CHAPTER I
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Alcoholism is a world wide problem not confined to either the developed or the developing nations. The adverse consequences of alcohol not only affect the individual, but also every aspect of the society, from family to work. Apart from this, society also carries the burden of increased crime and violence as well as loss of productivity associated with alcohol abuse. Hence the reaction an alcoholic elicits from society is one of hatred and feeling of rejection. The indulgence in alcohol is considered by the society as not arising due to a disease, but due to lack of concern and responsibility.

In India, alcoholism has become a problem affecting persons from all socio-economic strata. There has been a rising trend and concern over increased drinking (Ray 1989 & Singh 1989). Along with this there has also been an increased awareness of the disease concept of alcoholism.

In no other disease condition is the term "multiple loss" as applicable as in alcoholism. These extend from traffic accidents to fights and to frequent hospitalisation for conditions ranging from psychiatric to neurological to general medicine problems. In industrial spheres also, the loss of productivity due to alcoholism has been sensed. As
for alcoholics themselves, the loss due to alcohol has been immense. Apart from physical illness, chronic alcoholism is characteristically associated with a broad spectrum of brain disturbances ranging from the severe to mild cognitive disturbances. Cognitive disturbance persists even when abstinence is present up to 5 years (Brandt et al. 1983). These cognitive disturbances apart from rendering them as ineffective members of society, poses a burden on society due to their frequent brushes with law and order. If these individuals are to be helped, they need concerted efforts from various sources, including physicians, mental health professionals, voluntary bodies and law enforcement agencies in order to tackle the primary, secondary and tertiary aspect of alcoholism. This needs the whole problem to be tackled from a scientific perspective (Ray & Picton 1989). Currently, scientific approach has been applied to understand the cognitive deficit in alcohol related problem.

The recent developments in technology has made it possible to investigate the structural [Computerised Tomography (CT)] and functional (Evoked Potential) brain deficits in alcoholics, using non invasive procedures. CT Scan studies show, widening of sulci in alcoholics (Wilkinson and Carlen 1980b). Event related potentials (ERPS), have proven to provide a sensitive measure of alcohol related effects namely alcoholisation, tolerance, withdrawal and long term dysfunction (Begleiter and Porjesz 1977, Zilm, Kaplan
and Capell 1981). The toxic effect of alcohol on central nervous system (CNS) producing brain damage, has been one of the area of extensive investigation.

Treatment, as it is available has been from a short term perspective. Apart from tailoring it to be subject specific, the role of cognition in treatment outcome has also been considered. The dysfunction associated with alcoholism seems to be more of core function like attention, abstraction and memory. With the loss of these basic function, the patients ability to process information given during therapy sessions becomes questionable. This is further corroborated by studies which show that the best measure as a predictor of relapse is the patients neuropsychological performance (Abbott & Gregson 1981 and O'Leary et al 1979b), especially memory (Sussman, Rychtarik, Mueser, Glynn, Prue 1986). If a patient lacks the ability to attend, to abstract the information given and, more so, to remember it, then the utility of long hours of therapy given to them becomes a waste. Hence, the current trend is to help these individuals, with high abstractive treatment procedures like psychotherapy only after the cognitive makeup is ready for receipt of it. This is attempted by cognitive retraining programs to augment the recovery associated with abstinence. Else, treatment is initiated after the cognitive functions recover (Goldman 1983).
Of the deficits present as a sequelae of alcoholism, the most commonly reported one by the patient is memory deficit. This deficit has been found to be resistant to recovery even after 5 years of sobriety (Brandt et al 1983). Also, this particular cognitive function i.e., memory has been found to be affected in the whole continuum of individuals who use alcohol, i.e., social drinkers, intoxicated normals, alcoholics and Korsakoff amnesias. Ryback (1971) in the continuity hypothesis proposed that severity of memory deficits increases from intoxicated normals to Korsakoff's. Ryan et al (1980) further supports the theory by demonstrating this deficit in abstinent detoxified alcoholics. Again subjective loss of memory has been a common complaint in alcoholics (Cutting 1978b). This deficit is incapacitating, because it interferes with the day to day functioning of the individual.

Cognitive deficit in chronic alcoholics:

Investigators interested in the topic of alcoholism have until recently focussed their attention on the relatively small number of alcoholics who developed the Wernicke - Korsakoff Syndrome (Ryan & Butters 1983). The primary reason for this is that patients with this neuropsychiatric disorder manifest a set of circumscribed, clinically apparent cognitive impairment that can be dissected with a great degree of precision. Detoxified groups on the other hand was not widely studied. This group
needs to be studied much more extensively because 1) this forms the major group of alcoholics who seek treatment 2) this group of alcoholics are still effective members of the society and hence memory deficit can be quite frustrating for them 3) secondary intervention can be undertaken only on this group as they have already become dependent. Cognitive testing can be followed up with meaningful cognitive retraining technique for rehabilitation in this group.

Clinicians active during the 1940's until early 1950's sought evidence of cognitive deficits in the group of detoxified alcoholics who never showed any signs of neurological impairment. Administering their rather gross measure of cognitive competence to the group of neurologically intact alcoholics, they found few if any, obvious memory deficits and concluded that beverage alcohol was an innocuous drug and significant damage occurs only if the alcoholic was old as well as malnourished. The deficits of chronic alcoholics was ignored because sensitive techniques required for their detection was unavailable (Grant, Adams & Reed 1979, Goldman, Williams & Klisz 1983, Parson & Prigatano 1977, Butters et al 1977, Jonnsson et al 1962, Lee, Moller and Hardt 1979, Weingartner & Faillace 1971).

This belief has been challenged during the past fifteen years by two important research findings. Studies on animals
which were well fed and maintained well nutritionally showed that intake of alcohol on a regular basis was a potent neurotoxin. There was demonstrable deleterious changes in both peripheral and central nervous system (Bloom 1989). By inference, then in humans i.e., also chronic neurologically intact alcoholics should show neuropathological changes which could, in turn, disrupt information processing. The changes seen in the rats have been at hippocampal region (Siggins, Pittman and French 1987). This again adds to the necessity of giving importance to the subjective memory deficit reported by alcoholics, as hippocampus is important in memory processes (Milner 1989 & Teyler et al 1989).

Second corroborative findings come from the area of neuropsychological studies designed to test brain damaged group of individuals. By using neuropsychological batteries on chronic alcoholics it was found that this group demonstrate deficits in visuospatial memory, abstraction and problem-solving upto 5 years after abstinence (Brandt et al 1983). This led to the resurgence of interest in quantifying memory deficit in this group of chronic alcoholics.

Measurement of Memory:

The three classical approaches that have been used to study memory deficits in alcoholics are Psychometric, Neuropsychological and Information Processing approaches.
a) Psychometric Approaches:

Wechsler's Memory Scale (WMS) and Wechsler's Adult Intelligence Scale (WAIS) (Acker et al., 1984) are the tests most often used on chronic alcoholics. WMS had failed to demonstrate persistent differences between alcoholics and controls (Parsons & Prigatano 1977, Butters et al 1977), though it is sensitive in tapping the deficits of Korsakoff alcoholics. Likewise WAIS showed deficits in block design, digit symbol and object assembly with intact IQ as a general trend but not consistently in chronic alcoholics. These subtests though not a direct measure of memory, reflect components which are involved in memory processing. Results obtained in WAIS proved useful in delineating intellectual changes rather than memory, as the test was originally meant to assess intelligence and predict achievement. Hence WAIS also lacked the specificity and sensitivity in detecting the subtle amnestic deficits of chronic alcoholics.

Thus, we find psychometric test being insensitive in detecting the subtle memory deficits present in chronic alcoholics. The gross level of measures of these test were good for detecting the deficits in the severe amnestic group.

b) Neuropsychological Test:

The findings of WAIS, (Holland and Watson, 1980) led researchers to investigate the possibility of brain-damage in chronic alcoholics because in early 1950's the WAIS finding
was interpreted neuropsychologically. This paved the way for neuropsychological investigation in chronic alcoholics.

Neuropsychological tests detect brain-behaviour relationship. It is a non-invasive procedure and assessments are made based on behavioural performance. Wilkinson and Carlen (1980) in their study with chronic alcoholics found that 50% of those adjudged by neurologist as normal have been found to show deficit in neuropsychological tests. Further, studies showing defective cognitive functioning despite adequate neurological screening of this group of alcoholics led to the label of 'neurologically intact alcoholics' (Ryan and Butters 1983). Thus neuropsychological tests which detects early cognitive deterioration was used to assess brain damage.

The most commonly used neuropsychological test batteries are Halstead-Reitan Neuropsychological Battery (HRNB) and Luria-Nebraska Neuropsychological Battery (LNNB). The pattern of deficit most commonly obtained from these tests was that of a distinctive, mild, organic dysfunction (Chmielewski and Golden 1980). Detoxified alcoholics performed midway between controls and neurological patients. Certain subtests like HRNB category, Tactual Performance Test (TPT), Trail making Test, Block design, Digit symbol substitution test and Visuospatial memory tests were highly sensitive to the effect of alcoholism (Brandt et al 1983, Riege 1987).
The memory deficit shown by chronic alcoholics was modality specific. Verbal memory tasks showed no deleterious effect of alcohol, whereas visuospatial memory tasks showed decrement. Moreover, the deficit was lateralised to right hemispheric functioning, indicating that right hemisphere was vulnerable to the toxic effect of alcohol (Parson et al., 1972, Kapur and Butters 1977, Cutting 1978b, Jenkins and Parsons 1979a).

The modality specific visuospatial memory deficit obtained in neuropsychological tests becomes questionable. Detoxified Alcoholics performed as poorly on verbal modality also as in visual modality when the difficulty level was stepped up. Examples are memory tasks like learning of synonyms (Sharp et al., 1977) or of long word tests without mnemonic cueing or paired associate learning (Ryan and Butters 1980, Ellenberg et al 1980, Goldman & Rosenbaum 1977). Chmielewski & Golden (1980) using Luria - Nebraska tests on chronic alcoholics & found the deficit occurred on items which were functionally complex and required greatest amount of 'Cortical Integration'. This deficit was found to span over both visual and verbal modalities.

c) Information Processing Tests:

Meanwhile information processing studies conducted also highlighted the same trend. Alcohol has been proved to alter the subjective strategies used for memory processing. This
has been proved beyond doubt by studies conducted on normals who were intoxicated (Weingartner & Faillace 1971), alcoholics who were intoxicated (Goodwin 1977 & Lishman et al 1987), social drinkers (Ryback 1971) and Korsakoff amnesics (Kapur & Butters 1977). Processes implicated to be defective are Encoding (Ryan et al 1980b), Storage (Wickelgren 1975, Rosen and Lee 1976, Birnbaum & Parker 1977), Retrieval (Birnbaum et al 1978, Gerrein and Chechile 1977) and Subjective Organisation (Weingartner & Faillace 1971). However when the information processing approach was used to test the memory of neurologically intact detoxified alcoholics results did not show a consistent trend of memory deficit. Some studies found memory deficit (Reige 1987, Ryan et al 1980a), whereas a few ruled out the possibility that memory was affected (Weingartner & Faillace 1971, Jonsson et al 1962, Parsons & Prigatano 1977).

The end result of such voluminous literature showed that observed memory deficits in a group of neurologically intact alcoholics was not clearly specific to any modality or a defined factor. Until very recently investigation have been unable to demonstrate the presence of a significant, relatively stable memory defect in detoxified neurologically intact alcoholics (Storm and Caird, 1967).

Based on these above findings and the logic that if a neuropsychological test is made too difficult, most brain
damaged subjects will fail, Ryan and his co workers (1980) undertook a series of studies. These were designed in an information processing approach, as this approach offered the flexibility to vary the range of difficulty systematically along a continuum. Also, it becomes possible to localise the deficit along the continuum.

To assess the possibility that the simplicity of the tests had been masking the deficits of neurologically intact alcoholics, Ryan and his associates (1980) attempted to increase the test sensitivity by increasing the difficulty of learning and memory tests. Two of the redesigned tests measured the ability of subjects to form association between unrelated stimuli and the third test examined the subjects short term memory (STM). These 3 tests i.e., verbal-verbal paired associate learning, symbol-digit paired associate learning and four word short term memory tests became the sensitive tests to assess memory and learning. The selection criteria of sample was stringent. The results of the investigation revealed the following facts.

1) Presence of statistically significant learning and memory deficit in detoxified neurologically intact alcoholics.

2) That this memory deficit was independent of age, though age may have additive effect (Ryan & Butters 1980b & Riege 1987).
3) These alcoholics manifest subclinical memory deficits which appear only on tests which demanded increased information processing demands (Ryan et al. 1980a).

4) Psychological mechanism underlying the deficits seem to be due to encoding (Ryan 1980).

Clubbing the findings of various approaches the specificity of memory deficit in chronic alcoholics can be deduced as a mild, subtle and diffused one, with no modality specificity. It becomes detectable only in tasks demanding effortful coding and retrieving.

In order to further understand the memory deficit it is necessary to understand the various approaches in the study of memory.

Approaches in Memory Research:

The two classical approaches for understanding memory has been through Process models and Storage models (Baddeley 1976). Storage models view memory as a capacity to manipulate information whereas process models view memory as a process.

Storage Models:

The two important stores in memory are short term memory (STM) and long term memory (LTM). The two stores are differentiated with respect to storage capacity and the duration for which the information is held in the store.
Short Term Memory (STM):

Two major theoretical lines are being actively developed in STM research. 1) The notion of working memory (Atkinson & Shiffrin 1971) and 2) the formulation of attention and STS as proposed by Shiffrin and Schneider (1977).

In the concept of working memory, the stress is on an executive processor of limited capacity that plays a central role in most, if not all, nonautomatic cognitive functioning with its efficiency enhanced by auxiliary system like articulatory rehearsal loop as highlighted by Baddeley (1978). Miller (1956) limits the storage capacity to $7\pm2$ bits of information.

Shiffrin & Schneider's (1977) theory's central notion is the Short term store (STS) whose principal function is the active control of thinking, problem solving and general memory processes. In this respect STS is equivalent to the working memory of Atkinson & Shiffrin (1968) with the only difference being in structure. Instead of viewing it as a separate structure, Shiffrin & Schneider (1977) viewed it as a subset of the permanent long term store (LTS). Thus, there are no attentional limitation on input, but attentional processes select important information for maintenance, decision or transfer to LTS. Unattended information are lost and the loss is dependent on the level at which informations are encoded interfered by similar encoding in LTS.
Long term store (LTS), on the other hand, has been deemed to have unlimited capacity. The store is a permanent one, where information is represented through figural and propositional representation (Baddeley 1976).

Process Models:

The process model is based on information processing paradigm. This paradigm specifies that the processing of a stimulus involves an ongoing series of events that occur over time. The time between the stimulus and response can be divided into a sequence of discrete stages. During each stage, different operations are performed to transfer and transmit information. The manner in which these informations are selected, transduced, encoded and decoded is called information processing (Katzman, Spring & Zubin 1980).

In short term memory, the flow of information is analysed in terms of stimulus registration, encoding, storage and retrieval (Lacman, Lacman and Butterfield 1979, Katzman, Spring and Zubin 1980).

On the other hand, the various process involved in long term store are clustering and organisation (Baddeley 1976).

Encoding Processes:

Studies published during the last 15 years have examined memory from the point of depth; elaborativeness or extensiveness of the encoding induced at inputs. Most of the
work has been based on the Levels Of Processing viewpoint of Craik and Lockhart (1972). According to this theory, the retrieval of to-be remembered material is a function of the depth to which that material was processed. In this scheme, deeper levels of processing are those that are concerned with semantic and associative analysis of the stimulus while shallow processing are those concerned with physical and phonetic characteristics. Stated clearly, deeper the processing better is the recall and shallower the processing lesser is the likelihood of that material to be remembered. Later research on this paradigm showed that once an event is well encoded it apparently can be retrieved rapidly (Goldman & Pellegrino 1977) and with less effort than poorly encoded trace. The relative degree of integration and elaboration was also important (Goldman and Pellegrino 1977). That is, the modification of Levels of Processing suggested, that a deep, elaborated and well integrated trace is easy to retrieve than a shallow, less elaborated encoded material. This was upheld for both recall and recognition measures.

Encoding Specificity:

Although Craik's & Tulving's 1975 results lend support to the levels of processing approach, there is one major deficiency in this model. That is, the deficiency is the absence of any specification for retrieval process. Tulving (1978), has stressed that memory must be viewed as a joint
function of stored information (memory trace) and information provided to the subject at retrieval (the retrieval cue). Tulving and Thompson (1973) proposed that the input condition if present at the retrieval condition brings the maximum likelihood of that encoded material to be remembered. That is, it follows from the encoding specificity principle that the most effective retrieval condition should be akin to the encoding condition. Results tested using this principle show that the specificity of encoded information and the effectiveness of retrieval increases at deeper levels of encoding (Moscovitch and Craik 1976).

Bellezza, Richards & Geiselman (1976) contrasted the concepts of depth and organisation. They pointed out that 'depth' refers to the type of encoding whereas 'organisation' refers to further inter item processing. The view propounded by Bellezza, Richards and Gieselman (1976) was that deeper semantic processing was necessary for good recall, but was not sufficient; interitem organisation or Subjective Organisation was also necessary.

Bellezza, Chessman & Reddy (1977) distinguished between two types of "further processing" once an item has been comprehended semantically. They are, elaborative enrichment of the comprehended items and inter item organisation among the items presented. Thus, taking the theory and modification of levels of processing approach, the following postulates are seen:
1) Deeper codes are more meaningful.
2) Deeper codes are more durable.
3) Enrichment of the material and inter item organisation enhances retrieval.
4) Encoding specificity enhances better retrieval.

These are the various advancements that have stemmed out of the levels of processing approach. Even to date this models stands out as the standardized paradigm for testing encoding using the process model of memory.

Advancement in Assessment of Brain Functioning:

Cognitive psychology which was growing independently has now reached integration with other areas. The knowledge that the seat of cognition is localised completely in brain has helped its further integration to other neuroscience fields. The interest that has upsurged because of such a marriage is cognitive psychophysiology. The line of researches has been to find the seat of such cognitions in brain structures using indices of brain functions like electrical activity of the brain.

With the advent of computers, it is now possible to obtain objective quantitative data from the analysis of Event Related potential (ERP). ERP techniques offer a unique approach for assessing multiple levels of brain functioning as it permits the simultaneous investigation of
electrophysiology and cognition. Quantitative measurements of salient features extracted from ERP recordings reflect various aspects of brain function related to integrative processes and the functional integrity of different neuroanatomic systems. These powerful ERP techniques occupy the interface between cellular neurobiology and the behavioural sciences (Porjesz and Begleiter 1985).

An ERP is obtained by recording the time-locked brain electrical activity following the delivery of a discrete stimulus via a sensory modality (e.g., auditory or visual). The neuroelectric activity that is time locked to the stimulus is elicited with each stimulus presentation. Signal averaging technique makes it possible to extract the time-locked neuroelectric signal (ERP) from the background random 'noise' which essentially cancels out using these procedures. Thus ERP essentially reflects the functional integrity of the brain. ERP's show changes earlier to structural change.

ERP techniques have proven to be very useful for indexing the electrophysiological concomitants of cognitive performance. ERP's have an advantage over neuropsychological tests in that they can be recorded in conjunction with behaviour. Even when no behavioural response is required, they can be recorded and related to the information processing taking place in the brain at that time. Thus ERP techniques are sensitive indices of the functional integrity of the
brain. They reflect subtle dynamic moment-to-moment changes in brain functioning elicited when the brain is being challenged by a task (Hillyard et al., 1987, Donchin, 1981). These advancements in cognitive psychophysiology have also helped in understanding cognitive function in normals and diseased conditions. The various cognitive processes that have been tested out using this approach are attention, abstraction, anticipation and memory processes.

Cognitive Psychophysiology and Alcoholism:

ERP techniques using information processing task of responding to targets and inhibiting the response to non-targets has been used to study information processing deficits in abstinent medication free alcoholics. The studies show that abstinent alcoholics have abnormality in late components $N_1 - P_2$, but not in early components $P_1 - N_1$ (Porjesz and Begleiter 1985).

$P_{300}$, a cognitive processing component that peaks around 250-647 ms (Thier et al., 1986) after the stimulus has been presented has been researched extensively in abstinent alcoholics as well as with high risk alcoholic groups (Porjesz and Begleiter 1983, Begleiter et al 1984, Pfefferbaum et al 1979, Salamy, Wright and Faillace 1980 and Mukundan 1989). Porjesz et al's group show that $P_{300}$ amplitude was decreased or nearly absent in chronic alcoholics. Targets and non targets evoked comparable $P_{300}$
amplitude indicating impaired sensory filtering and probability matching process. Results have been the same with N₂ components which is an index of stimulus evaluation time (Renault & Leserve (1979)). Apart, from that alcoholics made more errors, in terms of both false alarms and missing target stimuli. This suggests that alcoholics employ different response strategies with stress being more on speed rather than accuracy (Porjesz and Begleiter 1985). This reflects a lack of inhibition in chronic alcoholics.

The brain area which has been implicated as damaged by these ERP's has been the hippocampus. Studies investigating the neural generators of P₃₀₀ showed that it to be a subcortical component, arising from amygdala and hippocampus (Halgren et al 1980, Milner, 1989).

Cognitive Psychophysiology approach in alcoholics have been used to test anticipation (Mukundan 1989). Readiness and volitional state in voluntary motor activity using Beritschafts potential has also been studied (Mukundan et al 1989).

In the area of memory, ERP studies have been conducted only on normal controls (Paller et al 1987).
Data relevant to the understanding of memory has come from ERP studies outside the explicit domain of memory research. Most ERP studies of memory have dealt with the formation and retrieval of episodic memories. That is, they have been designed to probe the nature of the processes involved when a subject recognises or recalls items presented during an experimental episode like the template matching process of Naatanen (1982), decaying 'trace' of the stimuli by Squires et al (1976). Thus only indirect evidence of memory has been reflected by these components.

The first line of ERP investigation in memory has been on memory search using Sternberg's Paradigm (Mulder et al 1984, Pfefferbaum et al 1980, Wickens, Braune and Stocke 1987).

The second line of hypothesis in memory has been given by Donchin's group. The 'Context Updating' hypothesis defines that the updating of representation of the stimuli into working memory as being reflected by P300. The amplitude of P300 is proportional to the amount of change required to update the event's representation in the working memory. According to Donchin and Coles (1988) P300 is intimately involved with the process of memory modification and one consequence of P3 elicitation is enhanced memorability. He also argues that context updating is
essential to maintain working memory which is the temporary storage of information processing.

The first to test this memory hypothesis was Karis et al (1981). A series of studies (Karis et al 1984, Fabiani et al 1986 and Donchin & Coles 1988a) have been done systematically by the same group to test this hypothesis. Results showed that:

1) Recalled words were associated with larger P300's on initial presentation than words that were not remembered.

2) P300 amplitude was predictive of subsequent recall and recognition.

3) P300 amplitude was not predictive of subsequent recall and recognition in paradigms where elaborated processing was employed. Instead a broad positive "slow wave" with a frontal distribution reflected elaborate encoding. Elaboration fostered recall of more items than rote memorization.

The next move was towards finding the proposed interaction between P3 amplitude, memory and subject's strategy carried out by Fabiani et al (1986). Results showed that memory related ERP's for rare categories appear to be later (800-1100 msecs) and centroparietal in distribution. The authors suggest that this later memory related effect may be a second P3 after the categorisation P3 which increases
the probability of recall. But they did not provide compelling evidence that it was indeed P3 and only P3, rather than a temporally overlapping process, that varied with memory. This group gave the direction that it may be possible to determine more precisely the cognitive process that is reflected in ERP for memory processing. $P_{300}$ amplitude has also been used to index storage capacity especially long term memory (Johnson et al 1985).

The next direction taken by memory research has been to investigate the process components of memory i.e., encoding. In particular several ERP researchers have looked to see whether any part of the ERP can be a metric of encoding operation. Much of these experiments were conducted within the levels of processing framework because it has been one of the most influential encoding based theories (Craik and Lockhart 1972). The logic being, encoding and the experimental manipulation of encoding is associated with physiological activity and this is amenable for assessment. For example, as proposed by Craik and Lockhart (1972) if depth of processing is a viable concept in memory trace formation, then it is possible that some ERP parameters might systematically vary with fluctuations in depth and thereby lend itself to be measured. This line of investigation adopted the information processing paradigm of levels of processing approach. There are two assumptions implicit in using ERP's in this way: 1) ERP waveforms that are
similar in morphology reflect the engagement of qualitatively similar process, whereas those that are different reflect the activity of qualitatively distinct processes. 2) Amplitude and latency changes in ERP component reflect quantitative and not qualitative differences in processing.

Researchers who have used this paradigm have been Sanquist et al (1980) and Pallers et al (1987). Sanquist et al (1980) found that words with semantic judgement led to better subsequent recognition than rhyme judgements. Paller et al (1987) conducted the experiments within the levels of processing paradigm. Results showed that ERP's elicited by the semantic tasks and those elicited by nonsemantic tasks differ either in morphology or distribution over the scalp. Results show that ERP's were predictive of subsequent recall as well as recognition. Memory related ERP affect was seen in the increased positivity seen within the time window 400 - 800 msecs, mostly in the central leads. He called this as late positive components (LPC). The derived waveform, i.e., the average waveform of nonrecalled words subtracted from average waveform of recalled words was termed as Difference Measure or "DM" waveform. The mean positivity within the time window 400 - 800 msecs of the DM waveform, referenced to baseline was termed as DM value. This DM waveform was suggested to reflect the pure memory-related ERP activity of
the individual. Paller et al concluded that the memory related ERP effect could be dissociated from the $P_3$. This finding, together with the observation that the ERP differences based on subsequent recognition to recall have time distribution (maximum positivity in the range 400 - 800 msecs) different from that of typical $P_3$ component, further suggested that the ERP effects are independent.

Thus memory related ERP studies have come a long way in scientific enquiry. But this has not been used with any clinical condition, though memory deficits is a common deficit seen in many organic conditions.

Processing Resources and Cognitive Psychophysiology:

ERP components especially $P_{300}$ has been used to understand the capacity of processing resources. The amplitude of the $P_{300}$ component of the ERP has proven useful in identifying the resource requirement of complex perceptual motor tasks. This is a measure of mental work load. A systematic relationship between $P_{300}$ amplitude and mental work load was demonstrated in a series of studies that employed dual - task techniques (Brown 1978, Ogden et al 1979). Results of these studies indicated that the amplitude of $P_{300}$ elicited by secondary task stimuli decreased as the demands placed on the subject by the primary tasks increased. Motor demands were found not to affect the amplitude of $P_{300}$ component (Israel et al 1980a).
Processing resource were interpreted within the framework of multiple resource theory (Kinsbourne and Hicks 1978, Wicken and Kessel 1980). These models propose that dual task performance can be conceptualised in terms of a number of different resources that are limited in quantity. Time sharing of this resource is greatly affected for tasks that require same type of resources. Workload is viewed as a hypothetical construct reflecting the interaction between task demands and operator attributes (Gopher and Donchin 1986). In a demanding multi task situation, if each tasks requires the same resources, tradeoffs in the performance will be observed (Donk & Sanders 1989). Then this paradigm apart from reflecting the available resource also indicates the effect of competition for resource by another task.

As information is processed within the neural networks of the human brain the electrical activity arising from millions of participating neurons is summated to form field potentials. ERP's reflect more discrete pattern of neural activity that underlie cognitive processes. This neurophysiological field potential can be termed as the processing resource of information processing. In other words, the processing resource is nothing but the summation of the discrete patterns of neural activity of the neurons participating in the processing of the particular information.
Processing Resources, being so important in information processing, have not been studied in clinical conditions, where cognitive dysfunction is common. Memory being a complex cognitive function, it would have interactions with processing resources.

Need for the Present Study:

Upto this point, research on chronic alcoholics have been going on independently in several directions. A closer look at the findings show the following lacunae in the research carried out on chronic alcoholics.

Information processing studies show that chronic alcoholics have memory deficit. The nature of this defective memory processing is not clear.

Though encoding processes have been implicated, the classical, levels of processing paradigm used to test encoding has not been used on chronic alcoholics. The level of processing paradigm has been used to test alcoholics with Korsakoff amnesia (Cermak 1977) and intoxicated subjects (Birnbaum and Parker 1977) but not detoxified chronic alcoholics. Thus, the assessment of memory deficits in chronic alcoholics is not backed by the theoretical framework of memory.

Studies based on CT scan and neuropsychological assessment show brain damage. Studies done in animals as
well as neuropathological findings of human brain show that one of the loci of deficit is hippocampus. Electrophysiological studies done on abstinent alcoholics also hypothesise that hippocampus may be involved. Since, this structure is closely related with memory, studies assessing memory processing in chronic alcoholics becomes more important. Studies based on advanced technique especially ERP's which lends itself for testing information processing and electrophysiology concurrently has not been used to study memory deficit in alcoholics, despite it being a common deficit in alcoholics.

Alcohol has been found to produce neuronal damage, thereby leading to probably neuronal death. Therefore the number of neurons in the neural network required for information processing could be limited. This has been thought to be one of the causes for cognitive dysfunction. Psychologically these neural networks signify processing resource. Estimation of processing resource and the effect of competition for resource by multiple tasks in chronic alcoholics who would have experienced subclinical neuronal death, needs to be investigated. Thus, a cognitive psychophysiology approach based on various memory processes like encoding, storage, retrieval, processing resource and subjective organisation needs to be investigated in a group of detoxified chronic alcoholics. The present study is an attempt in this direction.
process in chronic alcoholics using both process models and storage models of memory. A comprehensive study of memory functioning in chronic alcoholics using these theoretical models of memory has not been undertaken and the present study aimed to test memory based on the theoretical framework of Process Models and Storage Models. Storage Models assessed STM and LTM, whereas process models assessed key processes involved like encoding, retrieval, organisation and processing resources.

Since Cognitive Psychophysiology approach has proven to be very useful in indexing the electrophysiological concomitants of cognitive performance and lends itself for concurrent testing of information processing and electrophysiology, this approach was adopted to study both process models and storage models of memory. Wherever paradigms lend itself for cognitive psychophysiology approach (encoding, storage, processing resource and subjective organisation) it was used. Wherever this was not possible (elaboration and encoding specificity) it was tested with information processing approach alone. The memory related ERP used was DM value as studied by Paller et al (1987).
Utility of the study:

The study will be helpful in the following ways:

1) Understanding of memory deficit in alcoholics in terms of core memory processes. Looking at cumulative scores, do not give meaningful results. Compartmentalising this cumulative score helps in the real understanding of a deficit. Studying the core processes, is a refinement for better understanding of deficit as it entails componential analysis.

2) Neuropsychological Rehabilitation entails that one understands the deficits present, assess these deficits systematically and follow it with appropriate strategies to correct the deficit.

Psychological intervention in alcoholics such as psychotherapy are found to be beneficial only after correction of cognitive deficits. Therefore, the emphasis should be in helping the alcoholics to recover cognitively at the earliest. This needs a fine grain analysis of the deficit without which intervention becomes difficult. Since this group of alcoholics are yet functioning members of society, an intervention programme on chronic alcoholics becomes imperative. Currently intervention packages for chronic alcoholics do not have cognitive retraining within it's fold. This is because of the lack of understanding of the deficit and lack of intervention strategies based on these deficits.
The present study, targeted on the major group of alcoholics seeking treatment i.e., chronic alcoholics is aimed to understand the deficit, so that meaningful neuropsychological strategies can be designed.