 2006), which was presented to participants in a foreign language.

Research suggests that emotional differences were felt when people converse in other foreign language. Example: Praying, lying and I love you were felt differently when people say in native and in a foreign language (Pavlenko, 2005; Dewaele, 2010). This study shows how humans are more receptive in terms of feeling emotion when it comes to a native and foreign language. This level of being receptive is seen in other studies as well where children who attend school with a strong foundation in their mother tongue develops stronger literacy abilities (Baker., 2000; Cummins., 2000). In a review paper by Pavlenko (2012), mentioned there is an emotional advantage for native language compare with foreign language. This was seen when in a European study, when advertising slogans were written in respondent`s native language, he/she felt more emotional connection than written in foreign language. (Puntoni et al., 2009). Earlier research has also stated when people read words in native and foreign language. They responded more emotional for native words (Anooshian & Hertel, 1994). When it comes to processing of words, reduced emotionality has been seen in foreign language, that they use emotional words to interfere with processing (Colbeck & Bowers, 2012). Reduced emotionality for foreign language was seen in studies (Keysar et al., 2012; Costa et al., 2014) where participants made more rational decision when evaluating a vignette written in another foreign language.

These above stated evidence shows the potential cause why the MIP didn't response as expected. But this can't be concluded by the effects of emotional dominance in native language. In India, around a quarter of Indian children go to Private schools, significant of them are taught in English medium (Ahmed, 2021; Acharya, 2021). Research shows that people who are bilinguals, was not proficient in their native language showed same level of electro dermal response in emotional words when presented with both native and foreign language. (Harris et al., 2006). In the current study, significant of the participants are bilinguals and completed their schooling in English medium. At the same time, people who are strong and proficient in their native language / first language showed increased skin conductance response for childhood reprimands in native language than in foreign language. This study suggests that when a native language is strong then increased emotionality can be seen at the same time foreign language is less proficient (Degner et.al., 2010) When a language was acquired in early stage of life, learned via immersion, reflects increased level of emotional resonances than a foreign language. Early language and emotional regulation system both develops at same time. (Bloom & Beckwith, 1989). Thus, it is possible that early learned language is tightly connected to emotional system. (Caldwell – Harris, 2014). It is not that second language can't make us emotional, it can when it is used frequency and when learned via immersion rather than in school (Dewaele, 2010; Degner et al., 2011).

CONCLUSION

The aim of the study is to see the efficiency of manipulation technique. The results showed manipulation technique didn't work effectively. The reason could be methodological weakness or difference in processing of emotion content in foreign language. Further, scrutiny needed for this manipulation technique if it in non-native language. With further scrutiny in the method, this method can be used to study the effects of thought speed on other various cognitive domains. The limitations of the study would be the sample size was relatively small and the results were based on those and only young adults were called for the study and the study results were based on them.

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Original Research Article

Immediate and Intermediate Effects of Intensive Alpha Neurofeedback Training on Pain Symptoms and Mood States in Tension Type Headache: A Randomized Sham Controlled Study

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ABSTRACT

Aim: The current study aims to explore the effects of neurofeedback training on primary and associated symptoms of tension type headache (TTH) using a randomized sham control study design. **Methods:** 20 participants with the diagnosis of tension type headache with or without mild to moderate level of depression were recruited for the study after which they were randomly allocated to either the active intervention or the sham group. They underwent ten sessions of alpha enhancing or sham neurofeedback respective to their groups within a span of two weeks. Participants completed an assessment on three baselines i.e. pre intervention, after 5th session and post intervention on domains of mood states, anxiety levels, pain intensity and level of depression in both groups. The groups were compared using repeated measures ANOVA and spearman correlation coefficient was also computed. **Results:** The active neurofeedback group was associated with significant changes in mood states, state anxiety, affective and sensory domains of pain and depression levels when compared to the sham group ($p<0.05$).In addition significant negative correlations were found between the sensori-motor rhythms (SMR) and reported sensory pain. **Conclusion:** The present study provides evidence for efficacy of using alpha neurofeedback training in tension type headache as it has shown to be effective in reducing levels of anxiety, depression and pain in addition to being a non-invasive and time efficient process with minimum placebo effects.

Keywords: *Alpha Neurofeedback, Tension type headache, Mood states*

INTRODUCTION

Headache, an almost universal human experience, is one of the most common complaints encountered in medicine and neurology (Rizzoli et al., 2018). Chronic tension type headache is one of the most prevalent conditions with a lifetime prevalence of 30% to 78% (Kaniecki, 2015) affecting 0.5% to 4.8% of the world population (Yu and Han., 2015). A meta-analysis found that the overall pooled prevalence of headache in India was found to be 438.8 per 1,000 population, which was higher than previously reported data (Dhiman et al., 2021).Chronic tension type headache is also said to be involved in causing emotional difficulties and other co morbidities out of which depression is the most common and next in line are hypertension and anxiety disorders (Caponnetto et al., 2021). A cross sectional study conducted by Ghogare and Patil (2020) in a tertiary health care centre in central rural India found that tension type headache was comorbid with depression (found in 54.1%) and generalized anxiety disorder (found in 70.6%) when majority of the study participants were employed, married, literate and had rural residence. Further a case control study found that depression, negative affectivity, state and trait anxiety were the most co-morbid conditions with chronic tension type headache, therefore indicating in addition to management of pain symptoms, attention should be paid to these conditions as well for better control (Godoy et al., 2022). When sufferers of tension type headache also have a co-morbid conditionof anxiety, depression or underlying personality vulnerabilities it can seriously affect their quality of life, subjective happiness and overall satisfaction with life (Ashina et al., 2020).

Given the costs associated, a well-established, short term treatment plan with associated long term benefits is a key element to effective and holistic treatment of such patients (Jimenez et al., 2015).The pharmacotherapy remains the main resort to headache treatment and that may further lead to feelings of despair and uncontrollability in patients about their conditions. To bridge this gap techniques of neuromodulation and bio-behavioural therapy as a treatment modality may serve as a great benefit for patients suffering from headache (Ailana et al., 2021).

Neurofeedback is a non-invasive kind of biofeedback which targets the imbalanced electrical impulses of the cerebral neurons and is a reward based treatment lying on principles of conditioning. It can help the client learn how to independently manage their pain symptoms, therefore boosting their self- esteem and creating an optimistic view of alleviating their symptoms. A wide variety of neurofeedback (NF) types and protocols have been used for pain management aiming to either increase, decrease or regulate brain activity in certain areas theoretically associated with pain but there is sparse literature on the

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effectiveness of neurofeedback in headache syndromes, especially tension type headache (Roy et al., 2020).There is a need to understand the modulation of EEG activity after intensive neurofeedback training as a method to investigate the neuromodulatory effects due to the relaxation training using alpha protocol. Furthermore, neurofeedback has been found to be effective in wide ranges of conditions like depression (Melnikov.,2021), fibromyalgia (Wu et al., 2021), post-traumatic stress disorder (Steingrimsson et al., 2020), anxiety(Gadea et al., 2020) and other emotional problems (Boland et al., 2020).

In the current study was a sham controlled intensive Alpha neurofeedback training in tension type headache patients by providing ten sessions over the span of two weeks. In addition to the pain symptoms the levels of depression, state and trait anxiety and mood states were also studied. Studies have found that neurofeedback sessions had the potential of reducing pain symptoms and other related outcomes like depression and fatigue (Roy et al.,2020) and its efficacy remained stable over the period of almost 14 months (Nestroniuc et al., 2008). The previous studies have shown mixed outcomes of this training due to which the possible placebo effects of neurofeedback has also been an issue for its treatment efficacy; this has been addressed in this study by giving sham treatment to the control group, further enhancing the utility of the results.

METHODOLOGY

Participants and experimental designs:

The study included 20 patients. The inclusion criteria used for thr selection of the sample were: (i) Those fulfilling the criteria for tension type headache according to the International Classification of Headache disorders- 3rd edition; (ii) Age range of 18-45 years; (iii) who provided consent for the study; and (iv) those who had at least primary level of education and could comprehend English or Hindi.

Purposive sampling of patients with random allocation to either the experimental or control group was done from the Out-patient department (OPD) of the hospital (CIP, Ranchi).

The study protocol was approved by the Institute Ethical Committee (IEC) and Informed consent forms were filled and signed by both the participants and the caregivers and any questions queries related to the procedure were answered before starting the procedure.

The study was composed of three phases (I)Baseline assessment (II)Mid-line assessment (after the 5th session) and (III) Post treatment assessment. The patients were randomly assigned to two groups as follows- (I) the experimental group and (II) the Control group. Every patient was first tested on a baseline according to their moods, state anxiety levels, depression levels, and intensity of pain; then were given ten sessions of intensive neurofeedback training in three rounds of fifteen minutes each which was either real feedback or a sham feedback according to the group they belong to. The patients were blinded to the sham treatment.

Neurofeedback Procedure:

The present study used the Deymed neurofeedback system and the alpha protocol which is used in relaxation. It focused on the sensori motor, beta 1A and theta rhythms. The patient was brought to the laboratory and seated comfortably; the gel was used to place the electrodes on the skin. The electrodes were placed on the C3 and C4 channels, out of which C4 was the main focus of the study because it is involved in emotional processing and relaxation (Warner et al., 2013). The reference electrode was placed at Cz location and the ground electrodes were placed on the forehead.

The real neurofeedback included a video game in which there were rewards in the form of points flashed on the screen, the patient had to focus on the car and be relaxed; therefore, the more the patient was relaxed the better was their alpha activity. When the patient was relaxed, there was rise in alpha activity after which theywere rewarded by a point on the screen which further worked as reinforcement. Initially after 5 sessions the patient was tested on profile of mood states and pain intensities. Soon after the ten sessions over a period of 2 weeks they were again tested on the variables of their mood states, state-trait anxiety levels, pain intensity and depression levels. In the sham neurofeedback the patients were not provided with any visual stimuli but the electrodeswere placed on the same locations and the patients were seated in front of the system after which they relaxed with closed eyes but were not shown the video game and a 45 minute recording was done. They were also tested at the baseline, after the 5th session and after the 10th session in order to rule out the placebo effect and knowing the actual effectiveness of the intervention.

Assessment Methods

The participants were made to fill the following questionnaires: Profile of mood states (POMS) **(Terry et al., 2003),** State- Trait anxiety Inventory (STAI) **(Spielberger., 1983),** Mc Gill Pain Questionnaire **(Melzack& Raja 2005),** Headache Impact test (HIT) **(Kosinki et al., 2003),** Beck's Depression Inventory (BDI) (**Beck, 1961)**and Hamilton's Rating Scale for Depression(HAM-D) **(Hamilton, 1960).**

In addition the Sidedness Bias Schedule **(Mandal et al., 1992)**was used to determine the laterality of the patients and a well standardized Side effect questionnaire called

the discontinuation- emergent signs and symptoms (DESS) **(Rogel et al., 2015)**was administered before the first, fifth and tenth session of neurofeeedback. It includes the emotional, behavioral, cognitive and physical conditions that can be considered possible adverse side effects and is a checklist of 43 symptoms.

DATA ANALYSIS

Statistical analysis was done using the Statistical Package for Social sciences (IBM SPSS Version 25.0) with different parametric and non-parametric measures being used, wherever applicable as follows:

- Chi Square test for comparing discrete/ Categorical variables.
- Mann Whitney U Test for comparing continuous variables.
- Repeated measures ANOVA for comparing various variables between the active and sham over time and group.
- Spearman Correlation Coefficient for finding correlation among the continuous variables under study

In this study two levels of significance ($\alpha <= 0.01$ and $\alpha <= 0.05$) were considered to be statistically significant.

RESULTS

Socio Demographic profile and Comparative description:

The analysis shows that no significant difference was found between the experimental and control groups on variables of sex ($\chi2= 0.952$), age (U= 45.0), marital status ($\chi2= 0.0001$), education ($\chi2= 1.053$), occupation ($\chi2= 0.952$) and habitat ($\chi2= 0.952$).

Table 1: Comparative description of socio demographic variables

Variable		Experimental Mean ± SD/n (%)	Control Mean ± SD/n (%)	χ2/Mann Whitney U	df	p value
Sex	**Male**	4 (40%)	2 (20%)	0.952	1	0.628
	Female	6 (60%)	8 (80%)			
Age	-	27.70±6.83	27.70±4.21	45.00	1	0.722
Marital status	**Married**	2 (20%)	2 (20%)	0.0001	1	1.000
	Unmarried	8 (80%)	8 (80%)			
Education	**Primary**	0	1 (10%)	1.053	1	1.000
	Intermediate	10 (100%)	9 (90%)			
Occupation	**Employed**	6 (60%)	8 (80%)	0.952	1	0.628
	Unemployed	4 (40%)	2 (20%)			
Habitat	**Rural**	2 (20%)	4 (40%)	0.952	1	0.628
	Urban	8 (80%)	6 (60%)			

Clinical Profile and comparison between the groups:

On comparing the clinical variables it was found that there was no significant difference between the experimental and control groups because of drug status ($\chi2= 0.952$), psychiatric co morbidity ($\chi2= 0.267$), family history of psychiatric disorders ($\chi2= 1.250$) or handedness ($\chi2= 0.0001$).

Table 2: Clinical Variable comparison

Variable		Experimental Mean ± SD/n (%)	Control Mean ± SD/n (%)	χ2/Mann Whitney U	df	p value
Drug Status	**On drugs**	8 (80%)	6 (60%)	0.952	1	0.628
	Not on drugs	2 (20%)	4 (40%)			
Psychiatric	**Present**	3 (30%)	2 (20%)	0.267		1.000
Comorbidity	**Absent**	7 (70%)	8 (80%)			
Family	**Present**	3 (30%)	1 (10%)	1.250	1	0.582
History	**Absent**	7 (70%)	9 (90%)			
Handedness	**Right**	9 (90%)	9 (90%)	0.0001	1	1.000
	Left	1 (10%)	1 (10%)			

Table 3: Comparison of clinical scales between the experimental and control group

Variable		Experimental (Mean ± SD)	Control (Mean ± SD)	Time		Time*Group	
				Greenhouse Giesser (F)	Significance	Greenhouse Giesser (F)	Significance
POMS	**Baseline**	15.80 ± 7.8	11.50 ± 5.359	**20.626**	**>0.001***	**14.603**	**>0.001***
	5th session	14.40 ± 7.749	11.50 ± 5.359				
	Post	10.80 ± 6.63	11.10 ± 4.818				
STAI-A	**Baseline**	39.90 ± 12.60	25.80 ± 6.713	**42.722**	**>0.001***	**22.975**	**>0.001***
	Post	33.40 ± 13.14	24.80 ± 5.750				
Trait A	**Baseline**	29.40 ± 12.42	15.70 ± 8.367	1.068	0.315	0.545	0.470
	Post	28.80 ± 11.98	15.60 ± 7.777				
Pain (Affective)	**Baseline**	4.20 ± 1.874	3.40 ± 1.897	**5.784**	**0.015****	**5.784**	**0.015****
	5th session	3.60 ± 1.838	3.40 ± 1.897				
	Post	2.50 ± 1.080	3.40 ± 1.897				
Pain (Sensory)	**Baseline**	3.80 ± 2.044	4.00 ± 1.563	**7.950**	**0.005****	0.127	0.719
	5th session	4.10 ± 2.079	4.20 ± 1.549				
	Post	2.80 ± 1.549	3.20 ± 1.229				
BDI	**Baseline**	12.60 ± 8.07	9.80 ± 7.208	**6.826**	**0.018****	3.303	0.086
	Post	8.70 ± 6.201	9.10 ± 6.983				
HAM-D	**Baseline**	11.0 ± 7.630	8.90 ± 7.695	3.973	0.062	2.584	0.125
	Post	8.20 ± 5.613	8.60 ± 7.058				

On comparing the clinical scales between experimental and control group (From Baseline to post assessment) it was found that there was a significant difference between the mood states (F=20.62) and state anxiety (F = 47.722). There were no significant differences found in trait anxiety and the affective domain of pain but the sensory domain showed a significant difference (F= 7.950). The depression levels had reduced from the different assessment levels but were not significant enough.

Comparison of EEG frequencies (Alpha and Theta) between active and sham group:

When comparison wasdone with the frequencies of alpha and theta waves between the experimental group which received the active intervention to the sham group who did not receive an intervention; there was no significant difference between the two groups on either the Alpha waves (F=0.432) or the Theta waves (F= 0.329).

Table 4: EEG Frequency comparison between groups

Variable		Experimental (Mean ± SD)	Control (Mean ± SD)	Time		Time*Group	
				Greenhouse Giesser (F)	Significance	Greenhouse Giesser (F)	Significance
	Baseline	13.020 ± 2.07	12.80 ± 5.41				
ALPHA	**5th session**	13.30 ± 2.11	11.610 ± 2.84	0.432	0.652	2.099	0.141
	Post	14.59 ± 1.66	11.560 ± 5.10				
	Baseline	32.10 ± 8.50	21.52 ± 4.25				
THETA	**5th session**	31.84 ± 8.82	23.21 ± 4.86	0.329	0.695	4.055	0.031
	Post	28.80 ± 6.14	24.500 ± 4.12				

Table 5: Differences between EEG frequencies (Beta 1a and SMR) within the experimental group

Variable		Experimental (Mean ± SD)	Time	
			Greenhouse Giesser (F)	Significance
BETA 1a	**Baseline**	8.230 ± 3.54	0.018	0.955
	5th session	8.420 ± 1.51		
	Post	8.300 ± 1.64		
SMR	**Baseline**	8.130 ± 2.018	2.568	0.122
	5th session	8.70 ± 1.31		
	Post	9.60 ± 1.61		

The differences in Beta 1a and SMR (Sensori Motor Rhythms) within the experimental group itself from baseline (1st session) to the last session (10th) did not reveal a significant difference with F ratio of 0.018 and 2.568 respectively.

Correlations among the clinical variables and EEG frequencies of pre assessments:

The correlation between the clinical scales and the wave frequencies at the baseline (1st session) reveal that there was a significant negative correlation between the sensory domain of pain and the EEG frequency of theta and Sensori Motor Rhythm (SMR) which shows that the greater the theta inhibition and increase in sensori motor rhythm (SMR), the lesser will be the sensory pain. There was also a significant negative correlation between the depression scores and the EEG frequency of theta which reveals that the greater the theta inhibition the lesser will be the score of depression.

Table 6: Correlations at baseline:

	Alpha Baseline	**Beta1A Baseline**	**Theta Baseline**	**SMR Baseline**
POMS Baseline	.090	.234	-.551	-.111
STAI-A Baseline	-.342	.513	.094	.388
TraitA Baseline	-.316	.015	.338	.151
Pain A Baseline	-.024	.356	-.188	.092
Pain S Baseline	.445	-.608	**-.727****	**-.720****
HIT	-.0162	0.128	-.335	-.296
BDI Baseline	.195	.167	**-.668****	-.219
HAMD Baseline	.0113	.049	-.622	-.306

Correlations among the clinical variables and EEG frequencies of post assessments:

The correlation between the clinical scales and the wave frequencies at the post assessment (10th session) reveal that there was a significant negative correlation between the theta wave and the profile of mood questionnaire ($p <= 0.05$) which indicates that the more the theta inhibition the lesser will be the anxiety/ depression mood state. There was also a significant positive correlation between the sensory pain and Sensori Motor Rhythm (SMR) after the 10th session ($p<=0.05$) which reveals that the more the SMR the lesser will be the sensory pain experienced.

Table 7: Correlations after intervention

	Post Alpha	Post Beta1A	Post Theta	Post SMR
Post POMS	.418	-.117	**-.665****	.225
Post STAI-A	-.196	.345	.151	.285
Post Trait A	-.058	.327	.017	.532
Post Pain A	-.157	-.188	.094	-.235
Post Pain S	-.022	.427	.025	**-.554****
Post BDI	-.203	.070	.166	.110
Post HAMD	.017	.155	-.038	.224
Side effect Q	.339	-.262	-.214	-.412

DISCUSSION

The present study revealed differences in mood states, state anxiety levels and sensory pain as a result of receiving alpha neurofeedback as compared to the sham treatment, thereby indicating the absence of placebo effects to a high extend. The altered negative mood states of the person also cause a significant reduction in the quality of life of the patients. Earlier studies have generally shown the benefits of mood enhancement in fMRI based neurofeedback (Johnston et al., 2010) but the present study shows efficacy of EEG based neurofeedback on mood states which might be beneficial in exploring further treatment options which can be accessible to everyone. Significant improvements in the state level anxieties of experimental group is in synchronization with evidence for effectiveness of neurofeedback on anxiety as a study in which patients underwent 10 sessions of

neurofeedback had significantly reduced state anxiety and altered cortical arousal (Costa et al., 2016).

The reductions in pain and significant differences found are supported by earlier studies which show that there is significant reduction in pain intensity in patients post treatment and even an enhancement in quality of life as it could work as a tool of self regulation through neurofeedback (Jacobs and Jensons., 2015). Further there is drop in depression levels but has not been found to be significant which is supported by studies which used the Deymed neurofeedback found that 15 sessions of 20 minutes each have shown to be efficacious in dropping the depression levels and anxiety in patients (Sahraee., 2016).

The alpha band power increased in the experimental group but it was not a significant difference after 10 sessions; Studies conducted involving eight sessions of neurofeedback have found similar results that the sessions were successful in enhancing the alpha power but the results have not shown a significant improvement (Escolano et al., 2014) which might further indicate that more sessions may be needed for significant training of the alpha bands.

The within experimental group comparison of the SMR frequencies indicates that frequency has increased or enhanced as compared between the 5^{th} session mean and the 10^{th} session means but there is no significant difference between the two baselines. Previous studies involving the use of ten neurofeedback sessions aiming at enhancing the sensori motor rhytm activity have found similar results that there was increase in the amplitudes post intervention but the results were not significant, although there was significant improvement in sleep latency in terms of shortened duration for the same (Hoedlmoser et al., 2008).

The study findings has shown a positive correlation between the mood states and alpha wave frequency, Beta wave frequency and sensori motor rhythms (SMR) at the baselines. With regard to the readings post assessment the correlation coefficient values have increased and have found that there is a significant negative correlation between the theta frequencies and the mood states.

With regard to the affective domain of the pain levels there was a negative correlation to the alpha and theta frequencies whereas a positive correlation was found with beta and Sensori motor rhytms but these were not significant at the baseline or post assessment.Studies have also found that higher EEG frequencies have a negative relationship with pain perception whereas a positive relationship exists with low amplitude EEG brain waves, although the relationships found were not conclusive as a direct causal relationship has not been found (Jenson et al., 2008).

CONCLUSIONS AND FUTURE DIRECTIONS

The study provides evidence for using the Alpha protocol of neurofeedback as an effective treatment for Tension type headache as it helps reducing the situational anxiety and sensory pain across the sessions helping the patients learn self regulation of their symptoms, further enhancing their mood states. However studies with greater number of sessions and follow up of these patients might further help know its long term efficacy and study other significant variables.

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Original Research Article

A Study of the Impulse Control Behaviours in Persons with Parkinson's Disease

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ABSTRACT

Impulse control disorders and related behaviours (ICD-RBs) are found in patients with Parkinson's disease. Dopamine replacement therapy, disruption in frontal lobe functions, and other idiosyncratic factors are implicated in the formation of impulse control behaviours. As the prevalence of Parkinson's disease in India is lower compared to other countries and data regarding impulse control disorders/ behaviours in the Indian setting is limited, the present study was planned for the same. **Aim:** The present study aimed to explore the presence, patterns and severity of Impulse Control Behaviours (ICBs) in the sample of patients diagnosed with Parkinson's disease undergoing treatment and its relationship with frontal lobe functions, drugs used for treatment and disease correlates. **Method:** A sample of 33 consenting patients with Idiopathic Parkinson's disorder (IPD) was chosen purposively based on the inclusion and exclusion criteria from the Movement disorders clinic at IHBAS. The QUIP-RS was used to assess Impulse-control behaviours. FAB was used to assess frontal lobe functions and the disease stage was rated on the modified Hoen and Yahr scale. Other disease-related factors such as age at onset and medication details were obtained at the time of assessment. Data were analysed with the help of Descriptive statistics and Correlation analysis. **Results** indicate that there was the presence of significant subclinical levels of impulse-control behaviours in the sample. Hyper-sexuality and compulsive eating were the most frequently reported behaviours, whereas punding and excessive use of PD medication, were the least reported. Most of the impulsive-compulsive behaviours reported were associated with the use of dopamine agonists. No significant correlation was seen between impulse-control behaviours and frontal lobe functions as assessed on the Frontal Assessment Battery (FAB).

Keywords: *Parkinson's disease, Impulse control behaviours, Dopamine Agonists, Frontal Lobe Functions.*

INTRODUCTION

Parkinson's Disease (PD) is a progressive neurode generative condition resulting from the death of the dopamine-containing cells of the substantia nigra. People with Parkinson's Disease classically present with the symptoms and signs associated with Parkinsonism, namely hypokinesia (ie poverty of movement), bradykinesia (ie slowness of movement), rigidity and rest tremor (Royal College of Physicians,2006).

Although Parkinson's Disease is predominantly a movement disorder, the symptoms can be said to be neuropsychiatric which includes fluctuations in mood and anxiety, apathy, depression, psychosis, anxiety, cognitive deficits and dementia. These neuropsychiatric symptoms may have heterogeneous causes such as disease pathology, or it may be secondary to the disease, treatments, underlying co-morbid disorders or individual susceptibility (Voon V, Potenza N.M & Thomson T., 2007).

Treatment of Parkinson's disease and Impulse Control Disorders

The long-term use of Levodopa to manage the symptoms of PD leads to complications such as dyskinesia, postural instability, speech disturbance and cognitive decline (Hely et al., 2000). These complications necessitated the need for other drugs such as Dopamine agonists (DA). Sharma et al. (2015) noted in their work that it has been recognised that dopaminergic medications (medications used to increase dopamine activity) administered to remedy motor symptoms in Parkinson's disease are associated with increased riskfor Impulse control disorders and related behaviours (ICD-RBs). Some of these behaviours include hobbyism, punding, dopamine dysregulation syndrome (DDS) and walkabout. Punding refers to the performance of meaningless movements or activities (for example- Collecting,arranging, assembling and reassembling objects). Hobbyism is a type of punding that includes more complex repetitive behaviours such as gardening, painting, singing etc. which are not goal-oriented (Voon et. al., 2009). Dopamine dysregulationsyndrome (DDS) is an addiction-like state marked by excessive dopaminergic medication usage, particularly L-dopa and short-acting DAs.Walkabout is defined as excessive, aimless wandering (Weintraub, 2008).

Impulse control behaviours commonly occur without subjective distress, may go unnoticed or may be hidden because the patient may experience these behaviours to be internally consistent. However, these behaviours result in psychosocial consequences that

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may be devastating for the individual (Voon, et al. 2007).

Some factors associated with ICDs in PD include younger age of onset, duration of Parkinson's disease, history of symptoms related to Impulse control disorders before the onset of PD and receiving dopamine agonists for treatment (Weintraub et al., 2006). A review of previous studies done by Voon et.al. 2007 to study the prevalence of Impulse control disorders reports that hyper sexuality in PD is found in 2.4% to 8.4% of patients. The clinical manifestations of these disorders also vary in patients, for instance hyper sexuality being manifested as unrelenting sexual thoughts, promiscuity, uncontrollable masturbation, compulsive pornography, and paraphilias. (Ferrara &Stacy, 2008).

The prevalence of ICDs can also have cultural aspects. For example, compulsive gambling and compulsive shopping are found to be significantly more prevalent in the USA and Canada. Whereas the prevalence of gambling was the lowest in an Indian study (at 3.3% of subjects studied), perhaps because gambling is illegal in India (Goyal et. al, 2015).

Frontal lobe functions and impulse control

In Parkinson's disease impairment of executive functioning is thought to be related to cognitive deficits seen in PD which include deficits in memory, visuospatial reasoning and complex attention (Lima et. al, 2008). Executive functions include processes such as planning, inhibition of responses, the performance of goal-directed activities, self-monitoring and self-regulation (Barkely RA, 2001) and these processes are mainly dependent on the frontal lobes and structures connected to them such as the thalamus and basal ganglia. The relationship between executive dysfunctions in PD and its relationship with ICD and related behaviours is controversial and requires further evidence (Cilia & Eimeren, 2011).

Indian Studies

The results of Asian studies on the subject have been variable, reporting the presence of ICDs and related behaviours between 3.5% and 35%.A study done by Sarathchandran, et.al in 2013 found at least 1 ICD-RB was diagnosed in 96 patients out of 305 which constitutes 31.6% of the subjects. Punding was the most frequent (15.7%), followed by compulsive buying (8.2%), compulsive eating (7.8%), hyper sexuality (5.2%), pathological gambling (4.6%), and DDS (3.3%). Punding behaviours involved making newspaper cuttings of pictures of celebrities (more common in men) or arranging and rearranging clothes, utensils, and furniture for several hours of the day (more common in women), which differed from the classic punding behaviours reported in Western populations. Two or more ICD-RBs were observed in 7.5% of patients. Similar results were seen in a study by Goyal, et.al, 2015. This was an observational cross-sectional study on impulse control disorders and related behaviours. Their findings showed that 42 % of the subjects presented with some Impulse – control behaviours and that at least one ICD was present in 25% of the subjects. Their study also supports previous findings that younger age of onset, the addition of dopamine agonists and longer duration of treatment were associated with the presence of ICD and related behaviours.

Hence it can be seen that dopamine replacement therapy and disease related factors can contribute to Impulse control disorders and related behaviours. However their presence and patterns can be influenced by personality and cultural aspects. This indicates need for further research in the Indian milieu.

METHOD

Objectives.1) To explore the presence, patterns and severity of impulse control behaviours in the sample of patients diagnosed with Parkinson's disease.2) To compare the presence, patterns and severity of impulse control behaviours in the sample of patients undergoing treatment with different drugs. 3) To study the relationship between impulse control behaviours and frontal lobe functions.

Participants: A Sample of 33patients diagnosed with Idiopathic Parkinson's disease (IPD) was collected using purposive sampling technique from the Movement Disorders clinic of Neurology OPD from a major Neuropsychiatric hospital of North India. The Inclusion criteria considered were – (i) Persons diagnosed with IPD between the ages of 20 and 75 years of male or female gender; (ii). Diagnosis of Parkinson's disease based on the UK Parkinson's Disease Society Brain Bank Diagnostic Criteria; and (iii). The patient must have been undergoing treatment for Parkinson's disease at the time of assessment. However, Patients with other comorbid psychiatric disorders, or having history of long term psychotropic medications had been excluded. Also Patients with Parkinson plus and secondary Parkinsonism were not included in the sample.

Tools: Personal Data Sheet and the Proforma for Parkinson's disease were used to keep the details of patient demographics and treatment details which included the type of drugs used for treatment, its dosage and duration and response to treatment. The **Modified Hoen and Yahr Staging scale** was used for describing the stages of Parkinson's disease. The stages indicate progressive levels of disability in the patient. Stages 1,

2 and 3 indicate only minimal disability, whereas patients in 4 and 5 are severely disabled (Hoen&Yahr, 1967). Stage 1 refers to unilateral involvement only, usually with minimal or no functional impairment. Stage 2 indicates Bilateral or midline involvement, without impairment of balance. Stage 3 indicates the First sign of impaired righting re-flexes. This is evident by unsteadiness as the patient turns or is demonstrated when he is pushed from standing equilibrium with the feet together and eyes closed. Stage IV, fully developed, severely disabling disease; the patient is still able to walk and stand unassisted but is markedly incapacitated. Stage V indicates Confinement to a bed or wheelchair unless aided.

QUIP- RS (Questionnaire for impulsive–compulsive disorders in Parkinson's disease- Rating Scale). The QUIP-RS has 4 primary questions (about commonly reported thoughts, urges/desires, and behaviours associated with ICDs), each applied to the 4 ICDs (Compulsive gambling, buying, eating, and sexual behaviours) and 3 related disorders (Medication use, punding, and hobbyism). It uses a 5-point Likert scale (score 0–4 for each Question) to gauge the frequency of behaviours and instructs patients to answer questions based on behaviours that occurred in the preceding 4 weeks (or any 4-week period in a designated time frame). Scores for each ICD and related disorder range from 0 to 16, with a higher score indicating greater severity (i.e., frequency) of symptoms. The test–retest reliability was good, with r value being >.90 and the inter-rater reliability was also found to be >.90. (Weintraub, et al. 2012).Regarding validity, adequate cut-off points (ie, both sensitivity and specificity ≥80%) were determined for all 4 ICDs and hobbyism-punding. The questionnaire has four questions for each of the six categories namely a) Gambling b) Sex c) Buying d) Eating e) Performing tasks or hobbies and repeating simple activities f) Taking PD medications. For this study a seventh category was added to the questionnaire to collect information regarding any additional behaviour that might be elicited in the Indian population, keeping in mind the idiosyncratic nature of these behaviours and also the impact of culture, based on the review of the literature.

FAB (Frontal Lobe Assessment Battery. The FAB consists of **six** subtests exploring the following: conceptualization, mental flexibility, motor programming, sensitivity to interference, inhibitory control, and environmental autonomy. FAB has been shown to have good inter-rater reliability ($\kappa = 0.87$, $p < 0.001$), and internal consistency (Cronbach's coefficient alpha = 0.78). FAB correlated with dysfunction in a variety of cognitive domains including attention, memory, and executive functions. The FAB was concluded to have added value over the MMSE, particularly among non-demented patients. Kopp et.al. 2013 report several FAB scores (including composite and item scores) provide valid measures of right hemispheric lateral frontal lobe dysfunction.

Procedure. All participants were informed about the purpose of the study. After taking written informed consent, persons diagnosed with Idiopathic Parkinson's disease (IPD) based on the UK Parkinson's Disease Society Brain Bank Diagnostic Criteria at the Movement Disorders clinic at IHBAS were taken for the study. Patients who refused to participate, were excluded and their treatment procedure was not affected in any manner. Each subject's disease stage was rated based on the Modified Hoen and Yahr staging scale. Demographics, details regarding symptoms and treatment were obtained. The details of the medications were obtained with the help of the neurology consultant. Thereafter, the QUIP-RS was administered. The scale was clinician-rated and it was done in a semi-structured interview format. Information was obtained from the client as well as the informants, wherever possible and wherever necessary. Thereafter the frontal assessment battery was administered.

Results Analysis of data:

Data were analysed using descriptive statistics and Statistical Package for Social Sciences (SPSS) 22.0. Descriptive statistics were used to analyse data regarding the demographic details of the patient and treatment details associated with impulse-control behaviours. Correlation analysis was used to find the relationship between impulse control behaviours and frontal lobe functions.

In the study sample, 15 out of 33 (N=33, 19 males and 14 females) patients were screened to be having some kind of impulse control behaviours, constituting 45.45% of the entire sample. Out of the 15 patients having impulse control behaviours, 10 are male and 5 are female. Thus it can be observed in the presented data that twice the number of males were screened positive for ICBs when compared to females.

Concerning the frequency and type of impulse control behaviours, it was seen that the domain of behaviours involving preoccupation with sex has received the maximum frequency, followed by eating and lastly the use of PDmedications. None of the patients reported thoughts related to Gambling. Thoughts related to punding-hobbyism were also not reported by any of the patients.

In the total sample (n=33), 13 patients were taking Syndopa along with one Dopamine agonist and 20 were on treatment with only Syndopa. Of the 15 patients

who screened positive for ICBs, 9 out of them were on treatment with a DA in combination with Syndopa. Hence out of the 13 patients on DA treatment in the sample, 9 had some form ICBs, whereas only 6 out of 20 patients undergoing treatment with Syndopa at the time of assessment had ICBs. Hence, treatment with DA was presented with a higher frequency in patients with some form of ICBs. This is consistent with previous literature. The Data are presented in Table 1.

Table 1: *Showing the presence of ICBs based on the type of drugs used for the treatment of PD*

Drugs for treatment	Frequency	Percentage
Syndopa	6	18.18%
Syndopa with DA	9	27.27%
Total	15	45.45%

DA: Dopamine Agonists

For the next objective of the study, no significant correlations were seen between the scores on QUIP-RS and FAB i.e., no significant correlation was found between impulse-control behaviours and frontal lobe functions, as measured on the Frontal assessment battery. Also, no significant correlations were seen between impulse-control behaviours and other disease-related factors such as age at onset, disease stage and duration of treatment, although some previous studies have found younger age of onset to be associated with impulse-control disorders. Table 2 depicts the data.

Table 2: *Table showing the correlation between impulse control behaviours and other domains*

		QUIP	FAB	Age at onset	Disease Stage	Duration of Treatment
QUIP	r	1.000	.182	-.195	-.214	-.188
	p	.	.278	.278	.232	.294
	N	33	33	33	33	33

*p<.05

QUIP: scores on QUIP-RS FAB: Frontal assessment battery

DISCUSSION

Patterns and severity of Impulse control behaviours

As mentioned earlier there are very few Indian studies that have described the prevalence rates of ICBs in PD. In the present study, it was seen that 45.45% (15 out of 33) patients were reported to have some kind of impulse control behaviour present. This includes thoughts, urges and behaviours. This result is similar to study done in AIIMS, Delhi. Sharma et.al, in 2015 found that at least one Impulse control-related behaviour was present in 128 patients out of the 229 which comprises 42.8% of the clinical population studied. This result supports the finding that the presence of such behaviours in the Indian population is comparable to those found in Western countries. Although the current study limits itself to studying impulse control behaviours only and did not identify disorders using further interviews. Hence the high percentage (45%) indicates the presence of any behaviour that fell under the purview of the QUIP-RS regardless of its classification as a disorder.

In the present study the following percentages for the different classes of Impulse control behaviours were found. Based on the score on QUIP-RS, the highest scores were obtained on Eating (30%) as 10 patients (6 males and 4 females) out of 33 patients screened positive in this area. Hyper-sexuality was only positive for men (6 out 33) patients, comprising 18.18 % of the total sample. Both males and females screened positive for Items related to PD medications, comprising 9.09% (1 male and 2 female) of the sample. Finally, only female patients screened positive for Punding (2 females) and Buying (1 female) comprising 6.06 % and 3.03% of the sample respectively. None of the patients screened positive for pathological gambling.

These results at first look contradictory to the earlier findings. Sharma et. al,2015 in their study found that Punding was the most frequent (12.4%) followed by hyper sexuality (11.04%), compulsive hobbyism (9.4%), compulsive shopping (8.4%), compulsive medication use (7.7%), compulsive eating (5.35%), walkabout (4%) and pathological gambling (3.3%). Another Indian study done previously by Sarathchandran et.al, 2013 also showed similar results.

However, the difference in the present study could be explained by the choice of tool. Sharma et.al, 2015 in their study used the QUIP which uses the yes or no format of the answer; whereas the present study used the QUIP-RS which uses a Likert-type scale and has four different questions to rate the gradations of behaviours. The previous studies reported the presence of Impulse control behaviours only, whereas the present study also looks at the pre-occupation and urges that may be preceding these behaviours. In the present study only 1 out of 10 patients screened positive on the item describing difficulty in controlling behaviour which comprises 3.03% of the total sample. This percentage is closer to that reported in earlier studies for the presence of behaviours related to eating. Similarly for Hyper sexuality, only 2 patients reported difficulty in controlling these behaviours which accounts for 6.06% of the total sample. Other factors that may help explain the higher percentage of behaviours but not disorders in the sample could be psychological such depression, anxiety and a sense of isolation. These behaviours are also being looked upon

now as coping mechanisms to manage the adverse effects of the disease (Delaney et. al., 2012).

Patterns and severity based on the drugs being used for the treatment of PD

Another objective of the study was to see the pattern and presence of ICBs based on the type of drugs being administered for the treatment of PD. From the sample of 33 patients, 20 patients were under Syndopa monotherapy whereas 13 patients were taking Syndopa and Dopamine Agonist (DA) during the time of assessment. Of the 15 patients screened positive for ICBs, 9 were on Syndopa and DA therapy and 6 were on Syndopa monotherapy.

Consistent with findings in the previous studies, 5 out 6 male patients screening positive for hypersexuality behaviours were on DA therapy with Syndopa.

One patient who reported positive compulsive buying behaviours was also on DA therapy. Voon& Susan in 2007 found that previous studies that systematically assessed medication associations along with comparisons with PD control subjects, pathological gambling, hypersexuality, and compulsive shopping in PD were robustly associated with the use of dopamine agonists as a class but not with any specific agonists.

However, not all patients subjected to DRT show signs of Impulse control behaviours. This points towards individual susceptibility that may be accounted forby (1) the neurobiology of PD. Biology can also be modulated by temperamental traits or underlying cognitive processes. (2)specific medication practices, or (3) individual factors underlying the vulnerability to pathological gambling, addiction disorders, or impulse control behaviours (Voon et. al., 2007) and psychological factors as mentioned previously.

Impulse control behaviours and their relationship with frontal lobe functions

The last objective of the present study was to explore the relationship of the impulse control behaviours with frontal lobe functions. The results of the study show that although there is a positive correlation between the frontal lobe functions as measured by the FAB and the Impulse control behaviours however, this relationship is weak (rho= .182) and non-significant ($p=.312$, $p>.05$).

On the FAB, higher scores indicate better frontal lobe functioning and lower scores indicate worsening of the frontal lobe functions. On the QUIP-RS, higher scores indicate increasing frequency and severity of the impulse control behaviours. So the positive correlation seems to be counterintuitive which would mean that better frontal lobe functions are associated with ICBs. However in the current sample 28 out of 33 patients have obtained scores that are either below the cut-off point or just at the cut off (score of 12) on FAB and 53% of patients who presented with ICBs had a FAB score at or below the cut off. The mean score on the FAB for the sample was 9.42, which is below the cut-off point. This indicates that that for the majority of the patients in the sample, some difficulty in frontal lobe functioning was present. In the other words, even though there is a positive correlation between the FAB scores and QUIP-RS, this still indicates correlation between impairment of frontal lobe functions and ICBs.

This finding is consistent with previous research done in the field. It is seen that PD patients who undergo Dopamine replacement therapy (DRT), especially with DA are found to have impaired cognitive functions. In the present study 6 out of 8 of those patients whose FAB scores are at or below the cut-off point were on DA at the time of assessment.

This is thought to happen through the following mechanism. First, PD leads to a loss of dopaminergic neurons in the substantia-nigra, resulting in a pronounced depletion of dopamine in the nigrostriatal pathway (Bjarkam& Sorensen 2004 in Weintraub, 2008).Second, PD patients, even those without dementia, commonly display a range of impairment in executive abilities (Green, McDonald, Viteket.al., 2002). This impairment has been linked to degeneration in the striatal-frontal tracts secondary to cell loss within the substantia nigra (Brand, Labudda, Kalbe et.al,2004).A study done in 2007 by Frank et.al that involved administration of computerized decision-making tasks to PD patients on and off PD medications, the medicated group showed impairment in the ability to learn from negative decision outcomes, a psychological deficit that also may have relevance to the maintenance of ICD behaviours. Regarding differential effects of PD medications, there is also some evidence that DA, but not L-dopa, treatment impairs executive abilities in patients with early or mild PD (Brusa et.al., 2003 in Weintraub, 2008).

However this relationship of dopamine with executive functions is not a simple one and most likely not the only mechanism responsible for the disruption of cognitive functions in PD patients. Zgaljardic, Foldi, Mattis in 2003 in 'A Review of the Cognitive and Behavioral Sequelae of Parkinson's Disease: Relationship to Fronto-striatal Circuitry' found that patients with PD who were under dopamine withdrawal also demonstrated impaired performance on frontal/executive neuropsychological tests. Hence they opined that dopamine might be indirectly associated

with cognitive and behavioural dysfunctions in Parkinson's disease.

Secondly literature suggests that different neural pathways may better explain the dissociation of the motor from the cognitive and behavioural symptoms. That is, while some circuits mediate motor disruption, others connecting the basal ganglia with the frontal cortex may be implicated in the cognitive and behavioural profile of PD because similar impairments were exhibited by patients with PD and by those with focal frontalsystem lesions (Dalley et.al., 2007).

Moreover, although cognitive functions are known to be affected in PD, especially theexecutive functions, some of this also reflects the inconsistencies in tools that are being used to measure it. Different tests have varied abilities to assess cognitivefunction (Torralva, 2009; Kehagia et.al, 2012). Other cortical regions other than the frontal lobes have also been implicated in mediating performance on the executive function tasks (Struss & Alexander, 2000). This has been documented in other studies where unlike the original study by Dubois et.al.(2000) which showed no correlation between FAB and other cognitive tests, subsequent studies failed to replicate these findings suggesting that performance on the FAB does not reflect frontal function exclusively (Castiglioni et al., 2006 ; Lipton et al., 2005). This may help explain why in the current study also even though there have implications of executive functions playing a role in impulsive behaviours have been shown, no significant correlations was brought out in the study, between FAB measured executive functions and Impulse-control behaviours.

CONCLUSIONS AND CLINICAL IMPLICATIONS

There is a presence of significant subclinical levels of impulse-control behaviours in the sample. Hyper-sexuality and compulsive eating were the most frequently reported behaviours, whereas punding and excessive use of PD medication use were the least common. Most of the impulsive-compulsive behaviours reported were associated with the use of dopamine agonists. No significant correlation was seen between impulse-control behaviours and frontal lobe functions as assessed on the Frontal Assessment Battery (FAB).

The study gives empirical validation to the previously done Indian studies on the subject that there are the presence of impulse –control related behaviours in patients diagnosed with PD, even though it may exist at at-subclinical levels. However, it highlights the importance of making specific enquiries into these behaviours and discussing the same with patients and their caregivers, as these behaviours may not be reported due to shame, denial or lack of awareness. It may help with the diagnosis of ICDs, if they may develop in the future and help clinicians monitor and manage the treatment. Further more, psychological factors play a role in these behaviours and needs to be further researched.

LIMITATIONS

The first limitation that has been observed is that the data sample was small. This limits the generalizability of the data and prevented from rigorous statistical analysis. The analysis was based majorly on descriptive statistics and studying the correlation between few factors. The other factors such as the personality factors such as impulsivity were not included in the study.

FUTURE DIRECTIONS

Further research should aim to have greater sample size. Different tools can be used to study frontal lobe functions which are more precise at tapping different areas that the frontal assessment battery does not include. Since there are gradations observed in the impulse control behaviours, and there are differences in the patient perception related to the behaviours (ego-syntonic and ego-dystonic) phenomenological studies can be carried out to study the boundaries of these behaviours and also to improve accuracy in understanding the clinical manifestation of these behaviours.

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Response Inhibition and Visuospatial Ability among Manga Reading and Non Manga Reading Population

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ABSTRACT

The present study was a quantitative comparative research design. The aim of the present study was to examine the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among manga reading population and non-manga reading population. Data was collected from Manga readers and Non-Manga readers living in India within the age group of 15 to 25 years. Judgment (purposive) sampling technique was used for the study. A sample of 30 Manga readers consisting of 15 males and 15 females and 30 non manga readers, consisting of 15 makes and 15 females were taken for the study. The tools used for the study were the stroop task and mental rotation task on psytoolkit. After the data was collected it was analysed IBM SPSS. Descriptive statistics, Inferential statistics, Independent Samples T-Test was used to analyse the data. The results show that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population. The study reveals that there is a significant difference between the processing speed or response inhibition ability between the manga reading population and the non-manga reading population. When it comes to gender differences, it was observed in the study that there are no significant differences observed among the males and females of manga reading population and non-manga reading population for both, levels of response inhibition and visuospatial ability.

Keywords**:** *Response inhibition, visuospatial ability, Manga reader*

INTRODUCTION

Manga is a Japanese comic that has a multimodal medium of expression, giving you the cinematic expression through a multimodal perception. It not only consists of linguistic elements, (text) but the visual and spatial elements which is essential in the perception of movement in reading manga and the sound elements with the help of onomatopoeia (the formation of a word from a sound associated with what is named, e.g. sizzle, swoosh) are important factors influencing the manga reading experience. Another unique characteristic of Manga is that it is read from right to left. Even when translated to English, manga retain its original Japanese script's direction to give a more authentic experience.

Many people are aware of the popularity of graphic novels and manga in the Western world. This appreciation for alternative culture has spread to South Asia, particularly in India. Young Indians have been choosing to read both in recent years, exploring their varied genres and characters. While graphic novels and manga were once considered strange to read, India now embraces them. According to reports, 83% Indians prefer anime/manga over other animated content. It started with the entry of anime in Indian media. ("Manga Comics: The Latest Obsession of City's Youth," 2015). According to global statistics, India is second, after China, in the list of countries where anime is enjoyed the most. On an average, 73 per cent of Indians watched anime in 2021 (Research by Epic Dope, an anime-related website)

Social media expert Desmond Fernandez (2015) told Times of India: "Manga illustrations are very different from usual comics. The characters are detailed, and there is a lot more drama. It gives you a cinematic experience. It's not like the usual superhero comics you read, and it has a distinct appeal." ("Manga Comics: The Latest Obsession of City's Youth," 2015)

There are many studies and evidence supporting the fact that one's dominant language, of which we have years of reading experience, creates a direction bias within us, left-to-right bias or a right-to-left bias. The debate on biologically determined directionality and culturally acquired directionality has been going on for quite some time.

In a research conducted on the influence of a left-to-right bias in the reading direction on inhibition of return, Spalek and Hammad (2005) found differences between Canadian and Egyptian students on the inhibition of return measure of attention. Inhibition of return suggests that when searching for a target, an attentional mechanism biased to novel locations causes slower (inhibited) visual searches to locations that have already been examined. Left-to-right reading Canadians had a larger left to right inhibition of return effect, while a larger inhibition of return effect for right to left movement was observed among the Egyptian group. The findings replicated the left-to-right bias with an English sample, but showed the opposite bias in an Arabic sample, who read text from right to left. Thus, the regularity of shifting attention in a particular way during text reading seems to be the cause of the bias observed.

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In a research by Jordan et al., (2013) In English and other alphabetic languages read from left to right, useful information acquired during each fixational pause is generally reported to extend much further to the right than to the left of each fixation. However, empirical research has paid little attention to the asymmetry of the perceptual span for alphabetic languages read in the opposite direction (i.e., from right to left). As a result, this study used a gaze-contingent window paradigm to investigate the perceptual span for Arabic, which is one of the world's most widely read languages and is read from right to left. Skilled Arabic readers who were bilingual in Arabic and English read Arabic and English sentences while a window of normal text extended symmetrically 0.5o to the left and right of fixation or asymmetrically by increasing this window to 1.5o or 2.5o to the left or right of fixation. When reading in English, performance across window conditions was superior when windows extended to the right. When Arabic was read, however, performance was superior when windows were extended leftward, which was essentially the opposite of what was observed for English. The findings showed for the first time that a leftward asymmetry in the central perceptual span occurs when Arabic is read and provided a new indication that the perceptual span for alphabetic languages is modified by the direction of reading.

These findings imply that the asymmetry is caused by a bias that arises from the direction of text reading rather than an innate bias resulting from some form of hemisphere specialization in the attentional system. These studies establish that our reading experience produces a direction bias that influences our processing of information.

Therefore, as individuals who have an established left-to-right bias after years of reading in that direction, when they engage in reading manga, which is read from right-to-left, their initial tendency to read in the opposite direction needs to be inhibited.

Response inhibition refers to the suppression of actions that are inappropriate in a given context and that interfere with goal-driven behavior. It occurs when an individual cancels a prepared motor response due to a change in goals. Hence, we see response inhibition happening in an individual reading manga, as they suppress the action of reading from left to right to achieve a new goal i.e., reading manga and engage in an opposing goal driven behaviour, which is reading from right to left.

Visuospatial ability is a person's capacity to identify visual and spatial relationships among objects. The multimodality of Japanese manga, engages the reader's visuospatial ability for comprehension of the text for the perception of space, movement/motion etc., repetitive reading of manga would be involving the neurocognitive functions for visuospatial ability repeatedly which in turn might increase or strengthen those neurocognitive capacities, improving one's visuospatial ability.

According to research (Mayer et al., 1996; Moreno & Mayer, 1999), the spatial contiguity effect, which occurs when text and image are combined, can improve understanding. When the text is positioned close to the area of the image being described rather than below the image, the spatial contiguity effect is stronger. (e.g., Moreno & Mayer, 1999).

Text and images are combined in comic books in a number of different ways. Text is a useful represent comments from the narrator. Although it resembles a caption, narration is frequently included in the comic image itself rather than beneath it. A character's words and unsaid thoughts are expressed in text that appears in word and thought bubbles.Spatial contiguity in comics helps in better integration of information simultaneously with text and images which help in better spatial cognition in order to perceive the movement in relation to space of the context in the story.

METHOD

The aim of the study was to examine the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among the manga reading population and the non-manga reading population and also see if there are any gender differences in the level of response inhibition and visuospatial ability among these two groups. Data was collected from Manga readers (who have been reading manga for at least 2 years) and non-Manga readers (who do not engage in reading in a language that follows a script that has a right to left direction (e.g., Arabic, Sindhi, Kashmiri etc.,)) living in India within the age group of 15 to 25 years. Judgment (purposive) sampling technique was used for the study. A sample of 30 Manga readers consisting of 15 males and 15 females and 30 non manga readers, consisting of 15 makes and 15 females were taken for the study. The hypotheses of the study were:

Ho1: There is no significant difference between the processing speed or response

Inhibition ability between the manga reading population and the non-manga reading population.

Ho2: There is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population.

Ho3: There is no significant difference between the response inhibition ability or processing speed in males

and females among individuals who have been reading manga for at least 2 years.

Ho4: There is no significant difference between the response inhibition ability or processing speed in males and females among individuals who do not read manga.

Ho5: There is no significant difference between the visuospatial ability in males and females among individuals who have been reading manga for at least 2 years.

Ho6: There is no significant difference between the visuospatial ability in males and females among individuals who do not read manga.

The tools used for the study were the stroop task and mental rotation task on psytoolkit. The Stroop test is a neuropsychological test extensively used to assess the ability to inhibit cognitive interference that occurs when the processing of a specific stimulus feature impedes the simultaneous processing of a second stimulus attribute, well-known as the Stroop Effect. Stroop effect in Psytoolkit (measures the participant's processing speed, response inhibition, selective attention capacity and skills) There were least 40 trials, 20 in which the font colours and word names are different, and 20 in which the font colours and colour names match (e.g., the word "RED" in red font colour. Basu (2022) examined the validity and reliability and there was a positive correlation between the interference scores of manual and computerized versions of the Stroop Test ($r(11) = .65, = .014$). The computerized Stroop Test was also highly reliable (90 items; $\alpha = 0.74$) Mental Rotation in Psytoolkit (measures the visuospatial ability, the ability to mentally manipulate images). There are a minimum of 15 trials. One will need to find out which two object match each other. You can only do that if you mentally rotate the objects and see which ones match. In this version of the task, the stimuli are 2 dimensional, or 2D.) Once a response is selected, they will receive feedback on whether their response is correct or if they missed the trial due to exceeding the time limit. The first 5 trials are for training.

After the data was collected it was coded MS Excel and then analysed IBM SPSS. Descriptive statistics, Inferential statistics, Independent Samples T-Test was used to analyse the data.

RESULTS

The data obtained from the sample of 60 individuals out of which 30 were manga readers, consisting of 15 males and 15 females of the age group 15 to 25 years was analysed quantitatively using mean and standard deviation.

Table 1. Mean and standard deviation for Visuospatial Ability

Visuospatial ability	Manga reader	N	Mean	Std. Deviation
Mental rotation average reaction time	Manga reader	30	3852.1236	2088.3704
	Non Manga reader	30	4321.1636	2563.1816

Table 01 depicts the Visuospatial Ability of individuals by examining the average reaction time taken on mental rotation task on the basis of whether the participant is a manga reader or non-manga reader, the data was collected from a sample of 60 consisting of 30 Manga readers and 30 non manga readers. The mean value for Visuospatial Ability for manga readers was 3852.1236 and the standard deviation was 2088.3704 and for non-manga readers the mean value was 4321.1636 and standard deviation, 2563.1816, this shows that there was no much difference in the Visuospatial Ability among manga readers and non-manga readers however, it was seen that non manga readers had better average reaction time in contrast to that of manga readers showing that they might have better Visuospatial Ability in comparison.

Table 02 depicts the Response Inhibition ability of individuals by examining the average reaction time taken on the stroop effect task on the basis of whether the participant is a manga reader or non-manga reader, the data was collected from a sample of 60 consisting of 30 Manga readers and 30 non manga readers. The mean value for Response Inhibition for manga readers was 971.7022 and the standard deviation was 290.0899 and for non-manga readers the mean value was 1333.0606 and standard deviation, 280.6269, it was observed that manga readers had better average reaction time in contrast to that of non-manga readers in the stroop task, showing that reading Manga has made them better at response inhibition.

Table 2: Mean and standard deviation for Response Inhibition

Response Inhibition	Manga reader	N	Mean	Std. Deviation
Stroop average reaction time	Manga reader	30	971.7022	290.0899
	Non Manga reader	30	1333.0606	280.6269

Independent sample t-test was used to analyse if there is significant difference in the visuospatial ability and response inhibition among manga readers and non-manga readers and whether the differences are observed among males and females in these two groups. Table 03 shows that an independent sample t test was conducted to compare the response inhibition in manga reading population and non-manga reading population by analysing their performance on the Stroop task.

The null hypothesis, Ho1, stating that there is no significant difference between the processing speed or response inhibition ability between the manga reading population and the non-manga reading population, was rejected as there is a significant difference in the response inhibition of manga reading population (Stroop average reaction time, M= 971.7023, SD =

290.0899) and non-manga reading population (M = 1333.061, SD = 280.6269) ; t(58) = - 4.904 and p = 0.001 (p<0.05).

Table 03 also shows that an independent sample t test was conducted to compare the visuospatial ability in manga reading population and non-manga reading population by analysing their performance on the mental rotation task.

Table 3: t, df and p value on scores of mental rotation task and Stroop task for manga readers and non-manga readers

Logical Parameter	Manga Reader		Non-Manga reader		T(58)	P
	M	*SD*	*M*	*SD*		
Stroop average reaction time	971.7023	290.0899	1333.061	280.6269	-4.904	.001
Mental Rotation average reaction time	3852.124	2088.370	4321.164	2563.182	-.777	.440
Stroop number of correct	38.63	1.810	36.47	2.897	3.474	.001
Stroop number of wrong	1.00	1.486	1.70	1.579	-1.769	.082
Mental rotation number of correct	7.43	1.612	7.20	1.584	.565	.574
Mental Rotation number of wrong	2.53	1.634	2.67	1.668	-.313	.756

The null hypothesis, Ho2, stating that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population, was accepted as there is no significant difference between the visuospatial ability of manga reading population (stroop average reaction time, M= 3852.124, SD = 2088.370) and non-manga reading population (M = 4321.164, SD = 2563.182) ; t(58) = - -.777 and p =.440 (p<0.05).

Table 04 shows that an independent sample t test was conducted to compare the gender differences in the response inhibition and visuospatial ability among the males and females in manga reading population by analysing their performance on the stroop task and mental rotation task.

For response inhibition, the null hypothesis H03, stating that "there is no significant difference between the response inhibition ability in males and females among individuals who have been reading manga for at least 2 years", was accepted as there is no significant difference in the level of response inhibition among the males (stroop task average reaction time, M= 1046.895, SD = 356.1187) and females of manga reading population (M = 896.5100, SD = 188.0937); t(28) = - 1.446 and p = 0.159. (p>0.05)

Table 4: t, df and p value on scores of mental rotation task and stroop task for males and females among manga readers

Logical Parameter	Male		Female		T(28)
	M	*SD*	*M*	*SD*	
Stroop average reaction time	1046.895	356.1187	896.5100	188.0937	1.446
Mental Rotation average reaction time	3463.873	1743.125	4240.375	2381.724	-1.019
Stroop number of correct	38.67	2.024	38.60	1.639	.099
Stroop number of wrong	.87	1.356	1.13	1.642	-.485
Mental rotation number of correct	7.53	1.885	7.33	1.345	.335
Mental Rotation number of wrong	2.47	1.885	2.60	1.404	-.220

For visuospatial ability, the null hypothesis H05, stating that "There is no significant difference between the visuospatial ability in males and females among individuals who have been reading manga for at least 2 years", was accepted as there is no significant difference in the level of visuospatial ability among the males (mental rotation task average reaction time, M= 3463.873, SD = 1743.125) and and females of manga reading population (M = 4240.375, SD = 2381.724); t(28) = -1.019 and p = 0.317 (p>0.05)

Table 5: t, df and p value on scores of mental rotation task and stroop task for males and females among non-manga readers

Logical Parameter	Male		Female		t
	M	*SD*	*M*	*SD*	
Stroop average reaction time	1345.617	285.8375	1320.505	284.7581	.241
Mental Rotation average reaction time	4038.182	1819.349	4604.145	3182.366	-.598
Stroop number of correct	35.73	3.390	37.20	2.178	-1.410
Stroop number of wrong	1.87	1.642	1.53	1.552	.571
Mental rotation number of correct	7.00	1.732	7.40	1.454	-.685
Mental Rotation number of wrong	3.00	1.732	2.33	1.589	1.099

Table 05 shows that an independent sample t test was conducted to compare the gender differences in the response inhibition and visuospatial ability among the males and females in non-manga reading population by analysing their performance on the stroop task and mental rotation task.

For response inhibition, the null hypothesis H04, stating that "There is no significant difference between the response inhibition ability in males and females among individuals who do not read manga.", was accepted as there is no significant difference in the level of response inhibition among the males (stroop task average reaction time, M= 1345.617, SD = 285.8375) and females of non-manga reading population (M = 1320.505, SD = 284.7581); t(28) = .241 and p = .811. (p>0.05)

For visuospatial ability, the null hypothesis H06, stating that "There is no significant difference between the visuospatial ability in males and females among individuals who do not read manga", was accepted as there is no significant difference in the level of visuospatial ability among the males (mental rotation task average reaction time, M= 3463.873, SD = 1743.125) and females of manga reading population (M = 4038.182, SD = 1819.349); t(28) = -.598 and p = 0.555 (p>0.05)

DISCUSSION

It has been established through various pieces of evidence from different studies, throughout this paper, that every individual has an established direction bias which influences our asymmetry in central perceptual scan, scanning behaviour, drawing tendencies, and most importantly reading behaviour. Harsel and Wales (1987) found that when the stimuli were organized in a way that was compatible with the direction that people in the culture read printed text, people performed better on an inductive reasoning test. Thus, there is growing evidence that when attention begins on the side of the display where text would originate and progresses in a direction congruent with text reading and writing, performance is observed to be improved across a range of tasks. These findings imply that the asymmetry is caused by a bias that arises from the direction of text reading rather than an innate bias resulting from some form of hemisphere specialization in the attentional system.

Several such studies establish that our reading experience produces a direction bias that influences our processing of information. Therefore, as individuals who have an established left-to-right bias after years of reading in that direction, when they engage in reading a text in a new direction like manga, which is read from right-to-left, their initial tendency to read in the opposite direction needs to be inhibited, thus comes the role of the individual's capacity for response inhibition.

The current study tried to see if the continuous practice of reading manga, for a minimum period of 2 years, has an effect on their overall response inhibition ability. In accordance to the prediction of the study, people who engaged in reading manga would perform better in the response inhibition task (i.e., have better average reaction time in the stroop task). And the results showed a significant difference between people who read manga and those who don't in their levels of response inhibition.

Manga, a visual medium that frequently features rapid action and intricate narratives, may have a comparable impact on response inhibition. Additionally, reading manga demands a lot of concentration and focus in order to follow the plot and understand the illustrations, which may also help to boost cognitive function along with cognitive demands of engaging in an inhibitory reading direction.

Response inhibition is an integral component in reading comprehension, individuals require their executive functions to be focused, pay attention, and self-regulate their behaviour while they read since reading is not instinctive, at least during the early stages of its learning. Therefore, inhibition may play a role in the reading process, among other executive processes (Christopher et al., 2012), specifically to prevent guessing mistakes (i.e., substituting a word with its orthographic neighbour).

The current study also examined the effects of reading a multimedia text like manga on the visuospatial ability of its readers, the assumption was that individual who read manga that required more visuospatial perception in the comprehension of the myriad narratives would result in a better visuospatial ability. However, the results showed no significant difference between individuals who engaged in regular reading of manga and those who don't read manga.

The ability to cognitively manipulate and comprehend spatial connections and visual information is known as visual-spatial ability. While it is often held that engaging in activities like reading manga or other graphic novels may help one's visuospatial abilities, this might not necessarily be the case for everyone which could be a contributing factor to the results. First off, the substance and visual intricacy of manga may differ greatly. Some manga could be quite plain, with few subtle visual features or spatial relationships. In these scenarios, the amount of mental effort and spatial processing necessary to comprehend the narrative might not be sufficient to improve visuospatial ability. Second, while reading manga may include some spatial processing, it may not be the same kind of spatial processing needed for tasks like figuring out riddles or traversing a three-dimensional space. Thus, rather than reading manga, engaging in these other activities may be more beneficial at enhancing visuospatial ability.

Finally, it's crucial to bear in mind that a variety of other factors, including genetics, age, and past experience with spatial activities, can also have an impact on visuospatial ability. As a result, even if a person engages in activities that are known to improve visuospatial ability, like reading manga, they might not necessarily notice a large improvement if these other circumstances are not in their favour. In conclusion, reading manga could require some visuospatial processing, but it's not a certain strategy to sharpen that skill. This skill may be improved further by undertaking tasks that require more intricate spatial connections, such as puzzle-solving or 3D environment navigation.

CONCLUSION

The aim of the current study was to study the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among the manga reading population and the non-manga reading population.

The findings of the current study observe that there is a significant difference in the response inhibition of manga reading population and non-manga reading population, rejecting the null hypothesis and indicating that reading manga along with other contributing factors, does have an influence on the level of response inhibition of an individual. With regard to visuospatial ability, the finding showed that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population, and the null hypothesis was accepted. There are almost no prior studies examining the effect of manga reading in an individual's response inhibition and visuospatial ability, and further, more comprehensive studies are required for more conclusive evidence regarding the same.

Effective inhibitory mechanisms have been shown to be related to reading comprehension along with a number of other factors, including the knowledge one has of the material read, the capacity to monitor one's understanding of text and adjust reading strategies (Cornoldi & Oakhill, 1996), and working memory (Cain, 2006; Carretti et al., 2009; Cornoldi, De Beni, & Pazzaglia, 1996). These studies provide a significant implication on the importance of response inhibition in better reading comprehension. And a positive implication for the possibility of improving response inhibition by the use of reading manga as a form of fun intervention which is also on par with the increasing trend and prevalence of manga as a leisure activity among teens in India. Manga reading being a rising trend among the youth today and a less explored research area, more studies are required for further understanding regarding the different aspects and effects of manga reading. The possibility indicative of the findings from the current study can be a window for future studies to learn more about the same.

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Original Reserach Article

Cognitive Rehabilitation for Attention, and Working Memory in Patients with Negative Symptoms of Schizophrenia: A Comparative Study

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ABSTRACT

Background: Patients with schizophrenia having negative symptoms seem emotionally flat and unresponsive to things happening around them. They are unable to show emotion by varying their facial expressions, gestures or tone of voice. The person may not show much response to happy or sad events, or may respond in an inappropriate way. **Aim:** The current study examined the effectiveness of cognitive rehabilitation in improving the attention and working memory in patients of schizophrenia having negative symptoms. **Methods**: It was a hospital-based intervention study on30patients with mild to moderate negative symptoms of schizophrenia with 1:1randomizationto receive twenty-four sessions on Brainwave-R Cognitive Remediation (CR) training for six weeks in the first group and waitlist controls as the second group. The effects of training were evaluated using the digit span test and letter cancellation test (attention) with the Trail Making Test (Working Memory) after completion of six weeks. **Results:** A significant improvement was found in scores over "time" in experimental and control group for Digit Backward ($F= 0.293$, $p<0.002$). Scores in Letter Cancelation Test ($F=0.13$, $p=0.552$) indicated that there was no significant improvement in scores over a period of 6 weeks. **Conclusion:** Cognitive rehabilitation was found to be effective therapeutic management for patients with schizophrenia having negative symptoms.

Key words: *Attention, Working Memory, Negative Symptoms, Schizophrenia, Cognitive Rehabilitation*

INTRODUCTION

The care of people with mental and behavioral disorder has always reflected prevailing social values related to the social perception of mental illness. Impairment of cognitive functions is a significant cause of disability after brain injury and stroke which often leads to residual deficits in the physical and psychological spheres. The physical deficits and its resulting limitation are obvious. It is easy for the patient and the family members to accept that these are the beyond the patient's control. Psychological deficits are in nature of cognitive and emotional problems. They affect the functioning of the patient in family, social and occupational spheres. Cognitive rehabilitation is useful in improving psychological functioning of the patient. The improvement in turn reduces the difficulties faced by the patient in his everyday interaction in the family, occupational and society. Cognitive rehabilitation helps to restore the patient to his/her optimum level functioning.

Approximately 15–20% of people with schizophrenia experience negative symptoms that persist during periods of clinical stability and remain untouched by current treatments. Furthermore, negative symptoms are associated with poor functional outcomes. Thus, interventions that are designed to treat negative symptoms are of high priority since negative symptoms are strongly related to functional outcomes and they have an independent effect on outcomes relative to other symptoms of schizophrenia.

Further, there is now substantial evidence supporting the view that impairment in cognition is a core feature of schizophrenia, which is present prior to disease onset and independent of clinical symptoms. The level of cognitive functions a greater predictor of outcome than clinical symptoms.

Impairments in speed of processing, attention/vigilance, working memory, verbal memory, visual memory, problem solving and social cognition were frequently found in individuals with schizophrenia.

The relationship between cognitive deficits and poor functional outcome has prompted the development of cognitive rehabilitation (CR) approaches focused specifically on treating the cognitive deficits of schizophrenia.

Nuechterlein et al. (2004) reviewed evidence in this area and found that impairments in speed of processing, attention/vigilance, working memory, verbal memory, visual memory, problem-solving and social cognition were frequently found in individuals with schizophrenia.

(Saykin et al., 1991) has revealed that as many as 80% of people with schizophrenia exhibit neurocognitive deficits on measures of attention, learning and memory, problem solving, executive function, language and/or sensory motor skills.

A Pilot Trial in Brazil was to investigate the efficacy and feasibility of an attention and memory training programmer specially created in a developing nation, Pontes LM.et al. (2013). Total sample was 17

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stable Brazilians with schizophrenia were taken for the study. Sessions were conducted weekly during five months. Result showed that the cognitive training group showed significant improvements in inhibitory control and set-shifting over time.

Another study the efficacy of cognitive rehabilitation with Rehab Com programme in patients with schizophrenia by Mak M. et al., (2013). 41 participants and 40 control subjects were randomly selected. Both groups had the diagnosis of paranoid schizophrenia. Cognitive functions were checked with the Wisconsin Card Sorting Test, Trail Making Test, and Stroop Test at the beginning and end of the experiment. In the research group, each patient trained with the rehabilitation programme Rehab Com, whereas the control group did not receive such training. Result showed that Rehab Com procedures appear to be useful in the neuropsychological rehabilitation of cognitive dysfunctions in patients diagnosed with schizophrenia. The research group showed a moderate improvement in the training programmed.

Unfortunately, pharmacological treatments have limited effects on negative symptoms and may even contribute to or exacerbate secondary negative symptoms. In schizophrenia specific rehabilitation techniques like vocational and occupational rehabilitation, assertive community treatment, social skills training, cognitive remediation and other appropriate neuropsychological rehabilitation can be implied. Cognitive impairment is a core feature of schizophrenia. Deficits in cognitive functioning, including those in psychomotor speed, attention, memory, and executive functions, are thought to underlie the severe functional disability associated with this illness. This relationship between cognitive deficits and poor functional outcome in schizophrenia has paved the way of cognitive rehabilitation (CR). This approach of rehabilitation particularly gives focus on addressing the cognitive deficits of schizophrenia (Velligan et al, 2006).

In Schizophrenia Cognitive Remediation/Rehabilitation/ Neuropsychological Rehabilitation was used. Cognitive rehabilitation becomes an essential part of the rehabilitation of the patient and it aims at:

- Improving the impaired cognitive mechanism directly,
- Developing some compensatory mechanism and
- Changing environment so that the cognitive deficit has less effect.

The current study aimed was to examine the efficacy of cognitive rehabilitation in improving the attention and working memory in patients of schizophrenia with negative symptoms.

METHODS

The study approved by the Institutional Ethics Committee was conducted at the outpatient and inpatient departments of Central Institute of Psychiatry (CIP), Ranchi. It was a prospective pre -post intervention study conducted from (Mention the study period). Atotal of 30 patients with negative symptoms of schizophrenia were purposively selected and randomly assigned to the intervention and waitlist group using block randomization. The intervention is part of a larger design being carried out as post-doctoral research.

The participants were patients having Schizophrenia (ICD-10) over 2 years, aged 18 – 50 years, with minimum 8 years of education, and mild to moderate negative symptoms. Participants a co morbid psychiatric diagnosis, history of substance abuse/ dependence except for nicotine and caffeine, having received Electro-convulsive therapy in previous six months were excluded from the study.

Assessment tools

Socio- demographic and clinical data sheet was designed to record the socio-demographic and clinical variables.

Clinical assessment scales

Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987)

It is 30 items scales that is specifically developed to assess individual with schizophrenia and is used vary widely in research settings. The PANSS is based upon the premise that schizophrenia has two distinct syndromes, positive and a negative syndrome. The positive syndrome includes features like delusions and hallucinations, while the negative syndrome includes those features that are lacking/poorly developed in individuals with schizophrenia, such as social withdrawal and flattened or blunted affect. There are 30 items which rate along a 7-point continuum (l=absent, 7-extreme). The assessment provides separate scores in nine clinical domains including a positive syndrome, a negative syndrome, depression, a composite index and general psychopathology. Ratings are generally based upon information relating to past week.

Scale for Assessment of Negative symptoms (SANS) (Andreasen. 1981)

It is a 25-items scale, and is designed to assess negative symptoms in individuals with schizophrenia. The SANS items are rated on the basis of a clinical interview, direct observation, and any additional sources of information, including clinical staff or family members report. The SANS evaluates five domains of the negative symptoms complex including alogia, affective flattening, avolition-

apathy, anhedonia-asociality and attention. This scale is rated on a 0-5 spectrum (0=not present, 5=severe).

Calgary Depression Scale for Schizophrenia (CDSS) Addington et al, (1992)

The scale was specially developed to assess the level of depression in Schizophrenia. It consists of 9 items; all ratings of the items are defined according to operational criteria from 0-3. The CDSS depression score is obtained by adding each of the item scores. A score above 6 has 82% specificity and 85% sensitivity for predicting the presence of a major depressive episode.

Cognitive assessments

Attention

PGI- Digit span test Pershad et al. (1989)

Digit span test is part of Memory Scale from the Postgraduate Institute Battery of Brain Dysfunction hat has been developed in India. It consists of digits that are presented verbally to the subject. The subject is required to repeat the digits either in format of digit forward and digit backward Digit sequences are presented beginning with a length of two digits and two trials are presented at each increasing list length. Testing ceases when the subject fails to accurately report either trial at one sequence length or when the maximal list length is reached (9 digits forward, 8 backward). The total number of lists reported correctly is combined across forward span (FS) and backward span (BS) to produce a total correct score.

Letter Cancellation Test (LCT) Richards et al., (1999).

The test is a measure of sustained attention. The subject has to cancel the stimulus letters given to him, ranging from 1 letter to 6 letter cancellations.

Working Memory

Trail Making Test-Part-A & B(TMT)(Retain& Wolfson, 1985) is a brief paper and pencil test, a component of Halstead- Retain Battery that measures cognitive dysfunction. Part A examines visual scanning, numeric sequencing and visuo-motor speed while Part B assesses the executive functions related to the ability to plan, execute and modify a potential plan of action. TMT-A requires an individual to draw lines sequentially connecting 25 encircled numbers distributed in a sheet of paper. Task requirements are similar for TMT-B except that the person must alternate between numbers and letters (e.g., 1, A, 2, B, 3, C). The patient is instructed to connect the circles as quickly as possible without lifting the pencil from the paper. If the patient makes an error, it is to be pointed out immediately and the patient is allowed to correct it. Errors affect the patient's score only in that the correction of errors is included in the completion time for the task. The score on each part represents the amount of time required to complete the task, and the time taken to complete the test is used as the primary performance metric.

INTERVENTION

Brainwave-R Cognitive Rehabilitation (Brainwave-R) [20, 21]

The intervention involves five independent modules on attention, visual processing, information processing, memory and executive functions. For the present study, only three modules (attention, memory and executive function) were applied to patients of schizophrenia with negative symptoms for duration of six weeks as a part of the cognitive rehabilitation training.

A total 24 sessions were planned and conducted with each intervention sessions lasting for 60 minutes, four sessions per week for up to 6 weeks.

PROCEDURE

Upon recruitment, all the participants were rated on PANSS and SANS to document the severity of negative symptoms and rated on CDSS to exclude the presence of depression at baseline. The scores on the cognitive assessments were recorded thereafter. The participants randomized to Group 1 received cognitive rehabilitation training on Brainwave-R that was continued for six weeks. Cognitive exercises were selected for intervention on the basis of one task representing one group of activity, with tasks having cultural compatibility, comprehensibility and systematic progression into increasing levels of difficulty. The clinical and the cognitive assessments were repeated again at the end of six weeks of intervention.

For Group 2, Patients in this group, they will not receiving any specific psychological and psychosocial intervention only receiving treatment as usual.

Further Measurement was taken after six weeks (immediate end of the therapeutic module).

The Statistical Package for the Social Sciences (SPSS) version 23.0 was used for statistical analysis. The descriptive statistics were used to describe the socio-demographic and clinical variables. Repeated measure ANOVA was used to calculate the effectiveness of therapy over various time points in the participants. The two-sided level of significance was kept at 0.05.

RESULTS

Table 1: The change in attention and working memory over time (pre to post) between the two groups (treatment and control)

Sr.no.	Variables	Group 1 (n =15) (Mean ±SD)	Group 2 (n=15) (Mean ±SD)	Pillai's Trace F (df=27)	P
1	**Digit Span Test** Pre_ Digit Forward Post_ Digit Forward Pre_ Digit Backward Post_ Digit Backward	3.43± 0.52 4.20± 0.56 2.53± 0.52 3.27± 0.59	3.47±0.52 3.47±0.52 2.27±0.46 2.47±0.52	0.92 0.293	0.109 **0.002***
2.	**Letter Cancelation Test** Pre_ LCT Post_ LCT	11.33±4.12 15.33±4.74	12.47±7.99 10.13±5.44	0.009	0.621
3.	**Trial Making Test (A& B)** Pre_ total time taken in trial A Post_ total time taken in trial A Pre_ Total time taken in trial B Post_ Total time taken in trial B	1.59±0.70 1.06±0.513 3.03± 0.96 2.54± 1.08	2.17± 0.84 2.48± 1.27 3.74± 1.14 3.79± 1.22	0.13 0.088	0.552 0.117

Both the groups were comparable on the socio-demographic and clinical characteristics. Among the participants, receiving the intervention, the mean duration of illness was 8.67 $\pm$ 4.94 years with the mean age of onset being 23 $\pm$ 5.6 years. When the performances on the cognitive tests were compared over time (Table 1), a significant improvement was found in scores over "time" in experimental and control group for Digit Backward ($F= 0.293$, $p<0.002$). Scores in Letter Cancelation Test ($F=0.13$, $p=0.552$) indicated that there was no significant improvement in scores over a period of 6 weeks.

DISCUSSION

The present study examined the effectiveness of cognitive rehabilitation on attention, concentration & working memory in patients with negative symptoms of schizophrenia.

The most common cognitive impairments found in patients with schizophrenia are those of attention, memory and executive functions. Schizophrenia is characterized by deficits in attention and it has been claimed that these attention deficits are related to dysfunctional brain systems that underlie the pathophysiology of the disease (Robbins, 1990; Norman et al 1997)

According to the reviewed studies, cognitive rehabilitation was able to enhance the majority of cognitive functions (attention/concentration and vigilance, learning, working memory, verbal and visual episodic memory, executive functions, logical thinking and reasoning, mental flexibility, processing speed, metacognition, language, and perception) mostly via computerized programs and also via paper and pencil task.

Neurocognitive domains, such as memory, reasoning, attention, processing speed, and executive functions are reported as possible beneficial mediators of psychosocial functioning and aid in alleviating schizophrenia symptoms' disorganization.

This has been proven in various studies, while it has also been noted that cognitive rehabilitation therapy should not be a stand-alone therapy. Instead, it should be part of holistic programs aimed at cognition training and changes in the clinical condition of schizophrenia patients.

LIMITATIONS

In conclusion, it is very important to design and implement cognitive rehabilitation programs that are focused not only on cognition but on the enhancement of schizophrenia patients' everyday living and quality of life as well.

To conclude the cognitive rehabilitation training for improving attention, concentration and memory. Our result revealed the overall mean score of all the variables had been shown significant improvement after therapy. However, other domains of cognitive rehabilitation did not show a significant therapeutic effect.

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Review Article

Neural Correlates of Mental State Attribution a Scoping Review

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ABSTRACT

The paper is a scoping review of Neural Correlates of Mental State Attribution, which explains social cognition, neural correlates, mental state attribution along with the theory of mind. Initially 15 papers were identified and then finally 5 were selected after a screening process. The results of these 5 studies suggest that social cognition and mental state attribution are intricate cognitive processes that engage numerous neural circuits and brain regions. Social cognition refers to the cognitive processes involved in understanding and responding to social information, whereas mental state attribution involves inferring the mental states of others, such as beliefs, desires, and intentions. The ability to infer the mental states of others is linked to increased activity in the medial prefrontal cortex and the temporal-parietal junction, which are responsible for self-referential processing and social perception, respectively. Empathy, on the other hand, is associated with increased activity in the anterior cingulate cortex and the insula, which regulate emotions and interception. Attributing causes to oneself or others activates different brain regions, including the medial prefrontal cortex, precuneus, superior temporal sulcus, and inferior parietal lobule, depending on the target of attribution. Finally, the studies indicate that damage to certain brain regions, such as the ventromedial prefrontal cortex and the superior temporal sulcus, can impair social cognition and mental state attribution, with potential implications for treating social deficits in clinical populations.

Key Words: *Prefrontal Cortex, Social perception, Neural Correlates, Mental State Attribution, Temporal Sulcus, Parietal Lobule*

Social Cognition

According to the American Psychological Association (A.P.A,n.d.), "Cognition in which people perceive, think about, interpret, categorize, and judge their own social behaviors and those of others." is social cognition.

Social cognition is the study of how people process, store, and apply information about other people and social situations. It involves understanding how people think about, perceive, interpret, and respond to social information, including the thoughts, feelings, and behaviors of other people.

Mental State Attribution

"Mental State Attribution" has been introduced to describe the cognitive capacity to reflect upon one's own and other persons' mental states such as beliefs, desires, feelings and intentions. Mental state attribution is part of the broader concept of "social cognition" that involves the perception, processing and interpretation of social signals (Adolphs, 2001).

In cognitive neuroscience, mental state refers to the current cognitive and emotional state of an individual, which can be assessed through a variety of measures such as brain activity, behavior, and self-report. Mental states can include a wide range of cognitive processes, such as attention, perception, memory, language, decision-making, and problem-solving. These processes are associated with different neural networks in the brain, and cognitive neuroscience seeks to understand how these networks are organized and how they interact to support mental processes.

Theory of mind (ToM), a phrase created by David Premack and Guy Woodruff of the University of Pennsylvania in 1978, is the capacity to attribute mental experiences to oneself and to others (independent of the processes involved). It is a crucial aspect of social cognition, which refers to the ability to understand and interpret other people's mental states, including beliefs, intentions, and desires. This ability allows us to navigate complex social situations, anticipate others' behavior, and communicate effectively. ToM development typically begins around age 2-3 and continues to develop throughout childhood and adolescence. Researchers have identified various milestones in ToM development, such as the understanding of false beliefs (i.e. the recognition that someone can hold a belief that is not true), which typically emerges around age 4. Theory of mind is basically understood from two major theoretical frameworks which is Simulation Theory and Theory-Theory. According to experience sharing theory (also known as simulation theory), our capacity to copy, or unintentionally duplicate, other people's activities like facial expressions and eye contact, can help us infer some aspects of what they are thinking.

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There are occasions when mental states diverge from their external clues. There are several occasions where people conceal their genuine feelings and ideas in daily life. Our capacity to spot the discrepancy between outward behavior and inner intents is helpful for identifying persons who shouldn't be trusted in more severe situations. This is what Theory-Theory explains.

The neural basis of ToM has been extensively studied using various neuroimaging techniques, such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). Studies have found that ToM involves a network of brain regions, including the prefrontal cortex, the temporal lobes, and the superior temporal sulcus, among others. Furthermore, research suggests that various factors can influence ToM development, including genetics, early social experiences, and cognitive abilities.

Studying the mental states in cognitive neuroscience involves using a range of techniques such as neuroimaging (e.g., fMRI, EEG), behavioral experiments, and computational modeling to investigate how the brain processes information and generates mental states.

It is very important to understand the neural basis of mental states as it provides insights into the underlying mechanisms of cognition and emotion, as well as inform the development of interventions for mental health disorders.

Overall, understanding the neural basis and development of ToM and Mental State attribution is essential for gaining insight into the cognitive processes underlying social interaction and communication. This paper's aim is to find research studies related to Neural Correlates of Mental State Attribution and get a clear picture of the brain areas involved.

METHODOLOGY

Literature Search and Criteria for Paper Selection

A review of literature was conducted using the methodology framework developed by Arksey and O'Malley (2005), which was further improved by Levac et al. (2010). This framework consists of five stages, which involve identifying research questions, selecting relevant studies, choosing studies, organizing data, and summarizing and reporting the findings.

Initially, we scrutinized various studies by analyzing their titles, abstracts, and keywords that were relevant to our research. During this initial stage, we identified a group of keywords, including "cognitive neuroscience," "theory of mind," "social cognition," "mental state attribution," "neuroimaging techniques," "neural correlates," and "scans." Subsequently, we developed additional keywords by examining the titles, abstracts, and keywords of studies found during the first search phase. This iterative process led us to include keywords such as "MRI," "fMRI," "PET," and "CT" in our search strategy. Finally, we created the following search string to address the variables proposed in our research questions, specifically Cognition, Neuroimaging techniques, and Mental State Attribution

"Theory of Mind and Neural Correlates", "Mental State attribution and imagine techniques", "Neural correlates of mental state attribution", "Social Cognition and Neuroimaging techniques".

Research and articles were gathered from different online journals and sites such as "PubMed" "NCBI", "Science Direct", "Google Scholar", "Online Wiley Library", "Oxford University Press" and etc.

Inclusion and Exclusion Criteria

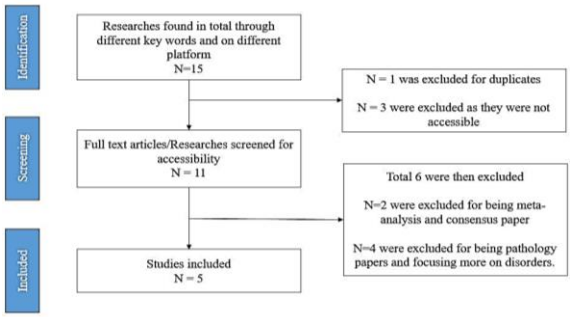
The authors of this paper conducted all the screening stages and resolved discrepancies and citations that partially met the criteria by reaching a consensus. This is because member checking is a well-recognized method for establishing "trustworthiness" in scoping review. The inclusion criteria is as followed:

- Studies related to cognitive neuroscience and mental state attribution only
- Hhad neuroimaging techniques as neural correlate was the main focus
- Studies shall be published in the last 10 years and not before that
- It should be an experimental study or the data collection method should be primary data collection.

Researchers found and screened

Figure 1 summarizes the screening procedure followed where the aforementioned inclusion and exclusion criteria were applied in order to select the key studies. Total of 15 studies were identified from different platforms as mentioned above. Out of which 1 one excluded as it was the same as another study, and then 3 were excluded as they were not accessible and free full access wasn't available. Later 2 were excluded as they were not first hand data collected but rather a meta analysis or was a consensus paper which is a document that reflects the collective agreement or viewpoint of a group of experts or stakeholders on a specific topic which wasn't needed for our paper. 4 more papers were excluded in the screening process as they focused more on pathology in relation to mental state attribution which can be a further scope of study but our paper only aims to focus on the Neural correlates of Mental State attribution.

Figure 1: *Screening Procedure of Journals/Articles*



RESULTS AND DISCUSSION

Table 1: *Results of all five researches.*

Brain Area	Function	Study
Medial Prefrontal cortex	Attributing causes to self	Kestemont, Baetens, Van Overwalle *et.al* (2015)
temporo-parietal junction	Attributing causes to other	
Inferior Parietal lobule	Attributing causes to situation	
Medial prefrontal cortex	Mental state attribution	Cohen-Zimerman, Khilwani, *et.al* (2021)
temporo-parietal junction		
Medial Prefrontal cortex	ability to infer the mental states of others	Birgit Vollm al (2006)
The temporal-parietal junction		
anterior cingulate cortex and the insula.	Empathy	
Medial prefrontal cortex, temporoparietal junction, and precuneus	Theory of mind	Sarah Carrington & Anthony J Bailey (2009)
Temporal pole MPFC	Naturalistic social interactions & social cognitions	L. Deuse et al (2016)

Reviewing all the 5 studies shows that medial prefrontal cortex (MPFC) is one of the most common brain areas involved in mental state attribution. In the study by Kestemont, Baetens, Van Overwalle *et.al* (2015) on "*Neural correlates of attributing causes to the self, another person and the situation*" they found MPFC to show increased activity while attributing causes to oneself. In another study by Cohen-Zimerman, Khilwani, *et.al* (2021) on "*the neural basis for mental state attribution"* also suggests network of brain regions, including the medial prefrontal cortex is involved in mental state attribution, and that this network was modulated by the complexity of the social situation being perceived. *"Neuronal correlates of theory of mind and empathy: a functional magnetic resonance imaging study in a nonverbal task"* by Birgit Vollm et al (2006) also suggests that the ability to infer the mental states of others is regulated by the medial prefrontal cortex. It is also seen that MPFC was constantly active during ToM tasks and during naturalistic social interactions as seen in the studies by Sarah Carrington & Anthony J Bailey (2009) and L. Deuse et al (2016) respectively.

Another major brain region found is the temporo-parietal junction. Kestemont, Baetens, Van Overwalle *et.al* (2015) found this region to be active when attributing causes to others while Cohen-Zimerman, Khilwani, *et.al* (2021) found it to be associated with mental state attribution.

Birgit Vollm et al (2006) also found temporo-parietal junctions to be associated with the ability to infer the mental states of others and even the study by Sarah Carrington & Anthony J Bailey (2009) found this area to be associated with the theory of mind tasks. L. Deuse et al (2016)'s study also found naturalistic social interaction and social cognition to be associated with the temporal pole.

Kestemont, Baetens, Van Overwalle *et.al* (2015)'s study also found Inferior Parietal lobule to be an important brain area of mental states and is associated with attributing causes to situation. The study by Birgit Vollm et al (2006) also found anterior cingulate cortex and the insula to be associated with empathy while attributing others' mental states. Lastly, precuneus was also found to be a brain associated with theory of mind.

CONCLUSION

Overall these studies suggest that social cognition and mental state attribution are complex cognitive processes that involve multiple neural circuits and regions of the brain. Social cognition refers to the mental processes involved in perceiving, interpreting, and responding to social information, such as facial expressions, vocal tones, and body language. Mental state attribution, on the other hand, refers to the ability to infer the mental states of others, such as beliefs, desires, and intentions.

The studies indicate that the ability to infer the mental states of others is associated with increased activity in the medial prefrontal cortex and the temporal-parietal junction. The medial prefrontal cortex is involved in self-referential processing, which may help individuals understand and predict the mental states of others by using their own mental states as a reference point. The temporal-parietal junction is involved in social perception and may help individuals integrate social cues and contextual information to infer the mental states of others.

The studies also suggest that empathy, which refers to the ability to share and understand the emotions of others, is associated with increased activity in the anterior cingulate cortex and the insula. The anterior cingulate cortex is involved in emotional regulation and

conflict monitoring, which may help individuals regulate their own emotional responses and empathize with the emotional experiences of others. The insula is involved in interoception, which refers to the perception of internal bodily states, and may help individuals simulate the emotional experiences of others.

The studies further suggest that attributing causes to oneself or others is associated with activation in the medial prefrontal cortex, precuneus, superior temporal sulcus, and inferior parietal lobule, depending on the target of attribution. The medial prefrontal cortex and the precuneus are involved in self-referential processing and may help individuals attribute causes to themselves. The superior temporal sulcus and the inferior parietal lobule are involved in social cognition and may help individuals attribute causes to others by processing social cues and contextual information.

Finally, the studies indicate that damage to certain brain regions, such as the ventromedial prefrontal cortex and the superior temporal sulcus, can impair mental state attribution and social cognition.

IMPLICATIONS

These findings may have implications for understanding and treating social deficits in clinical populations, such as individuals with autism spectrum disorder, schizophrenia, or traumatic brain injury. By identifying the neural circuits and regions of the brain involved in social cognition and mental state attribution, the studies provide important insights into the neural basis of social interactions and may help develop more targeted interventions for social deficits.

LIMITATIONS

We have also found a few common limitations of all 5 studies mentioned above and these limitations include Relatively small sample sizes, Potential confounding effects of task difficulty, Limitations of neuroimaging techniques, including low temporal resolution, potential for artifacts, and reliance on blood-oxygen-level-dependent (BOLD) signals, Use of nonverbal stimuli or simplified tasks that may not fully capture the complexity of social cognition, Heterogeneity of studies, including variability in ToM tasks and limited clinical populations studied, and Publication bias and lack of consensus on specific brain regions involved in ToM and empathy processing.

However it is worth noting that these limitations are common across many studies in the field of cognitive neuroscience, and researchers are constantly working to address and overcome them in order to further our understanding of the neural basis of complex cognitive processes like social cognition and empathy.

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Review Article

Brain and Behavior: Evidences of Neuroimaging and Neuropsychological Testing in Alzheimer's Disease Pathology

Shallu Joon[1] and Chandani Pandey[2]

ABSTRACT

The impairment in cognitive functions is an important indicator in neurodegenerative disease. Both in-vitro and in vivo studies indicates that various neurochemical activities in the brain seems to play an important role in the disease etiology. Along with neuroimaging, neuropsychological tests are done to identify the nature of cognitive deficits. These are performance-based measures of individual's cognitive capacities. Studying brain region-specific alteration of these neurochemicals along with specific neuropsychological tests in can provide an insight towards diagnosis, progression pattern, response towards treatment functional potential and prognosis. This article aims to highlight the importance of neuropsychological testing in neurodegeneration as strong diagnostic indicator collaborating the literature based findings with different neuroimaging techniques.

Keywords: *Neuropsychology, Neuroimaging, Neurodegeneration, Cognitive impairment, Alzheimer's Disease*

HIGHLIGHTS

- Neuroimaging techniques can quantify changes in neurometabolites in brain diseases.
- Neuropsychological tests provide cognitive profile to understand brain deficits.
- Brain Autopsy and In vivo studies of neurodegenerative diseases are discussed.
- Correlation indicated an early predictive model of cognitive decline in AD.
- These changes are also seen in different psychiatric disorders.

INTRODUCTION

In the modern era of technological advancements human life expectancy has significantly increased due to several factors like education, income, advanced healthcare facilities (Mathers et al., 2015). Old age-related problems are increasing in number with all these advances. Dementia as one of the geriatric diseases affecting millions of people bringing negative consequences to patients as well as family members as caregiver's burden, affecting emotional wellbeing and quality of life worldwide making it a pressing issue that needs to be addressed(Mohamed et al., 2010).

The numbers of cases of Alzheimer's disease (AD) are increasing exponentially as more than half cases of dementia are diagnosed as AD(Garre-Olmo, 2018), characterized by cerebral atrophy caused by microscopic changes as amyloid plaques and neurofibrillary tangles(Terry et al., 1964).Researches are going on find the diagnostic markers for these neurodegenerative diseases(Liu et al., 2022; Mandal et al., 2022a, 2022b).Alongside various advanced brain mapping techniques, neuropsychological assessments have proved to play an important part in the early identification ofsigns &symptoms and ensuring the timely diagnosis so that it could lead to better outcome for patients with neurodegenerative conditions (Pasquier, 1999).

Various structural and chemical changes occur in the neurodegenerative disease. These changes might lead to change in brain functionality which is represented by impairment in many aspects of behavior. Brain mapping and imaging techniques can be highly beneficial tools for predicting changes in specific brain areas in neurodegenerative conditions. However, due to limited accessibility to these techniques and the high cost of administration, neuropsychological tests can provide a useful alternative for initial screening and detailed analysis of brain functioning. While brain mapping and imaging techniques remain an important diagnostic tool, neuropsychological tests can play a critical role in the comprehensive assessment and management of neurodegenerative conditions. Structural aspects of brain are studied widely however efficacy of neuropsychological testes in relation to a deeper level i.e., relating to brain neurochemistry has not been explored in detail. This article provides insight that how neuropsychological tests are of importance by taking literature evidences and correlating the findings with neurochemical functioning in neurodegeneration, especially in AD, which ultimately can be used for neuro-rehabilitation.

Brain Neurochemistry in various psychiatric disorders:

Inter neuronal communication primarily occurs by electrical and chemical transmission. The two differs in the mode of transmission. In electrical transmission the current flows through gap junctions whereas in chemical

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transmission major role is played by several neurotransmitters which binds to receptors and facilitate the communication process (Pereda, 2014). Each neurotransmitter directly or indirectly is linked with regulation of human behavior as they act on specific sites of brain which are responsible for their respective behaviors. Different neurological and psychiatric disorders are linked with altered functioning of neurochemicals in various brain regions (Table 1). This alteration in neurochemicals can lead to significant contribution towards pathology. It is important to look for such changes that helps in the identification of various biomarkers in various neuropsychiatric illnesses.

Table 1: Various neurochemicals involved in various psychiatric and neurological disorders

Disorders	***Major Brain Regions involved***	***Neurochemicals and neurotransmitters***
Alzheimer's Disease	• Medial temporal lobe (MTL) • Hippocampus • Parahippocampalgyrus (Kesslak et al., 1991)	• Acetylcholine • Glutamate • γ-Aminobutyric acid (GABA) • N-Acetylaspartate (NAA) • Serotonin(Kristensen, 1990)
Parkinson's Disease	• Substantia nigra • Basal ganglia (Lees et al., 2009)	• Lack of dopamine • The alterations in cholinergic, adrenergic, serotoninergic and peptidergic systems (Pascual & Misiego, 1997).
Schizophrenia	• Prefrontal lobe • MTL (Karlsgodt et al., 2010)	• Dopamine (Guillin et al., 2007) • Serotonin excess as a cause of both positive and negative symptoms in schizophrenia (Woolley & Shaw, 1954) • A selective neuronal degeneration within the norepinephrine reward neural system has been hypothesized for the occurrence of anhedonia (Wise, 2008). • GABA-ergic dysfunction (de Jonge et al., 2017). • Acetylcholine (ACh) and Nicotine (Martin & Freedman, 2007)
Mood Disorders	• Medial and caudolateral orbital cortex • Amygdala • Hippocampus, • Ventromedial parts of the basal ganglia,	• The activity of catecholamines (norepinephrine and dopamine) is too high or low. Elevated levels are associated with mania and diminished levels with depression (Lambert et al., 2000). • Norepinephrine: Down regulation or decreased sensitivity of β-adrenergic receptors (Pandey et al., 1985). • Dopamine: Mesolimbic dopamine pathway are dysfunctional in depression (Nestler & Carlezon, 2006). • CSF is the major metabolite of Dopamine, homovalllinic acid is elevated in mania (Swann et al., 1983). • Deficiency in serotonin activity in both mania and depression (Moncrieff et al., 2022). • Reductions in GABA levels (Petty, 1995). • Adrenergic cholinergic disbalance (Fritze, 1993).
Panic Disorder	• Brainstem • Limbic system • Prefrontal cortex. (Sobanski & Wagner, 2017)	• Low levels of GABA (Goddard et al., 2001). • Cardiovascular symptoms of panic can be triggered by Noradrenergic activity within various brain areas (Gorman & Sloan, 2000).
OCD	• Prefrontal cortex • Basal ganglia, • Thalamus (Huey et al., 2008)	• Dysregulation of serotonin (Pigott, 1996). • Involvement of norepinephrine (Dell'Osso et al., 2006).
ASD	• Cerebellum • Frontal cortex • Amygdala (Donovan & Basson, 2017)	• Elevated platelet serotonin (5- HT), and mTOR (Veenstra-VanderWeele & Blakely, 2012).
ADHD	• Prefrontal cortex • Basal ganglia • Cerebellum (Curatolo et al., 2010)	• Involvement of dopaminergic and adrenergic systems (Levy, 1991).

Neuropsychology and Neuroimaging in neurodegeneration:

Neuropsychology is a specialized branch of psychology which deals with brain–behavior relationships. Introduction of scientific methods in psychology led towards the origin of psychological testing William James hypothesized for more empirical based research for mental processes in his functionalistic viewpoints. This effort led towards development of more scientific methods to study psychology (Stebbins, 2007). Lashley, Halstead and Luria further contributed towards the basis for neuropsychology as a specialized function to assess brain lateralization and localization functions (Stebbins, 2007). These tests or batteries are used for evaluation of cognitive functions to target any pathology or insult to the brain and impairment related to severe mental illnesses. This functional assessment helped in identifying abnormal behavior related to brain changes in different disorders through paper pencil based tests. These tests are performance-based tests specialized in assessing different cognitive domains like memory, executive functioning, decision making etc.

Various neuropsychological tests provide information about diagnosis, areas and level of cognitive impairment, pattern of disease progression, response towards treatment, functional potential and prognosis. Detailed neuropsychological assessments provide a panoramic view for the cognitive deficits. Also these can prove valuable in initial stages of disease which is important for early identification of various diseases such as of AD. Studies have highlighted the efficacy of Tests like Mini mental status examination (MMSE) (Folstein et al., 1975), Clock Drawing test (CDT)(Wolf-Klein et al., 1989), Trail making tests (TMTs) (Ashendorf et al., 2008). These tests assesses the possibility of any cognitive deficits and thus has the ability to be used as screening tools.

Structural and functional brain impairment are important indicators in various disorders. There are many changes that occur in different psychiatric, neurological, neurodevelopmental another medical conditions. With detailed information about cognitive capacity and brain functioning of an individual, these tests are helpful in eliciting pathognomonic signs. For disorders like depression, anxiety, personality disorders, alcohol and substance abuse, developmental disorders etc. with behavioral symptoms clinical interview and psychological assessments act as key diagnostic indicator. However, in specific neurological disorders like AD, it become important to do understand various neuroimaging technique and their specific functionality towards diagnosis. Neuroimaging methods can be of invasive and noninvasive in nature. Invasive approaches involve stimulating the targeted brain area by inserting some chemical compound in the body. In contrast noninvasive methods do not use any external agentto enter in the body to stimulate are of interest. These techniques study brain regions majorly in three different aspects i.e. structural, functional and neurochemical. Structural aspects represent anatomical study of brain which gives details about location of various brain regions and changes. For e.g. cerebral atrophy which a major change in AD can be seen through volumetric magnetic resonance Imaging (MRI)(Scahill et al., 2002). Functional techniques try to assess the brain regions which are involved in different body functioning. Electroencephalogram (EEG) can map brain electrical signals, functional MRI (fMRI) which identifies functional changes through blood flow and metabolic activity in brain region (Glover, 2011). Newer research tool is magnetic resonance spectroscopy (MRS) which identifies neurochemistry and detects presences of neurochemicals in various brain region in healthy and disease conditions. For e.g., changes NAA concentration in hippocampus is detected in AD (Schuff et al., 2006). Figure 1 represents a detailed flowchart of several neuroimaging techniques along with list of major cognitive areas that are measured by neuropsychological tests.

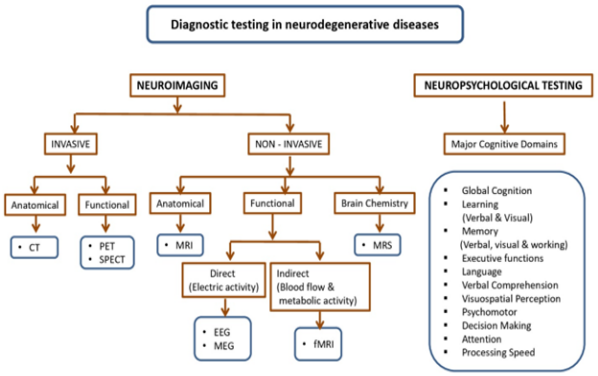

Figure 1. Details of various techniques of neuroimaging and neuropsychological testing used for diagnosis making in different types of neurodegenerative diseases.

CT=Computerized Tomography; PET=Positron Emission Tomography; SPECT= Single-Photon Emission Computerized Tomography; EEG=Electroencephalogram; MEG = Magnetoencephalography, fMRI = functional MRI, MRS = Magnetic resonance spectroscopy

Diseases where neuropsychological testing has advantage over other methods including neuroimaging as clinical features have significant behavioral symptoms. These tests help in identifying underlying disease much before the actual functional impairment so that an early diagnosis can be made. In psychiatric disorders testing provides important information as for disorders like depression, personality, developmental

disorders where no set imaging biomarkers are available. In neurological disorders like Dementia, Parkinson's disease (PD), traumatic brain injuries (TBI) and in case of tumors where neuroimaging markers are quite sensitive, psychological testing helps in determining brain changes as it gives confidence in making early diagnosis and further rehabilitation strategies can be applied.

Evidence from literature:

Neuroimaging is widely used in diagnosing neurodegenerative diseases like AD and PD. Neurobiological boundaries remain unclear in psychiatric disease like schizophrenia, schizoaffective and bipolar disorders (Kloppel et al., 2012). Braun et al. (2011) highlighted importance of assessments in neurological, neurodevelopmental, medical and psychiatric disorder. Various studies have also proved that there is much need of research in field of neuroimaging to set and validate biomarkers in different mental illnesses. However most of these studies provide evidence about utility of neuropsychological tests.

Table 1: Relationship of various neuroimaging modalities and neuropsychological tests in AD.

S.No.		Sample	Imaging Method	Area of study	Imaging and Neuropsychological tests correlation results
1.	(Waragai et al., 2017)	289 subjects	MRI and ^{1}H MRS	PCC	▪ Significant positive correlation of MMSE scores with the NAA/MI ratio. ▪ MMSE scores showed negative correlation with the MI/Cr ratio ▪ No correlation with the NAA/Cr ratio.
2.	(Duff et al., 2018)	17 MCI 8 HC	MRI	Hippocampal volumes	▪ Hippocampal volume was positively correlated with Brief Visuospatial Memory Test – Revised (BVMT-R) and Hopkins Verbal Learning Test – Revised (HVLT-R) (Total &Delayed Recall). ▪ Hippocampal volume was negatively correlated with Trail Making Test- B.
3.	(Riese et al., 2015)	21 HC and 15 aMCI	MRS	PCC	▪ GABA, Glx, and NAA levels were found to be correlated to positively to CERAD word learning scores.
4.	(Zhu et al., 2015)	28 aMCI and 24 V-MCI 34 HC	^{1}H-MRS	left frontal lobe, left basal ganglia and left hippocampus.	▪ Positive correlation between CAMCOG-C (in recent memory domain in and NAA/Cr ratio measured in the brain region of left hippocampus in A-MCI group. ▪ NAA/Cr ratio and frontal lobe were also found to be positively correlated with CAMCOG- Cin various domains like praxis, orientation, language, language comprehension in V-MCI group.
5.	(Watanabe et al., 2012)	54 HC, 42 aMCI and 67 AD.	MRI,^{1}H-MRS	Bilateral hippocampi and PCG	▪ Apositive correlation was found between NAA concentration in left hippocampus cognitive domains of verbal, visual and general memory, attention and concentration, delayed recall, logical memory 1, verbal paired memory 1, visual paired memory 2, and verbal paired memory ▪ NAA conc. in right hippocampus was also positively related with verbal and general memory. ▪ However the MI concentration in left hippocampus were significantly negatively correlated with verbal, logical and general memory, delayed recall, verbal paired memory , visual paired memory and visual reproduction. ▪ Right hippocampal MI concentration was also negatively correlated with verbal, logical memory 1, visual reproduction 1, digit span, and visual reproduction in WMS - R.
6.	(Oeltzschner et al., 2019)	13HC and 13 MCI	MRS, Beta amyloid PET,		▪ mI/tCr in ACC and PCC was negatively correlated with MMSE test. ▪ D-KEFS scores had a positive correlation with GSH/tCr in the PCC ▪ Glu/tCr and NAA/tCr were having positive correlation with CVLT scores and these scores were negatively correlated with mI/tCr.
7.	(Jessen et al., 2001)	13 AD	MRS	MTL	▪ A decrease in MMSE scores was corelated with decline in NAA/Cr ratios in MTL. ▪ NAA/Cr negatively correlated with cognitive part of AD Assessment scale (ADAS – Cog)

S.No.		Sample	Imaging Method	Area of study	Imaging and Neuropsychological tests correlation results
8.	(Kantarci et al., 2002)	67 HC, 18 MCI and 33 AD	^{1}H MRS	Posterior cingulate gyri	▪ Positive correlation between Dementia Rating Scale Total and NAA/Cr. ▪ Auditory Verbal learning test was not associated with any of the ^{1}HMRS metabolite ratios.
9.	(Lee et al., 2007)	29 AD & 15 HC	^{1}H MRS	PCC	▪ Naa/Cr ratio had a positive correlation with MMSE scores ▪ mI/Naa ration was negatively correlated with MMSE scores. ▪ The mI/Cr ratio showed no correlation with scores of MMSE.
10.	(Zhang et al., 2009)	13 AD, 9 MCI and 13 HC	^{1}H MRS, apparent diffusion coefficient (ADC)	The hippocampus and the temporoparietal region	▪ Decrease of NAA/Cr and phosphocreatine (NAA/Cr) was correlated with decrease in MMSEscore. ▪ Myoinositol/Cr (mI/ Cr) and the MMSE score were found to be negatively correlated.
11.	(Zimny et al., 2011)	30 AD, 23 aMCI and 15 HC	MRI, H-MRS, PWI,DTI	Posterior cingulate region	▪ NAA/Cr ratio was positively correlated with MMSE scores. ▪ NAA/Cr was negatively correlated with scores on CDR. ▪ mI/NAA was negatively correlated with MMSE and significantly positively correlated with CDR score. ▪ mI/Cho was negatively correlated with MMSE scores. ▪ mean FA was significantly positively correlated with MMSE and negatively correlated with CDR.
12.	(Lim et al., 2012)	23 HC, 36 AD and 19aMCI	MRS	Anterior and posterior cingulate gyri	▪ Negative correlation was seen between mI/Cr of the posterior cingulate gyrus with the scores of MMSE. ▪ The mI/Cr of the anterior cingulate gyrus found to be positively correlated with the scores on neuropsychological inventory.
13.	(Chiang et al., 2017)	Cognitively normal subjects (N= 15)	^{1}H MRS and PET	PCC and precuneus	▪ Lower GSH levels were found to be associated with greater brain amyloidosis in the temporal and the parietal region. ▪ No significant associations between GSH and Repeatable Battery for Neuropsychological Status (RBANS).
14.	(de Rover et al., 2011)	16 control and 15 MCI	f-MRI	Hippocampus	▪ Percentage of correct response on PAL task was significantly lower in the MCI group compared to the control group. ▪ MCI patients activating significantly more than controls at low loads and significantly less at higher loads
15.	(Grossman et al., 2013)	18 HC, 15 PAD, 18 aMCI	fMRI	Temporal–occipital cortex (TOC), prefrontal cortex (PFC)	▪ Significant positive correlation between overall judgment accuracy on fMRI task and performance on the Pyramid and Palm Tree. (Semantic memory)
16.	(Binnewijzend et al., 2012)	Total 105 AD (N= 39), MCI (N= 23) & HC (43).	fMRI	Regional functional connectivity (FC)	▪ Lower regional functional FC is associated with lower scores on MMSE. ▪ Lower regional FC and worse test performance were found for Digit Span (backward), Stroop test, TMT (A and B), VAT, RAVLT (immediate and delayed), Category Fluency, and Rey Figure Copy test. ▪ A strong correlation was found between DMN FC values and RCFT outcomes in AD.

AD = Alzheimer's Disease; CAMCOG,= Cambridge Cognitive Examination; CDR = Clinical Dementia Rating Scale; CSF = cerebrospinal fluid ;cerebral blood flow ; CERAD = Consortium to Establish a Registry for Alzheimer's disease; Cr = creatine compounds; CVLT = California Verbal learning test; DLB = Dementia with Lewy bodies ; DMS= Delayed matching to sample; DTI = Diffusion tensor imaging; DVR = delayed verbal recall test, FA = Fractional anisotropy; FAS = letter fluency for words beginning F, A, S; FCSRT = Free and Cued Selective Reminding Test ; fMRI = Functional MRI;GABA = Gamma-Aminobutyric acid; Glx= Glutamine/glutamate , GSH = glutathione ; HC = Healthy Controls; MD = mean diffusivity ; MCI = Mild cognitive impairment; MRI = Magnetic resonance imaging; MMSE = Mini-Mental

State Examination ; MRS = Magnetic resonance spectroscopy; MTL= medial temporal lobe; MI = Myo-inositol; NAA= N-Acetylaspartic acid; PAL = Paired Associate Learning; PCC = Posterior cingulate cortex; PCG = posterior cingulate gyrus; PET = Positron Emission Tomography ;^{1}H-MRS = Proton magnetic resonance spectroscopy; RAVLT = Rey Auditory Verbal Learning Test; RCFT = Rey–Osterrieth Complex Figure Test TMT = Trail Making Test; WMS = Weschler Memory Scale.

Various advanced neuroimaging techniques like positron emission topography (PET), diffusion tensor imaging (DTI), MRI, fMRI, MRS can help in diagnostic clarification of these clinical conditions but these are majorly restricted up to diagnosis of neurological and organic brain diseases. Above discussion indicated a high correlation with various neurochemical level changes in diseased condition with different neuropsychological test. MMSE being the most widely used test in AD relates with the neurochemicals, which proves its efficacy. Along with this other neuropsychological test relating to cognitive domains also measure functions in various brain regions. Figure 2 show conclusive findings of various biomarkers in AD measured through various neuroimaging techniques.

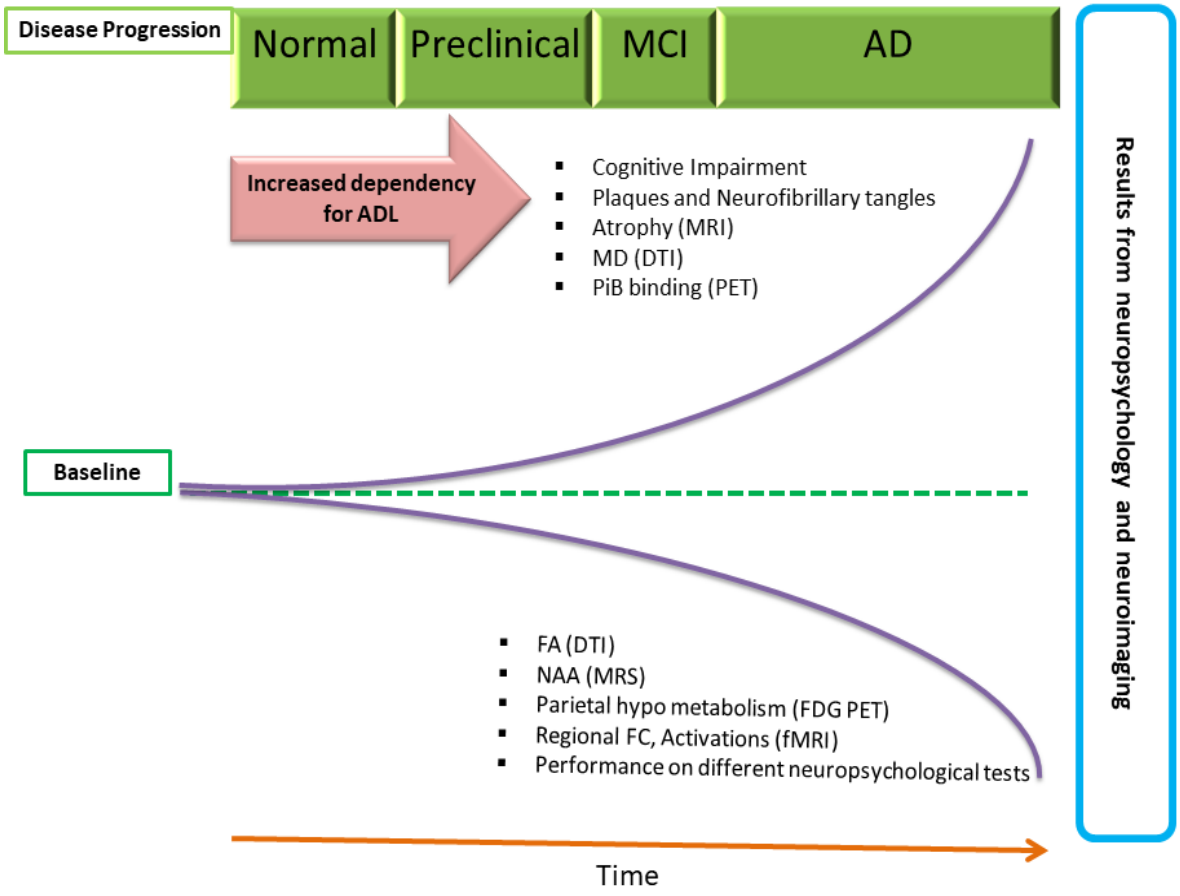

Figure 2 Changes in different domains in from normal toMCI and AD. There is increase in cognitive impairment, number of plaques and neurofibrillary tangles, cerebral atrophy, Mean Diffusivity and PiB Binding. Also there is decline in performance on various neuropsychological tests, amount of certain neurochemicals like NAA, Fractional anisotropy, regional Functional connectivity & activation level measured by different techniques with progression in time, age and diseases severity.

Combined perspective:

Different imaging techniques are also able to monitor brain's structure and functioning as these techniques are more closely able to detect changes in neurochemicals and neurotransmitters that are linked to behavioral changes that can be detected by neuropsychological tests. There is much scope present in the field of neuropsychology for early screening and diagnosis of such disorders. Early diagnosis allows for the prompt

initiation of treatment, which can significantly improve outcomes and slow down the progression of the disease. As, Neurodegenerative disease pathology of brain is linked with dysregulation in various neurochemicals like Choline (Cho), total Creatine (tCr), lactate, inositol, dopamine, serotonin etc. Hypothalamus, a region primarily affected in AD, shows alteration in various neuro chemicals and neurotransmitters. These changes results in significant impairments in behavior so, a systematic analysis of neuropsychological, neuroimaging, and neurochemical data can provide a comprehensive understanding of the underlying mechanisms of neurological and psychiatric conditions, leading to more accurate diagnosis and personalized treatment plans. Some widely used test like MMSE, MoCA, TMTs can provide quick screen to a large population whereas presently, neuroimaging at a greater scale cannot be a feasible solution. Tests like Stroop test, digit span, verbal tests, memory tests etc. point out to region specific, cognitive impairment in patients and help in diagnosis of various neuropsychiatric diseases. Hence, specialized training in neuropsychology is the need of the hour for possible early screening, treatment and management of these diseases.

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Case Report

Cognitive Rehabilitation of Language and Speech Deficits in a Case of Herpes Encephalitis Sequelae

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ABSTRACT

Acute encephalitis is a debilitating syndrome of global brain dysfunction that develops as a rapidly progressive encephalopathy (usually in less than 6 weeks) which can be caused by brain inflammation, both systemic, secondarily affecting the brain, and primary in the brain itself. Patients of all ages may get affected by encephalitis which represents a significant burden to self, family, and society as they usually follow a more chronic course. Initial or predominant symptoms consist of cognitive deficits as well as behavioral changes, emotional dysregulation, and reduction of self-awareness. A 32-year-old, right-handed married female, belonging to MSES was brought for consultation in the post-acute phase after around one and a half years of treatment for Herpes Encephalitis. After further stabilization of her complaints of pain in her right side, tremors in her hands and seizures; was referred to the neuropsychology unit for rehabilitation in December 2014. The clinical presentation revealed a loss of expressive language skills, significant deficits in memory, regression in terms of behavioral changes, and seizures controlled with medicine. Based on the findings of the neuropsychological assessment, an individualized tailored rehabilitation plan was formulated using a multidimensional rehabilitative approach with the aim to promote language reconstruction to integrate the training into daily life communication and enhance the recovery of the patient. The patient received intensive cognitive remediation training for initial 6 months followed by spaced sessions for the next year. Neuropsychological and functional assessments were performed again after six months and the next one-year rehabilitative training showed an improvement in different cognitive functions specifically speech and language, and overall behavioral aspects. Also, maintenance of these treatment effects at around 5-year follow-ups is extremely encouraging.

Keywords: *Acute encephalitis, cognitive rehabilitation, Aphasia, Multimodel Intervention*

INTRODUCTION

Acute encephalitis is a debilitating syndrome of global brain dysfunction that develops as a rapidly progressive encephalopathy (usually in less than 6 weeks) (Venkatesan et al, 2013) which can be caused by brain inflammation, both systemic, secondarily affecting the brain, and primary in the brain itself. Patients of all ages may get affected by encephalitis and represent a significant burden to patients, families, and society (Imor et al, 2008; Vora et al, 2010) as they usually follow a more chronic course, and the initial or predominant symptoms of cognitive as well as behavioral changes, emotional dysregulation, and reduction of self-awareness.

The literature review indicated a dearth of studies describing cognitive and language impairments following encephalitis in adult patients whereas language and speech impairments have been suggested mostly in children with severe encephalitis. Consequently, there has been limited going-over to see possible impacts of improvement in speech on quality of life or participant's satisfaction as such information is necessary to minimize unnecessary healthcare spending and improve patient outcomes. Progressively, findings are supporting the significance of residual non-linguistic cognitive abilities in general in rehabilitation after acquired brain injury (Lin et al, 2022) and thus can be key predictors in the outcome of language functions also (Brownsett, 2014, Lin et al, 2022, Simic,2022). Memory, attention and working memory (WM) are prerequisite cognitive processes for language and other cognitive functions, while other language difficulties may stem from impaired motor function(Pennington, et al., 2009). This directs attention to the notion that aphasia rehabilitation must focus not only on content (language representations) but also on the process (non-linguistic cognitive structures) as aphasia treatments eventually aim to improve communication, rather than reduce language impairment (Carragher, Conroy, Sage, & Wilkinson, 2012).

Till date cognitive rehabilitative training in patients with post-encephalitis sequelae has not received much attention thus, no standardized protocol was examined extensively. The aim of this case report is to describe a specific neuropsychological rehabilitative treatment for a patient, focusing on her impaired language function and behavioral changes after encephalitis. An individualized tailored rehabilitation plan was formulated using a multidimensional rehabilitative approach based on psychotherapy and neuropsychological method with the aim to promote language reconstruction to integrate the training into daily life communication and enhance the recovery of patient by reintegration with her family and society.

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The Case:

Ms. R.M. (name changed for maintaining the confidentiality), a 32-year-old, right-handed married female, belonging to MSES was brought for consultation in the post-acute phase after around one and a half years of treatment for Herpes Encephalitis. After further stabilization of her complaints of pain in her right side, tremors in her hands and seizures; was referred to the neuropsychology unit for rehabilitation in December 2014. The clinical presentation revealed loss of expressive language skills, significant deficits in memory, regression in terms of behavioral changes, and seizures controlled with medicine. MRI finding was suggestive of large gliotic encephalomalacia in temporoparietal region with ex-vacuo dilation of the underlying left lateral ventricle. R.M. was active, and mostly cooperative during the sessions but not oriented to place, person and time. Her visual fields, auditory abilities and motor functions were grossly intact. The initial interview revealed that her spontaneous language production was non-fluent and would mostly respond by echoing the question itself. She had difficulty finding words and using conventional grammar in constructing simple spoken sentences correctly, and difficulty identifying or writing letters, numbers and objects. After much prompting and cueing, she would repeat her personal and family information vaguely. In her interaction and behaviour, she appeared like a child. The patient could not perform any structured neuropsychological assessment. It took around one month to make her cooperative and prepare for assessment and intervention. Written informed consent was obtained from the patient and her primary caregiver (mother) for carrying out assessments and interventions.

In September 2012, R.M. developed sudden onset of fever. Two days later she was taken to a private hospital as she had a severe headache, vomiting and disturbance of consciousness. Based on a detailed clinical history, complete general and neurological examination, routine blood and CSF analysis, and brain MRI (ill-defined hyperintensities seen in patients with white matter nonspecific ischemic changes) she was diagnosed and treated for acute encephalitis. After 25 days, when she was discharged from the hospital she was completely dependent for her basic and instrumental ADLs due to significant loss of speech and language, memory functions and personality changes with regressive behaviour. Although none of her admission symptoms appeared again in last18-month, her mother reported no significant improvement in expressive speech, reading, writing arithmetic skills and needs prompting/assistance for her ADLs. Before contracting encephalitis patient was working as senior manager in a corporate sector with a professional master's degree. Her competence in all three languages i.e. English, Hindi, and Punjabi was reported by her mother to be very high and was managing her personal and professional responsibilities very well. Due to above problems discord erupted in marital relation and mother was the only care giver. That was the added stressor and burden to their lives.

Assessments:

A range of personalized standardized assessments (Table 1) was carried out to ascertain the type and severity of aphasia and pattern on selected cognitive functions. The subtest from the Western Aphasia Battery (used both Hindi adaptation and English version) (WAB; Kertesz, 1982) which was found to be useful to quantify the severity of deficit, assess prognosis, monitor progression, and planning rehabilitation (John et al., 2017) and the Boston Naming Test 15 item short form (Kaplan, Goodglass, & Weintraub, 2000) which is sensitive to deficits in semantic retrieval were used to assess speech and language deficits. The standard test criteria were used to apply and correct the items named spontaneously plus additional items named correctly after semantic cues. Subtests of the WAB include spontaneous speech, auditory verbal comprehension, repetition and naming. The assessment revealed severe aphasia (WAB AQ-33.4), comparatively intact auditory comprehension, and intact repetition yet nonfluent oral speech, reading and writing, more indicative of mixed trans-cortical aphasia. Her speech was characterized by abnormal intonation, dysarthria, effortful Short (1–2 words, telegraphic style) < 10-15 words, no grammar yet content and meaning.

Table 1: Pre and Post Remediation training Findings on Neuropsychological Assessment

Variable	Baseline assessment	1st Post Remediation training (After 6 Month)	2nd Post Remediation training (After 18 Months)
WAB AQ	33.4	50	73.7
Spontaneous Speech	3	11	16
Auditory Comprehension	7.2	10.2	12.9
Repetition	3.4	4.8	7.2
Naming	2.5	4.1	5.7
Reading &Writing	.6	4.1	5.9
Apraxia	5	7.5	12.5
Constructional & Calculation	3.4	10.8	11.3
Boston Naming Test	2	9	13
PGI Memory Scale	Below 20th Percentile	20-40 Percentile	40-60th Percentile
N-Back Visual	8.08	6.3	5.72
N-Back Verbal	10.92	8.07	5.97
Rey-Osterrieth Complex Figure Test	24	28	31
FIM™(Motor & Cognitive Items)	6,3	6,4	7,6

WAB AQ- Western Aphasia Battery Aphasia Quotiont, FIM™- Functional Independence Measure

Performance on subscales of PGI Memory Scale (Pershad & Wig, 1977), Rey-Osterrieth Complex Figure Test (Rey& Osterrieth, 1993) and N-Back test showed significant impairment in linguistic aspects while comparatively preserved non-linguistic functions in

terms of memory and attention. In N-Back test stream of information is monitored with the goal of deciding whether the current item matches an item that was "n" number of trials ago in the sequence for which a simple recognition response is required (Baddeley,2021). Thus a variety of stimuli, from letters, words to spatial locations can be presented making it easier to differentiate linguistic and non-linguistic deficits. The neuropsychological tests showed significant impairment in all cognitive domains with particularly enhanced deterioration of semantics. Successful attempts of repetition test (simple one), which requires an intact working memory, suggested that impairment of language functions cannot be solely explained by the deterioration of attention and short-term memory.

The Functional Independence Measure (FIM™,2009) evaluates the functional skills of individuals in six domains of function i.e. self-care, sphincter control, transfers, locomotion, communication, and social cognition on a 7-point ordinal scale, with scores of 1 to 5 indicating a need for caregiver assistance. The FIM™ was found to be more responsive to different client populations and improvement over the course of rehabilitation (Lee, 2022).Patient's scores on motor functions indicated modified dependence (Average score of 6) whereas communication and social cognition scores were in the complete dependence category (Average score of 3).The complete battery of tests for neuropsychological assessment was administered in three sessions.

Intervention:

The patient received an intensive cognitive remediation training for initial 6 months (twice weekly for 3 month then once in a week) followed by spaced sessions for next one year (once in two week).Based on the findings of the neuropsychological assessment, individualized tailored rehabilitation plan was formulated focusing on patients' impaired language function to promote language reconstruction and integrate the training into daily life communication. Eventually, to achieve the goal of best recovery of patients' language communication skills and enhance her reintegration with her family and society. Her caregiver was primarily the mother who was psycho-educated to help make sense of the patient's behavior and facilitate home assignments for the transfer of training in daily living subsequently. Speech and language functions, working memory and its extension in ADLs were targeted as interventions for this patient.

Considering the psycholinguistic properties known to influence word acquisition and retrieval (e.g., imageability, visual complexity and naming latency; Mätzig, Druks, Masterson, & Vigliocco, 2009) 40 items consisting of 20 nouns and 20 verbs (2 sets of 20 items, 10 nouns and 10 verbs)were selected initially to train the patient. For the selection of these items in consultation with her mother, different categories of nouns were utilised consisting of food, body parts, household objects, shapes, occupations, clothes, animals, etc. For practice verbal targets progressed along a hierarchy of stimulus complexity and task difficulty in the sequence of simple drawing of items, writing and reading the word with fading cues to assist verbal production. One hour practice session included casual interaction with the therapist and a short break for refreshment to sustain the participants' interest and motivation during the intensive treatment program.

The patient was encouraged to make a simple drawing of the item followed by the writing step wherein initially stimulus word was shown completely with gradual fading of cues overtime. At this stage patient was introduced to three tasks described by Luria (1970) as retraining strategies for reading in English: (a) counting the letters in individual spoken and written words, (b) counting syllables in an individual spoken and written word, and (c) synthesizing words from individually pronounced/written letters (i.e., recognizing word). Her performance on these tasks was better for short words (three to five letters) in comparison to increasing word length. Her strategy involved both letter-by-letter reading and counting phonemes referring to the sounds. It was interesting to observe that patient was able to count phonemes referring to the sounds rather than letters in written words which were presented in the English language. Even when these strategies failed to result in literal paralexias (thumb-th, m, d), with training gradually she would often correct herself and recognize the short word. The mother was encouraged to make her practice a similar task as the retraining strategy for auditory items in Hindi as the patient's efforts to communicate with the mother was in this language mostly. In the next step in reading and writing when she seemed to use a direct visual strategy in immediately recognizing the single words, a word combination of noun and verb was added gradually (I take my meal, I made a coffee) increasing the complexity.

Along with this WM training, consisted of practice on an n-back task (either with pictures or spoken words) in the same frequency during sessions and thrice a week at home. Some other tasks included in WM training consisted of digit span tasks (backward and forwards) of varying difficulty levels, as well as a paced auditory serial addition task (i.e., adding the last two numbers heard in a continuous list). For transfer of training in relevant settings client was encouraged to use at least one word each in the home setting (e.g., naming an item during meal preparation or making a request for an item e.g., during traveling, in a local shop) aiming shaping of socially driven communication task. Also patient informed that she has started reading simple picture

books, interaction-based games and listening to English news suggesting her motivation for therapy.

Outcomes:

Neuropsychological and functional assessments were performed again after six months and the next one-year of the rehabilitative training to evaluate the cognitive and behavioral changes that resulted from treatment. The changes in scores and reported functional improvement (Table-1) indicated patient showed an improvement in cognitive tasks as well as behavioral aspects. She could respond verbally and write to dictation at the word-by-word level for short sentences. Western Aphasia Battery indicated significant improvement in clients' everyday communication from severe to progressing towards mild aphasia (WAB AQ: 50 and 73.7 in 2nd and 3rd assessments). Multi-modal cues (drawing, writing and reading the word while not restricting the use of gestures) assisted verbal production. A considerable change was observed in her speech quality in terms of better production (<40-50 words/min) and normal intonation, effortful telegraphic style normal phrase length. Response during functional communication/discourse (Can you tell me about your family? How do you prepare tea?) and quality of life results (Cognitive score on FIM™) further add weight to the efficacy of remedial training. Also, maintenance of these treatment effects at around 5-year follow-ups was extremely encouraging although improvement gained further was slow-paced.

DISCUSSION

Acute encephalitis (AE) may present with a wide variety of symptoms including cognitive regression accompanied by loss of language skills. Despite high prevalence where around 50 percent of patients presented with language impairment in AE(Guevara-Silva et al, 2022)primarily linguistic functions have not been studied in detail. The dual stream model of language processing postulates that the bilateral posterior-medial temporal gyrus and posterior-inferior temporal gyrus regions is the seat for semantics regulation while auditory-motor transformation, repetition of words, verbal working memory and auditory attention are monitored through the left temporal plane and left posterior frontal lobe (Hickok & Poeppel, 2002).Index patient's patterns suggesting severe reading and writing difficulties were similar to mixed non-fluent and transcortical motor aphasia as fewer such difficulties were reported in amnesic, Broca and conduction aphasia (Gonzalez et al., 2020). Thus significant semantic and cognitive deficits in this client raised concern about pieces of evidence pointing to the negative impact of semantic and cognitive impairment on response to aphasia treatment (Lambon, Snell & Fillingham, 2010).The patient showed significant impairment in all cognitive domains but especially in semantics skills and relatively spared repetition and non-linguistic abilities which do not require semantics skills, suggesting somewhat preserved linguistic processes of encoding, storage, and production governed by phonological working memory. The outcome of the WAB, and Functional Independence Measure (FIMTM) was consistent with the report that with intensive comprehensive treatment more severe aphasia tended to show greater recovery in language ability and functional communication than those with mild aphasia (Persad et al., 2013). There are findings suggesting the use of external devices, memory notebooks, or mnemonic strategies to improve memory performance in encephalitis patients (Emslie, 2007; Langenbahn et al, 2013) which was initially not possible with this client due to limitations in writing skill and behavioral regression. This was tried to compensate using regular socially mediated practice contexts of learned tasks that may work positively to facilitate the transfer of training. Importantly, WM training which is considered to involve speed of processing focussed attention, task switching and updating comprehensively representing crucial parts of executive functions also helped in improvement in sentence comprehension and everyday memory activities as supported by a study where participants demonstrated improvements in functional communication (i.e.,understand ability and intelligibility of spoken messages on familiar everyday topics) (Zakariás, Salis & Wartenburger, 2018).It is evident that the WM task requires both maintenance and updating of information with each trial which activates a bilateral frontoparietal network. Neuroimaging studies indicate that activation of this region overlaps with language networks (Rottschy, 2012). Sreedharan et al., 2019, mentioned the role of plasticity of the isotopic brain area of the ipsilateral or contralateral brain replacing the function of the damaged core language area. Thus, further improvement can be explained on the basis of neuroplasticity and functional connectivity of the brain, replaced or supported by a cerebral language area different from the original one affected by encephalitis. A major limitation of this study was the lack of supportive findings in terms of any radiological or other investigations indicating structural change as the patient did not cooperate with the MRI later. Therefore, addressing cognitive deficits, especially language deficits, could improve quality of life by using available cognitive resources.

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Case Study

Deficits in Neurocognitive Domains of Sustained Attention and Memory in Depressed Youth: A Case Report

Mrinalinee Rana[1]

ABSTRACT

Background: Neurocognitive impairment in depression is common in youth and is associated with longer recovery periods, increased risk of relapse and occupational and social communication difficulties. This case study highlights the need to consider neurocognitive deficits in this age group as primary symptoms of depression in clinical practice. *Method*: A 23 year- old graduate presented with symptoms of depression and anxiety. A comprehensive psychological and neuropsychological evaluation was conducted over two days to assess the severity of these problems along with neurocognitive abilities of attention, verbal learning and memory. Cognitive remediation and mindfulness meditation techniques were applied in her treatment to see their effects on these domains. *Results*: After 4 months of weekly sessions, her mood, motivation, attention and working memory significantly improved. *Discussion:* It is crucial for practitioners to assess cognitive deficits in this population and construct therapy interventions based on each patient's symptoms and needs. Early intervention in this regard can lead to better outcomes in treating young adults with depression and improve their quality of life.

Keywords: *Neurocognitive Impairment, Depressed Youth, Cognitive Remediation, Mindfulness*

INTRODUCTION

Depression is one of the most common mental health disorders worldwide. A recent report by WHO (2021) suggests that depression, anxiety and behavioural disorders are the leading causes of disability in 1 out of every 7 adolescents. A meta-analysis of 29 studies on 80879 youth population suggests that prevalence of anxiety and depression has doubled globally during covid times (Racine, McArthur, Cooke, et al, 2021). 1 in 4 and 1 in 5 have clinically elevated levels of depression and anxiety respectively.

Generally, people link depression with low mood, sleep disturbance, loss of interest in activities, bouts of crying and fatigue. But the magnitude of disability that it causes is much bigger. While neurocognitive (NC) impairment is well established as a common feature in adults with depression (Goodall, Fisher, Hetrick, Phillips, Parrish, Allott, 2018), research is comparatively new in these deficits in children, adolescents and young adults (Baune, Fuhr & Hering, 2014). Additionally, peak onset of depression occurs during adolescence, a developmental period that spans between 12 and 25 approximately (Arain et al, 2013). NC abilities, specifically executive functioning, emotional regulation and reasoning, are underdeveloped in this age due to certain brain regions not fully maturing until the mid 20s. A meta- analysis conducted on 23 studies by Goodall et al, 2018 has shown poorer performance in domains of attention, verbal memory, visual memory, verbal reasoning, and IQ compared to healthy controls impacting academic, occupational and social functioning capabilities. Furthermore, research also shows that there are significant differences in these abilities in children less than 15 years and those older (Huizinga & Molen, 2007). These age-related differences can greatly affect the ability to grasp concepts in therapeutic approaches like cognitive behavior therapy and cannot be ignored.

PURPOSE OF THE CASE STUDY

It intends to highlight the importance of identifying and treating NC dysfunction in depressed young adults. It also focuses on the effects of cognitive remediation and mindfulness on these symptoms, specifically attention and memory.

CASE PRESENTATION

Anjali (name changed), a 23-year-old graduate from North India pursuing a diploma in early childhood care and education from Delhi in 2021 presented with depression symptoms of low mood, decreased motivation for around 2 months. She also reported difficulty in concentration and would often forget simple things to finish in everyday life. Even though she loved her course she could not focus well in class and felt lethargic most of the time. She had a very small appetite and ate less with hardly any vegetables. Her only happy place was with her boyfriend of many years. She was not eating properly at all and would have difficulty falling asleep.

Family history of mental illness

She reported a family history of depression and severe anxiety on both sides. Her grandfather had early onset of dementia and her mother suffered from severe anxiety. Her father in his early 50s had diabetes, obesity and gait problems. Her presenting complaints required a

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thorough psychological and neuropsychological evaluation to ascertain her mental health status.

Mental State Examination (MSE) and Neuropsychological Assessment

Anjali appeared depressed and anxious with her attention wavering. Her speech was clear with a slight sad affect. Her thinking was negative with no thought and perceptual distortions. She also had an excellent insight.

A mini mental state examination was also conducted to screen for any cognitive impairments. Her score on this test was 29 on 30 where she could not recall one word out of the three.

Depression Anxiety Stress Scale (DASS-21) was used in the first session to screen for stress, anxiety and depression symptoms. Her scores on all three parameters were in the severe category so a further evaluation was done with the help of Beck Depression Inventory (BDI-II) and Beck Anxiety Inventory (BAI) to gauge the degree of severity of these symptoms. Since she felt a little tired and overwhelmed, the remaining assessments were carried out the next day. Trail Making test (TMT), Rey's Auditory Verbal Learning Test (RAVLT) and Digit Span Test evaluated her visual attention & processing speed, verbal memory and working memory respectively. RAVLT also helps in gauging a person's learning methods, their ability to retrieve information and the role of retroactive and proactive interference in memory processes. Though her processing speed seemed fine, there were deficits in sustained attention, verbal learning and memory. This was mostly visible in the 15 -word list task where she wanted to hurry up recalling words; therefore all five trials were conducted. There was minor confabulation (memory error) in two trials and her immediate and delayed recall of verbal stimuli was also poor.

Diagnosis and treatment

Based on the clinical presentation, testing and interview, Anjali was diagnosed with moderate levels of depression along with comorbid anxiety and neurocognitive deficits. She was advised medication and therapy with a focus on cognitive remediation. The latter is an essential aspect in intervention since traditional psychotherapy approaches require patients to understand basic negative patterns, challenge and modify them. She was apprehensive about psychiatric medication and had spoken to me about her fears on that. But she was comfortable in consulting her homeopath for the same. She also enjoyed daily prayer and occasional visits to the gurudwara that made her happy. In each session she was taught skills to manage studies and other necessary activities of daily living. An activity chart was prepared for behavioural activation and she was psycho-educated on effects of food, exercise and sleep on mental health.

Cognitive remediation was designed keeping in mind her specific needs and goals. Since depression hampers the ability to focus and pay attention to stimuli, it becomes difficult to recall information negatively affecting memory. An essential system to store environmental stimuli is through encoding. This helps in easily recalling items in question. Providing visual, semantic and auditory stimulation can help this process. Some of these exercises taught were as follows:

1. Paying attention to everyday objects for 30 seconds and recalling its features
2. Visualisations to enhance attention and focus
3. Reading a newspaper article, verbally summarising and writing its main points
4. Listening to random letters and clapping on a particular one. This helped in improving sustained attention as there were gaps of 5 seconds between the chosen letters
5. Problem solving exercises like jigsaw puzzles, beginning with 100 pieces.
6. Brainstorming solutions to make/believe or real problems

Mindfulness meditation techniques were brought in therapy once her span of attention increased. Simple yogic principles were explained and the session began with 'watching the breath' or in other words simply paying attention to our breathing. In the next session she was taught a 20 minute guided meditation on mindfulness body scan for self-compassion.

RESULT AND DISCUSSION

Overall, she responded well and was enthusiastic about the activities, as she had never done them earlier. First two weeks of therapy and cognitive training improved her motivation slightly and she felt less fatigued. After 4 months of regular intervention, she was reassessed on domains of attention and memory using the same scales with slight individual items changing to avoid bias such as recall from memory. Her working memory improved and that was evident from better management of study schedule and focus on important house activities. Her power of imagination and ability to visualise in mindfulness meditations improved and became enjoyable. However, to keep the pace going it was important to give breaks to her as she would skip some days completely and go back to a sedentary lifestyle. She was encouraged to increase the difficulty level on activities carried out in sessions, for example, once she was adept at the 100 piece jigsaw, she would move to 200 and so on. Currently, she is married and has started

working in a reputed company and feels motivated and fruitful. She continues to consult me once in a month or whenever she requires a session.

CONCLUSION

Understanding the nature and severity of neurocognitive deficits in depressed youth could aid in developing targeted interventions to improve cognitive functioning in this population. It could also inform practitioners of the need to assess these domains in clinical practice thoroughly to formulate treatment plans depending on each patient's areas of dysfunction.

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Letter to Editor

A Living Legend of Cognitive and Clinical Neuro Psychology

Manoj Kumar Bajaj[1]

As a M.Phil. C.P. intern (Academic Sessions 2005-2004) at IHBAS, Delhi; I had opportunity to meet and interact with Dr. C.R. Mukundan a former Professor from NIMHANS who visited IHBAS, Delhi during my tenure of training several times; to deliver invited guest lectures and to conduct two training workshops (each one of one-week duration).

His teachings and practical training were highly enriching, cogent and relevant academically and professionally for all curious M.Phil. C.P trainees of IHBAS at that time. When IHBAS had just emerged as a training centre of Clinical Psychologist on the national scenario. That is how we came to know the contribution of Professor Champadi Raman Mukundan to Cognitive and Clinical Psychology.

Talking about Neuropsychological Assessments, Cognitive retraining, Lateralization and localization to the current trend of ascertaining functional level was marvellous and lucidly explained to us by Professor Mukundan.

Professor C.R.Mukundan was Teaching, Clinical, & Research faculty at NIMHANS from 1974 to 2003, where he successfully set up the clinical facility in Clinical Neuropsychology. NIMHANS), Bangalore during 1975 -79 for testing brain dysfunction in patients with diseases of the brain. This was the first effort that started clinical neuropsychological examination procedure in India for neurological and neurosurgical patients.

Further at NIMHANS he developed Neuropsychology Battery of tests for testing brain dysfunction and their lateralization and localization. The battery consists of clinical examination procedures for detecting impairment and focal signs in different functional systems controlled from different cerebral lobes. The battery of tests evaluating and assessing various dysfunctions were validated against CT scan and neurosurgical findings in the

late 1980s. The battery is widely used in different clinical centers in India.

On the recommendations of Dr. Mukundan Neuropsychology was included as specialty subject for examination at the M.Phil. in Clinical Psychology at NIMHANS, which led to Neuropsychology being accepted as a specialty subject in other clinical disciplines of Neurology, Neurosurgery, Psychiatry, and Neurosciences. Neuropsychology Laboratory, of NIMHANS is the contribution of Dr. Mukundan, where he successfully set up first Cognitive Electrophysiological Laboratory at NIMHANS in 1979 – 81; with provision of facilities for evoked potential and event related potential recording, (computerized), EEG analysis. Expanded by adding brain mapping system and EEGSYS program provided by NIAAA of USA in 1993. The first international publications from India on computed EEG and evoked and event related potentials are from the Neuropsychology Laboratory. He Designed and built a 32 channels EEG-ERP amplifier for use with the EEGSYS (EEG-ERP recording and analyses) program in 1993-94. Professor Mukundan also designed and built all necessary electronic supportive infrastructure for the laboratory. Who developed and headed a research team consisting of faculty from Psychiatry,Neurology, Neurosurgery & Neuropsychology for cognitive electrophysiological research.

His recent contribution is development of BEOS Profiling technique (Brain Electrical Oscillations Signature Profiling)

This is a technology for using brain electrical activation for recording the neurocognitive process of remembering since 1998. The technology was later used for eliciting remembrance of experiential knowledge in forensic applications. Brain Signature profiling technique is based on the findings that during awareness of past actions (autobiographical memory), the brain produces typical electrical oscillations, which form a Signature of the awareness of the experience remembered. Presence of brain electrical Signature, when provoked by a contextually relevant probe, is indication of the presence of Experiential Knowledge of the action/crime committed by an individual. Brain electrical oscillations signature profiling can be used to detect the presence of Experiential Knowledge of participating or committing the criminal act in question. The technology helps to find out the presence of such Experiential Knowledge in the brain of the suspect, if he or she has committed/participated in the act being investigated. The technique is based on the neurocognitive principles of acquisition and evaluation of signals elicited from the brain during retrieval of autobiographical information provoked by probes.

Brain electrical oscillations of the suspect is recorded using multi-channel amplifier system using a frequency pass band of 0.016 – 85 Hz. Special probes are designed in a "Nestled manner" and presented in auditory mode to the suspect. Control probes are used for validation of the techniques and Target probes are used for detecting "Experiential Knowledge" of the crime related activities

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suspected to have been committed. Additionally, the suspect's version, if present may also be included. A set of neutral probes involving primary semantic processing is used for correcting baseline activity.

The analysis consists of signal processing of the oscillations for computing the energy parameters, and measurement of time domain changes. The response provoked by each probe is statistically analyzed. The entire signal processing, statistical analysis and interpretation of the results are automatically carried out. The analysis detects primary processing or sensory registration of the probe, its encoding, source localization, attending to retrieved information, familiarity of the content, presence of Experiential Knowledge, etc.

All this was designed & developed I.e.the hardware and software for analysis with the help of a computer software company – Axxonet Solutions at Bangalore. Licensed the product to this company for manufacture and sale of the technology. International collaborations are being signed for the use of technology for service and research. International Patent for the BEOS technique is awarded. The BEOS technique is internationally considered a new memory-based paradigm for forensic testing of individuals as well as for medical assessment of memory of experiences. The test is already used in forensic laboratories at Mumbai and Gandhinagar. The test findings have already helped as aid for investigation in several cases which provoked national curiosity. Many more state, central, and international laboratories are in the process of acquiring the system.

Polygraph facility at the Neuropsychology Laboratory, NIMHANS for lie- detection testing purposes was another important area as part of collaborative agreement between NIMHANS and Forensic Science Laboratory, Bangalore in 1997. The facility was later shifted to Forensic Science Laboratory, Bangalore.

Brain Function Therapy developed by Mukundan is a computer software called Brain Function Therapy for (1) cognitive retraining in, children with learning disability, head injury and other brain lesion patients, and for (2) enhancement/enrichment of cognitive functions in normal children and adults (1993).

The program allows retraining and enhancement of brain functions such as selective and focused attention, working memory - both the Central Executive enhancement and widening and strengthening of verbal and visual buffer memory systems, encoding and transcoding, immediate and delayed verbal and visual recall, learning new associations, visual scanning, visuospatial perception – both analysis and synthesis, training in response inhibition. The program also involves methods for conceptual enrichment in different sensory – perceptual realms. Different versions of the program are commercially available for use in India and abroad. It is used by head injury patients, other brain lesion patients with cognitive deficits, children with learning disability, scholastic backwardness, etc., as well as for cognitive enhancement.

Neurobehavioral Control and Potentiality Measurement (NCPM) by Dr. Mukundan is a Computer administered test for measuring personality and potentiality of individuals in corporate organizations (2001). The test is based on the assessment of the type and levels neurocognitive controls used by an individual for the control of behavior and in developing cognitive styles, interpersonal skills, decision-making skills, and application of emotional intelligence, etc. It is a unique test for predicting the cognitive and behavioral richness and versatility of an individual. The test presents 40 different work situations with the several alternate choices for decision making, acting, and responding and the subject is expected to give his or her agreement – disagreement with each response.

The entire computer analysis carried on the response patterns of the individual is graphically represented.

The subscales of the test are (1) Goal Directed and Action Orientation, (2) Adaptability, (3) Pro-activeness, (4) Being Focused, (5) Team Sharing, (6) Work Completion, (7) Critical Thinking, (8) Problem Solving, (9) Risk Taking, (10) Conflict Confrontation, (11) Self-Expression, (12) Openness, (13) Discretion, (14) Empathy, (15) Sociability, (16) Cooperation, (17) Leadership, (18) Self-Dependence.

Looking at the wide range of Contribution by Professor Mukundan I feel he is a living legend of Clinical Neuropsychology in our country.

Call for Papers

Psychotherapy in India

Special issue of IJCP, Vol. 50, December 2023 to be published in the Golden Jubilee year of IJCP

Last date of submission of Paper for this special issue:

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Availability of online and print version of this special issue by

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Papers are invited on Psychotherapy under various groups of Psychotherapeutic techniques. Specifying the name of a type of Psychotherapy limits the scope, as the area of Psychotherapy is expanding.

Editors encourage with priority in publication to a Review & Status paper covering the contribution of Clinical Psychologists and other allied Mental Health Professionals in Psychotherapy; followed by empirical observations, quantitative and qualitative research findings, brief research report, Case Studies and Letter to Editor.

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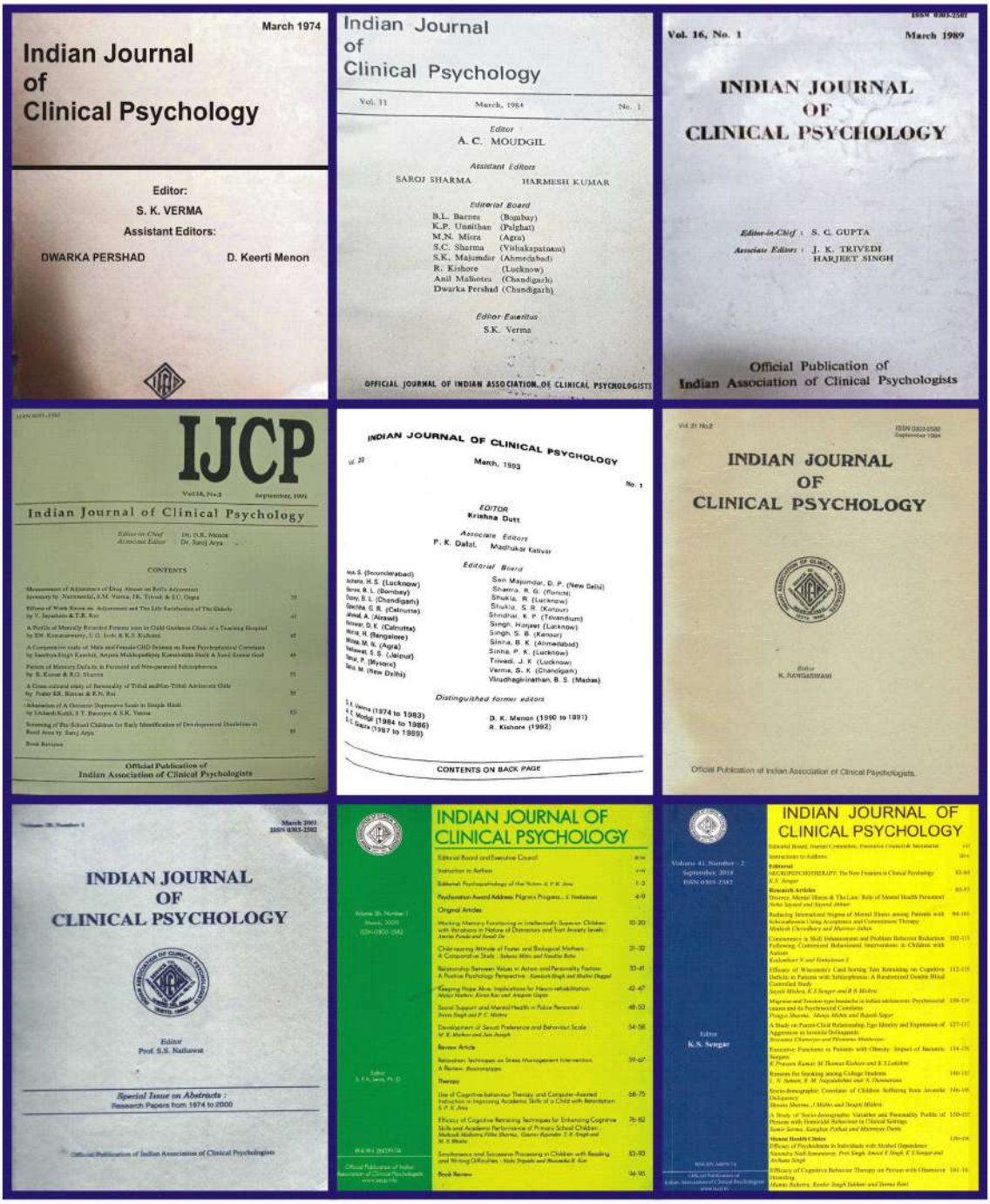

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