An Experimental Study of Phonemic and Semantic Information in Explicit and Implicit Memory in Relation to Age

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TO MY

MOTHER
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CHAPTER -I
INTRODUCTION

Over the years, the study of implicit and explicit memory has achieved special prominence in experimental psychology. Psychological studies on human memory have traditionally been dependent on standard memory tests such as free recall, cued-recall, and recognition. These memory tests have their own characteristics. They require subjects to recall earlier learned items in a conscious or deliberate manner. However, memory can also be expressed by facilitated performance on tests that do not require conscious recollection of the informations encoded in a specific learning episode. Instead of being asked to try to remember recently presented informations, subjects simply require to perform a task such as word fragment completion (e.g. Warrington & Wieskrantz, 1974; Graf, Mandler, & Haden, 1982), word identification (e.g. Jacoby & Dallas, 1981; Feustel, Shiffrin & Salasoo, 1983; Jacoby 1983), lexical decision (e.g. Mckoon & Ratcliff, 1979; Scarborough, Gerared, & Cortese, 1979), free association (e.g. Shimamura & Squire, 1984; Schacter, 1985a), and reading of mirror inverted script (e.g. Kolars, 1975, 1976). The former type of memory is called explicit memory while later type of memory is called implicit memory. (Graf & Schacter, 1985, 1987; Schacter & Graf, 1986a, 1986b). Thus, explicit memory refers to conscious recollection of recently presented information, as expressed on traditional tests of free-recall, cued-recall, and recognition whereas
implicit memory refers to expression of recently presented information without conscious or deliberate recollection on certain priming tests.

The dissociation between priming tests like word completion and standard memory tests such as recall and recognition, is attributed to different informational requirements (Graf, Mandler, & Haden, 1982). In a word completion test, for instance, subject receives first three letters of a word studied in a learning episode and he is required to write the first word that comes to mind which produces an acceptable completion. The partial presentation of the word activates schema component of all relevant words, this activation spreads more rapidly to the missing components of the target word. A standard memory test such as recall and recognition, on the other hand, requires retrieval of the words that have recently been presented. Recall is determined by the success of the search process which depends on the available paths to the target words (Graf & Mandler, 1984). Cued recall is closely related to word completion test. Both tests present some cues to the subjects which facilitate their performance. However, these tests are sensitive to different aspects of memorial representation. Word completion is concerned with integrative process that makes word more accessible, whereas cued recall is sensitive to elaborative process that helps retrievability
In their study Graf & Mandler (1984) and Nelson et. al. (1987) compared the performance in word completion vs free recall word completion vs recognition; and word completion vs cued recall, under semantic and non-semantic processing. They hypothesized that semantic processing of the task would help the recall performance since subjects would be encouraged in their attempt of retrieval in addition to sheer reproduction of highly accessible words, and on the other hand, semantic and non-semantic processing would have no effect on word completion performance. Results of their study confirmed their hypothesis. This pattern of findings elucidate that word completion (priming test), and recall and recognition (standard memory test) are the measure of two different kinds of memory. It would be worthwhile to have a glance here at historical background of implicit memory.

Descartes, the author of "the passions of the soul" (1649), was the first man who made a clear reference to implicit memory. He observed that a frightening or aversive childhood experiences may "remain imprinted on his brain to the end of his life" without "any memory remaining of it afterwards" (Haldane & Ross, 1967, p. 391). Descartes did not, however, elaborate on the philosophical consequences of this phenomenon. A systematic doctrine of implicit memory was developed by
Leibniz (1704). He emphasized the importance of "insensible" or "unconscious" perception: ideas of which we are not consciously aware but which do influence behaviour (Leibniz 1916).

Following Leibniz, Maine de Biran (1929), a French philosopher, discussed systematically the phenomena of implicit memory. Maine de Biran studied human behaviour and thoughts through analyses of habit and highlighted the unconscious acts of human behaviour. According to him, a repeated activity can execute a habit automatically without awareness of the act itself and without awareness of the previous episode in which the habit was learned. The most striking feature of Maine de Biran system, however, was coining of a taxonomy of memory system. He classified memory system under three categories: mechanical, sensitive, and representative. The first two types of memory refers to the unconscious or implicit expression of repeated movement (mechanical) and feelings (sensitive), the third type (representative) is involved in conscious recollection of ideas and events (pp. 150-157). Thus according to Maine de Biran:

"If signs (in Maine de Biran system ω sign is motor response code) are absolutely empty of ideas or separated from very representative effect, from whatever cause this isolation may arise, recall is only a
simply repetition of movements. I shall call this faculty for it a mecanical memory, when the ... recall of the sign is accompanied or immediately followed by the clear appearance of a well circumscribed idea, I shall attribute to it representative memory. If the sign expresses an effective modification, a feeling or even a fantastic image whatsoever, a vague, uncertain concept, which can not be brought back to sense impression... the recall of the sign... will belong to sensitive memory (p. 156)."

Various 19th century thinkers were mainly concerned with the problems of unconscious mental processing (Cf. Eüllenberger, 1970; Perry Laurence, 1984). Carpenter (1874) delineated the concept of unconscious cerebration to refer the mental activities that occurs outside the awareness: "The ideas which have passed out of the conscious memory, sometime express themselves in involuntry muscular movements, to the greater surprise of the individuals executing them..." (1874, pp. 524-525).

Swald Hering, in 1870, introduced the idea of organic and unconscious memory (Hering, 1920), he criticized the writers who restricted their analysis to conscious or explicit memory. Memory refers to the capacity of intentional reproduction of ideas or series of ideas. Hering emphasized on the necessity to consider the unconscious memory which is involved in involuntary recall, the development of automatic and
unconscious habitual actions and even in the process of autogenetic development and heredity.

By the end of 19th century, systematic empirical and theoretical analysis of implicit memory developed in five different areas: "Psychical" research, neurology, psychiatry, philosophy and experimental psychology.

**PSYCHICAL RESEARCH:**

Psychical researchers of late 19th century were the first to document implicit memory in the light of controlled empirical observation. Crystal ballgazing and automatic writing were employed as two tests of implicit memory. These tests did not require subjects to make explicit reference; they simply had to perform a task: either to report what they "saw" in the crystal or wrote whatever came to mind (Benet, 1890; Barkworth, 1891; Prince, 1914).

**NEUROLOGY:**

Dunn (1845) described a case of amnesic women who learned how to make dress, even though she apparently did not explicitly remember that she had made any dress. The observed phenomena was similar to implicit memory, although Dunn did not discuss the theoretical implications of his observations. The first theoretical implication of implicit
memory in neurological case was given by Sergei Korsokoff (1889). He described amnesic syndrome in one of his two classic papers. He observed that... "although the patient was not aware that he preserved traces of impressions that he received those traces however probability existed and had an influence in one way or another on the course of ideas, at least in unconscious intellectual activity" (1889, p. 512). Memory traces of amnesic patients, according to Korsokoff, are not strong enough to enter the conscious memory but they can affect behaviour unconsciously. Korsokoff emphasized that his observations had important implications for psychologists. Over twenty years later Claparede (1911/1951) reported observations that were similar to Korosokoff's. He interpreted implicit expression of memory in terms of a disconnection between the ego and memory trace.

PSYCHIATRY:

In late 1880s and early 1890s, P. Janet and S. Freud observed and reported the phenomena of implicit memory in patients suffering from hysterical amnesia as a result of emotional trauma.

In the light of studies of several cases of amnesic patients, Janet (1904) concluded that hysterical amnesia
consists of two key factors: (1) "the inability of the subject to evoke memories consciously and voluntarily, and (2) the automatic, compelling, and untimely activations of these same memories" (p.24). Like Janet, Freud also emphasized the importance of unconsciousness. He argued that unconscious memories exert powerful influence on behaviour. His concept of unconscious memories played an important role in psychopathology. Like Janet and Freud, an American Psychiatrist Morton Prince (1914) also recognized the importance of implicit memory for normal cognitive functions. On the basis of his observations of implicit memory from work on hysterical patients, hypnosis dreams, and automatic writings, Prince concluded that "... a conscious experience that has passed out of mind may not only recur again as conscious memory, but may recur subconsciously below the threshold of awareness" (p.8).

PHILOSOPHY:

Henri Bergson (1911) made a substantial contribution to the analysis of implicit memory in early 20th century. His views are consistent with Main de Biran, although he did not discussed about him in his writings. Henri Bergson (1911) argued that "the past survive under distinct forms: first in motor mechanisms; secondly, in independent recollection"
According to him the motor mechanisms make no explicit reference to any specific past event that influence the habit and skills of individual while the second form of memory, i.e. independent recollections, refer to the explicit remembering of past events.

**Experimental Psychology:**

In late 19th and early 20th centuries, the phenomena of implicit memory was not elucidated by experimental psychologists. Though almost all experimental psychologists made no attempt to distinguish between implicit and explicit memory; however, some exceptions can be found. For instance, Ebbinghaus (1885) acknowledged that not all effects of memory are expressed in conscious awareness (1885, p. 2). He observed a saving over 24 hr. retention interval for items that were not consciously remembered having studied before.

Ebbinghaus's saving paradigm, in which memory is tested by relearning previously studied list, can be viewed more generally as an implicit memory test: explicit recollection of prior episode or list is not called for during relearning (Slamecka, 1985b). Ebbinghaus pointed out that one advantage of saving method was that it could provide the evidence for the existence in memory of information that could not be
recollected consciously (1885,p. 8). Consequently a large number of subsequent investigators used saving method to analyse learning and transfer of training and their work can be perceived as the study of implicit memory (Slamecka, 1985b).

After Ebbinghaus, it was W. McDougall (1924) who became the first investigator to use the term implicit and explicit with reference to the different ways in which memory can be expressed. He distinguished between explicit recognition and implicit recognition. According to him the former involves conscious recollection of a past event whereas the later involves change in behaviour that is attributable to a recent event yet contains no conscious recollection of it. Later on, other investigators like Thorndike & Rock (1934) and Hull, (1933) also recognized the existence and importance of implicit memory. Thorndike & Rock demonstrated that subject could learn various rules without conscious awareness of them or explicit memory for them. Hull, on the other hand, provided numerous demonstrations of implicit memory for skills, condition responses, and facts acquired during hypnosis.

Recent experimental and neuropsychological researches have documented a variety of striking dissociation between implicit and explicit memory which have demonstrated that under certain conditions, implicit and explicit memory can
be entirely independent of one another. It has been observed by numerous investigators that implicit and explicit memory are affected differentially by several experimental variables such as subliminal perception, amnesia, type of study processing, modality-change, duration of retention interval, retroactive and proactive interference and age.

Subliminally encoded stimuli have revealed the phenomena of implicit memory without explicit reference of them. Although early studies have severely been criticized (Eriken, 1960); recent researches purporting to elucidate implicit memory, using a variety of new experimental techniques, have demonstrated that stimuli that are not represented in subjective awareness are nevertheless processed to high levels by the perceptual system (e.g. Fowler, Wolford, Slade & Tassinary, 1981; Dixon, 1981; Marcel, 1983; Cheesman & Merikle, 1986). Holender (1986) criticized these studies on the ground of methodological deficiencies. However, several other studies relevant to the present concern, have also demonstrated that the stimuli that are perceived without awareness, can not be explicitly remembered, but have influence on subsequent behaviour and performance on task that do not require conscious recollection such as free association (Haber & Erdelyi, 1967; Shevrin & Fritzler, 1968; Shimamura & Squire, 1984) and imaginative story and fantasy productions (Giddan, 1967);
Kunst-Willson and Zonic (1980); Kauff (1983); and Willson (1979) also emphasized that subliminal encoding of stimuli have detrimental effect on explicit memory but little or no effect on implicit memory. Bargh, Bond, Lombardi & Tota (1986) presented subliminally various other type of words and observed similar implicit effect. Lewicki (1985) found that after subliminal exposure to adjective noun pairs (e.g. old tree) subjects tended to choose the previously exposed adjectives in response to the question concerning how they "felt" about the noun (e.g. is a tree big or old?).

Somewhat recently, Eich (1984) measured implicit memory in a different way. Attenuating conscious perception of target words, through a specific device, Eich yielded data consistent with the foregoing results.

Results from the studies of amnesia also seem to provide the evidences for the fundamental differences between implicit and explicit memory. Amnesic patients are unable to remember explicitly new informations (Rozen, 1976; Moscovitch, 1982; Weiskrantz, 1985; Squire, 1986). Amnesic patients are found to be severely impaired on explicit recall and recognition tests and are usually disabled in their daily lives to the point of needing supervisory care. Despite these disabilities, amnesic patients preserve some form of learning and memory
without awareness of the sources of information. Amnesic patients can acquire and maintain in a normal fashion the skill of reading words from a mirror reversed display, without remembering either the particular words that were read or the fact that the skill had been practiced on previous occasions (Cohen & Squire, 1980). Similar kind of memory in amnesic patients was observed by Cohen & Squire (1981); Moscovitch (1982); and Squire (1982b). Some other kinds of skills in amnesic patients like puzzle solving (Brook & Baddeley, 1976), rule learning (Kinsbourne & Wood, 1975) and serial pattern learning (Nissen & Bullemer, 1987), was observed.

Studies of amnesic patients have documented a large amount of evidences about the dissociation between implicit and explicit memory. Repetition priming effect is an other major area of research in amnesia which have confirmed the existence of implicit memory in amnesic patients as well as in normals, which is entirely different from explicit recall and recognition. Warrington & Weiskrantz (1968; 1970; 1974; 1978) conducted a series of studies to observe the phenomena of implicit memory in amnesic patients. These authors found that amnesic patients could show normal retention of a list of familiar words when tested with word-stem or fragment cues, whereas some patients were profoundly impaired on free recall and recognition tests. Warrington and Weiskrantz (1968) noted
that patients often did not remember that they had been shown any study list items and treated the fragment test as a kind of "guessing game". In subsequent research, using the fragment cuing procedure, amnesic patients' performance was found to be more impaired than those of control subjects (e.g. Squire, Wetzel, & Slater, 1978).

Similarly, numerous investigators have found that amnesic patients show impaired explicit memory but their implicit memory remain intact. They have, therefore, argued that different processes operate in explicit and implicit memory (Graf, Mandler, & Haden, 1982; Jacoby & Weitherspoon, 1982; Graf, Squire & Mandler, 1984; Cermac, Talboot, Candler, & Walborst, 1985; Graf & Schactor, 1985).

Studies of repetition priming effect, discussed so far in amnesic patients have their own limitations regarding the study material that consisted items with integrated or unitized pre-existing memory representation, such as common words, linguistic idioms, or highly related paired associates. Recent several studies purporting to demonstrate whether or not amnesic patients will show normal priming for novel information that does not have any pre-existing representation as a unit in memory, such as nonwords or unrelated paired associates, have not obtained the results consistent with each other. A group of
investigators have demonstrated that amnesic patients do not show priming of nonwords (e.g. Cermak, et. al. 1985; Diomond & Rozen, 1984; Graf & Schacter, 1985; and Schacter & Graf, 1986b). On the other hand, another group of psychologists assessed normal implicit memory in amnesic patients for unrelated words (e.g. Moscovitch et. al 1986; Mc Andrews, Glisky, & Schacter in press).

Results from the studies of amnesic patients are strong enough to provide evidence for the dissociation between implicit and explicit memory. However, studies using other experimental variables have demonstrated a distinction between implicit and explicit memory. For instance, Murrel & Morton (1974), Osgood & Hoosain (1974) reported a differential effect of morphologically and visually or phonologically similar words on implicit and explicit memory. They have reported that morphologically similar words facilitate implicit memory while visually or phonologically similar words have detrimental effect on implicit memory.

Variation in level or type of study processing has been extensively used as an experimental variable in the studies of implicit and explicit memory. These studies have established beyond doubt that variations in level or type of processing have differential effect on implicit and explicit memory. More
specifically it has been demonstrated that elaborative study processing facilitate explicit memory whereas implicit memory remain unaffected (Winnick & Daniel, 1970; Craik & Tulving, 1975; Jacoby & Dallas, 1981; Graf et. al. 1982; Graf & Mandler, 1984; Schacter & Graf, 1986; Schacter & McGlynn, 1987).

The dissociation between implicit and explicit memory may also be demonstrated by the effect of study-test change in modality of presentation and other type of surface information. Modality change from study (auditory) to test (visual) has a detrimental effect on implicit memory whereas the explicit memory remains unaffected (e.g. Kirsner & Smith, 1974; Kolers, 1975, 1976; Scarborough et. al, 1979; Jacoby & Dallas, 1981; Clark & Morton, 1983; Kirsner et. al. 1983; Graf, Shimamura & Squire, 1985; Roedger & Blaxton, 1987; Roedger & Weldon, 1987).

For the most studies using duration of retention interval as experimental variable, also provide evidence for dissociation between implicit and explicit memory. A large number of investigators have found that delays of days and weeks have no effect on implicit memory while explicit memory is inversely related with the duration of retention interval (e.g. Jacoby & Dallas, 1981; Tulving et. al, 1982; Forster & Davis, 1984; Graf & Mandler, 1984; Graf et. al. 1984; Komatus & Ohta, 1984; Shimamura & Squire, 1984).
Substantial number of current researches, discussed thus far, have revealed a variety of evidences about the dissociation between implicit and explicit memory. Most recently, Graf & Schacter (1987) examined the effect of interference manipulation on implicit and explicit memory for normatively unrelated words. Their findings showed that interference affected explicit memory, as indexed by performance on cued recall, pair matching and modified free recall test, but it did not affect implicit memory, as indexed by performance on a word completion test. This pattern of result complements several previous findings on performance dissociation between implicit and explicit memory for new associations.

Finally, numerous studies conducted on human memory have considered the age differences to be a powerful factor to affect the memory. Gilbert (1941) found a decline in performance with the age on a variety of learning and memory tasks. Burke & Light (1981); Craik (1977, 1983); Craik & Rabmowitz (1984) observed a decrement in memory for new informations across the adult years. These studies were restricted to the domain of explicit memory measures. The age related deficit in memory was obtained through the traditional memory tests such as recall and recognition. In a recent study Light & Singh (1987) examined implicit and explicit memory in young and older adults. They observed a significant age
related decrement in performance on the traditional measures of money, while implicit memory was unaffected across the age.

The above discussion provides impressive evidence in favour of dissociation between implicit and explicit memory. However, some researchers have advocated in favour of similarities between implicit and explicit memory. For instance, Jacoby (1983a); Schacter & Graf (1986a); and Sloman et. al (in press) have argued that under certain conditions manipulation of retention interval have parallel effects on implicit and explicit memory. Moreover, Jacoby (1983a) has shown that manipulation/list context at the time of test has no differential effect on these two forms of memory. Further evidence in favour of similarities between implicit and explicit memory came from the studies of Graf & Schacter (1985, 1987); Schacter & Graf (1986a, 1986b); Mokson & Ratcliff (1979, 1986); Moscovitch et.al (1986) who have demonstrated that both implicit and explicit memory are influenced by newly acquired associations between unrelated word pairs. Graf & Schacter (1985) and Schacter & Mcglynn (1987) further pointed out that implicit memory for new associations resembles explicit remembering of new associations in so far as it depends on some degree of elaborative processing at the time of study. Final evidence in favour of similarity between implicit and explicit memory
was reported by Johnston, Dark, & Jacoby (1985). They demonstrated that processes subserving implicit memory can also affect performance on an explicit memory task.

The foregoing discussion reveals that there is still controversy regarding processes underlying implicit and explicit memory. A sizeable number of researchers hold the view that different processes operate in implicit and explicit memory while others are of the opinion that same processes underlie both forms of memory. The present study is designed to resolve this controversy. More specifically, the present research is undertaken to investigate the effect of phonemic and semantic similarity of the task and age on implicit and explicit memory.

As mentioned earlier several studies have demonstrated that priming of word identification occurs for morphologically similar words (Murrel & Morton, 1974) but not for visually similar words (Osgood & Hoosain, 1974) or phonologically similar words (Neisser, 1954). Moreover, Graf & Mandler (1984) have demonstrated that semantic and non-semantic processing of study material have no effect on implicit memory whereas semantic processing has facilitative effect on explicit memory. These studies (i.e. Neisser, 1954; and Graf & Mandler, 1984) suggest that phonemic processing of study material impairs implicit memory and have no effect on explicit memory whereas semantic processing of study material has no effect on implicit memory but facilitate
explicit memory. These findings were explained in terms of two processes: (a) activation of mental representation; and (b) elaboration. Activation is assumed to occur automatically, independently of elaborative processing that is necessary to establish new episodic memory traces. It also strengthen the relations among its components and increases its accessibility. Elaborative process, on the other hand, establishes relations among different mental contents and increases retrievability. It means that activation of mental representation that involves phonemic encoding decreases the accessibility of target informations but such phonemic encoding has no effect on the retrievability of the target information. Activation of mental representation that involve semantic encoding, on the other hand, has no effect on the accessibility of target information but such semantic encoding increases retrievability. These interpretations of the results as given by Graf and Mandler (1984), require scrutiny. It should be noted that, in their study, Graf & Mandler induced semantic processing experimentally by asking subject to rate the unrelated words on a 5-point liking scale. This method of inducing semantic processing may not be strong enough to influence accessibility or retrievability of the target information and consequently the interpretation of the results may become doubtful. In order to ensure the presence of semantic and phonemic processing of the target information and their effect on accessibility and retrievability of the material, it
is necessary that study material should be semantically or phonemically similar. The present study is a step in this direction. The findings of the study would not only be helpful in resolving the issue whether same or different processes operate in implicit and explicit memory but would also contribute in the development of theoretical accounts of implicit memory.

...
CHAPTER -II
In the preceding chapter we have observed both similarities and differences between implicit and explicit memory. Thus, there is still controversy regarding the process underlying these two kinds of memory. The present study, as mentioned in chapter-I, is undertaken to resolve this controversy, that is to explore whether same or different processes operate in implicit and explicit memory. In this chapter we would review some of the most relevant studies which bears directly or in directly to this problem.

After extensive review of numerous studies, Herman Ebbinghaus (1885) observed that not all effects of memory are expressed in conscious awareness. His saving paradigm, in which memory was measured by saving during relearning, can be viewed as an index of implicit memory in the sense that relearning of a previously studied list does not require explicit reference to a prior learning episode, although the influence of prior episode is revealed by saving during relearning (Slamecka, 1985). However, it is not entirely clear what saving studies tells us about implicit memory, as little efforts have been made in this direction. The most directly pertinent evidence has been provided by Nelson (1978) who has shown saving for items that were neither recallable nor recognized, and thereby suggest that saving can occur in an entirely implicit manner.
Nelson (1978) conducted three experiments to investigate the relative sensitivity of recognition test and saving test for detecting information about items that were non-recallable. Four weeks after learning a list of number-word pairs, subjects had a test of recall followed by a test of forced choice recognition and relearning (saving). In experiment 1, 24 under-graduate students served as the subject. Each subject learned a list of 20 paired associates. The cues were two digit numbers of low association value from the norms of Batting and Spera (1962). The targets were nouns (four to six letters in length) of AA association value from the Thorndike-Lorge (1944) norms. Crossing 20 cues with 20 targets yielded 400 cue target combinations. From these, twenty-four 20 item lists were randomly constructed with the restriction that each cue and each target were used once in each list, and across all lists, each cue target combination was used approximately equally often. Each of these 24 lists was used once so that the cue target combinations were counterbalanced across subjects.

Prior to study, a practice and warmup task was given to each subject and then the main list of number noun pairs was presented visually via a Kodak Carousel projector at a rate of 4 seconds per pair. During each test trial, the cues were presented alone at a 8 seconds rate, and the subject responded vocally. The list was blocked so that a minimum of 10 items
(either being studied or tested) intervened between the study and test of a given item, this procedure minimized short-term memory effect during acquisition of the list. Acquisition continued via this study test procedure until attainment of the criterion of one errorless trial on the entire list. Then the subject was dismissed without being informed of the subsequent retention test.

Four weeks after acquisition, the subjects returned for the second session. First, the subject had a self-paced forced-response retention test in which he saw each cue for as long as he wanted before eventually making a recall response. After all 20 items had been tested for recall, the subject had a self-paced 20 alternative forced choice (20 AFC) recognition test. The subject's task during recognition was to select the particular target that he had acquired to the cue 4 week earlier. There was no feedback to the subject concerning his correctness on either the recall test or the recognition test. After all 20 items had been tested for recognition, there was a delay of 10 min., during which the subject worked on a puzzle while the experimenter arranged the slide tray for relearning.

The relearning list was constructed as follows. First, the items were divided into three pools: (a) incorrectly recalled and incorrectly recognized, (b) incorrectly recalled but correctly
recognized, (c) correctly recalled-most (89%) of the correctly recalled items were also correctly recognised. Second, for each of the above pools, half of the items remained the same as during the acquisition (designated as old items), whereas other half of the items (designated as new items) were changed by randomly re-pairing the cue and targets within a given pool. Finally, the cues and targets were never intermingled across the three pools listed above; this segregation insured that remembered associations would not differentially interfere with the relearning of new associations that came from the pool of forgotten items. Thus, a relearning advantage of old over new for non-recognized items demonstrates that originally learned information can be detected by a saving test.

The findings of Nelson's major interest came from the analysis of saving score during relearning. Results of the experiment showed a considerable saving during relearning even for items that were neither recalled non-recognised.

The above findings prompted the investigator to replicate and extend the first experiment. Thus, the experiment 2 was a replication and extension of the experiment 1.

The method of exp 2 was the same as for the exp 1 except. (a) Instead of one recall test of each item, a second recall
test occurred after every item had been tested once. This change was made to provide a "purer" pool of non-recalled items, because items are occasionally correct on a second test trial even after they have been incorrect on the first test trial.

(b) Instead of a 20-AFC recognition test, a 3-AFC recognition test was employed. The distractors came from the same pool as the target, in terms of correct vs incorrect recall during the retention test (i.e., the distractors for the recognition test of an incorrectly recalled item were the target from other incorrectly recalled items). (c) To produce more forgetting, a weaker criterion of original learning was employed. Once a given item correctly recalled during acquisition, it was deleted from the study and test phase of the list. Thus, rather than an acquisition criterion of one errorless trial on the entire list, the acquisition criterion was one correct response per item. (d) Because of the dropout procedure, blocking the list (as in exp 1) to prevent recall from short term memory became impractical. Therefore, the interpolation of 20 sec number shadowing between study and test was employed. (e) The items were presented on an index card at a 5 second rate during study. (F) subjects were 30 under-graduate students.

Finding of exp 2 were consistent with the results of exp 1. A considerable saving during relearning after 4 weeks
was observed even for the items that were neither recalled non-recognized. However, the magnitude of saving was lower in exp2, than the magnitude of saving in exp 1. It was due to change in acquisition criterion which was weaker than the criterion employed in exp 1.

Experiment 3 was designed to examine the possibility that a recognition test is more sensitive than a saving test for measuring the retention.

This experiment was an exact replication of exp 2 except three changes:

(1) The second recall test was not followed by a recognition test. Instead, the relearning study test trial occurred, with half of the items being old and half being new.

(2) After the relearning test trial, the subjects had a self paced 3-AFC recognition test on the relearning items. The items were divided into two pools: correct during relearning versus incorrect during relearning. Thus, for a given cue, the three recognition alternatives consisted of the relearning target along with two distractors drawn randomly from the appropriate pool.

(3) Sample was consisted of 38 under-graduate students.
Results of the experiment disconfirmed the hypothesis that recognition test might be more sensitive, in some cases, than the saving test. Nelson's major interest of the study was to explore which test is more sensitive to the retention. It was found that relearning method is most sensitive measures of memory. Since saving during relearning occurred even for the non-recallable and non-recognizable items while no explicit reference was made to the prior learning episode, it may be concluded that saving occurs entirely in implicit manner.

Although, the saving paradigm used by Nelson makes a reference to implicit memory but he did not discuss about the nature of this phenomenon. Several studies have demonstrated that priming effects in implicit memory measures are independent of explicit recall and recognition. Tulving, Schacter, & Stark (1982) for instance, observed that priming effects in word fragment completion are independent of recognition memory. They selected a pool of 192 words and corresponding graphemic fragment which allowed only one legitimate completion, one half of the words (96) were presented to the subjects for a single study trial. These words were referred as 'old' words and remaining (96) words served as 'new' test items in subsequent test. Each test item whether old or new appeared in both Yes/No recognition test and the word fragment completion test. In addition to the type of test items (old Vs new) two other
variables were also manipulated in the design: (i) retention interval 1 hr to 7 days and (ii) order of test-recognition followed by fragment completion (Rn-FC) or fragment completion followed by recognition (FC-Rn). Thus, the design of the experiment was $2 \times 2 \times 2$ factorial design.

In all eight conditions, subjects were tested individually in two successive test phases separated by 7 days. Half of the old 4 test items (48) with another set of (48) new items were tested in one session and remaining 48 old and 48 new items were tested in the second session. Thus, the item tested once in one session was not retested in the second session. In each session the test items were sub-divided into two subsets of 24 old and 24 new words. For one of the subset, the test was given in Rn-FC order and for the other subset the order of test was FC-Rn. The sequence of the test was same for all subjects in both test sessions.

Results of the experiment demonstrated a dissociation between recognition memory and word fragment completion. Performance on recognition test was found impaired on a 7 days retention interval whereas the performance on fragment completion test was found unaffected. Priming occurred in both Yes/No recognition and fragment completion. The proportion of yes responses in the recognition task was higher in FC-Rn order than in the
Rn-FC order. It was due to additional opportunity to study the successfully completed words.

Graf, Mandler & Hadden (1982) also observed a dissociable performance on recall and word-completion tests. They tested two groups of subjects, one group was required to process the word elaboratively, and the other group was given a task that allowed construction of an integrated representation but was prevented elaborative processing. The elaborative processing task required subjects to rate their liking for each word on a seven point scale (liking group). The other group was prevented from elaborative processing by requiring them to decide whether a word shared any of its vowels with the preceding word (Vowel group).

Each subject studied a list of 20 words which was preceded by 8 filler words to acquaint the subject with the task and followed by 4 filler words to prevent from extensive rehearsal of last few words of the list. After studying the list, each subject first received the completion test and then the recall test. In completion test, the subjects had to complete the initial three letter stem of the studied words with the first word that came to mind. The free recall test was given with the instructions to write down the words from the study list in any order.
On the completion test, the liking and vowel group produced a similar proportion of the study list word in response to the three letter stems whereas, on the other side, the performance of liking group on free recall test was substantially higher than the performance of vowel group. This pattern of findings is evident that different and separate processes are responsible for the completion and recall performance.

Following Graf et. al (1982), Graf, Squire and Mandler (1984) conducted a series of three experiments to compare the performance of amnesic patients with alcoholic control subjects on both priming tests and standard memory measure under two orienting conditions, namely elaborative and non-elaborative.

In experiment 1, the performance of two groups, patients with alcoholic Korsakoff syndrome and alcoholic control subjects, was compared on word-completion and free-recall test. Each subject studied a list of words twice in succession in either the elaborative or non-elaborative orienting condition. Under elaborative orientation, subjects were required to rate each word on a 5 point liking scale. In non-elaborative orientation, subjects were required to underline common vowel in two successive word pairs. Vowel comparison task prevented elaborative processing of the study material so that the test performance was mainly determined by activation process.
Immediately following the list presentation, subjects were asked to recall the list words in any order and then they were given a word completion test.

The results of free recall and completion tests were examined in separate ANOVAs. For the free recall data, there was a significant effect of orienting task (elaborative/non-elaborative) and patient group (amnesic/control). The performance was higher in elaborative condition than in the non-elaborative condition. Amnesic patients were found impaired in recall performance than the control subjects. There was also a significant interaction of orienting task x patient group. Analysis of simple main effect showed a significant differences in the liking (elaborative) conditions but not in the vowel (non-elaborative) condition.

Analysis of completion test data showed a significant main effect of orienting task and no other significant effect. The overall higher completion performance was observed in the liking condition than in the vowel condition.

In experiment 2, an additional variable of retention interval was also manipulated. Findings of experiment 1, that amnesic patients performed equal to the normal subjects on completion test, suggested the activation is spared in amnesia. However, it was assumed that the information that determines
performance on the completion test may decay more slowly in normal subjects than in amnesic patients. Under this condition amnesic patients were supposed to be impaired on completion test at long retention interval even though their performance may appears normal at short retention interval. To test this hypothesis, the performance of amnesic patients on completion test was compared with normal subjects, at different retention intervals. In addition, a recognition memory test was also administered at each retention interval. Since recognition performance according to Mandler (1980), depends on both activation process and available paths of retrievability, it was expected that amnesic patients will be impaired on recognition test.

The entire experiment was divided into three different sessions, scheduled on three different days. After the study of list of words, subjects were tested by a delay of 0, 15, 120 min, on each day. The sequence was (a) study list 1, than (b) study list 2, then (c) study list both again in the same order. Each list was studied either in vowel or in liking orienting condition and then subjects were given completion and recognition tests at scheduled retention intervals.

Analysis of obtained data showed that overall performance on the completion test was similar for amnesic and control subjects while the recognition performance was found severely impaired in amnesic patients, particularly in the liking
condition. The tendency to complete three letter cues to form recently presented list words was well above chance at zero and 15 min delay but it declined to chance level after 120 min delay. An ANOVA of the completion test results involving the factor of patient type (amnesic/control), orienting task (vowel/liking), and test delay intervals, 0, 15, 20 min, revealed significant effect of test delay and orienting task. No other effects approached significance.

Recognition performance was also evaluated by an ANOVA. The results revealed significant effect of patient type and test delay. Retention performance on test of recognition was markedly impaired in amnesic group, it was higher in liking condition than in vowel condition and it decreased with increasing delay. There was also a significant interaction of patient type and task, orientation which reveals that the difference between amnesic patients and control subjects occurred in the liking (elaborative) condition but not in vowel (non-elaborative) condition. This pattern of findings suggests that only elaborative process is impaired in amnesia but the process of activation (non-elaborative) is remain intact.

Experiment 3, was designed to compare the word-completion performance of amnesic patients and control subjects with the closely related cued-recall test under both liking (elaborative) and vowel (non-elaborative) orienting condition. In the completion test, three letter cues were given with instructions to
write the first word that comes to mind. In the related cued-recall test, the three letter cues were given with the instructions to recall the words from the learning list. Since the completion performance, according to Graf and Mandler (1984), mainly determined by activation process, a process that appears to be intact in amnesia, but the cued-recall involves additional process like elaboration that is impaired. Thus, it was assumed that amnesic patients would be impaired on test of cued-recall but not on word completion and findings confirmed their hypothesis.

In general, the main findings of the study were: (a) amnesic patients performed equally to the normal subjects on word completion test but their performance was found impaired on standard tests of memory like recall and recognition. This difference in their performance was found under only elaborative processing condition. Under non-elaborative processing condition of the study material, amnesic patients were equal to the normal subjects in completion performance, (b) Retention interval had detrimental effect on both word-completion and recognition performance. Thus, the study reveals both similarity and differences between implicit and explicit memory.

In a subsequent study, Graf and Mandler (1984) conducted another series of three experiments to compare different memory tests for word, that were studied under either semantic or non-
semantic processing conditions. Duration of retention interval was also manipulated in the experiments to observe its effects on various kinds of memory tests.

In experiment 1, a word completion, a free recall and a recognition test was given to the subjects under three semantic and three non-semantic processing conditions of the task in each test. Since performance on word completion test reflects primarily the increased accessibility of the words as a consequence of an automatic activation process. Thus, the word completion performance was expected not to be influenced by semantic and non-semantic processing of the task. Retrievability, on the other hand, is a function of elaboration which is independent of automatic activation and recall and recognition tests are sensitive to retrievability, therefore, a higher recall and recognition performance was expected under semantic processing condition of the task than under non-semantic processing condition.

Six groups of the subjects participated in the experiment. 3 groups studied the word under semantic processing condition. They had to rate the words on a 5 point scale in either of three following ways: like/dislike, meaningful/not meaningful, and concrete/abstract. Remaining 3 groups were prevented from semantic processing of the task in following three ways. One group of subjects required to report whether the preceding word
had a vowel in common with the subsequent word. The second group was required to count T junctions (i.e., two intersecting lines) in each word and the third group had to count both enclosures (i.e., totally enclosed spaces) and T junctions. After studying the words, subjects were tested for word completion, word recognition and free recall.

Findings of experiment revealed that semantic and non-semantic processing of the task has a pronounced effect on recall and recognition performance but has little effect on completion performance. Different kinds of semantic and non-semantic processing conditions had no effect on any type of the test.

Experiment 2 was designed to study the time course of completion and recognition performance. Each subject received a recognition and completion test immediately after the presentation of the study list, after 20 minutes delay, and after a 90 minutes delay. Since different semantic and non-semantic processing conditions showed no difference in experiment 1, only one semantic processing condition i.e., liking rating and one non-semantic processing condition (i.e., counting of enclosures and T junctions) was given to the subject. Experiment 2, also examined the effect word frequency on recognition and completion performance. Half of the words in study list were of low frequency (5.1 occurrence per million) and the remaining half
of the words were of high frequency (95.6 occurrence per million).
Six alternative completion tests and three recognition tests were
given to the subjects at different retention intervals after the
practice and study phase.

Recognition performance was affected severely in semantic
Vs non-semantic processing condition while there was little
influence of task processing on completion performance. Duration
of retention interval had the same effect on both kinds of test.
No effect of word frequency on any test was found.

Experiment 3, was designed to compare the completion
performance with the closely related cued-recall test. First
three letters of word, were presented as cue in each test. The
completion test was given with the instruction to complete each
cued with the first word that comes to the mind whereas the
cued-recall test was given with instruction to use the cues
to help the recall of the words from the study list. Subjects
studied the words in condition that required either semantic
or non-semantic processing. Hypothesis was the same as in
experiment 1, and 2, that elaboration in semantic processing
of the task would increase retrievability and would raise
cued-recall performance above completion performance by
providing additional retrieval paths for finding the words.
In contract, the lack of elaborative information produced by
non-semantic processing of the task was expected to result in reduced retrievability and thus cued recall performance was expected to be poorer.

Results of the experiment showed a significant main effect of task processing. The overall performance was higher in semantic processing condition than in the non-semantic processing condition. There was also a significant interaction of task processing and test type. This interaction was due to overall lower cued-recall than completion performance with non-semantic processing but higher cued-recall than the completion performance with semantic processing. The test order affected completion performance but not cued-recall. Completion performance was significantly higher when it followed rather than preceded cued-recall testing, but only with semantic processing task which suggests that when cued-recall test was given first, the recall of studied words may have increased their accessibility due to additional activation.

Results of these studies are consistent with the findings obtained by Shimamura and Squire (1984). They examined paired associate learning and priming effect in amnesic patients and in normal subjects. In their experiment subjects studied unrelated word pairs and then they were asked to complete three letters word stem to form a word. The word stem could be completed by using stimulus word from the study list. Just
after the word completion test, paired associate memory was assessed on cued-recall test. Results of the study showed that the performance of amnesic patients on word completion test was as good as the performance of control subjects whereas, on the other hand, the performance of amnesic patient on cued-recall test was impaired. Control subjects performed better on the test when they were given explicit instructions. All these results support the views, espoused by Jacoby (1983); Mandler (1979); and others that different memory tests are sensitive to different aspects of the underlying memorial representations.

Studies of amnesic patients have suggested a distinction between two memory systems. One system is damaged in amnesia and depends on the integrity of the damaged brain region and the other is intact in amnesia and is independent of these regions. Keeping in view the above facts, Squire, Shimamura, and Graf (1985) examined the relation between recognition memory and priming effects in patients receiving electroconvulsive therapy (ECT). ECT is known to cause anterograde and retrograde amnesia as a prominent side effect of treatment.

Three groups of subjects were used in the experiment. One group consisted of the patients receiving bilateral, ECT, the second was receiving unilateral ECT, and the third group consisted of normal subjects. Subjects were tested on three
different days during the course of bilateral or unilateral treatment when patients were receiving their third, fourth, fifth, or sixth ECT treatment. On the first and third day patients studied and were tested on word completion test after 45 min, 65 min and 85 min of bilateral or unilateral ECT treatment. On the second day patients studied and were tested for recognition memory after 45 min, 65 min, 85 min, and 9 hrs ± 1 hr. of ECT. Thus, there were 10 study and test conditions in all, 6 for assessing word completion and 4 for assessing recognition memory. The 10 learning lists were counterbalanced across these 10 test conditions. For the control subjects there were four test conditions. Three for assessing word-completion on one day, and one for assessing the recognition memory on the following day.

The word-completion ability was found intact in both groups of patients after 45 min of ECT. Word completion performance did not differ significantly at different delays after ECT with the normal subjects. Recognition memory of the patients was found impaired at 45 min after ECT. It was just near to the chance level. After 65 min of ECT, the anterograde amnesia had diminished to some degree, and after 85 min of the treatment the recognition scores of these patients was significantly higher than chance level. These findings supported the view that recognition memory and priming test performance are
independent of each other and there by suggested that the process that support priming makes little, if any, contribution to recognition memory.

Graf, Shimamura, and Squire (1985) further reported similar findings that support the view of multiple memory system. In their study they conducted two experiments to examine the priming across modality and priming across category levels that extends the domain of preserved functions in amnesia. In experiment 1, the priming effect measured by word-completion, and deliberate recollection, measured by free recall, was examined across modalities and within modalities. Four groups of subjects, two amnesic and two control, were presented the words visually in one condition and auditorily in another condition and then they were tested alternatively for completion and free recall in a counterbalancing order.

Priming was observed in both visual-visual and auditory-visual modalities but the magnitude of priming was significantly larger under within the modality than in across the modalities whereas the change in modality did not affected free-recall. Amnesic patients performed as better as the control subjects on word completion test whereas the performance of amnesic patients was found impaired on free-recall.
In experiment 2, subjects were presented a random list of words belonging to different conceptual categories, and then they were given a priming test. Subjects were presented a category label as cue, and they were required to generate the first eight exemplers that came to mind. A free recall test followed the priming task. In this way two groups of amnesic patients and two control groups, studied and were tested.

Analysis of the performance of amnesic patients, healthy controls and alcoholic control group on word-production and free-recall showed that the average level of recall was similar for healthy control group and alcoholic control group but the performance of amnesic patients was significantly lower. In word production by category cue, each group showed a significant tendency to generate target words from the study list more often than expected without a study list presentation. Findings of similar amount of priming in amnesic patients and control groups is inconsistent with the view that subject accomplish priming by using a recall strategy, because amnesic patients were severely impaired on free-recall test while they showed normal performance on word production test. Thus, the study reveals a dissociation between recall and priming tests.

Graf and Schacter (1985) may be regarded as pioneer in using the terms implicit and explicit memory. According to
them, implicit memory refer to the performance on priming test like word-completion whereas explicit memory refers to the performance on traditional memory test such as recall and recognition. To explore whether the same or different processes operate in implicit and explicit memory, Graf and Schacter conducted two experiments to examine whether either newly acquired associations or pre-existing associations affect completion test performance. In experiment 1, 64 subjects equally divided into four groups, studied related and unrelated words pairs in elaborative and non-elaborative study conditions. In the related pairs, the target words were linked by an familiar association and in unrelated pairs, the target words had no pre-existing relation. Subjects learned either under elaborative or under non-elaborative condition. Under elaborative conditions, subjects used a 5-point scale that had the labels 'Easy to relate' and 'Difficult to relate' at its end. Under non-elaborative condition, subjects had to report a common vowel between the two words of the pair. The design of their experiment included two between subject factors: type of study list pairs (related Vs unrelated) and study task (elaborative Vs non-elaborative). The design also included completion test context (same Vs different) as a within subject factor. Under same context, the initial three letter stems of the response words were paired with the same
word as in study list and under different context these stems were paired with the word different from the study list, at the time of test. Retention performance of the subjects was assessed on a word-completion test. A cued-recall test, in addition, was also given to assess the explicit memory.

The experiment yielded three main findings. First, following an elaborative study task, there was a higher level of completion performance when the study context was reinstated at testing than when study and test context were different, for both related and unrelated study list word pairs. In contrast, following vowel comparison task, there was no same different effect on either type of word pairs. Second, across all type of different context test items, there were similar and significant increase above the chance level of completion performance under both elaborative and vowel comparison task condition. Third, there was a higher level of recall for related pairs than for unrelated pairs as well as a higher level of recall under elaborative than vowel comparison task condition.

The first finding of the study i.e. a higher level of completion performance on same context test items versus different-context, test items under elaborative study condition,
but not under vowel comparison condition was used to argue that implicit memory is mediated by automatic processes. In contrast, explicit recall and recognition were assumed to be mediated by strategic or controlled processes because of their dependence on study task manipulation. On this view, the observation that the same-different effect depends on elaborative processing suggested that the completion test measures explicit rather than implicit memory. Thus, the same-different context effect may not provide evidence of implicit memory.

Keeping in view the above facts, experiment 2, was designed to compare the cued-recall and completion performance of amnesic patients with the control subjects. Since amnesia is a such type of disease that deteriorate the explicit memory but has no effect on implicit memory. It was assumed: (a) If amnesic patients and control subjects show a comparable performance superiority on the completion test in the same context condition over the different-context condition, there would strong support for the view that the same different effect is mediated by implicit memory for newly acquired associations. (b) If amnesic showed a similar level of completion performance on same and different context test items, it would suggest that the same different effect found in experiment 1, was mediated by explicit remembering.
Experiment 2, was similar to experiment 1, except the three changes: First, materials were presented under elaborative processing condition because same different effect was observed only under elaborative study condition in experiment 1, second, the type of study material (related and unrelated word pairs) was included as within subject factors; third, a simplified word completion test was used, with fewer items, for assessing performance in different context condition. Each subject saw both related and unrelated word pairs and then received a word-completion test followed by a cued-recall test.

Results of the experiment 2, revealed that there was a higher level of completion performance when the study context was reinstated at testing (same-context) then when study and test contexts were different, for both related and unrelated word pairs. This pattern of finding supported the view that the same different effect on the word completion test is mediated by implicit memory for new associations. In spite of their severely impaired recall, the amnesic patients showed entirely normal level of completion test performance after studying unrelated and related word pairs. These findings lent support to the view that implicit and explicit memory for new associations are mediated by different underlying processes.
Studies of amnesic patients strongly support the view of performance dissociation on implicit and explicit memory tests. Several studies, using other experimental variables, have also demonstrated a dissociation between implicit and explicit memory.

Thus, Lewicki (1985) observed nonconscious biasing effects of single instance on subsequent judgement. He presented adjective noun pairs (e.g. old tree) through a cathod ray tube for a period of 30 ms. A computer was used to register subject's responses and response time. Immediately after the presentation of the material, it was marked by a string of Xs having the same length as that of words which remained on the screen for 50 ms. Responses were measured by presenting two adjectives (e.g. is a tree old or big) with the instructions to select one of them which, according to his judgement, would fit better with the noun. Lewicki found that subjects tend to choose the previously exposed adjective in response to question concerning how they felt about the noun (e.g. is a tree big or old). The findings clearly indicated the existence of implicit memory. As 30 ms exposure of a stimulus can not elicit an explicit memory response which was, however, sufficient to measure implicit memory.
Schacter and Graf (1986) examined the effect of elaborative processing on implicit and explicit memory for new associations. Experiment 1, was designed to examine whether the variation in degree and type of elaborative processing of the study material have the same or differential effect on implicit and explicit memory for newly acquired associations. One group of subjects was required to perform a sentence generation task and the second group was instructed to generate only a word to link the member of each pair. It was hypothesized that the word generation task would require less associative elaboration than the sentence generation task, and hence, explicit memory for new associations would be lower after word generation than after sentence generation, since explicit memory is dependent on elaborative process. No assumption was made about the influence of degree and type of elaborative processing on implicit memory. The design of the experiment included two between subject factors, type of study task (sentence generation Vs word generation), and type of test (word completion Vs letter cued recall), and one within subject factor, type of test context (same Vs different).

The rate of word completion was found higher in same context than in different context condition following word generation, thereby demonstrating that this task, too, can
produce an associative effect on completion performance. Moreover, performance in the same context condition which reflects this associative influence, did not differ in the word generation and sentence generation task. An ANOVA revealed a significant main effect of test context on word completion performance. No other effects approached significance.

Analysis of cued-recall performance revealed that recall performance in the same context condition was significantly higher following sentence generation than word generation task.

The overall pattern of results suggests that implicit and explicit memory for new association may depend on different consequences of elaborative processing. Explicit memory relatively benefits more from sentence generation than from word generation; whereas implicit memory does not.

Experiment 2, compared word completion and recall performance following two type of study condition. In one condition, the sentence generation task from experiment 1, was used to induce active elaboration of unrelated word pairs. In a second condition, subjects were shown sentences that included the same target pairs and they required to rate how well these sentences related the targets. An additional variable of retention interval was also manipulated in the experiment.
Results of the experiment showed that the completion performance was higher in the same context condition than in the different context. This difference was present in both sentence generation and sentence rating condition and was evident on both the immediate and delayed tests. An ANOVA revealed a significant main effect of test context. In contrast, there was no effect of study task. The interaction between delay and test context, delay x study task, and delay x study task x test context, was not significant. There was some evidence of main effect of retention interval on word completion performance. Performance declined across the retention interval in both the sentence generation and sentence rating task and in both the same and different context condition. At the 24 hr. delay, completion performance remained significantly above base line level in the same context condition following both sentence generation and sentence rating. In the different context condition, however, delayed performance did not exceeded baseline level following either word or sentence generation.

Analysis of cued-recall data showed significant main effect of test context. Type of elaborative processing also had a large effect on explicit remembering of new associations. Recall in the same context condition was substantially higher following sentence generation versus sentence rating at both test delays. ANOVA also revealed a significant test type x Study
Task interaction and also a marginally significant Test Type x Study Task x Test context interaction.

Overall pattern of results demonstrated that active generation of elaboration is not necessary to observe implicit memory of new associations and suggested that encoding of even a small amount of information that relates or unites two randomly paired word is sufficient to produce implicit memory for new associations. However, it is not clear whether it is necessary to encode only meaningful relations between two words in order to observe implicit memory for new associations. Experiment 3, was addressed to this issue.

Experiment 3, was similar to experiment 2, except some changes in type of elaboration. In one condition subjects rated the meaningful sentences as in experiment 2, and were tested with both completion and recall tests. In the other condition, however, they rated and were tested on anomalous sentences that resembled the filler sentences that were used in experiment 2. These sentences though grammatically correct, did not provide a meaningful relation between the two critical words.

The main finding of the experiment 3, was that studying word pairs in anomalous sentences did not produce a significant associative effect on word completion test performance, whereas
studying the pairs in meaningful sentences did. Thus, the finding suggests that encoding of a meaningful relation between two words is necessary to produce implicit memory of new associations. Encoding the meaning of individual words without a meaningful relation between them, as was done in the anomalous sentences, does not produce implicit memory of new associations.

Experiment 4 was designed to examine whether rating the pleasantness of each word in an unrelated pair is sufficient to produce an associative influence on word completion test. For the comparative purpose, the sentence generation task from experiment 1 and 2, was also used.

The results of the experiment 4 were consistent with results of preceding experiment. Following the sentence generation task, an associative effect on completion performance was found. The completion performance was higher in the same context condition than in the different context condition. In contrast, there was much weaker evidence of an associative effect following pleasantness rating. This pattern of the result indicates that encoding the meanings of individual words in a pair is not sufficient to produce implicit memory of new associations.
Thus, the results of the study have revealed both similarities and differences between implicit and explicit memory. Degree and type of elaboration have a large effect on explicit memory but little or no effect on implicit memory. However, these two kinds of memory are similar in the sense that both are dependent on elaborative processing of study list, since implicit memory was not observed without a meaningful relation between the two words of a pair.

In a subsequent study, Graf and Schacter (1987) conducted two experiments to examine the effect of interference manipulation on implicit and explicit memory for new associations. Historically, interference research has focused on associative memory and has firmly established that explicit remembering is impaired by interference manipulation. In view of pervasive findings of associative interference on explicit memory tests, it was expected that studies of the effect of interference on implicit memory should have significant theoretical implications. The main purpose of their study was to examine whether interference manipulation have the same or differential effect on implicit and explicit memory. The general strategy for the experiment was that the subject was required to study unrelated word pairs and then received either an explicit or an implicit memory test. The critical manipulation involved an AB, AC interference paradigm. Under interference condition subjects were required
to study a list of target word pairs (e.g. Shirt-Window) that had same stimuli or A word as the interference list pairs (e.g. shirt-finger). Under control condition, the target and interference list had no word in common. The design of the experiment included two between subject factors (RI & PI as type of interference and recall and completion as type of test) and one within subject factor (experimental and control as study condition) under retroactive interference condition, subjects studied the interference list preceded by target list and it was followed by target list under proactive interference condition. Implicit memory was measured by word completion test and a letter cued recall test was given to assess the explicit remembering. Half of the words, in each type of test, were tested in same context (i.e. paired with the same words) as in the study list, and remaining half of the test items were tested in different context (i.e. paired with different word) than in the study list.

Results of the experiment showed that overall performance was higher on same versus different context test items on both word completion and latter cued recall tests. The critical new findings were that interference manipulation had no effect on word completion performance, whereas, it produced a significant impairment on latter cued recall test. The finding that interference effects were considerably larger on same than different
context test items, emphasizes that interference manipulation had selective effect on explicit memory for new associations.

Experiment 2, was designed to examine the effect of interference manipulation for two reasons. First, the interference manipulation in experiment 1, was too weak and secondly, interference might fail to affect the recognition memory.

Second experiment was similar to the first experiment except two changes: first only one interference manipulation -RI- was used because both RI and PI showed similar effect in experiment 1, and secondly an item recognition test - pair matching was used to assess the explicit memory, since it has been consistently found that interference has no effect on explicit recognition test.

The design of the experiment 2, included study condition (experimental and control) and test type (word completion and pair matching) as between subject factors. In experimental condition, each subject learned two interference lists AC and AD that had the same A word as the target list, whereas in the control condition, subjects studied and were tested on two interference lists EC and ED that had different stimulus words than the target list. The interference lists were always studied after the target list.
The overall completion performance was substantially higher in same than in different context condition. An ANOVA showed a significant main effect of test context (same Vs different) with no other effect approaching significance which suggests that interference manipulation did not affect implicit memory. In sharp contrast, recognition performance was found severely impaired after interference manipulation. Recognition performance was considerably higher in control than in experimental condition.

The other experimental variable that has been frequently used to demonstrate whether the same or different processes underly implicit and explicit memory is age. Thus, light and Singh (1987) conducted a series of three experiments, to examine the effect of age differences on implicit and explicit memory. Two age groups, young and older adults, were used in all the three experiments. The average age of young adults was 23.5 years (range = 19-32 year) and the average age of older adults was 67.7 years (range = 60-76 years). All the subjects studied under two conditions in each experiment. In one condition, subjects had to rate the words on a 7 point pleasantness scale, whereas the second condition required the subjects to report a common vowel in two successive words in the study list. In experiment 1, subjects were tested for implicit memory on a word completion test, and free recall and item recognition tests
were given to assess the explicit memory. The experiment 2, was same as experiment 1, with one exception that is a cued recall test was given to the subjects instead of free recall. In experiments 3, the implicit memory was assessed by perceptual identification and the explicit measures were free recall and item recognition tests.

Overall pattern of results, showed a significant main effect of age and encoding task. There was very little effect of either age or encoding condition on completion performance. In sharp contrast, recall and recognition performance was affected reliably by these two variables i.e. age and encoding conditions. A2 (age)x 2 (encoding task) ANOVA yielded main effect of age, encoding task, and age x encoding interaction. It was found that the young adults recalled more than the older adults and that pleasant rating task produced better recall and recognition. These results suggested that explicit memory declines across the age but implicit memory remain unaffected.

The above review of relevant studies reveals that variables such as type of study processing (Jacoby & Dallas, 1981), Modality change (Graf, Shimamura, & Squire, 1985; Roediger & Blaxton, 1987), retention interval (Konatsu & Ohta, 1984) and retroactive and proactive interference have differential
effect on implicit and explicit memory. These studies have provided impressive evidence in favour of dissociation between implicit and explicit memory. Other studies, however, have revealed several similarities between implicit and explicit memory (Jacoby, 1983a; Schacter & Graf, 1986a; Sloman, Hayman, Ohta and Tulving, 1988; Graf & Schacter, 1985, 1987; Schacter & Graf, 1986b; McKoon & Ratcliff, 1979, 1986; Moscovitch, Winocur, McLachalan, 1986; Johnston, Dark & Jacoby, 1985). These conflicting results lead us to conclude that there is still controversy regarding the processes underlying the implicit and explicit memory. The present study is an attempt to resolve this controversy.

A thorough review of the literature also reveals that no attempt has been made so far to study the differential effect of task similarity on implicit and explicit memory. In case of short and long-term memory there is substantial amount of evidence to suggest that phonemic similarity has adverse effect on short-term memory but has no effect on long-term memory whereas semantic similarity has adverse effect on long-term memory but has no effect on short-term memory (Kintch & Buschke, 1969; Philip, 1972; Saeeduzzafar, 1976) is it possible to dichotomise implicit and explicit memory in the same way as short and long-term memory have
been dichotomised? There is some scattered findings which lead us to assume that phonemic and semantic similarities should have differential effect on implicit and explicit memory. The present research is also undertaken to test this assumption.

The findings of the present research may not only be helpful in resolving the existing controversy regarding the processes underlying implicit and explicit memory but may also enhance our understanding about human memory system.
As mentioned in the preceding chapter, the present research was designed to study the effect of phonemic and semantic similarity of the task on implicit and explicit memory in relation to age. More specifically, the present investigation was undertaken to answer the following questions:

1. Do young and old subjects differ with respect to implicit memory?
2. Do semantic and phonemic similarity have differential effect on implicit memory?
3. Do young and old subjects differ with respect to explicit memory?
4. Do semantic and phonemic similarity have differential effect on explicit memory?
5. Does age have differential effect on implicit and explicit memory?
6. Does phonemically similar information have differential effect on implicit and explicit memory?
7. Does semantically similar information have differential effect on implicit and explicit memory?
8. Is there any interactional effect of stimulus similarity and age on implicit and explicit memory?

Experimental Design:
A 2 x 2 factorial design, in which one task variable (i.e. similarity) and one personality variable (i.e. age) each
varying in two ways, was used in the present experiment. The two values of task variable were: (a) Phonemic similarity, and (b) Semantic similarity. The age was varied by selecting young subjects (approximately 24 years old) and old subjects (approximately 63 years old). Thus each of the two group of subjects, namely, young subjects and old subjects, was presented a list of paired-associates, half of which consisted of phonemically similar stimulus members and the other half consisted of semantically similar stimulus members paired with unrelated meaningful common words. The types of items being counterbalanced. Thus, it yielded four observations on two groups of subjects for each of the two measures of the dependent variable. In other words, the retention scores obtained for phonemically similar items and those for semantically similar items, though correlated observations, were treated as separate observation of the two sets of items presented in the mixed list of each of the two groups of subjects. The two measures of the dependent variable (i.e., retention) employed in the present experiment were implicit and explicit memory.

The design of the experiment may be stated diagramatically as follows:
Group I  Received 4 trials on a mixed list consisting of 28 paired associates. In the half of the list, stimuli of two successive pairs were phonemically similar and responses were unrelated words, while in the other half of the list, stimuli of two successive pairs were semantically similar attached with unrelated words as response member. The types of paired associates were counterbalanced.

Group II  Received 4 trials on the same mixed list, used for group I.

Received name word cued

Received completion test to recall

Received test to measure

Received assess explicit memory.

Received implicit memory.
The learning and test sequence for each group of subjects was as follows: First a ready signal was given to the subject, then a mixed list of 28 paired associates was presented at a rate of 4 second per pair for four trials through an electrically operated memory drum. Immediately after presentation of last word pair at 4th trial each subject received a distractor task and then memory tests. The function of distractor task was to engage subject in an unrelated activity for about 3 minutes before administering the critical memory tests, and more importantly, to induce an appropriate set for word completion testing. For the distractor task, subjects were presented with a test sheet consisted of 15 initial three letter stems of the common names of persons. Subjects were required to complete each stem with the first surname that came to their mind.

Following the distractor task, a word completion test was given to the subjects to assess the implicit memory and then explicit memory was tested by cued-recall test. Separate test form was used for word completion and cued-recall test, each consisted of a single page. The test form used to measure the implicit memory showed a random arrangement of 24 test items each consisted of a stimulus word attached with initial three letter stem of response word (e.g. liberty-car...). Out of
24 test items, 6 test items were the members of phonemically similar word pairs, 6 were the members of semantically similar word pairs of the target list and the remaining 12 test items were distractor item which were not given in the study list and the responses of these items were not included in retention score. The purpose of distractor items in word-completion test was to disguise its memory testing aspects, for once memory testing aspects of a word completion test become apparent to the subjects, a completion test may be transformed into a cued-recall test. Cued-recall and word-completion differ in instructions only. For completion test the instructions made no reference to memory for the study list. Thus, on word completion test, following instructions were given to the subjects:

"Before giving you a memory test, I am presenting a second completion test. Here, few words alongwith word stems are presented to you. You are requested to read aloud each context word and then complete the stem next to it with the first word that comes to your mind. You can write any word except proper nouns. Since this material will be used in my future research, you are, therefore, requested to complete as many word stems as possible within ten minutes. Do you understand"?
The test form used for cued-recall test showed 12 test items, out of which 6 items were from phonemically similar word pairs and remaining 6 were from semantically similar word pairs of the target list. It is important to note that these test items were not used in completion test. Moreover, it was unwarranted to use distractor items in cued-recall test, hence distractor items were not used. Like in completion test, each test item consisted of a stimulus word plus a three letter stem of response word but different instructions were given to the subject which made clear reference of a memory test. The instructions were as follows:

"I am going to present you few words alongwith word stems. You are required to read allowed the word next to each word stem and use the stem as an aid for remembering a response word of the study test pairs. Try to recall as many words as possible within five minutes. Do you understand"?

**STIMULUS MATERIAL AND APPARATUS:**

The stimulus material and apparatus employed in the experiment were: (a) list of paired associates, (b) electrically operated memory drum.

The list of paired associates was consisted of fourteen blocks of twenty eight pairs. In the seven blocks of fourteen
pairs, the stimulus word of two successive pairs were semantically similar, paired with unrelated words and in the other seven blocks of fourteen pairs, the stimulus member of two successive pairs were phonemically similar attached with unrelated words. To prepare the first type of seven blocks of fourteen pairs, a preliminary study was conducted. First, 50 nouns were given to 50 under-graduate students with the following instructions:

"I will show you a list of stimulus words one by one. You are required to write down within one minute the synonym of each stimulus word presented to you. For example, if I pronounce the word 'HAPPY' then you may write 'GLAD', 'CHEERFUL' etc. as its synonyms".

In this way responses of 50 subjects to each of the 50 nouns were obtained and tabulated to determine the most suitable synonym for each stimulus word. Out of 50 stimulus words only seven nouns and their seven corresponding synonyms were selected on the following criteria: (a) that each stimulus word has more or less equal numbers of letters; (b) that the synonym of each stimulus word is the nearest possible one; and (c) that neither stimulus word nor its synonym evokes any emotion, i.e. stimulus words and its synonyms are neutral words. Each of the fourteen stimulus word (i.e. seven noun and seven their corresponding synonyms) was paired with the unrelated
words taken from Thorndike-Lorge (1944) norms with the conditions that the initial three letters stem of each word had atleast six alternative completion and each stem had to occur twice only on entire list. The pairs were arranged in such a way that the stimulus member of the two successive pairs were semantically similar paired with unrelated words but the initial three letter stems of the response words were the same. If, for example, the first pair of a block of two pairs was 'FREEDOM-CARPET', then the second pair of the block was 'LIBERTY-CARROT'. In this way seven blocks of fourteen pairs were arranged.

In order to prepare remaining seven blocks of fourteen pairs, another preliminary study was conducted. Another set of 50 nouns was given to a group of under-graduate students with the following instructions:

"I will present to you some stimulus words one by one and you are required to write down within one minutes the homonym of each stimulus word presented to you. For example, if I pronounce the stimulus word 'COUNCEL' then you may write 'COUNSEL' as its homonym, i.e. you may write all those words as homonym whose sound is like the sound of the stimulus word presented to you".
The responses of 50 subjects to each of the 50 nouns were obtained and tabulated to determine the most suitable homonym of each stimulus word. Out of the 50 stimulus words, only seven stimulus words and their seven corresponding homonyms were selected on the criteria: (a) that each stimulus word has more or less equal number of letters; (b) that the homonym of each stimulus word is the nearest possible one; and (c) that all seven stimulus word and their seven corresponding homonyms are neutral words. Each of the fourteen stimulus items (i.e. seven stimulus words and their seven corresponding homonyms) was paired with the unrelated words taken from Thorndike-Lorge (1944) norms with the same condition as for the blocks of synonyms. The fourteen pairs were arranged in such a way that the stimuli of the two successive pairs were phonemically similar. For example, if the first pair of a block of two pairs was 'WHOLE-CONFIRM', then the second pair of the block would be 'HOLE-CONSIDER'. In this way, all of the fourteen pairs were arranged in seven blocks.

The two sets of paired-associates so prepared were arranged in counter-balancing order on a sheet to obtain a mixed list of fourteen blocks of twenty eight paired associates out of which twelve blocks (6 PS + 6 SS) of twenty four pairs were designated as critical word pairs and two blocks of four
pairs served as filler items. Out of two blocks of filler items one block of two pairs was given at the beginning of the study list to control the recency and primacy effects and one block of two pairs was given at the end of study list in order to prevent rehearsal of the last responses of the pairs. The filler items were not tested subsequently. The arrangements of paired-associates for study and for subsequent test of implicit and explicit memory are given in the following tables:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kattle-Along</td>
<td>Packet-Accord</td>
<td>Seen-Blend</td>
</tr>
<tr>
<td>Cattle-Aloud</td>
<td>Bundle-Accept</td>
<td>Scene-Blade</td>
</tr>
<tr>
<td>Reign-Chair</td>
<td>Ability-Encode</td>
<td>Lever-Stamp</td>
</tr>
<tr>
<td>Rain-Change</td>
<td>Capacity-Enclose</td>
<td>Liver-Stable</td>
</tr>
<tr>
<td>Wood-Drink</td>
<td>Freedom-Carpet</td>
<td>Steel-Proper</td>
</tr>
<tr>
<td>Would-Drill</td>
<td>Liberty-Carrot</td>
<td>Steel-Process</td>
</tr>
<tr>
<td>Hole-Confirm</td>
<td>Border-Reveal</td>
<td>Weather-Remedy</td>
</tr>
<tr>
<td>Whole-Consider</td>
<td>Margin-Review</td>
<td>Climate-Remember</td>
</tr>
<tr>
<td>Success</td>
<td>Baggage-Crown</td>
<td></td>
</tr>
<tr>
<td>Victory-Ballot</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table-2: Showing Implicit Memory Test

<table>
<thead>
<tr>
<th>Implicite Test</th>
<th>Implicit Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nation-Int...</td>
<td>Said-Clo...</td>
</tr>
<tr>
<td>Actor-Wat...</td>
<td>Whole-Con...</td>
</tr>
<tr>
<td>Rain-Cha...</td>
<td>Liver-Sta...</td>
</tr>
<tr>
<td>Bucket-Yea...</td>
<td>Trust-Fam...</td>
</tr>
<tr>
<td>Victory-Bal...</td>
<td>Liberty-Car...</td>
</tr>
<tr>
<td>Growth-Pla...</td>
<td>Ankle-Hou...</td>
</tr>
<tr>
<td>Would-Dri...</td>
<td>Margin-Rev...</td>
</tr>
<tr>
<td>Wring-Dan...</td>
<td>Board-Pur...</td>
</tr>
<tr>
<td>Bundle-Acc...</td>
<td>Baggage-Cro...</td>
</tr>
<tr>
<td>Capacity-Enc...</td>
<td>Book-Rec...</td>
</tr>
<tr>
<td>Farming-Her...</td>
<td>Bear-Pr...</td>
</tr>
<tr>
<td>Scene-Bla...</td>
<td>Steel-Pro...</td>
</tr>
</tbody>
</table>

### Table-3: Showing Explicit Memory Test

<table>
<thead>
<tr>
<th>Explicit Test</th>
<th>Explicit Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reign-Cha...</td>
<td>Hole-Con...</td>
</tr>
<tr>
<td>Success-Ball..</td>
<td>Lever-Sta...</td>
</tr>
<tr>
<td>Wood-Dri...</td>
<td>Freedom-Car...</td>
</tr>
<tr>
<td>Packet-Acc...</td>
<td>Border-Rev...</td>
</tr>
<tr>
<td>Ability-Enc...</td>
<td>Luggage-Cro...</td>
</tr>
<tr>
<td>Seen-Bla...</td>
<td>Steel-Pro...</td>
</tr>
</tbody>
</table>
The apparatus used in this experiment was an electrically operated memory drum in which the timing device was so adjusted to allow each word pair to be exposed for a period of 4 seconds.

SAMPLE:

In all 80 male subjects participated in the experiment. Out of them 40 subjects were young subjects with the average age of 22.7 years and the remaining 40 were old subjects with the average age of 63 years. Thus, there were two groups of subjects viz. young and old. All the young subjects were post-graduate students and were randomly selected from the Faculty of Social Sciences of Aligarh Muslim University, Aligarh with the mean age of 22.7 years (range = 17 to 27 years). Subjects of old group were randomly selected from the Ex-Service man of Aligarh Muslim University, Aligarh. All of them were retired B grade service man. These two groups were matched in their formal education. Both groups had a mean of 16.8 years of schooling.

PROCEDURE:

All the 80 subjects were tested individually and both the groups i.e. young and old, were run simultaneously i.e. first subject was tested from the young group, second subject was tested from the old group, and the third subject was tested from the young group and so on.
As the subject entered the laboratory, he was seated comfortably on a chair facing the aperture of memory drum and the following instructions were given to him:

"I am going to present you a list of few paired-associates one by one through electrically operated memory drum. Each paired-associate will appear in the aperture of memory drum for four seconds. In this way the whole list will be presented for four times. You are required to see each paired-associate carefully and read aloud each word pair. At the end of fourth trial you will be given a name completion test, a word completion test, and then a memory test. Do you understand?"

According to the instructions given above each subject was tested for implicit as well as explicit memory.

The data obtained were tabulated group-wise and statistically treated to draw necessary inferences.

...
CHAPTER IV
As mentioned in the preceding chapter, a 2 x 2 factorial design of experiment was employed in the present study. Two independent variables i.e. similarity of the task and age, each varying in two ways were used. The two values of the task variable (i.e. similarity) were (a) phonemic similarity; and (b) semantic similarity. The personality variable (i.e. age) was varied by selecting (a) young subjects; and (b) old subjects. Each of the two group of subjects, namely, young subjects and old subjects was presented a list of paired associates, half of which consisted of phonemically similar stimulus members and other half consisted of semantically similar stimulus member, the types of items being counter-balanced. Thus, it yielded four observations on two groups of subjects for each of the two measures of the dependent variable. In other words, the retention scores obtained for phonemically similar items and those for semantically similar items, though correlated observations, were treated as separate observation of the two sets of the items presented in the mixed list to each of the two groups of the subjects.

Keeping in view the main objectives of the present study, the data were analysed for implicit and explicit memory separately and were statistically treated by using analysis of
variance. Thus, 'F' ratios were calculated separately for implicit and explicit memory.

The implicit memory scores of the two groups of subjects obtained under phonemic and semantic similar tasks are given in table 1(a), their mean scores in table 1(b) and their 'F' ratios in table 1(c).

Table I(a): Showing raw scores obtained by two groups of subjects under phonemic and semantic similar task on implicit memory test.

<table>
<thead>
<tr>
<th>Young Group</th>
<th>Old Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phs</td>
<td>SS</td>
</tr>
<tr>
<td>1.</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
</tr>
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<td>3.</td>
<td>4</td>
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<td>8.</td>
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<td>9.</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>5</td>
</tr>
<tr>
<td>12.</td>
<td>3</td>
</tr>
<tr>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
Table I(b): Showing mean implicit memory scores obtained by two groups under phonemically and semantically similar task.

<table>
<thead>
<tr>
<th>Similarity of task</th>
<th>Young</th>
<th>Old</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonemic Similarity</td>
<td>3.17</td>
<td>3.05</td>
<td>3.11</td>
</tr>
<tr>
<td>Semantic Similarity</td>
<td>3.65</td>
<td>3.42</td>
<td>3.53</td>
</tr>
<tr>
<td>Mean</td>
<td>3.41</td>
<td>3.23</td>
<td></td>
</tr>
</tbody>
</table>

Table I(c): Showing ANOVA for implicit memory scores.

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean sum of square</th>
<th>F ratio</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.22</td>
<td>1</td>
<td>1.22</td>
<td>1.79</td>
<td>P = NS</td>
</tr>
<tr>
<td>Task Similarity</td>
<td>7.22</td>
<td>1</td>
<td>7.22</td>
<td>10.61</td>
<td>P &lt; .01</td>
</tr>
<tr>
<td>Interaction, Age x</td>
<td>0.10</td>
<td>1</td>
<td>0.10</td>
<td>0.14</td>
<td>P = NS</td>
</tr>
<tr>
<td>Task Similarity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject (Individual differences)</td>
<td>63.01</td>
<td>39</td>
<td>1.61</td>
<td>2.36</td>
<td></td>
</tr>
<tr>
<td>Residual (Subject x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment Interaction</td>
<td>79.45</td>
<td>117</td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A perusal of table I(c) reveals that ‘F’ ratio for variation in personality variable i.e. age, is 1.79 which is insignificant. The result suggests that young and old age have no differential effect on implicit memory. Ignoring similarity of the task, we find in table I(b) that mean of the means for young subjects is 3.41 (i.e. 3.17 + 3.65/2) and the mean of the means for old subjects is 3.23 (i.e. 3.05 + 3.42/2). Since the difference between these two mean of the means (i.e. 3.41 and 3.23) is negligible, it may be concluded that age has no differential effect on implicit memory.

F ratio for variation in task variable i.e. similarity is 10.61 (Ref. table I(c) which is significant at .01 level. The result shows that phonemic similarity and semantic similarity have differential effect on implicit memory. Disregarding age variable, the table I(b) shows that mean of the means for phonemically similar task is 3.53 (i.e. 3.65 + 3.42/2). Since the mean of the means for semantically similar task is higher than the mean of the means for phonemically similar task, it may be concluded that phonemic similarity has more detrimental effect on implicit memory than semantic similarity. In other words implicit memory is sensitive to phonemic similarity of the task while it is relatively insensitive to semantic similarity of the task.

F ratio for interaction between age and similarity of the task, as shown in Table I(c) is 0.14 which is insignificant.
We may, therefore, infer that in case of implicit memory no interaction exist between age and similarity of the task. As shown in table I(b) the mean implicit memory score for both the young and old subjects are higher under semantic similarity of the task than the mean implicit memory scores under phonemic similarity of the task. Since both the groups obtained higher mean implicit memory scores with semantically similar material than with phonemically similar material, we may safely conclude that there is no interactional effect of age and similarity of task on implicit memory.

The explicit memory scores of the two groups of subjects obtained under phonemic and semantic similarity of the task are given in table II(a), their mean scores in table II(b) and their F ratios in table II(c).

Table II(a): Showing raw scores obtained by two groups of subjects under phonemic and semantic similar task on explicit memory test.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Phs</td>
<td>SS</td>
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<tr>
<td>1.</td>
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<td>2.</td>
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<tr>
<td>20.</td>
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<tr>
<td>21.</td>
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<td>22.</td>
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<tr>
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<td>2</td>
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<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
Table II(b): Showing mean explicit memory scores obtained by two groups under phonemically and semantically similar task.

<table>
<thead>
<tr>
<th>Similarity of task</th>
<th>Age</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young</td>
<td>Old</td>
</tr>
<tr>
<td>Phonemic Similarity</td>
<td>3.47</td>
<td>2.80</td>
</tr>
<tr>
<td>Semantic Similarity</td>
<td>2.87</td>
<td>2.17</td>
</tr>
<tr>
<td>Mean</td>
<td>3.17</td>
<td>2.48</td>
</tr>
</tbody>
</table>
Table II(c): Showing ANOVA for explicit memory scores

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean sum of square</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18.90</td>
<td>1</td>
<td>18.90</td>
<td>54.00</td>
</tr>
<tr>
<td>Task Similarity</td>
<td>15.00</td>
<td>1</td>
<td>15.00</td>
<td>42.86</td>
</tr>
<tr>
<td>Interaction, Age x Task Similarity</td>
<td>0.01</td>
<td>1</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Subject (individual differences)</td>
<td>129.94</td>
<td>39</td>
<td>3.33</td>
<td>9.51</td>
</tr>
<tr>
<td>Residual (subject x treatment Interaction)</td>
<td>40.59</td>
<td>117</td>
<td>0.35</td>
<td></td>
</tr>
</tbody>
</table>

F ratio for age variation, as shown in table II(c) is 54.00 which is significant at .01 level. The result reveals that young age and old age have differential effect on explicit memory. Ignoring task similarity variable, we find in table II(b) that the mean of the means for young subjects is 3.17 (i.e. 3.47 + 2.87/2) and mean of the means for old subjects is 2.48 (i.e. 2.80 + 2.17/2). Since mean of the means for young subjects (3.17) is markedly higher than the mean of the means for old subjects (2.48), it may safely be concluded that young subjects show better explicit memory than old subjects. In other words, old age has pronounced adverse effect on explicit memory.
F ratio for similarity variation is 42.86 (table II(c)) which is also significant at .01 level. It may, therefore, be suggested that phonemic and semantic similarity has differential effect on explicit memory. Disregarding age variable, it may be observed in table II(c) that the mean of the means for phonemic similar task is 3.13 (i.e. 3.47 + 2.80/2) and mean of the means for semantic similar task is 2.52 (i.e. 2.87 + 2.17/2). As is evident in table II(b) that mean of the means for phonemically similar information (3.13) is much higher than mean of the means for semantically similar information (2.52), it is established beyond doubt that semantic similarity of the material has more pronounced detrimental effect on explicit memory than phonemic similarity of the material. In other words explicit memory is highly sensitive to semantic similarity of the task whereas it relatively insensitive to phonemic similarity of the task.

A perusal of table II(c) also reveals that F ratio for interaction between age and similarity of the task is 0.03 which is insignificant. We may, therefore, infer that in case of explicit memory also no interaction exist between age and similarity of the task. In table II(b) we find that mean explicit memory scores for both the young and old subjects are higher when the information is phonemically similar than when
it is semantically similar. Since both the groups obtained higher mean scores under phonemically similar task than under semantically similar task, we may conclude that there is no interactional effect of age and similarity of the task on explicit memory.

**DISCUSSION:**

The main findings of the present research are as follows:

1. Age has no differential effect on implicit memory i.e., young and old subjects show more or less same performance on implicit test of memory.

2. Phonemic similarity and semantic similarity of the task have differential effect on implicit memory. More specifically, phonemic similarity has greater detrimental effect on implicit memory than semantic similarity.

3. Age has differential effect on explicit memory. More specifically, young subjects show better explicit memory than old subjects.

4. Similarity of the task has differential effect on explicit memory i.e., semantic similarity of the material has more pronounced adverse effect on explicit memory than phonemic similarity of the task.

5. Since age has no differential effect on implicit memory but affects explicit memory differentially, it is concluded that age affects implicit and explicit memory in different ways.
6. Similarity of the task has differential effect on implicit and explicit memory. Phonemic similarity as compared to semantic similarity has more pronounced detrimental effect on implicit memory whereas semantic similarity as compared to phonemic similarity has stronger adverse effect on explicit memory. In other words, implicit memory is sensitive to phonemic similarity whereas explicit memory is sensitive to semantic similarity of the task. Thus, it may be concluded that similarity of the task has differential effect on implicit and explicit memory.

7. There is no interactional effect of age and similarity of the task either on implicit memory or on explicit memory.

The first finding of the present research i.e. young and old subjects do not differ in implicit memory, is consistent with the findings obtained by numerous investigators. (Moscovitch, 1982; Rabbit, 1982; 1984; Howard, 1985; Light et. al., 1986; Light & Singh, 1987), who have also found no age difference on various tests of implicit memory.

The finding also provide empirical support to activation theory of implicit memory. According to activation view, priming effects on implicit memory tests are attributable to the temporary activation of pre-existing representations, knowledge structures or logogens (Rozin, 1976; Morton, 1979; Mandler, 1980; Graf & Mandler, 1984). The theory further states that activation occurs automatically, independently of the
elaborative processing that is necessary to establish new episodic memory traces. An activated representation readily "Pops into mind" on an implicit memory test, but it contains no contextual information about an item's occurrence as a part of recent episode and therefore does not contribute to explicit remembering of the episode. Thus, unlike tests of explicit memory such as recall and recognition where older subjects are found to be less able than young adults to process information semantically because semantic encoding requires allocation of attentional processing resources which are in short supply, but in tests of implicit memory such as word completion and fragment completion tests, older subjects may relatively be unimpaired in repetition priming because implicit memory depends on activation processes that require little or no attentional capacity. Hence, age differences are assumed to be absent on tests of implicit memory. The first finding of our study provides empirical evidence to this assumption.

The second finding of the present investigation i.e. young subjects show better explicit memory than older subjects, is in agreement with the findings obtained by Eysenck (1974); Craik (1977, 1983, 1985); Perlmutter (1978); Hasher & Zacks (1979); Craik & Rabnowitz (1984); Light & Singh (1987).
Our second finding is also compatible with the view that old subjects are less likely to store or to subsequently utilize contextual information about the circumstances in which an event is experienced in tests of explicit memory (e.g. recall and recognition). Moreover, numerous studies have shown that old subjects may be impaired in integration of items with other items or with their contexts (Burke & Light, 1981; Kausler & Puckett, 1980; 1981; Rabinowitz, 1984; Rabinowitz & Ackerman, 1982; Simon, 1979; Winocur & Moscovitch, 1983). Such findings support the claim that age related deficits in cued recall are due to problem in context processing. Our finding also provides empirical support to this claim.

The third and fourth findings of our research i.e. phonemic similarity as compared to semantic similarity of the task has greater detrimental effect on implicit memory whereas semantic similarity as compared to phonemic similarity of the material has more pronounced adverse effect on explicit memory, require careful analysis. One possible explanation of such findings may be the fact that encoding of phonemically similar material is easy and leaves short lived memory trace (Baddeley & Ecob, 1979) and consequently phonemic encoding of the material may impair the activation of automatic processes whereas encoding of semantically similar material is relatively difficult and leaves durable memory trace (Baddeley & Ecob, 1979) and
therefore, is less likely to interfere the activation of automatic processes. In other words since implicit memory depends on the activation of automatic processes, phonemically similar material may inhibit the activation simply by creating confusion whereas semantic encoding requires allocation of attentional processing, it is unlikely to affect implicit memory. Explicit memory, on the other hand, involves conscious recollection and attentional capacity, semantically similar material is likely to impair the attentional capacity of the subject whereas phonemic encoding requires no allocation of attentional processing it is unlikely to affect explicit memory.

The third and fourth findings of the present research reveals a trend suggesting similarities between implicit memory and short-term memory and between explicit memory and long-term memory. Numerous investigators have demonstrated that phonemic similarity has adverse effect on short-term memory but has no effect on long-term memory whereas semantic similarity impairs long-term memory but has no effect on short-term memory (Kintch & Bugchke, 1969; Philip, 1972; Saeeduzzafar, 1976). The same pattern of results have been found in case of implicit and explicit memory. Further, research is therefore needed to ascertain whether or not same processes are involved in implicit and short-term memory and in explicit and long-term memory.
The fifth and sixth findings of the present research i.e. age and similarity of the task have differential effect on implicit and explicit memory, resolves the existing controversy regarding the distinction between implicit and explicit memory. It may be recalled that there are conflicting results regarding the dissociation between implicit and explicit memory. A number of investigators have demonstrated clear distinction between implicit and explicit memory (e.g. Kunst, Wilson & Zonic, 1986; Eich, 1984; Murrel and Morton, 1974; Jacoby & Dallas, 1981; Graf & Mandler, 1984; Graf, Shimamura, & Squire, 1985; Komatsu & Ohta, 1984; Graf & Schacter, 1987), whereas other investigators have revealed several similarities between implicit and explicit memory (Jacoby, 1983(a); Schacter & Graf 1986(a); Graf & Schacter, 1985; 1987; Mckoon & Ratcliff, 1979, 1986; Moscovitch, et. al. 1986; Schacter & McGlynn 1987). The findings of the present study strengthen the dissociation view of implicit and explicit memory.

The last finding of our research i.e. there is no interactional effect between age and similarity of task either on implicit memory or on explicit memory, simply suggest that implicit and explicit memory of young and old subjects are essentially independent of the similarity of the task. These findings reveal that age and similarity of the task have
independent effect on implicit as well as on explicit memory but when these two variables are combined their effect disappears.

The overall findings of the present research not only demonstrate striking dissociations between implicit and explicit memory but also have raised fundamental questions concerning the nature and composition of memory and consequently have opened the fertile field for future research. Moreover, our findings have important implications for the development of the theory of implicit memory.

...
SUMMARY
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Over the years, the study of implicit and explicit memory has achieved special prominence in experimental psychology. Psychological studies on human memory have traditionally been dependent on standard memory tests such as free recall, cued-recall, and recognition. These memory tests have their own characteristics. They require subjects to recall earlier learned items in a conscious or deliberate manner. However, memory can also be expressed by facilitated performance on tests that do not require conscious recollection of the informations encoded in a specific learning episode. Instead of being asked to try to remember recently presented informations, subjects simply require to perform a task such as word fragment completion (e.g. Warrington & Wieskrantz, 1974; Graf, Mandler & Haden, 1982), word identification (e.g. Jacoby & Dallas, 1981, Feustel, Shiffrin & Salasoo, 1983; Jacoby, 1983), lexical decision (e.g. McKoon & Ratcliff, 1979; Scarborough, Gerared & Cortese, 1979), free association (e.g. Shimamuna & Squire, 1984; Schacter, 1985a), and reading of mirror inverted script (e.g. Kolars, 1975, 1976). The former type of memory is called explicit memory while later type of memory is called implicit memory. (Graf & Schacter, 1985, 1987; Schacter & Graf, 1986a, 1986b). Thus explicit memory refers to conscious recollection of recently presented information, as expressed on traditional
tests of free-recall, cued-recall, and recognition whereas implicit memory refers to expression of recently presented information without conscious or deliberate recollection on certain priming tests.

The dissociation between priming tests like word completion and standard memory tests such as recall and recognition, is attributed to different informational requirements (Graf, Mandler, & Haden, 1982). In a word completion test, for instance subject receives first three letters of a word studied in a learning episode and he is required to write the first word that comes to mind which produces an acceptable completion. The partial presentation of the word activate schema component of all relevant words, this activation spreads more rapidly to the missing components of the target word. A standard memory test such as recall and recognition, on the other hand, requires retrieval of the words that have recently been presented. Recall is determined by the success of the search process which depends on the available paths to the target words (Graf & Mandler, 1984). Cued recall is closely related to word completion test. Both tests present some cues to the subjects which facilitate their performance. However, these tests are sensitive to different aspects of memorial representation. Word completion is concerned with integrative process that makes word more
accessible, whereas cued recall is sensitive to elaborative process that helps retrievability (Graf & Mandler, 1984). In their study, Graf & Mandler (1984) and Nelson et. al (1987) compared the performance in word completion Vs free recall word completion Vs recognition; and word completion Vs cued recall, under semantic and non-semantic processing. They hypothesized that semantic processing of the task would help the recall performance since subjects would be encouraged in their attempt of retrieval in addition to sheer reproduction of highly accessible words, and on the other hand, non-semantic processing would have detrimental effect on recall performance. Results of their study confirmed their hypothesis. This pattern of findings elucidate that word completion (priming test), and recall and recognition (standard memory test) are the measure of two different kinds of memory.

Recent experimental and neuropsychological researches have documented a variety of striking dissociation between implicit and explicit memory which have demonstrated that under certain conditions, implicit and explicit memory can be entirely independent of one another. It has been observed by numerous investigators that implicit and explicit memory are affected differentially by several experimental variables such as sublimenal perception, amnesia, type of study processing,
However, some researchers have advocated in favour of similarities between implicit and explicit memory. For instance, Jacoby (1983a); Schacter & Graf (1986a); and Sloman et. al (in press; have argued that under certain conditions manipulation of retention interval have parallel effects on implicit and explicit memory. Moreover, Jacoby (1983a) has shown that manipulating list context at the time of test has no differential effect on these two forms of memory. Further evidence in favour of similarities between implicit and explicit memory came from the studies of Graf & Schacter (1985, 1987); Schacter & Graf (1986a, 1986b); Mekoon & Ratcliff (1979, 1986); Moscovitch et. al (1986) who have demonstrated that both implicit and explicit memory are influenced by newly acquired associations between unrelated word pairs. Graf & Schacter (1985) and Schacter & McGlynn (1987) further pointed out that implicit memory for new associations resembles explicit remembering of new associations in so far as it depends on some degree of elaborative processing at the time of study. Final evidence in favour of similarity between implicit and explicit memory was reported by Johnston, Dark, & Jacoby (1985). They demonstrated that processes subserving implicit memory can also affect performance on an explicit memory task.
The foregoing discussion reveals that there is still controversy regarding processes underlying implicit and explicit memory. A sizeable number of researchers hold the view that different processes operate in implicit and explicit memory while others are of the opinion that same process underlie both forms of memory. The present study is designed to resolve this controversy. More specifically the present research is undertaken to investigate the effect of phonemic and semantic similarity of the task and age on implicit and explicit memory. As mentioned earlier several studies have demonstrated that priming of word identification occurs for morphologically similar words (Murrel & Morton, 1974) but not for visually similar words (Osgood & Hoosain, 1974) or phonologically similar words (Neisser, 1954). Moreover, Graf & Mandler (1984) have demonstrated that semantic and non-semantic processing of study material have no effect on implicit memory whereas semantic processing has facilitative effect on explicit memory. These studies (i.e. Neisser, 1954; and Graf & Mandler, 1984) suggest that phonemic processing of study material should impair implicit memory and should have no effect on explicit memory whereas semantic processing of study material should have no effect on implicit memory but should facilitate explicit memory. The present research aimed to test this assumption.
A 2 x 2 factorial design, in which one task variable (i.e., similarity) and one personality variable (i.e., age) each varying in two ways, was used in the present experiment. The two values of task variable were (a) Phonemic similarity, and (b) Semantic similarity. The age was varied by selecting young subjects (approximately 24 years old) and old subjects (approximately 63 years old). Thus each of the two group of subjects, namely, young subjects and old subjects, was presented a list of paired-associates half of which consisted of phonemically similar stimuli members and the other half consisted of semantically similar stimulus members paired with unrelated meaningful common words, the types of items being counterbalanced. Thus, it yielded four observations on two groups of subjects for each of the two measures of the dependent variable. In other words, the retention scores obtained for phonemically similar items and those for semantically similar items, though correlated observations, were treated as separate observation of the two sets of items presented in the mixed list of each of the two groups of subjects. The two measures of the dependent variable (i.e., retention) employed in the present experiment were implicit and explicit memory.

In all 80 male subjects participated in the experiment. Out of them 40 subjects were young subjects with the average
age of 22.7 years and the remaining 40 were old subjects with
the average age of 63 years. Thus, there were two groups of
subjects viz. young and old. All the young subjects were post-
graduate students and were randomly selected from the Faculty
of Social Sciences of Aligarh Muslim University, Aligarh with
the mean age of 22.7 years (range = 17 to 27 years). Subjects
of old group were randomly selected from the Ex-Service man
of Aligarh Muslim University, Aligarh. All of them were retired
B grade service man. These two groups were matched in their
formal education. Both groups had a mean of 16.8 year of
schooling.

All the 80 subjects were tested individually and both
the groups i.e. young and old, were run simultaneously i.e.
first subject was tested from the young group, second subject
was tested from the old group, and the third subject was tested
from the young group and so on.

The main finding of the present research is that both
the independent variables, i.e. age and task similarity, have
differential effect on implicit and explicit memory.

Retention performance of old subjects was found signifi-
cantly poorer than the retention performance of young subjects,
on traditional test of explicit memory. In sharp contrast,
implicit memory performance of young and old subjects on word-completion test was more or less equal. This pattern of findings suggest that decrement in retention performance across the age is restricted to the domain of explicit memory; and implicit memory remains unaffected across the age. Furthermore, the findings also suggest that implicit and explicit memory are the two different kinds of memory. The results are consistent with the findings obtained by Graf, Mandler, & Haden (1982); Graf & Mandler (1984); Graf & Schacter (1985); Light & Singh (1986, 1987).

Impaired explicit memory performance of old subjects is attributable to their poorer attentional capacity and their relative inability to store and utilize the contextual information (Craik, 1983). Since explicit recall and recognition involve conscious recollection and attentional capacity, old subjects are found impaired in explicit memory performance. Implicit memory, on the other hand, is dependent on activation process that require little or no attentional capacity e.g. (Graf & Mandler, 1984). Hence, age differences are assumed to be absent on tests of implicit memory.

Another important finding of the present research is that the phonemic similarity as compared to semantic similarity has greater detrimental effect on implicit memory whereas
semantic similarity as compared to phonemic similarity has more pronounced adverse effect on explicit memory. One possible explanation of such findings may be the fact that encoding of phonemically similar material is easy and leaves short lived memory trace (Baddeley & Ecob, 1970) and consequently phonemic encoding of the material may impair the activation of automatic processes whereas encoding of semantically similar material is relatively difficult and leaves durable memory trace (Baddeley & Ecob, 1970) and therefore, is less likely to interfere the activation of automatic process. Since implicit memory depends on the activation of automatic processes, phonemically similar material is assumed to deteriorate the implicit memory whereas semantic encoding involves allocation of attentional processing, it is unlikely to affect implicit memory. Explicit memory, on the other hand, involves conscious recollection and attentional capacity, semantically similar material is likely to impair the attentional capacity of the subject whereas phonemic encoding requires no allocation of attentional processing, it is unlikely to affect explicit memory.

The overall findings of the present research not only demonstrate striking dissociation between implicit and explicit memory but also have raised fundamental questions
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