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# VISUOSPATIAL CONSTRUCTIONAL ABILITY, VISUAL MEMORY AND RECOGNITION ABILITY AMONG INDIVIDUALS WITH CHRONIC ALCOHOL DEPENDENCE ON THE REY COMPLEX FIGURE TEST (RCFT)

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## SUMMARY

### Background:

The aim of the study was to assess the attention concentration, the visuospatial constructional ability, visual memory and recognition ability among the chronic alcohol dependents and to compare them with normal controls.

### Material/ Methods:

The sample consisted of 30 in-patients, with alcohol dependence (diagnosed according to DCR of ICD-10) from RINPAS. Thirty normal controls were selected from the local community after screening with the General Health Questionnaire – 5. The Rey Complex Figure Test and Recognition Trial (RCFT) were used to assess the visuospatial constructional ability, visual memory and recognition ability. Before administering the test, the patients were interviewed, a Mental Status Examination was taken and attention concentration was assessed through the Digit Span Test.

### Results:

The results suggested that there is a significant difference among the substance groups and normal controls, concerning visuospatial constructional ability, visual memory and recognition ability, which were moderately to severely impaired in the substance groups.

### Conclusions:

Neuropsychological evaluation must be a routine component for substance abuse treatment programs and since comprehensive test batteries are often time-consuming and costly, RCFT could be a suitable option.

**Key words:** chronic alcohol dependents, visuospatial constructional ability, visual memory, recognition ability

## INTRODUCTION

Research shows that alcohol adversely affects the brain and its functioning. The most prevalent alcohol-associated impairments affect visuospatial abilities and higher cognitive functioning. Higher cognitive functioning includes the abstract-thinking capabilities needed to organize a plan, set it in motion, and change as needed. Visuospatial functions represent the brain's highest level of visual processing, and require the proper functioning of our parietal cortex (Pachalska et al., 2012; Pachalska & Kaczmarek 2012). Visuospatial construction processes enable us to reproduce drawings or use components to construct objects or shapes. The ability of an individual to see an object or picture as a set of parts and then to construct a replica of the original from these parts is known as visuospatial constructive cognition. Examples of visuospatial construction include drawing, buttoning shirts, constructing models, making a bed, and putting together furniture that arrives unassembled. Visuospatial construction is a central cognitive ability. Cognitive psychologists have identified three important components of visuospatial construction: spatial working memory, flexibility in the use of spatial reference systems that are necessary for defining spatial properties, and flexibility in the hierarchical organization of objects and configurations. All these component abilities are likely to be important for success in pattern-construction tasks (Mervis et al., 1999).

A complex figure was originally developed by Rey in 1941 (Corwin & Bylsma, 1993) to investigate visuospatial constructional ability and visual memory in brain injured patients (Lezak, 1995). In more recent times, the Complex Figure Test (CFT) has been frequently employed as a neuropsychological test for visuospatial constructional ability and visuospatial memory (Butler et al., 1991; Lezak, 1995). Though a variety of administration procedure was reported by professionals, generally a copy trial is used to assess a visuospatial constructional ability, followed by immediate recall and delayed recall trials to assess visuospatial memory. The Recognition Trial measures the respondent's recognition memory for the elements of the complex figure stimulus and assesses the respondent's ability to use cues to retrieve information, thus evaluating the relative contributions of encoding, storage, and retrieval process to memory performance.

As a measure of visuospatial constructional ability, research has shown that the CFT is sensitive to traumatic brain injury (Osterreth, 1944), cerebrovascular disease (Binder, 1982), Alzheimer's disease and Huntington's disease (Brouwers et al., 1984), Parkinson's disease (Ogden et al., 1990), temporal lobe epilepsy (O'Callaghan, 1985), and undifferentiated brain damage (Schorr et al., 1992). As a measure of visuospatial memory, the CFT has been shown to be sensitive to laterality of cerebral lesion (Osterrieth, 1944), especially right hemisphere involvement (Loring, Lee, & Meadore, 1988), frontal lobe damage (Le Gall et al., 1990), traumatic brain injury (Leininger et al., 1990) and Parkinson's disease (Ogden et al., 1990). Performance on the CFT may also be useful in differentiating among different forms of memory disorder (Bigler, 1988). Due to the quick

administration of the test, it can be used not only as a screening tool, but also to monitor whether the patient's cognitive level is deteriorating further or improving.

An extensive body of research findings suggests the presence of general cognitive impairment and executive function impairment among substance-abusing patients (Grohman et al., 2004; Morgenstern & Bates, 1999). Numerous studies have examined cognitive deficits in alcoholics and noted mild-to-moderate neurocognitive impairment among the individuals who are chronic users of alcohol and other psychoactive drugs (Atkinson, 2000, Tarter & Edwards, 1986), and investigators have proposed that cognitive performance worsens in direct proportion to the severity and duration of alcoholism.

Dementia associated with alcoholism consists of a global loss of intellectual abilities with impairment in memory function, together with disturbances of abstract thinking, judgment, and other higher cortical functions. Studies have found deficits on tests of learning, memory, abstracting, problem-solving, perceptual analysis and synthesis, speed of information processing, and efficiency among alcoholics and heavy social drinkers (Parsons, 1998).

Narang et al. (1991) conducted a study among 30 alcoholic patients from Ludhiana Medical College & Hospital and 30 healthy, non alcoholic controls to find out the degree of cognitive impairment in Indian alcoholics. The cognitive functions were assessed by PGI Battery of Brain Dysfunction. There was a significant difference on the cognitive functions in alcoholics as compared to the control. The cognitive impairment increases with the duration of alcohol use. Mann et al. (1999) investigated the pattern of cognitive deficits in a group of 49 chronic alcohol-dependent men in an in-patient treatment unit. They found evidence that chronic alcoholism has effects on cognitive functioning, particularly for the memory of verbal material. Thirty male alcoholics were assessed by using the PGI Battery of Brain Dysfunction and the result revealed that the mean dysfunctional rating score of the alcoholics group was significantly high on all the variables when compared to the non alcoholics group, the alcoholics group performed poorly on memory and intelligence tests and also suggests that the long duration of alcohol intake caused more deterioration in cognitive functioning (Singh et al., 2008).

However, visuospatial constructional ability, visual memory and recognition ability are the areas that are the least studied among chronic alcohol abusers and so are in need of further investigation. Therefore, the present study was aimed to assess the attention and concentration, the visuospatial constructional ability, visual memory and recognition ability among the chronic alcohol dependents and to compare them with normal controls.

## **MATERIAL AND METHODS**

### **Sample Characteristics**

With the purposive sampling technique 30 chronic in-patients, who had been diagnosed with alcohol dependence according to the International Classification

of Disease-10 (ICD-10, DCR Criteria, WHO, 1993), were selected after obtaining their consent for the study, from the different wards of the Ranchi Institute of Neuro-Psychiatry and Allied Sciences (RINPAS) in Ranchi, India. All the patients had a minimum 3 years history of alcohol dependence and were right handed. This is a center based comparative study with an alcohol and normal group. All the patients were male with the age range of 20 to 50 years, who had a minimum education of 5<sup>th</sup> standard and were cooperative and able to comprehend the instructions properly. Patients who were not cooperative, unable to comprehend the instructions, had a history of seizure or severe head injury, co-morbid psychiatric disorder or active psychopathology and who had any vision, hearing and drawing difficulties were excluded from the study.

Similarly, 30 normal controls, who had a minimum education of 5<sup>th</sup> standard, were cooperative and falling in the age range of 20 to 50 were selected from local community after screening with the General Health Questionnaire – 5 and Handedness Scale. Individuals with any significant physical problems or a history of seizure or severe head injury and who were illiterate and uncooperative were excluded from the study.

Statistical analysis of the sample characteristics suggests that there was no significant difference between the alcohol dependent group and the normal controls in respect to age ( $\chi^2 = .091$ ), education ( $\chi^2 = .602$ ), occupation ( $\chi^2 = .217$ ), marital status ( $\chi^2 = .302$ ), economic status ( $\chi^2 = .176$ ) and family history of mental illness ( $\chi^2 = .150$ ). However there was a significant difference in the domicile ( $\chi^2 = .001$ ) and religion ( $\chi^2 = .007$ ) of the study groups. The most likely reason for this difference could be that most of the alcohol dependent inpatients were from the urban population (19: 63.3%) while Muslim alcohol dependent inpatients were very few (1: 3.3%).

### **Tools for the assessment**

**Socio-Demographic and Clinical Data Sheet.** This is a semi-structured Performa especially designed for the study. It contains information about the socio-demographic variables like age, religion, marital status, education, occupation, socio-economic status, and domicile. It also includes the total duration of substance abuse and the family history of mental illness.

**Handedness Scale** (Annet, 1970). This scale was constructed by Annet (1970). It is published in the British Journal of Psychology. It has 5 items which determine the dominant hemisphere.

**General Health Questionnaire-5** (Shamsunder et al., 1986). The test consists of 5 questions. It was designed to assess the general health of the individual and it was used to identify and exclude individuals for the normal control group.

**Eysenck's Series of Digit Span Test (ESDST).** This sub test was taken from the Memory Scale used in the PGI Battery of Brain Dysfunction-PGI-BBD (Perashad & Verma, 1989) and is used to assess the attention concentration of the study samples using the Digit Forward and Digit Backward series.

**Rey Complex Figure Test and Recognition Trial** (Meyers & Lange, 1994). This test was originally developed by Rey in 1941 to investigate the visuospatial constructional ability and visual memory in brain injured patients, and it was standardized by Osterrieth in 1944, and has been referred to as the 'Rey-Osterrieth Complex Figure'. This test was modified by Meyers and Lange in 1994 and referred to as the Rey Complex Figure Test (RCFT), which was used in the present study. Administration of the RCFT consists of four test conditions – a Copy trial, 3 minutes after – Immediate Recall trial, 30 minutes after- Delayed Recall trial and Recognition trial (Meyers & Lange, 1994), which is administered immediately after the Delayed Recall trial. The Recognition trial presents 12 of the 18 scoring elements of the complex figure stimulus, along with 12 designs that serve as foils. The test-retest reliability coefficient for Immediate Recall, Delayed Recall, and Recognition Trial are .76, .89, and .87 respectively.

### Procedure

After obtaining informed consent and cooperation, 30 chronic alcohol dependent patients were selected according to the inclusion and exclusion criteria for the study. Assessment was done only after two weeks of admission in the hospital. A clinical interview and required history was taken from each patients and the socio-demographic and clinical data sheet were filled in. ESDST was administered to each participant before administering the RCFT. Similarly according to the inclusion and exclusion criteria, 30 individuals were selected from the local community for the normal controls, after screening them with GHQ-5 to exclude those persons who were physically and mentally unfit for the study and with the Handedness Scale to exclude left handed persons. Then the RCFT was administered and scored according to the standard procedure.

### Statistical analysis

Statistical analysis was carried out using the Statistical Package for Behavioural Sciences (SPSS) version 17 (SPSS Inc., Chicago: Illionois). The Pearson Chi-square test was used for the data analysis.

## RESULTS

The alcohol dependent group and normal control group showed significant difference in attention, concentration, visuospatial constructional ability, visuospatial memory, recognition ability and memory pattern. Table 1 explains the

Table 1. Compares scores in attention and concentration among the alcohol dependents and normal controls

Variable	Group		$\chi^2$	P	
	Alcohol (N%)	Normal (N%)			
Attention	Intact	22 (73.3%)	30 (100%)	9.231	.002
	Impaired	8 (26.7%)	0 (0)		
Concentration	Intact	23 (76.7%)	30 (100%)	7.925	.005
	Impaired	7 (23.3%)	0 (0)		

Table 2. Compares visuospatial constructional ability, visuospatial memory, recognition ability and memory pattern among the alcohol dependents and normal controls

Variable		Group		$\chi^2$	P
		Alcohol (N%)	Normal (N%)		
Copy Trial impairment	Absent	18 (60)	30 (100)	15.00	.000
	Present	12 (40)	0		
Immediate recall impairment	Absent	9 (30)	30 (100)	32.308	.000
	Present	21 (70)	0		
Delayed Recall Impairment	Absent	8 (26.7)	30 (100)	34.737	.000
	Present	22 (73.3)	0		
Recognition Impairment	Absent	16 (53.3)	29 (96.7)	15.22	.000
	Present	14 (46.7)	1 (3.3)		
Memory pattern	Normal	2 (6.7%)	26 (86.7%)	38.899	.000
	Retrieval	20 (66.7%)	2 (6.7%)		
	Disrupted	8 (26.7%)	2 (6.7%)		
Atypical Recognition errors	Absent	25 (83.3%)	29 (96.7%)	2.963	.085
	Present	5 (16.7%)	1 (3.3%)		
Number of Atypical errors	Absent	25 (83.3%)	29 (96.7%)	3.096	.213
	One	4 (13.3%)	1 (3.3%)		
	Three	1 (3.3%)	0		

performance of the patients with alcohol dependence and normal controls on the Eysenck's Series of the Digit Span Test (ESDST). The result suggests that every participant in the normal controls had intact attention and concentration, whereas 8 (26.7%) of the alcohol dependent patients showed impairment in attention and 7 (23.3%) showed impairment in concentration, and there was a statistically significant difference between the groups concerning both attention ( $c^2 = 0.002$ ) and concentration ( $c^2 = 0.002$ ).

Table 2 illustrates the performance of the alcohol dependent group and the normal controls on the Rey Complex Figure Test and Recognition Trial (RCFT). The result reveals that many of the alcohol dependent patients' visuospatial constructional ability, visuospatial memory, and recognition ability were impaired and there was a statistically significant difference between the alcohol group and the normal controls. With regard to memory pattern 20 (66.7%) patients showed a retrieval memory pattern and 8 (26.7%) showed a disrupted memory pattern, whereas only 2 (6.7%) showed a retrieval and disrupted memory pattern among the normal controls and there was a significant statistical difference between the groups ( $c^2 = 0.000$ ). There was no statistically significant difference between the groups concerning the Atypical Recognition errors committed. Four (13.3%) among the alcohol group and one (3.3%) among the normal controls committed one atypical recognition error each and one alcohol group participant committed 3 atypical recognition errors.

## DISCUSSION

The aim of the study was to assess the attention concentration, the visuospatial constructional ability, visual memory and recognition ability among the chronic alcohol dependents and to compare them with normal controls. The result of the study revealed that these functions of the chronic alcohol dependent patients

were significantly impaired, whereas no participants in the normal controls showed impairment except a moderate level of recognition impairment with one participant.

Attention involves focusing awareness on a narrowed range of stimuli or events and concentration is the ability to direct and maintain all our effort and attention on one thing for a certain period of time. The present study reveals that the attention and concentration of the alcoholic dependents were significantly impaired in comparison to the normal controls and found that attention was impaired among the 26.7% and concentration was impaired among 23.3% of the participants in the alcohol group. The result is consistent with the findings of Loeber et al. (2009) and Ratti et al. (1999). Alcoholics, when compared to healthy controls, performed worse with regard to the performance index Attention/Executive function and alcoholics performed worse than controls on some neuropsychological tests, i.e. the Attention Matrices Test, Verbal Judgment Test, Forward Digit Span, Story Recall and Remote Memory Test. Neuroradiological data showed a pre-eminent and a more frequent atrophy of the frontal region.

Increased distractibility is a common impairment in alcoholism. Compared to controls, alcoholics showed ERP (event-related brain potentials ERPs) abnormalities over the left frontal region, and a positive posterior deflection instead of the frontally distributed reorienting negativity (RON), which suggests encoding into the working memory of task-irrelevant auditory events and provides neurophysiological markers of impaired involuntary attention mechanisms in chronic alcoholism (Polo et al., 2003).

Visuo-spatial constructional skills were measured by RCFT Copy trial. A lower copy score indicates reduced visual perceptual and visuomotor integration skills. In the present study 40% of the alcohol dependent patients showed impairment in visuo-spatial constructional skills, in those 10% displayed a moderate level of impairment and 30% showed a severe level of impairment in the Visuo-spatial constructional skills. Reduced Immediate and Delayed recall scores suggest reduced visuo-spatial recall ability/ impaired visual memory skills, and impairment in right hemisphere functions. In the present study, the immediate recall ability of the participants in the alcohol dependent group was found impaired in a mild level for 23.3%, a moderate level for 13.3% and a severe level for 30%, and a total of 70% showed impairment in immediate recall ability. The delayed recall ability of 73% of the alcohol dependents was found impaired, and among them 23.3% were mildly impaired, 20% were moderately impaired and 30% were severely impaired.

Recognition total correct measures the ability to retrieve visuo-spatial material when given retrieval cues and 46.7 % of the alcohol dependents showed an impaired recognition ability in the present study. Findings suggest that 33.3%, 10%, and 3.3% of the alcohol dependents showed a mild, moderate and severe level of recognition impairment respectively, whereas in the normal controls only one (3.3%) participant's recognition ability was found moderately impaired.

The findings from this present study suggest that the visuospatial construc-

tional ability, visual memory and recognition ability of the chronic alcoholic patients were significantly impaired in comparison to the normal controls. This is consistent with the findings of Beatty et al. (1996, 1997). In their study twenty-eight chronic alcoholics (19 men, 9 women) were compared to 20 (10 men, 10 women) controls of comparable age and education on a battery of tests of visuospatial scanning, construction, mental imagery, and anterograde and remote spatial memory and alcoholics displayed impairment in visuospatial scanning, construction, utilizing and manipulating information from visual images and on three tests of anterograde spatial memory. On all the measures of visuospatial perception and construction and on all the measures of visuospatial learning and memory, all groups of alcoholics were impaired relative to the controls.

Memory pattern was assessed to know whether the participants' cognitive processing was within the normal range or not. In normal memory pattern the delayed recall score may be slightly higher than the immediate recall. In this study 66.75% of the alcohol dependents and 6.7% of the normal controls showed Retrieval Memory Pattern, which suggests that they are able to function independently, and might benefit from the use of a memory book or other memory compensatory strategies memory on locio or from retrieval cues (Wilson, 1987). Disrupted Memory Pattern is the indicators of disturbed attention, encoding and storage process and in the present study 26.7% of the alcohol dependents and 6.7% of the normal controls showed disrupted memory pattern.

In the RCFT Recognition trial there are several items rarely answered incorrectly. An incorrect answer to these items is referred to as atypical recognition errors. Atypical Recognition Errors are the indicators of the presence of brain damage and a cutoff score of 2 or more Atypical Recognition Errors is cautiously suggested to be in need of further investigation. In the present study there was only one patient who committed an Atypical Recognition Error above the cutoff point.

While most studies suggest that neuropsychological evaluation is necessary in order to provide appropriate treatment for the substance abusers (e.g., Fals-Stewart, 1997), and that such assessment should be carried out as a routine component of substance abuse treatment programs. There is a prohibitive feature to such testing for comprehensive test batteries are often time-consuming and costly, both in terms of personnel and supplies. In such situations RCFT could be a suitable option.

## **CONCLUSIONS**

Neuropsychological evaluation must be a routine component for substance abuse treatment programs and since comprehensive test batteries are often time-consuming and costly, RCFT could be a suitable option.

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