

FACTORS RELATED TO THE DECLINE OF MEMORY

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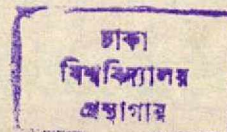
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ABSTRACT

The present study was undertaken to investigate the relative importance of the factor of competition as compared with the factors of age, sex and passage of time respectively in producing decline of memory. The study was conducted on one hundred children and one hundred old people of both the sexes. The age range of the children was from 12 years to 15 years and the age range of the old people was from 45 years to 50 years. The subjects memorized a list of paired associate words comprising of 4 noncompetitive, 4 somewhat competitive and 4 competitive pairs. They were then tested for short-term and long-term memory. It was assumed that differences in the degree of competition in the paired associate list would produce differential performance in the subjects shewing thereby the importance of the factor of competition in producing decline of memory.

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The results showed significant interactions between competition and age, sex and passage of time respectively and the main effects of all of these four factors were also found to be significant. Further analysis of the data however, showed no significant differences in the mean number of errors between the children and the old people, the males and the females and between long-term and short-term memory in respect of noncompetitive pairs. But significant differences were found between these groups when comparisons were made in respect of somewhat competitive and competitive pairs. Similarly, when comparisons were made between the performances of the subjects at three levels of competition it was found that the subjects performed differently due to the difference in the degree of competition. The results therefore showed that competition emerged as more dominant variable as compared with age, sex and passage of time in producing decline of memory.

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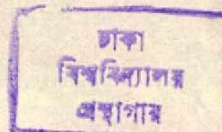


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CHAPTER I

INTRODUCTION

The notion that memory declines with ageing seems to be a matter of belief. Older people in every society are found to suffer from loss of memory. Therefore, it is argued that ageing is responsible for decline in memory. Not to speak of laymen, even educated people subscribe to this notion. It is true that people are not being able to memorize events or things as effectively in old age as they could have done in early years of their life. One can not, however, pause to think that there may be other cogent factors which may explain decline of memory in the later years of life. Ageing per se may not at all be responsible for such a decline.

It is generally observed that as people grow old particularly when they cross their middle age deterioration of some physiological functions sets in. Decline in some psychological functions such as intelligence and memory may not also be uncommon. The definition of the term ageing itself shows that some changes are closely related to ageing. Birren (1959) writes, "ageing is a process of change involving all aspects of the organism. Its consequence range from altered structure and functions of the component tissue of the body to an altered relationship of the organism to its physical and social environment".

Therefore, it can be expected that with the advancing years there will be some change in different aspects of the organism of which memory is one aspect. But as Birren (1959) points out, "old people seem more forgetful partly because they have so much to forget; repression and emotional blockages are also responsible and organic loss due to deteriorative change in the nervous system may be there". So it gives rise to the question whether the decline of memory which is generally observed in old people is really due to ageing or to some other factors which have not so far been properly probed into.

Works of some of the psychologists (Lawton, 1945; Gilbert, 1941; Willoughby, 1927; Jones et al, 1928; Kube, 1938; Welford, 1958; Rene & Serge, 1960) maintain that decline in short-term memory is due to ageing itself.

Jones et al, (1928) found great deficiency of older subjects in immediate recall. But one of the drawbacks of the experiment conducted by Jones et al. (1928) is that they did not control the factor of speed of perception and other processes that may be involved in apprehending the content of the material (here in this experiment it was motion picture).

Kube (1938) found that decline in memory becomes apparent in the late seventies in case of women and in the early eighties in men.

Results of the experiment conducted by Gilbert (1941) show reliable differences between the scores of the younger and older groups giving clear evidence of the decline of memory due to ageing and greater loss was found in the field of immediate recall.

Welford (1958) showed that the decline in short term retention is one of the most important changes occurring in old age. Rens and Serge (1960) also showed that great decline in short term retention takes place with age and after 40 the rate of decline is accelerated. In a study on short-term memory Talland (1965) also found that performance on short-term memory task declines from maturity to old age.

Taub & Long (1972) conducted an experiment on short-term memory of the old and young subjects where the average age of the old subjects was 70.6 years and that of the young subjects was 25.2 years. They found that the younger subjects recalled digits better than the older subjects but the older subjects improved their memory performance with practice and these improvements remained relatively stable over 6 months (inter-session interval).

The decline of short-term memory which seems to be the function of ageing may be due to the deterioration in the physiological and neural processes which themselves are the functions of advancing years (Goodenough & Tyler 1934; Hill, 1957; Kirchner, 1958; Taub, 1968). "It is possible that unknown physiological changes that form the basis of learning may become less stable as age progresses thus making for quicker forgetting of material learned during the later years" (Goodenough & Tyler 1934).

Support of this view comes from a study by Moenster (1972). The results of his study showed that though the age of the subjects varied from 20 years to 94 years memory differences for learned materials between young and older adult subjects became statistically nonsignificant when memory performance was adjusted for learning performance.

Hill (1957) maintains that age is not necessarily a deterrent to recalling. According to him physical handicaps cause a difference in performance as do interest, desire and determination.

In the experiment conducted by Kirchner (1958) the subjects were to press the Key (1) where the light appeared (2) where the light had just gone out (3) where the light had gone out two positions before and (4) where the light had gone out three positions before. Excepting the first condition the performance of the older subjects was inferior to that of the younger subjects.

Kirchner suggested that central organizing processes of the brain may be responsible for the poor performance of the older subjects. In the one-back, two-back and three-back conditions the subjects ^{were} are to store some pieces of information as well as a continual process of giving and taking of the responses should go on. It is assumed that central nervous system organizes these materials and so according to Kirchner the poor performance of the older subjects is due to the slowing down of the Central processes. This hypothesis was confirmed by the performance of the older subjects where results improved markedly when they were given more time.

Schenfield and Robertson (1966) found that in recall of words the subjects showed poorer performance with advancing years. But when recognition method was used they did not find any difference between the performances of the older and the younger groups. They suggested that older subjects showed no losses in acquisition and storage but were much less efficient at retrieval of the material in store. This argument follows from the notion that while recall involves a "search" of memory, the search process is largely by-passed in the case of recognition. Thus the words are just available but less accessible for older subjects.

Mc Nulty & Caird (1966) argued against the accessibility hypothesis. According to them acquisition and storage may actually be poorer in older subjects but that the partial information available may be sufficient to yield good recognition scores although it is not sufficient for adequate recall.

Mc Ghie et al, (1965) showed that short-term retention of visual information declines rapidly with the increasing age but the retention of auditory information suffers no loss. Averbach & Corriell (1961) and Mc Werth (1962) and Crossman (1964) explain why rapid decline of short-term retention of visual information takes place. Visual images can be recoded into auditory images and thus could have more stable storage. But according to Mc Ghie et al (1965) with older people this recoding procedure leads to an overloading of an already limited capacity. Broadbent & Gregory (1965) also found little difference in age in simple visual span but in all bisensory conditions decline in short-term memory was found with ageing.

Fraser (1958) and Inglis and Ankus (1965) uphold the view that decline in short-term memory which apparently seems to be the function of ageing may be due to the decay of the memory traces. This was also implied in the law of Disuse proposed by Thorndike (1914). According to Thorndike, "when a modifiable connection is not made between a situation and a response during a length of time that connection strength is decreased". The implication of this law is that disuse produces forgetting. Gates (1930) writes, "disuse is a passive state in which trained mechanisms are left inactive and connections are weakened through disuse".

It has long been assumed that when any specific event occurs some trace or some group of traces is made and stored up in the organism (Bartlett, 1932) and forgetting occurs when the traces are faded out (Dashfield, 1949; Fraser, 1951). Brown (1956) explains the Decay Theory in the following manner: "when something is perceived, a memory trace is established, which decays rapidly during the initial phase of its career, some decay of the trace is assumed to be compatible with reliable recall - just as partial fading of print may be compatible with legibility. But recall will cease to be reliable if decay of the trace proceeds beyond a critical level".

In the way of explaining the nature of the memory trace Oldfield (1954) suggests that "the idea behind the existence of memory trace is that some simulacrum of the past occasion must be preserved, carried with it the implication that the alteration in the matter of recall must be quantitative comparable to the gradual erasure of an inscription on stone or the fading of a photograph".

Thus this view emphasizes the structural phase of the memory trace and portrays it as fixed independent lifeless trace which was opposed by Koffka. Koffka (1935) postulated activity trace - a dynamic interaction between the traces. Those who have approached the memory process from the stand point of the Gestaltists maintain that the traces have a shape and although they grow dim with time they possess certain lively properties of their own, certain internal forces and they occupy position within a field. They rub elbows with those neighbours that crowd them too closely; and in a mutually shared psychological space they modify each other's shapes intruding upon their neighbours when the weak boundaries of the latter afford too little resistance, moving over to join their similars as forces of alteration operate* (Cole, 1933).

But Lovibond (1958) found no such evidence of the progressive change in the memory trace.

Hebb (1949) proposed Dual Trace Mechanism to explain the nature of memory trace and suggested that short term memory and long term memory involve two separate neural mechanisms. Transient memory or short term memory involves "activity trace", i.e., a memory trace which is wholly a function of a pattern of neural activity independent of any structural change.

The long term memory involves relatively permanent "structural trace". The activity trace of short term memory, Hebb suggests, depends upon something like active recurrent circuits in the nervous systems. The activity trace is subject to rapid decay over time and it is disrupted and wiped out if anything acts to interfere with the event to be remembered.

The transient, unstable activity trace of the short term memory is transformed into the permanent structural trace of the long term memory if sufficient time is allowed to prevent any interference from other materials.

In theoretical discussion of memory, the concept of traces has an important position. According to Postman and Egan (1949) the "term trace" refers simply to the modification which the organism has undergone as a result of learning. Having learned, the organism is no longer the same as it was ; learning has left a trace in the organism. And "this memory trace enable us to retain something when the stimulus is no longer in the environment" (Morgan, 1961). Melton (1961) accepts the construct of memory trace as the carrier of $S^H R$, Association bond or S-R Association.

Ash (1968) proposed associative retrieval hypothesis which explains the relationship between the S-R association and the memory trace. According to him, associative retrieval hypothesis can be diagrammed as an A-a-b-B chain. The test stimulus 'A' will evoke associative retrieval only if it "makes contact with " the corresponding memory trace 'a' of its previous occurrence. This trace in turn can be associated with a memory trace "b" of the overt response 'B'. The initial contact step is assumed to be based upon the similarity of 'A' to 'a' not upon association between these elements.

The question that logically follows is ; can trace explain the decline of memory ? It has been found that memory declines with passage of time spent between learning of the material and its recall.

Fraser (1951), Conrad (1957, 1958) Conrad and Hillie (1964) and McNicoll (1970) showed that these traces fade out or decay over time. Hunter (1957) draws an analogy to explain the process of decay of memory traces. "Learning lays down a neural trace in the brain. When a muscle is frequently exercised, it draws nutrient from the blood-stream and thereby maintains itself. But when it is no longer in use, it cannot compete with nutritional demand of other active muscles and organs; it has to give up some of its own substance and in doing so atrophies traces. If it remains inactive for sometimes it may lose out in physiological competition with active parts of the nervous system and thus will undergo deterioration". Most of the experiments on short term memory do not allow rehearsal of the learned materials. So according to Hunter (1957), decline in short term memory may be assumed to be due to the deterioration or decay of the memory traces, which itself is the result of lack of rehearsal of the learned materials. Brown (1958) and Peterson and Peterson (1959) also maintained that short term forgetting reflects the fading of a memory trace.

Broadbent (1962) showed that decay occurs when information subsequent to the stimulus must be processed. Processing shift is considered to decrease or eliminate rehearsal and produce a retention loss.

Roberts (1972) and Grant and Roberts (1975) experimented with pigeons. They found that repetition of the sample stimulus progressively strengthens a memory trace of the stimulus and the passage of time allows this trace to decay. The degree of interference between traces will depend upon the extent to which the distribution of traces of the interfering stimulus overlaps or exceeds in strength of the to be matched stimulus.

William and Knox (1944) tested the hypothesis of the fading of traces in time and found some evidence in favour of it. Results of the experiment of Goldmier (1941) uphold William & Knox's (1944) finding and they also supported the reconstruction hypothesis, i.e., traces are not completely wiped out but are deviated towards familiar forms. Oldfield (1954) also forwarded some evidence to confirm the hypothesis that changes in the memory traces take place as time passes on. But Irving and Phina (1959) found that "although the trace, insofar as it represents shape does not change, it does become increasingly unavailable over time".

Fraser (1958) conducted his experiment on groups of young and old Canadian School teachers. He found that the groups were very similar in immediate memory at a fast rate but the older subjects did much worse when the rate was slow. So Fraser assumed that fading of the trace is responsible for the decline of short term memory. Inglis and Ankus (1965) supporting the findings of Fraser suggested that trace decay accelerates with age. Inglis and Ankus (1965) presented two sets of digits to ears of the subjects. The results showed that the accuracy of recall of the second half-sets decreases with age but there is little significant impairment in ability to recall the First-half set. It was suggested by Inglis and Ankus that perhaps some short term storage mechanism is affected by advancing years. Yntema & Trask (1965) suggested that both members of the dichotic pair are in short term storage at the time of presentation and each digit is "tagged" according to the side on which it was heard. The material reproduced is

poorly recalled because it had been held longer in a similar system & subjected to trace decay & response interference. With the help of the findings of Inglis and Ankus that the trace decay accelerates with age it can be assumed that as age advances greatest impairment would be found in the half-set recalled.

But studies of memory span have shown little or no age decrement (Bromley, 1958; Craik, 1968). In an experiment Craik (1968) showed that the last few words in free recall lists are also recalled as well by the older subjects as they are by a young group. He also showed that long-term storage declines between the ages of 22 years to 65 years.

Broadbent and Heron (1962) presented two tasks simultaneously to the subjects and the performance of the older subjects was found to be inferior to that of the younger subjects.

Inglis and Caird (1963) also found that performance on short term memory task declines from maturity to old age when simultaneous stimulation was used. Taub (1968) also showed that age differences were found when the subjects were required to make storage and response at the same time.

All of these three studies by Broadbent and Heron (1962), Inglis and Caird (1963) and by Taub (1968) which show age decrement on short term memory it is found that the common factor that the tasks all required the subjects to divide their attention between two processes; either two sources of input or perception and storage or storage and response. From the view point of the Decay Theory it may be assumed that while attending to the

distraction task, decay of the stored information from the main task took place. But Broadbent and Heron suggested that distraction task had its effect upon elmer subjects through interference rather than through decay. Thus they put forward "Interference Theory" to explain decline in memory.

Postman (1961) writes that "Interference Theory occupies an unchallenged position as the major significant analysis of the process of forgetting. The only serious opposition has come from the trace theory of the Gestalt psychologists, but that point of view has thus far proved experimentally sterile and resistant to rigorous test. As a result, the recent years have seen little debate about the basic assumption of Interference Theory".

The history of interference theory begins in the year 1932 when Mc Geoch put forward her theory of Forgetting and the Law of Disuse, although the works of Ebbinghaus had a similar implied notion. Mc Geoch (1932) maintains that forgetting varies with the interpolated condition rather than with disuse; and disuse, in her opinion, is relatively unimportant. She even goes to the extent of announcing that disuse is probably entirely ineffective and pronouncing interpolated activities as necessary conditions of forgetting. Thus McGeoch emphasizes the importance of interference theory rather than that of decay theory.

According to McGeoch, inhibition occurs due to the competition of the original and interpolated responses. According to VonWright (1959), the competitive strength of a response decays over time. But Melton and Irwin(1940)

in their two-factor theory of retroactive inhibition maintain that besides the factor of competition between the original and interpolated responses at the time of the attempted recall of the original material, another factor, viz., the unlearning of the original responses comes into action at the time interpolated responses are being learned. But the amount of unlearning of the original responses according to Thune and Underwood (1943), is constant after a few trials on the interpolated list. The results of the experiment by Melton and VenLackum (1941) confirmed the findings of Melton and Irwin (1940).

It is more or less a confirmed statement that interpolated activity has a detrimental effect upon subsequent recall (Melton and Irwin 1940 ; Melton and VenLackum, 1941 ; Minami and Dallen Bach, 1946 ; Leess and Mc Burney, 1965).

Leess and Mc Burney (1965) presented word triads and consonant trigrams individually and tested after a nine seconds of interpolated task. The interpolated tasks were either active (subtraction) or passive (uttering digits). Recall was best without interpolated task and was poorest in the active interpolated condition. Thus interpolated activity was suggested to be the cause of inhibition.

Pesner and Kenick (1966) also supported this view when they found that a classification task involving a relatively high degree of information processing led to poorer recall than other tasks, such as counting backward or addition that had a lower processing involvement.

Retractive inhibition (RI) was assumed to be the function of similarity between the original learning and interpolated learning (Nagge, 1935; McKinney, 1935; Gibson, 1941; Melton and Von Lackum, 1941; Slanscka, 1959; Murray, 1966; Mickelgren, 1966; German & Wickens, 1968).

McKinney (1935) used advertisement as the learning material and found that the similar advertisements produce the greatest amount of retractive inhibition and the dissimilar advertisement produced the least. By using nonsense syllables he found a greater amount of retractive inhibition than that was produced by advertisements. Melton and Von Lackum (1941), when trying to find out evidence for the two-factor theory of RI, found that the amount of retractive inhibition and proactive inhibition were greater when the two lists were similar than when they were dissimilar. According to Nagge (1935), the retractive inhibition is greater between similar stages than it is between different ones.

Gibson (1941) showed that the degree of RI of the original learning varies directly with the strength of the tendency for stimulus members of an interpolated list to generalize with those of an original list. She employed paired list method and found that as the degree of generalization between corresponding stimulus members of a first and second list is increased and when the response in the second list are different there is a tendency for the second list to be harder to learn.

Murray (1966) in his experiment varied the similarity of the interpolated materials, rate of presentation and length of stimulus lists.

He found that recall was poor when the interference items were more similar and when there was less time available for rehearsal. Confirmation of the findings of Murray was found in the works of Slamecka (1959, 1960).

Wickelgreen (1966) found retroactive inhibition as a function of acoustic similarity whereas German & Wicken_g (1968) found retroactive inhibition as a function of class similarity. When paired - associate method was used similarity factor was found to interfere with the performance. Holbern (1973) showed that performance was markedly hindered by high similarity among response term of pairs. Underwood (1974) found no difference in recognition memory for associated and nonassociated pairs.

But in a later experiment Underwood (1976) found that the subjects recognised the associated pairs (high) significantly better than nonassociated word pairs (zero).

There are two possible reasons for these contradictory results.

(1) In 1976 experiment, in choosing high and low pairs from word association tables, only stimulus words that had homonyms were allowed. This restriction was not imposed on 1974 experiment.

(2) Bruder and Silverman (1972) suggested that subjects may displace rehearsal and thereby spend more time on difficult items than on easy items when mixed list is used. Thus in 1974 study in which zero and high pairs were found to be equivalent in recognition, the subjects may have selectively rehearsed the zero pairs at the expense of the high pairs or that in the 1976 study high pairs were rehearsed at the expense of the zero pairs.

When unpaired pairs were used by Underwood (1976) though the subjects made more errors in recognition memory for zero pairs the difference was not statistically significant.

But similarity factor was found to be negligible in producing retroactive inhibition (Pillsbury & Sylvester, 1940; Osgood, 1948; Gladis & Braun, 1958; Brown, 1958).

Pillsbury & Sylvester (1940) did not find similarity of the interpolated task reducing recall rather they found the difficulty of the task to reduce recall.

Brown (1958) varied the similarity of the interpolated task but did not find any similarity effect on retroactive inhibition in immediate memory.

Gladis and Braun (1958) found an increase in retroactive interference with the decrement in the degree of similarity between the response members of the original list and the interpolated list.

Osgood (1948) used paired association method and there was meaningful relationship (similar or opposed) between the pairs. The result showed that there was no significant differences between similar and opposed material in producing either proactive interferences or retroactive interferences and Osgood concluded that the statement that greater the similarity the greater the retroaction is not valid everywhere.

Tulving and Thornton (1959) showed that retroactive inhibition (RI) is significant in immediate memory and proactive inhibition (PI) is significant in short term retention. Underwood & Richardson (1956) maintained that PI is the major cause of forgetting.

Melton & VonLackum (1941) found that PI occurs because of the competition of the original responses at the time of recall and relearning of the interpolated responses.

Bergstrom's (1895) work showed that as the time interval between the two sets of learning material increases, the interference decreases. Maslow (1934) used different materials but he confirmed the findings of Bergstrom (1895).

Bunch (1939) after experimenting on rats concludes that "the negative transfer effect of the first habit on the second when the two are learned in immediate succession, decreased rapidly with passage of time".

Slamecka (1961) showed that PI is a function of length of retention interval and it increases directly with the retention interval.

Pellack, Johnson & Knaff (1959) found PI effect in the recall of messages with uncertain length than with message of certain length.

Olson (1961) gave four stories, separately to the control group and in a series to the experimental group. He found significant proactive inhibition.

Whitely & Blankenship (1936) also found that recall scores are best when learning occurred under the normal condition or no activity preceding learning.

When analysing proactive inhibition in short term memory Murdock (1964) emphasized Broadbent's (1958) hypothesis of a limited capacity system, i.e., the individual has a limited capacity for the recall of a list of items presented once.

According to Bartlett (1932), past experience may control present memorization. Confirmation of this statement may be found in the works of Kay & Poulton (1951) and Poulton (1953).

Kay & Poulton (1951) showed that the active retention of the earlier items in a series can interfere with the memorization of original material and memorization of later material is due to the subjects' available 'energies' - a finite quantity divided between trying to retain the old and memorizing the new. The findings of Kay & Poulton were supported by the results of a later experiment by Poulton (1953). He showed that new items could not be memorized effectively while previous items were being recalled. During the learning of any item subject may be devoting part of his attention to recalling and organizing the previous items; thus memorization of the later items become ineffective.

Galton (1883) was the first person to suggest that women seem to have more vivid mental imagery than men in every sense modality, though to

what extent such a difference may be the result of sex differences in occupations and other traditional activities are yet to be seen.

Thompson (1903) found that the males perform better than the females in different memory task.

Beck and Meadow (1928) found that the performance of the female students on memory tests is superior to that of the male students.

Mc Nemar (1942) found that girls excel in most tests of memories. In the standardization sample of the 1937 Stanford - Binet test, a significantly greater percentage of girls passed the test of picture memories and copying a bead chain from memory. No significant difference in favour of either sex was found on other memory tests in the scale except the memory for a story about acrobats which appealed more to the interests of boys than to those of girls.

According to Carmichael (1946), sex differences are negligible and inconsistent in digit span and in memory for geometric forms.

Osgood et al (1957) found female superiority in the memory for meaning.

Anastasi and Foley (1957) show that in memory for narratives, the direction of sex differences often depends upon the relative appeal of the content for the two sexes. However when the contents favour neither sex, girls tend to excel more consistently in logical than in rote memory. The female superiority in memory tests is attributable to the role of verbal

functions in facilitating retention and recall of most types of material.

Brown & White (1971) did not find any sex difference in recognition memory.

Messe et, al (1968) found that males were superior to female on a simple word recognition test. They considered that the perceptual difference might be due to (1) inherent or experimental variables or (2) differences in the ability to organize stimuli or (3) in the tendency to respond to partial cues. Two discrepancies with the procedures and results of Messe et. al. may be pointed out. (1) They used exposure duration at which a subject first responded correctly to a stimulus as the recognition criterion. (2) Their reported difference between male and female scores was actually no better than a chance occurrence.

A review of relevant literature on the decay of traces shows that memory declines with the fading of trace and as fading of the trace takes place more rapidly with the advancing years so poor memory is found in old people. But the interference theory suggests that any form of activity inhibits the learned material to be retained and thus causes poor retention. So it can be assumed that the amount of forgetting will depend upon the amount of interfering activities one is faced with and not upon the factor of one's age. Persons who are to go through more interfering activities are supposed to have poor retentive capacity. It is an widely observed fact that in most cases the women folk have more stable and steady life than their counterparts and they also face less conflicting activities. So their memory should be better than the memory of the males. But very few researches

have been carried on to investigate the relation between memory and sex variations and most of these studies were carried on young children.

However, it was found that activities cause interference which in turn act as the determining factor for the decline of memory. Accordingly it is expected that girls will have better memory because of the fact that their activities are so limited that there is hardly any interference and most of the studies confirm the statement. Similarly, children are less exposed to conflicting situation than the older people. It may therefore be argued, that children would have better retentive capacity than the older people. It can, therefore, be hypothesized that 'age' per se, is not an important variable for the decline of memory; there are other variables which may be more important than the factor of age in causing decline of memory. One of such variables is inhibition. Inhibition occurs when a person is exposed to conflicting activities. In saying that inhibition will play a significant role in causing decline of memory, it is not however ruled out that age will have no influence on the decline of memory. What is asserted is that age is not the only factor that is responsible for the decline of memory. There may be other important factors related to the decline of memory. On the basis of these assumptions the following hypothesis were formulated.

- (1) When faced with conflicting situation the children are likely to recall better than the older people and
- (2) When faced with conflicting situations the females are likely to recall better than the males.

CHAPTER II

METHOD

Before undertaking the final study two pilot studies were conducted.

Experiment I

This pilot study was undertaken to observe whether there was any competition between the responses of the paired associates list used in this study and whether interference caused by this competition was responsible for the decrement in memory.

Subjects : Twenty subjects, all of whom were either undergraduate or Postgraduate students of the Dacca University, were taken for this exploratory work. The group comprised both males and females and their age ranged from 18 to 23 years.

Apparatus : As some of the areas where the final study was carried on did not have electricity, the apparatus was manipulated by hand. The apparatus was a flat wooden board standing on two wooden stands. In the middle of this board was an one-inch by two inches (1" X 2") window through which the words were presented successively to the subjects. During the anticipation trials and the recall sessions a shutter operated by the experimenter was lowered over the window so that only the stimulus member of each pair was exposed.

A metronome and a stop watch were used for the control of time factor.

Learning Material :

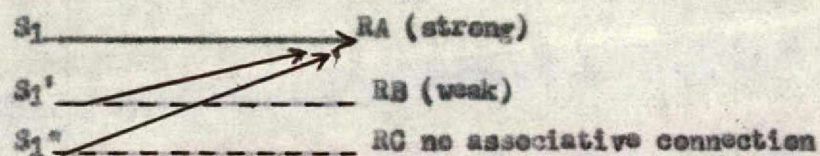
It was found that relatively little attention has been directed towards interference as a phenomenon occurring within the learning of a single list attributable to interactive effects among the various items constituting the list. Gibson's (1940) formulation based on the concept of stimulus generalization which was a notable exception has also been subjected to increasing criticism due to its restrictiveness and limited empirical relevance as well as the operational ambiguity of the concept of stimulus generalization itself.

However, in this experiment of paired associate learning intralist interference was introduced because of 'the composition law' that competing responses should be introduced in the same list as in such competing response situations the response that has the greater excitatory potential at the moment will be the one that will occur. Newman (1964), Umenoto and Hilgard (1961), Young (1961) and others also demonstrated that the paired associate learning was interfered with when same items occurred as S terms and R terms.

The learning material shown in Appendix A consisted of 12 paired Bengali adjectives which are common to the day-to-day verbal communication of the Bengali-speaking people. These adjectives were paired in such a way so that very strong and specific competition was introduced in the list. As a result of past-experience, words tend to become associated with other words to varying degrees and for each word the hierarchy of associative

strengths tends to be similar for individuals in the same culture. Confirmation of this statement was found in the works of Kent and Rosanoff (1910). Among the 12 paired adjectives in case of 4 pairs marked by asterisk associative connection between the words of the pairs was thought to be very high as a result of past verbal experience. For each of the stimulus words of these four pairs two synonymous adjectives were selected as stimulus words for the remaining eight pairs. Four of these eight stimulus words were paired with an adjective with which it had little associative connection. And the remaining 4 words were paired with adjectives with which it had no associative connection. Thus for each triad of synonymous stimulus words, one was paired with response words with which it had no association, another one was paired with response word with which it had very weak association and one was paired with a highly associated word.

Following Spence (1960) this relationship between the paired associates might be shown as follows :



As the stimulus words S_1' and S_1'' were highly synonymous with S_1 so they had high associative connection with RA. As a result, the learning of the pairs S_1' -RB and S_1'' -RC would involve a strong competition because, due to the associative connection the subject would have a tendency to pair S_1' and S_1'' with RA.

The four pair of words between which there was strong associative connection were termed as noncompetitive pairs and the four pair of words between which there was little associative connection were termed as somewhat competitive pairs and the pairs of words where there was no associative connection between them were termed as competitive pairs. On the basis of the assumption that competition leads to decrement in memory it could be presumed that the stronger the competition the more would be the decrement in memory.

All subjects participated in the experiment individually under the same experimental condition. Immediately following the reading of the instruction describing the method of learning (provided in Appendix B), the paired-associate list was repeatedly presented to the subjects until they achieved the criterion of one perfect recall. In each learning trial all 12 pairs of associated words were presented in a randomized way following immediately by a recall series, during which stimulus words of each pair were also randomly exposed and subjects attempted to utter the appropriate response word. The subjects were asked to memorize the list but no mention was made of performance criterion. After the perfect performance the subjects were given a 5-minutes rest-period which was followed by a recall session, the procedure of which was the same as the procedure of the recall series following each learning trial. After 24 hours the subjects sat for a second recall session.

A 5-second rate (4 sec. exposure, 1 sec. between successive pairs) of exposure was maintained throughout each trial, with a 2-second interval between trials.

On each trial, correct anticipations and errors were recorded. An error consisted in either making no response or an incorrect response during the anticipation trial and in the recall session.

RESULTS

The effects of interference was determined by comparing the difference between the mean number of errors made in recalling the graded competitive associated pairs in the two recall sessions. Each error was designated a score of one. According to the experimental design, the total possible maximum errors of each subject in each recall session was four in each of the three different groups of paired associates viz., noncompetitive, somewhat competitive and competitive pairs. Data obtained for this purpose are presented in Table I. A graphical representation of the means of the errors is shown in Figure I.

In order to test the hypothesis that there would be significant difference in the number of errors committed in recalling the associated pair of words due to the difference in the competitive strength of the pairs, the obtained scores were analyzed by a simple analysis of variance of a single factor with repeated measure on the factor of competition. Summary of the analysis presented in Table 2 indicates that the hypothesis was confirmed ($F=30.09$; $df=2, 36$) at the .05 level of significance. In

TABLE I

Errors in Two Recall Sessions

Nature of paired associates	N	Total number of errors made in the recall session after 5 minutes	Total number of errors made in the recall session after 24 hours
Noncompetitive pairs	20	3	7
Somewhat competitive pairs	20	18	25
Competitive pairs	20	25	35

TABLE 2

Summary of the Analysis of Variance for Errors
Committed by the Subjects in Recalling the Graded
Competitive Pairs of Words in the Recall Session
after 5 minutes.

Source	df	Ms	F
Between Subjects	19		
Within Subjects	40		
Competition	2	6.32	30.09*
Residual	38	.21	
Total	59		

* $P < .05$

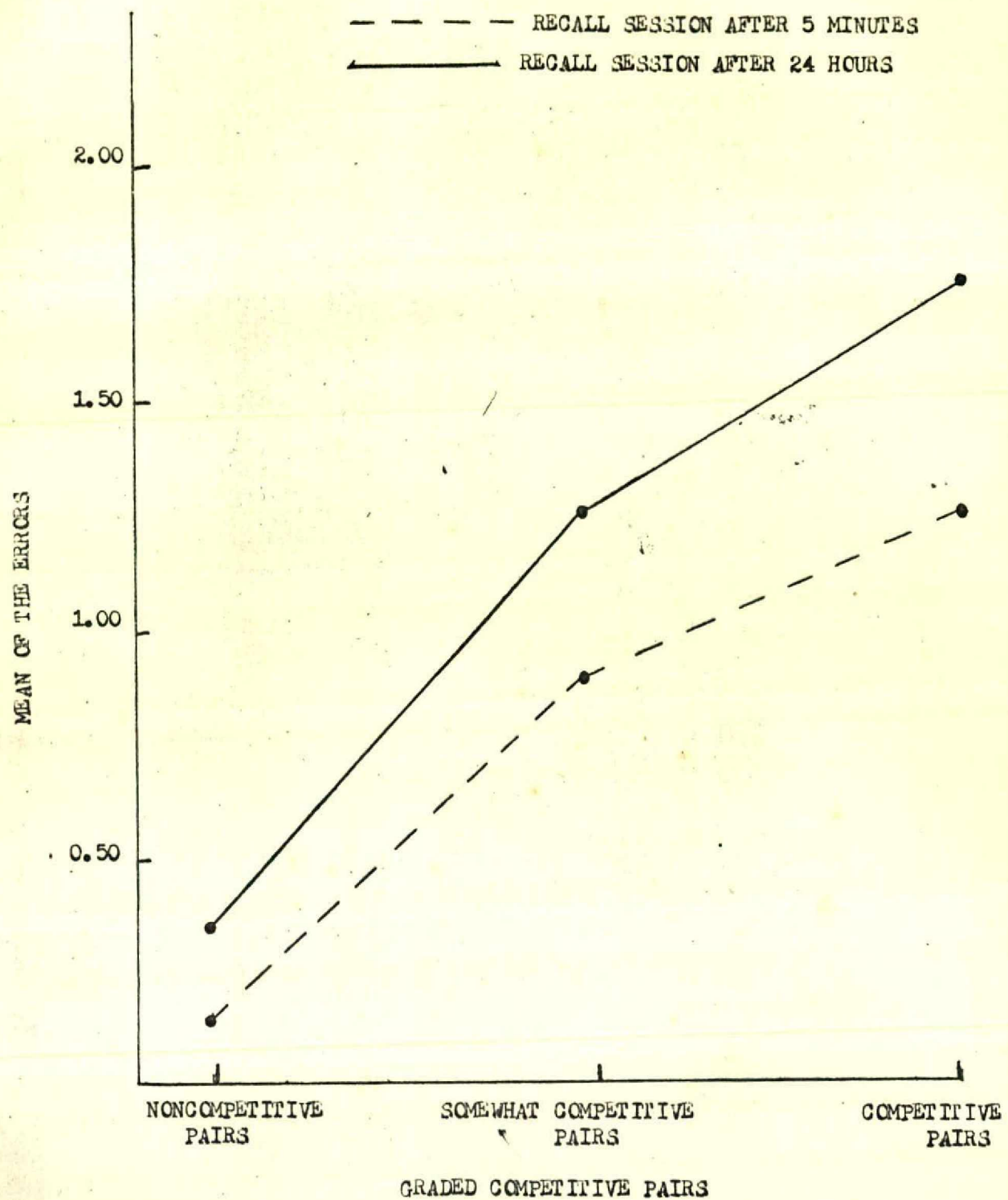


Fig.1 MEAN OF THE ERRORS COMMITTED BY THE SUBJECTS IN THE
RECALL OF GRADED COMPETITIVE PAIRS IN THE TWO RECALL
SESSIONS

other words, the subjects showed differential performance in recalling the pairs of words due to the factor of competition. The profile corresponding to this differential effects was plotted in Figure I.

This pilot study was also undertaken to answer the question whether competition played an equally important role in long-term memory. To answer this question the subjects were asked to recall the relevant materials in two different sessions, i.e. one after 5 minutes and the other after 24 hours. The scores obtained in the second recall session were analyzed by a simple analysis of variance of a single factor with repeated measure on the factor of competition. Results provided in Table 3 indicated that the hypothesis that there would be significant difference in the number of errors committed in recalling the associated pair of words due to the difference in the competitive strength of the pairs was confirmed ($F=21.23$; $df=2, 38$) at the .05 level of significance. In other words, results of the recall session after 24 hours again bear testimony to the importance of competition in producing decline in memory. The profile corresponding to this differential effects of competition was shown in Figure I.

A question might be raised in respect of having the learning materials in three grades of competitive pairs. The assumption in this connection was that the higher the competition the greater would be the decline in memory. Newman - Kuels multiple comparisons of the means under three grades of competition both in short term and in long term memory indicated that the number of the errors as predicted was highest for the competitive pairs,

TABLE 3

Summary of the Analysis of Variance for Errors
Committed by the Subjects in Recalling the Graded
Competitive Pairs of Words in the Recall Session
after 24 hours

Source	df	Ms	F
Between Subjects	19		
Within Subjects	40		
Competition	2	8.07	21.23*
Residual	38	.58	
Total	59		

* $P < .05$

lowest for the noncompetitive and intermediate for the somewhat competitive pairs (errors in competitive pairs > errors in somewhat competitive > errors in noncompetitive pairs). The results provided in Table 4 for short-term memory (for recall session after 5 minutes) and in Table 5 for long-term memory (for recall session after 24 hours) show that these differences between noncompetitive and somewhat competitive pairs, noncompetitive and competitive pairs and somewhat competitive and competitive pairs were found to be not significant at .05 level of significance. However, the results show a positive trend in the expected direction i.e. the more was the competition the higher was the number of errors committed by the subjects in recalling the pair of words. That the differences were not significant might be the result of an artifact of a small sample. So, it was hoped that when the test would be administered to a large sample there might be significant differences between the performances of the subjects at three levels of competition.

Experiment 2

This pilot study was conducted to observe whether education had any influence on the memory of the list used in this study.

Subjects: Forty subjects from different offices of the Dacca city were taken for this exploratory work and their age ranged from 25 to 30 years.

Total number of subjects were then divided as follows :

Total No. of Subjects				
40				
(1)	(2)	(3)	(3)	(4)
10 subjects with educational level from class five to class eight.	10 subjects with educational level of class nine and ten (these plucked in Matriculation Examination were included)	10 subjects with educational level of Intermediate & Degree Examination passed (these plucked in Degree Examination were included)		10 subject with educational level of Post-Graduate degree holder & those plucked in Post-Graduate Examination.

TABLE 4

Comparisons Between the Means of the Errors Committed
by the Subjects in the Recall of Graded Competitive
Pairs in the Recall Session after 5 minutes

Differences Between Pairs	Nature of Paired Associates	Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
	Noncompetitive Pairs	-	.75	1.10
	Somewhat Compe- tative Pairs			.35
	Competitive Pairs			-
		$r = 2$		3
	$q_{.95}(r, 56)$	2.86		3.44
	Critical values	5.85		7.01

* $P < .05$

TABLE 5

Comparisons Between the Means of the Errors
Committed by the Subjects in the Recall of
Graded Competitive Pairs in the Recall Session
after 24 hours

Differences Between Pairs	Nature of Paired Associates		
	Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
Noncompetitive Pairs	-	.90	1.40
Somewhat Competitive Pairs			1.50
Competitive Pairs			

 $r = 2$

3

9.95 (r, 58)

2.86

5.44

Critical values

7.86

9.46

* $P < .05$

Apparatus and procedure: The apparatus, instruction and the learning materials were exactly the same as those used in the preceding study (Experiment I) and likewise the procedure of the experiment was also identical.

RESULTS

The effects of education were determined by comparing the total number of errors made by different groups in recalling the graded competitive pairs in the two recall sessions. The results obtained for this purpose are presented in Table 6 and 7. A graphical representation of the means of the errors are provided in Figure 2 and Figure 3. Description of the groups 1, 2, 3 and 4 were given in the description of the subjects.

In order to answer the question as to whether "education" could make any difference in the number of errors committed in recalling the associated pair of words used in this study, it was hypothesized that no significant difference would be found between the errors committed by 4 groups of subjects for noncompetitive, somewhat competitive and competitive pairs. In statistical term, it was predicted that main effect of education would not be significant. In order to test the hypothesis the obtained scores were analyzed by the a 4 X 3 factorial design with repeated measure on the last factor. The summary of the analysis is presented in Table 8. It indicates that the hypothesis was confirmed ($F = .21$; $df = 3, 56$) at the .05 level of significance. In other words the main effect of education

TABLE 6

Errors in the Recall Session after
5 minutes (Short-term Memory)

Group	N	Total Number of Errors		
		Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
1	10	2	9	15
2	10	1	9	12
3	10	1	7	12
4	10	1	8	13

TABLE 7

Errors in the Recall Session after
24 hours (Long-Term Memory)

Group	N	Total Number of Errors		
		Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
1	10	3	11	18
2	10	3	12	16
3	10	2	10	16
4	10	2	10	16

TABLE 8

Summary of the Analysis of Variance for Errors
Committed by the Different Groups of Subjects in
Recalling the Graded Competitive Pairs of Words
in the Recall Session after 5 minutes

Source	df	MS	F
Educational level	5	.21	.21
Subjects within groups	56	.97	
Total	59		
Competition	2	15.97	65.50*
Educational level X Competition	6	.12	.54
Competition X Subjects. w. Groups	72	.22	

* $P < .05$

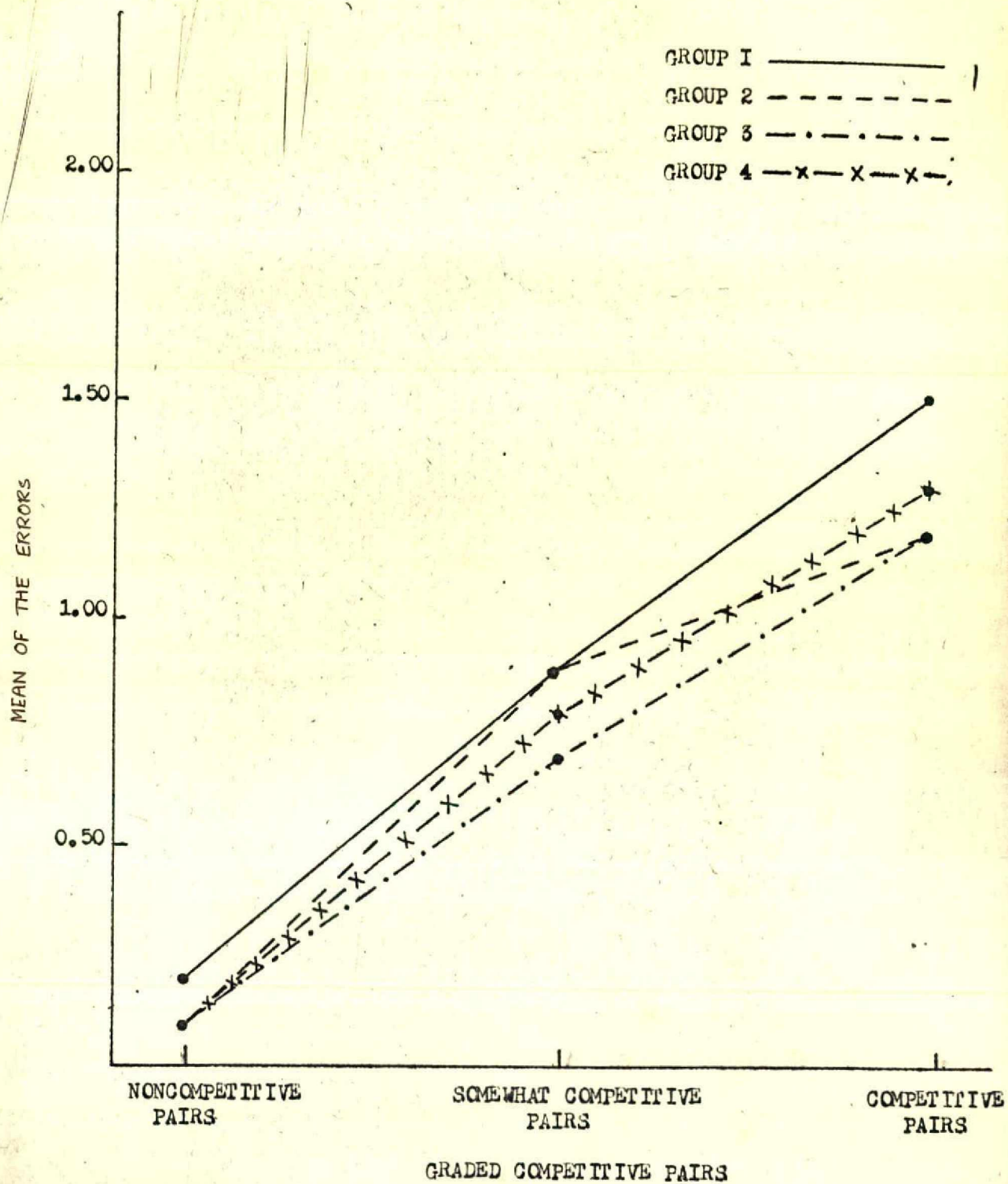


Fig.2 MEAN OF THE ERRORS COMMITTED BY DIFFERENT GROUPS OF SUBJECTS HAVING DIFFERENT LEVEL OF EDUCATION IN THE RECALL OF GRADED COMPETITIVE PAIRS IN THE RECALL SESSION AFTER 5 MINUTES

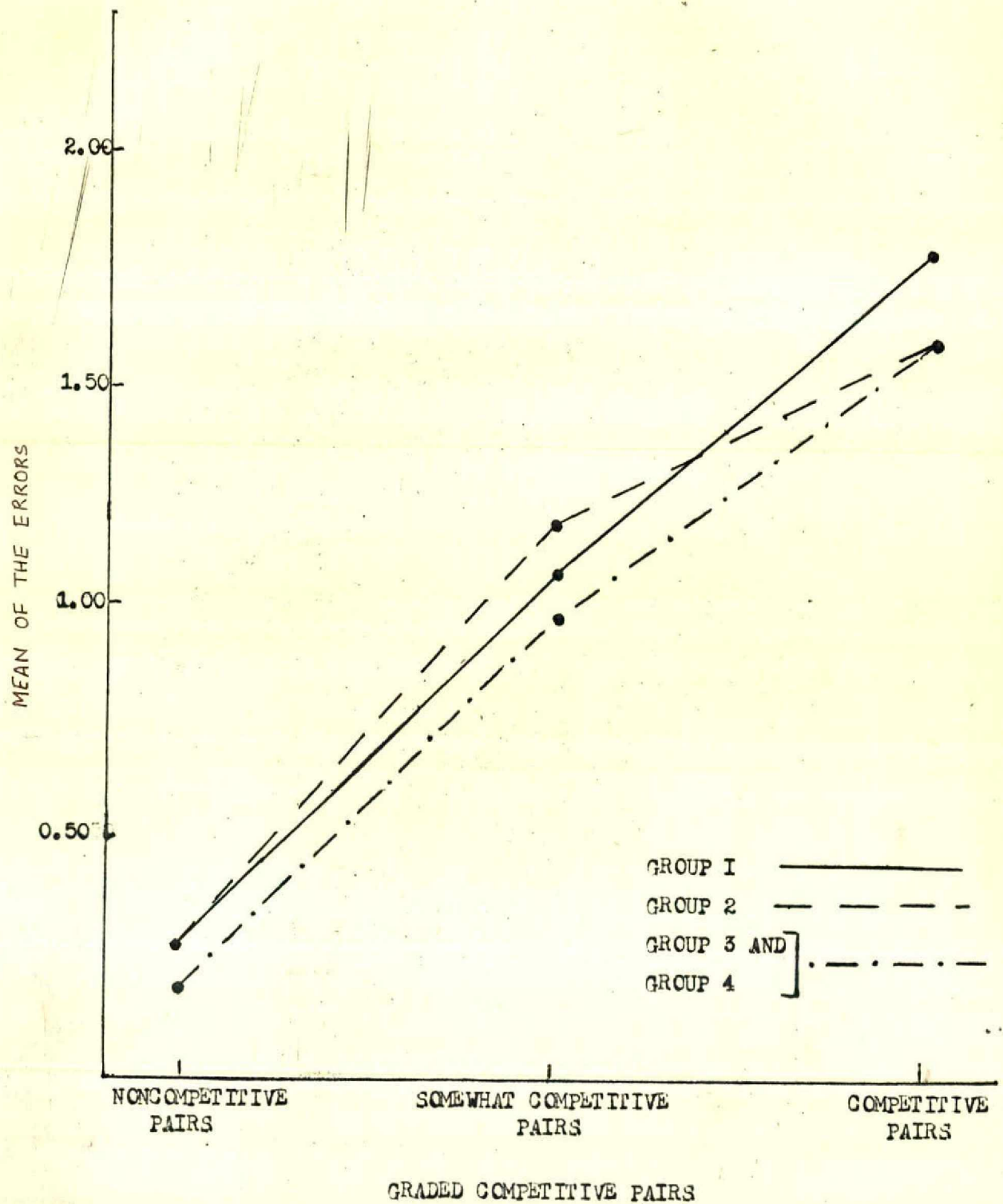


Fig. 3 MEAN OF THE ERRORS COMMITTED BY DIFFERENT GROUPS OF SUBJECTS HAVING DIFFERENT LEVEL OF EDUCATION IN THE RECALL OF GRADED COMPETITIVE PAIRS IN THE RECALL SESSION AFTER 24 HOURS

was found to be statistically not significant. The profiles corresponding to this effect were shown in Figure 2 which indicates that there was no significant difference in the number of errors committed by different groups having different levels of education in the recall of noncompetitive, somewhat competitive and competitive pairs of words.

As the design of the main study required the subjects to recall the relevant materials after a passage of 24 hours there might be a subsidiary question as to the effects of education on the recall of the list of paired associate words used in this study after a passage of 24 hours. In order to answer this question the subjects were asked to recall the relevant materials after 24 hours. The obtained scores were analyzed by a 4×3 factorial design with repeated measure on the last factor. The summary of the analysis provided in Table 9 suggests that the hypothesis that there would be no significant difference between the number of errors committed by the subjects having different levels of education in the recall of graded competitive pairs of words after a passage of 24 hours was confirmed ($F = .12$ $df = 3, 36$) at the $\alpha .05$ level of significance. In other words, the main effect of education was found to be statistically nonsignificant. The profiles corresponding to this effect plotted in Figure 3 showed that the different groups of subjects having different levels of education did not show differential performances in the recall of the noncompetitive, somewhat competitive and competitive pairs of words.

TABLE 9

Summary of the Analysis of Variance for Errors
Committed by the Different Groups of Subjects
in Recalling the Graded Competitive Pairs of
Words in the Recall Session after 24 hours

Source	df	MS	F
Educational level	3	.14	.12
Subjects within groups	36	1.10	
Total	39		
Competition	2	19.81	86.15*
Educational level X Competition	6	.04	.17
Competition X Subjects w. groups	72	.25	

* $P < .05$

The results, therefore, suggested that neither upon short-term nor upon long-term memory of the list used in this study education would have any influence. That is, there would be no significant difference in recall due to the difference in the educational level of the subjects.

DISCUSSION

The results of Experiment 1 show poor memory of the subjects in case of somewhat competitive and competitive pairs than in case of non-competitive pairs. It might be maintained that these differences in recall are due to the differences in the competitive strength of the associated pairs, since the number of errors increased with increase in the magnitude of competition.

The next question that might be asked was that could competition lead to decline in memory? It is shown in the result section, that the performance on 4 weakly associated pairs (somewhat competitive) and on 4 pairs having no association between the words of the pairs (competitive) is poor than the performance on 4 pairs in which the associative strength between the words of the pairs is very high. The response words of the highly associated pairs inhibit the response words of the weakly associated pairs and the response words of the pairs having no association, their retention as well as recall is also inhibited because of the associative connection between the stimulus members of the highly associated pairs and the stimulus members of the pairs having weak or no association. Thus it is evident that competition led to interference which, in turn, is responsible for the decline of memory.

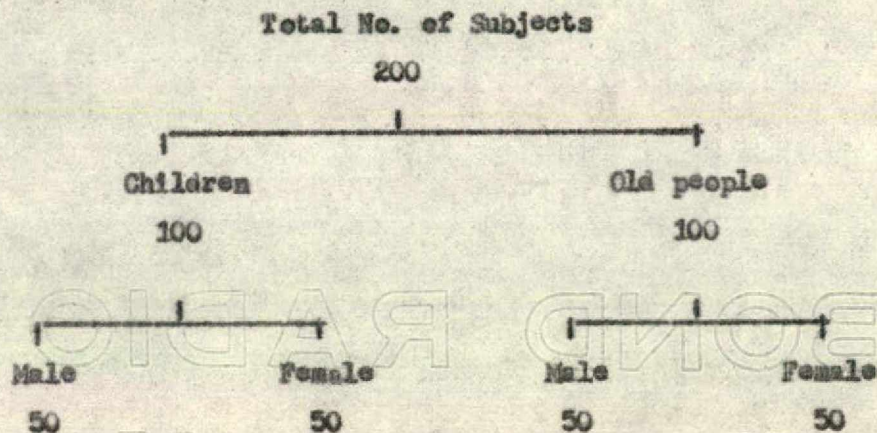
The design of this study included recall of the relevant material by the subjects after 24 hours in order to see whether competition still remained effective after a lapse of 24 hours in producing decline in memory. The results show that the subjects recalled the noncompetitive pairs better than the somewhat competitive and competitive pairs. This indicated that the factor of competition remained effective in producing decline even in long-term memory. It could, therefore, be expected, that there would be no difference both in short-term as well as in long-term memory between the children and the old people and between the males and the females in case of noncompetitive pairs but significant difference would be found between them in case of somewhat competitive and competitive pairs.

The results of Experiment 2 indicate that difference in the educational levels of the subjects would have no effect upon the memory of the paired associates used in this study. The subjects for the final study were selected from two age groups of which the younger groups was from 12 to 15 years and the older group was from 45 to 50 years. In Bangladesh, the children of 12 to 15 years are generally students reading in from classes seven to ten, whereas it is difficult to find individuals of 45 to 50 years whose educational levels are from class seven to class ten. Therefore, the words of the present list of paired associates were selected from the words common to the day to day verbal communication of the Bengali speaking people and which were uninfluenced by education. The result showed that the words were selected appropriately, i.e., it could be administered to any individual whose mother tongue was Bengali and who could read Bengali irrespective of his or her educational level.

FINAL STUDY

Subject :

The total number of subjects was 200 and the subjects were grouped in the following manner :



All subjects were naive with respect to the experimental task. The age of the younger subjects varied from 12 years to 15 years and the age of the older subjects varied from 45 years to 50 years. For the sake of convenience for conducting the study, the study was restricted to the Dacca district. All the thanas of the Dacca district were listed and three thanas from this list were randomly selected. The thanas thus selected included Ramna Thana, Tejgaon Thana and Joydevpur thana of the Dacca district. All the subjects were then randomly selected from different areas under these three thanas.

As it was found in the pilot study that education had no influence on the memory of the list used in this study, the factor of education was

not controlled. The subjects who failed to make a single correct response in the first trial as well as the subjects who did not complete the experiment were discarded.

Apparatus and Procedure : Apparatus and learning materials used and the procedures followed in the final study were the same as those used and followed in Experiment I.

Treatment of Data :

The data collected from the subjects were analyzed by a $2 \times 2 \times 2 \times 5$ factorial design with repeated measures on the last two factors. The detail discussion on the nature of the analysis would be furnished in the following chapter.

CHAPTER III

RESULTS

The criterion measure was the number of errors made by the subjects in recalling the graded competitive associated pairs in two recall sessions. Each error was designated a score of one. According to the experimental design, the total possible maximum errors of each subject in each recall session was four in each of the three different groups of paired associates viz., noncompetitive pairs, somewhat competitive pairs and competitive pairs. Errors committed by different groups of subjects in short-term and long-term memory are shown in Tables 18 and 19 in Appendix C. A graphical representation of the means of the errors committed by different groups are plotted in Figure 4.

Two major hypotheses were formulated for the present investigation. The first hypothesis probes into the question whether age per se would make any difference in the number of errors committed in recalling the paired associate words or whether age will interact with competition to produce a differential effect on the number of such errors committed. It was hypothesized that age per se would not produce any differential effect but would do so when in interaction with competition. In statistical terms an interaction between age and competition was predicted. It was further hypothesized that when compared with age competition would emerge as a more dominant variable. In statistical terms simple effects of competition would become pronounced when age would be kept constant.

In order to test the major hypotheses the obtained scores were analyzed by a $2 \times 2 \times 2 \times 3$ factorial design with repeated measures on the

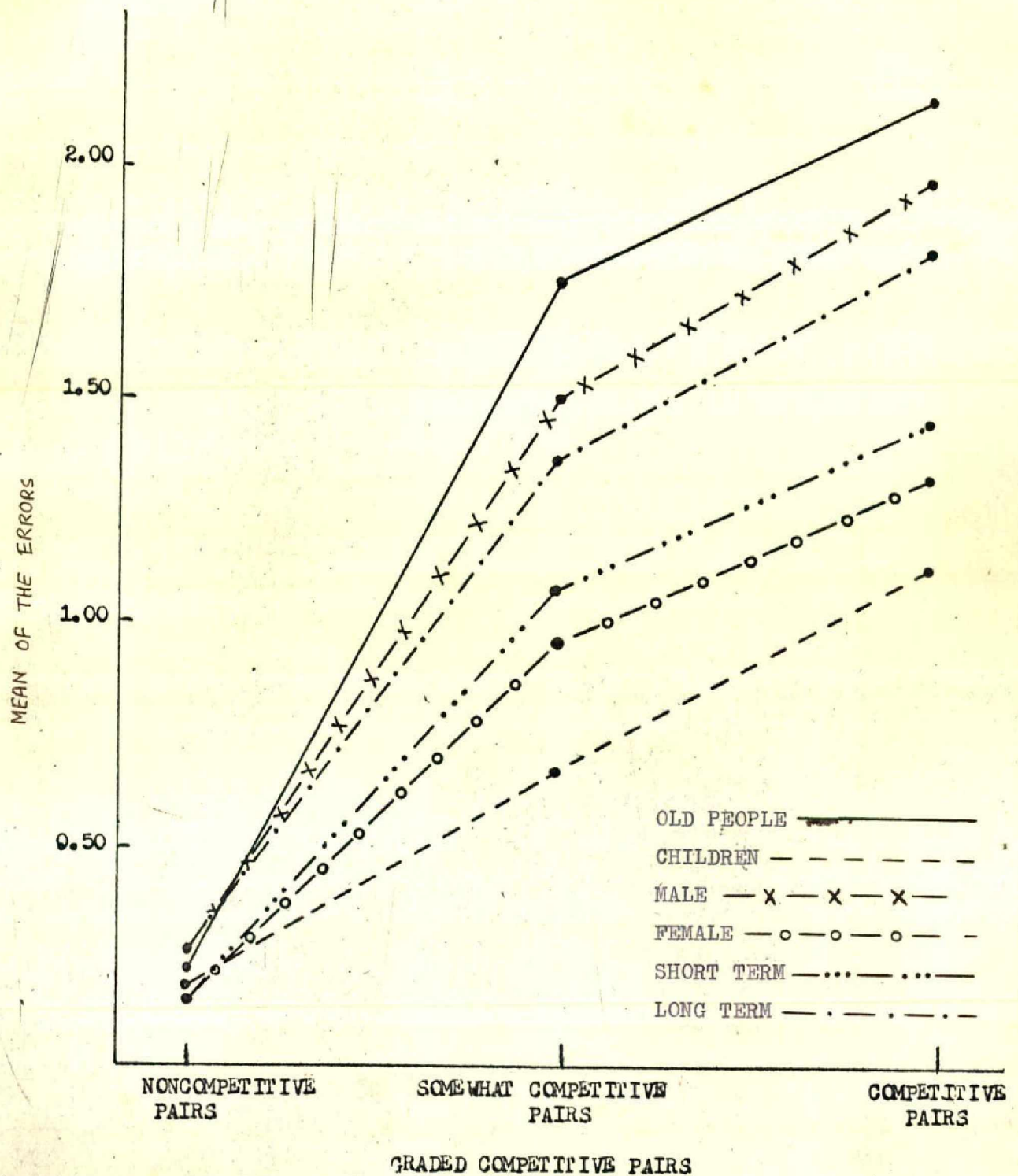


Fig. 4 MEAN OF THE ERRORS COMMITTED BY DIFFERENT GROUPS OF SUBJECTS IN THE RECALL OF GRADED COMPETITIVE PAIRS

last two factors. The obtained results of the present investigation which are shown in Table 10 confirm the first major hypothesis since interaction between age and competition was found to be statistically significant ($F = 86.07$; $df = 2, 392$) on the .05 level of significance. The profiles corresponding to this interaction effect are shown in Figure 4. As interaction between age and competition was significant it was necessary to analyze the simple effects. Keeping competition constant simple effects of age were analyzed for different degrees of competition. The results presented in Table 11 indicate that the simple effects of age for non-competitive pairs are not significant ($F = .59$; $df = 1, 588$) but the simple effects of age are significant for somewhat competitive ($F = 175.55$; $df = 1, 588$) and competitive pairs ($F = 155.28$; $df = 1, 588$) at the .05 level of significance.

The data therefore indicate that for different degrees of competition age has differential effects but competition merged as a more dominant factor in producing such differential effects. It may be noted that no significant difference was found in number of errors committed among the children and the older people in respect of noncompetitive pairs. But significant difference was found in the number of errors committed among the children and the older people in respect of somewhat competitive and competitive pairs. The data therefore indicate that competition was more important in producing the differential performance between the children and the older subjects. Had it been otherwise a significant difference between the performance of the children and the older subjects would have been found in respect of noncompetitive pairs also.

TABLE 10

Summary of the Analysis of Variance for Errors Committed by
the Different Groups of Subjects in Recalling the Graded
Competitive Pairs of Words in Two Recall Sessions

Source	df	MS	F
Age	1	165.02	127.07*
Sex	1	55.90	42.03*
Age X Sex	1	1.37	1.03
Subj. W. Groups	196	1.33	
[error(between)]			
Total	199		
Passage of Time	1	20.02	32.29*
Age X Passage of Time	1	.52	.83
Sex X Passage of Time	1	.01	.01
Age X Sex X Passage of Time	1	.07	.11
Passage of Time X Subj. W. Groups	196	.62	
Competition	2	213.66	534.15*
Age X Competition	2	34.43	86.07*
Sex X Competition	2	8.20	20.50*
Age X Sex X Competition	2	.02	.05
Competition X Subj. W. Groups	392	.40	
Passage of Time X Competition	2	2.06	6.64*
Age X Passage of Time X Competition	2	.26	.83
Sex X Passage of Time X Competition	2	.02	.06
Age X Sex X Passage of Time X Competition	2	.06	.19
Passage of Time X Competition X Subj. W. Groups	392	.31	
Total	1000		

* $P < .05$

TABLE 11

Summary of the Analysis of Variance for Simple Effects of Age for Noncompetitive, somewhat Competitive and Competitive Pairs

Source	df	MS	F
Age for Noncompetitive Pair	1	.42	.59
Age for Somewhat Competitive Pairs	1	125.21	173.53 *
Age for Competitive Pairs	1	110.25	155.28 *
Between Subject + D X Subj. W. Groups **	588	.71 +	

* $P < .05$

+ Winer, B.J. Statistical Principles in Experimental Design. McGraw-Hill Book Company, 1962, 323.

** Where D is competition.

The result of the preceding section might not be quite convincing in respect of the assertion that competition was a more important variable in producing the differential effects. In order to guard against this criticism 'age' was kept constant and comparisons were made between the errors committed in recalling the three groups of associated pairs i.e. the simple effects of competition for each level of age were tested. The results presented in Table 12 indicate that the children as well as the old people showed significantly differential performance ($F=108.15$; $df= 2, 392$ and $F= 512.07$; $df= 2, 392$ respectively) at the .05 level of significance due to the effect of competition.

The foregoing results show that subjects of different age levels performed differentially in three levels of graded competition. It may therefore, be argued that for each age level difference in the level of competition produced differential performance. Therefore, it may be asserted that even when compared with age competition emerged as a more important variable. These results, therefore, lend further support to confirm the first hypothesis.

Results presented in Table 10 further indicate significant main effects of age ($F=127.07$; $df= 1, 196$) and competition ($F=534.15$; $df=2, 392$) at the .05 level of significance. This implies that both age and competition are important in causing differential performance of the subjects. But as the interaction between age and competition was found to be significant it was argued that differential performance of the subjects is the joint function of age and competition. The question therefore rose as to which of these

TABLE 12

Summary of the Analysis of Variance for Simple Effects
of Competition on the Children and the Old People

Source	df	MS	F
Competition for the Children	2	45.26	108.15*
Competition for the Old People	2	204.83	512.07*
D X Subj. W. Group	392	.40	

* $P < .05$

** Where D is competition.

two factors was more important in producing the differential performance of the subjects. The analysis of simple effects showed clearly that competition was more important variable.

Since it was argued that people who are less exposed to conflicting experiences would recall better than those who are more exposed to conflicting experiences, it was thought that the females in Bangladesh would recall better than the males in view of the fact that they are less exposed to conflicting experiences than the males. Here also it may be argued that different levels of competition might influence the performance of the males and the females differently. In statistical terms, therefore, a significant interaction between sex and competition was predicted. It was also hypothesized that as compared with sex, competition would emerge as a more important variable. In other words, when sex would be kept constant significant difference in performance would be found in respect of three levels of competition. On the other hand when competition would be kept constant, no significant difference would be found among the males and the females in respect of noncompetitive pairs, but significant differences in performances would be found among the males and the females in respect of somewhat competitive and competitive pairs. The analysis of data presented in Table 10 indicates a significant interaction between sex and competition ($F=20.50$; $df= 2, 392$) at the .05 level of significance implying that both sex and competition jointly produced differential effects on the performance of the subjects. The profiles corresponding to this interaction effect are shown in Figure 4.

Since the interaction between sex and degrees of competition was significant simple effects of sex for each level of competition were tested. The results presented in Table 13 indicate that the simple effects of sex were not significant for the non-competitive pairs ($F=1.54$; $df = 1,588$), but the simple effects of sex were significant for somewhat competitive ($F=42.60$; $df= 1,588$) and competitive pairs ($F=57.69$; $df= 1,588$) at the .05 level of significance. The obtained results therefore lend support to the contention that as compared with sex competition was a more important variable in producing differential effects in the performance of the subjects.

In order to further justify the contention that competition (as compared with sex) was a more important factor, the simple effects of competition for each sex were tested. The results presented in Table 14 indicate that both the males and the females showed significantly differential performance ($F=581.07$ $df=2,592$ and 175.57 ; $df= 2,592$ respectively) at the .05 level of significance in recalling the different groups of associated pairs of words having different degrees of competition. The foregoing results again show that competition emerged as a very important variable in producing differences in the number of errors committed by the males and the females. Had 'sex' been more important in producing differential performance the females would have performed better than the males even in respect of noncompetitive pairs. Moreover, it could be seen that the subjects performed differentially only when competition was introduced. Since in the absence of competition there was no difference in the performance between the males and the females competition could be treated as more important variable.

TABLE 13

Summary of the Analysis of Variance for Simple Effects of Sex
for Noncompetitive, Somewhat Competitive and Competitive Pair

Source	df	MS	F
Sex for Noncompetitive Pairs	1	1.10	1.54
Sex for Somewhat Competitive Pairs	1	30.25	42.60 *
Sex for Competitive Pairs	1	40.96	57.69 *
Between Subjects + D X Sub. W. Groups **	588	.71 +	

* $P < .05$

+ Winer, B.J. Statistical Principles in Experimental
Design. MC Graw. Hill Book Company, 1962, 525.

** Where D is competition.

TABLE 14

Summary of the Analysis of Variance for Simple Effect of
Competition on the Males and the Females

Source	df	MS	F
Competition for the Males	2	152.45	381.07*
Competition for the Females	2	89.45	173.57*
D X Subj. W. Groups **	592	.40	

* $P < .05$

** Where D is competition .

The foregoing results therefore lend support to the contention that as compared with sex competition was a more important variable in producing differential effects upon the performance of the subjects.

Another relevant point involved in competition relates short-term and long-term memory. The question asked is whether competition remains equally effective in long-term memory if it is effective in short-term memory. In literature passage of time is considered to be an important variable in producing decline in memory. Without contending assertion the present study proposed to test whether competition (as compared with passage of time) was a more important variable. Assuming that both passage of time and competition are important in influencing the performance of the subjects an interaction between passage of time (in this study passage of 24 hours) and competition was predicted. Results presented in Table 10 indicate a significant interaction between passage of time and competition ($F=6.64$; $df=2,392$) at the .05 level of significance. The profiles showing this interaction effects are plotted in Figure 4.

Since the interaction between passage of time and competition was found to be significant analysis of simple effects became necessary to find out the relative importance of these two factors. It was hypothesized that if competition was more important its effect would be pronounced when simple effects of competition would be tested keeping passage of time constant or simple effects of passage of time would be tested keeping competition constant.

The results presented in Table 15 indicate that the simple effects of passage of time were not significant for noncompetitive pairs ($F=2.68$; $df=1, 392$), but the simple effects of passage of time were significant for somewhat competitive ($F=895.02$; $df = 1, 392$) and competitive pair ($F=37.09$; $df= 1, 392$) at the .05 level of significance.

The obtained results, therefore, suggest that in long-term memory also competition continued to be the most important variable in producing decline in memory. Had passage of time (here passage of 24 hours) been more important than the factor of competition in producing decline in memory, differences between long-term and short-term memory would have been found not only in case of the somewhat competitive and competitive pairs but also in case of noncompetitive pairs. To justify further whether competition when compared with passage of time was more important factor in producing differential effects in the performance of the subjects the simple effects of competition for each type of memory (short-term and long-term) were tested. The results provided in Table 16 show that due to the factor of competition a significant difference between the number of errors committed by the subjects were found in short-term memory ($F=248.45$; $df= 2, 392$) and also in long-term memory ($F=367.88$; $df= 2, 392$) at the .05 level of significance.

After having made these comparisons it can reasonably be claimed that competition continued to be an important factor in long-term memory also. And the results reported in connection with the long-term memory were in conformity with the contention that competition was more important for producing

TABLE 15

Summary of the Analysis of Variance for Simple Effects of Passage of Time for Noncompetitive, somewhat Competitive and Competitive Pair.

Source	df	MS	F
Passage of Time for Noncompetitive Pair	1	1.10	2.68
Passage of Time for Somewhat Competitive Pair	1	366.96	895.02 *
Passage of Time for Competitive Pairs	1	15.21	57.09 *
C X Subj. W. Groups + CD X Subj. W. Groups **	392	.41 +	

* $P < .05$

+ Winer, B.J. Statistical Principles in Experimental Design. McGraw-Hill Book Company, 1962, 323.

** Where C is passage of time and D is competition.

TABLE 16

Summary of the Analysis of Variance for Simple Effects
of Competition on Short-Term and Long-Term Memory

Source	df	MS	F
Competition for Short-Term Memory	2	86.96	248.45 *
Competition for Long-Term Memory	2	128.76	387.88 *
D X Subj. W. Groups +	392	.35 +	
DC X Subj. W. Groups **			
S			

* $P < .05$

+ Winer, B.J. Statistical Principles in Experimental
Design. McGraw-Hill Book Company, 1962, 523.

** Where C is passage of time and D is competition.

the difference in the number of errors committed in recalling the associated pairs of words. One trend might, however, be noted that in all cases the number of errors increased when recalled after 24 hours as against 5 minutes. This was in line with the findings reported in literature in respect of long-term memory. It might also be noted that the number of errors increased with the increased levels of competition i.e. as compared with somewhat competitive pairs number of errors committed in noncompetitive pairs was less. Similarly as compared with competitive pairs number of errors in somewhat competitive pairs was less. These trends were reported in the Tables 20, 21 and 22 in Appendix C. This trend might be explained again with reference to the contention that with the passage of time competition became stronger as a result of which number of errors increased.

Furthermore, Newman-Kuels multiple comparisons of the means under three grades of competition indicate that the mean of the errors as predicted was highest for the competitive pairs, lowest for the noncompetitive and intermediate for the somewhat competitive pairs. (Errors in competitive pairs > errors in somewhat competitive pairs > errors in noncompetitive pairs.) The results provided in Table 17 show that the differences between noncompetitive and somewhat competitive pairs, noncompetitive and competitive pairs and somewhat competitive and competitive pairs were found to be significant at the .05 level of significance. This suggests that the more was the competition the higher was the numbers of errors committed by the subjects in recalling the pairs of words. It may, therefore, be concluded from the findings of the present study that competition emerged as a very important factor in producing differential effects upon the performance of the subjects or in causing decline in memory.

TABLE 17

Comparisons Between the Means of the Errors
Committed by the Subjects in the Recall of
Graded Competitive Pairs

Differences Between Pairs	Nature of Paired Associates	Noncompetitive Pairs	Somewhat Compe- titive Pairs	Competitive Pairs
	Noncompetitive Pairs	-	1.01*	1.43*
	Somewhat compe- titive Pairs		-	.42*
	Competitive Pairs			-

 $r = 2$

5

9.95 (r, 392)

2.77

3.51

Critical values

.08

.09

* $P < .05$

CHAPTER IV

DISCUSSION

The present study was undertaken to examine whether 'age' per se is the determining factor for the decline of memory. As an alternative to the importance of 'ageing' competition was hypothesized to be one of the determining factors for the decline of memory. That competition was an important factor in causing decline of memory was supported by the results of the present study. The main effect of competition was found to be significant at .05 level of significance. It is also reflected in the results that competition interacts with other factors such as ageing, sex and passage of time to produce differential effects of the performance of the subjects. The interaction effect of competition and ageing was found to be significant at .05 level of significance. This indicates that both competition and ageing are important in causing decrement in recall scores of the subjects. But an analysis of simple effects indicates that competition was a more dominant factor than ageing in producing decrement in recall scores. When performances of the children and the elder people were compared keeping age constant it was found that both children and elder people showed differential performances as the levels of competition were varied. This finding agrees with the findings of Broadbent and Heron (1962) in which the memory of the elder subjects were found to be inferior to that of the younger subjects due to the effect of interference. Similarly, when performances of the subjects at three levels of competition were compared keeping competition constant it was found that there was no significant differences in the performance of the children and the elder

people in respect of noncompetitive pairs. But there were significant differences in respect of somewhat competitive and competitive pairs. These results, therefore, imply that competition was a more important variable when compared with ageing. That 'ageing' per se did not produce the differences was indicated by the fact that when comparisons were made in respect of noncompetitive pairs there was no significant difference in the mean number of errors between the children and the old people. Had 'ageing' per se been important in producing the decline there would have been difference of the performance of the children and the old people even in respect of noncompetitive pairs. Moreover, the old people showed relatively poor memory than the children only in respect of somewhat competitive and competitive pairs. This indicates that as the old people showed decline in memory with the introduction of different degrees of competition in the paired associate words it might be maintained that this decline took place due to the interaction between the factors of competition and age. This finding contradicts the findings of Kube (1938), Gilbert (1941) and others which showed that in older people decline of memory took place because of the factor of ageing itself.

The modern society is structured in such a way that the older people are burdened with various activities most of which are conflicting in nature. These overloaded conflicting activities inhibit one another which results in poor memory. This leads to the idea of decline of memory in old age. Comparatively, the children have to undergo few conflicting activities and therefore, their memory appears to be superior to that of the old people.

The most important rationale for hypothesizing that not 'ageing' per se but 'ageing' in interaction with competition would bring about decline in memory was as follows : recalling is facilitated if it is not interfered with conflicting situations or materials; in the presence of conflicting situations, however, efficiency in recalling suffers. In order to support this assertion certain auxiliary hypothesis were formulated in the present study.

It is an widely observed fact that the activities of the females in Bangladesh are very limited and more or less confined to their respective homes. This limitation of activities saves them from facing conflicting activities of the world outside their home and therefore they live a more calm and quiet life than their counterparts. It was therefore hypothesized that when faced with conflicting situations the females of Bangladesh are likely to recall better than the males. In other words, the study predicted that the factor of sex would produce difference in the memory of the males and the females only when in interaction with the factor of competition. It was shown in the preceding chapter that the hypothesis is confirmed by a significant interaction between sex and competition ($F=20.50$; $df= 2, 392$).

That the difference in sex itself did not produce the difference is indicated by the fact that when comparisons were made in respect of noncompetitive pairs there was no significant difference in the mean number of errors between the males and the females. Moreover, as the males showed relatively poor memory than the females only when they had to recall paired associate words having different degrees of competition, it might be maintained that the males

showed poorer memory than the females due to the interaction between sex and competition. Since the main effects of both the factors of sex and competition were found to be significant a question might arise as to the relative importance of the factor of sex and the factor of competition in producing decline of memory. In order to answer this question sex was held constant and comparisons were made between the number of errors committed in recalling the paired associates having different magnitude of competition.

Results indicate differential performances by the males and also by the females due to the difference in the magnitude of competition. The profiles of the mean number of errors in Figure 4 show that both the males and the females recalled the noncompetitive pairs better than the somewhat competitive and the competitive pairs and the somewhat competitive pairs better than the competitive pairs. As these comparisons were made keeping the factor of 'sex' constant and varying the factor of 'competition' it might now, therefore, be maintained that the factor of competition played a more important role in producing these differences in the performance of the subjects.

The question whether competition when compared with sex was more important in producing differential performance of the subjects may also be answered by analysing the simple effects of sex keeping competition constant. The results show no significant differences between the performances of the males and the females in respect of noncompetitive pairs but they performed differentially when competition was introduced. Since in the absence of competition there was no significant difference between the performances of the males and the females competition could be treated as more important variable as compared with sex in producing decrement in memory.

Another major criticism that might be directed against the so far established point of view was that competition might not play an important role in long-term memory as it might have played in short-term memory. The basis of this criticism might be that with the passage of time competition would be less effective in producing decline of memory. To guard against this criticism the design of the present study included recall of the relevant materials by the subjects after 24 hours. It had been reported in the preceding chapter that when comparisons were made between the errors committed by the subjects in the two recall sessions (one after the retention interval of 5 minutes and another after 24 hours) no significant difference was found in respect of noncompetitive pairs. But significant differences were found between short-term and long-term memory for somewhat competitive and competitive pairs. These findings confirm that the factor of competition played a joint role with the factor of passage of time in producing decline in long-term memory for somewhat competitive and competitive pairs of words. That passage of time was not the sole determinant factor for the differences in the number of errors committed by the subjects is evident from the fact if passage of time would have been the determining factor then decrement in recall should have been found not only in case of somewhat competitive and competitive pairs but also in case of noncompetitive pairs.

So far it is shown that 'passage of 24 hours' have interacted with 'competition' to produce the differences between the number of errors committed by the subjects in recalling the somewhat competitive and competitive pairs

in the two recall sessions. A subsidiary question might arise as to the relative importance of these two factors in producing differences in the performances of the subjects. In order to answer this question the passage of time was kept constant and simple effects of competition for each recall session were tested. Results indicate differential performance by the subjects in short-term memory as well as in long-term memory due to the difference in the magnitude of competition i.e. both in short-term and in long-term memory significant differences were found between the number of errors committed by the subjects in recalling the noncompetitive, somewhat competitive and competitive pairs of words. The profiles plotted in Figure 4 show that in both the recall sessions the subjects recalled noncompetitive pairs better than somewhat competitive and competitive pairs and somewhat competitive pairs better than competitive pairs.

As these comparisons were made keeping the factor of 'passage of time' constant these findings confirm that 'competition' continued to play an equally important role in long-term memory (after 24 hours) as it has played in short-term memory (after 5 minutes) and therefore lend further support to the hypothesis that competition plays a more important role as compared with passage of time in producing decrement in memory. Moreover, the importance of the factor of competition in producing decline of memory was further verified when simple effects of passage of time were found to be not significant for noncompetitive pairs but significant for somewhat competitive and competitive pairs. That competition was the more important factor as compared with passage of time is evident from the fact that the subjects showed differential performances in the two recall sessions only with the introduction of competition in the paired associate list.

One trend, might however, be noted that in all cases the number of errors increased in long-term memory than in short-term memory. This was in line with the findings reported in literature in respect of long-term memory. It might also be noted that in case of noncompetitive pairs the increase of errors was less as compared with the increase of errors in somewhat competitive and competitive pairs.

In the present study, the passage of time (long-term) had been operationally defined as the passage of 24 hours of time. It should, therefore, be remembered that when it was maintained that the factor of competition played a more important role than the factor of passage of time in producing decline in long-term memory, it indicated that after 24 hours the factor of competition would be more important in producing the decline in memory. But it was not known, whether the factor of competition or the passage of time would be more effective in producing decline in long-term memory if the passage of time was lengthened.

On the basis of the hypothesis that not 'age' per se but an interaction between the factors of competition and age where competition played the dominant role, it might also be assumed that the more the competition, the more would be the decline of memory. It was shown in Table 17 that the difference between somewhat competitive and competitive pairs were found to be significant and the profiles provided in Figure 4 indicated that these difference were in the expected direction i.e. the subjects recalled the somewhat competitive pairs better than the competitive pairs.

Implications of the present study and Needs for Further Research.

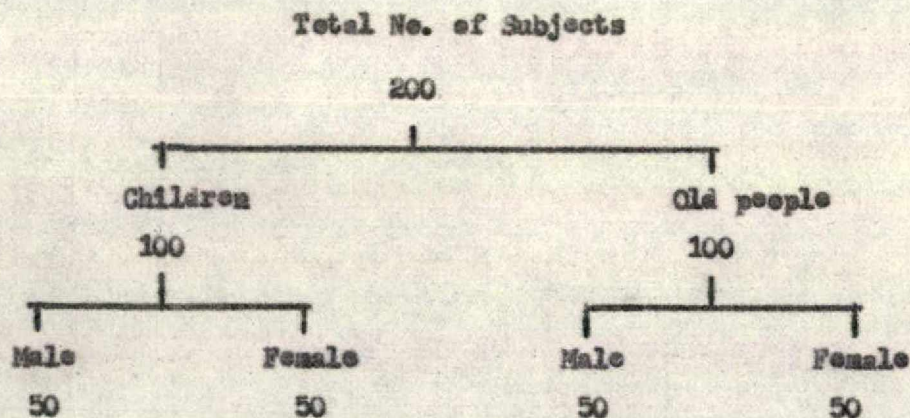
The implications of these results are far reaching. People have been seen to be fatalistic when a stereotype idea persists that with the advancing years decline of memory is bound to be there. If, however, evidence is found to the contrary, people would not say that they cannot do anything about their recall since they are ageing. Such argument makes people optimistic and extends scope for wider participation in the enflow of the events of life. Besides, knowing that ageing per se is not the sole determinant for the decline of memory, one may take steps against the factors that are responsible for the decline in memory. In the context of the present study it may be suggested that in the interest of efficient recalling people should try to avoid, as far as practicable, conflicting situation. This suggestion means to indicate that the knowledge of the factor that conflicting situations would produce decline in memory, may itself be a reminder to all to get involved in fewer and fewer conflicting situations. It might also lead to the idea of such academic atmosphere as would involve less conflicting situations in order to facilitate efficient learning.

CHAPTER V

SUMMARY AND CONCLUSION

It is generally observed that after crossing middleage, decline in physical aspects as well as in the field of memory and intelligence becomes more and more prominent. On the basis of this casual observation the notion of decline of memory with ageing has become a stereotype. It has also been observed in the literature that due to competition in the learned materials efficiency in recalling tends to decrease. So it was assumed that exposure to conflicting activities leads to competition which acts as one of the determining factors for the decline of memory. On the basis of this assumption the following hypotheses were formulated. (1) When faced with the conflicting situations the children are likely to recall better than the old people and (2) When faced with the conflicting situations the females are likely to recall better than the males.

The study was conducted on a sample of the size of 200 subjects and the total number of subjects were then divided as follows ;



The age range of the children was from 12 years to 15 years and the age range of the old people was from 45 years to 50 years. The subjects were randomly selected from different areas under Joydevpur thana, Ramna thana and Tejgaon thana of the Dacca district.

The subjects memorized a list of paired-associate words comprising 4 noncompetitive, 4 somewhat competitive and 4 competitive pairs. Then they sat for two recall sessions, one after the retention interval of five minutes and another after the retention interval of twenty four hours.

The criterion measure was the number of errors committed by the subjects in recalling the associated pair of words. The data were analysed by a $2 \times 2 \times 2 \times 3$ factorial design with repeated measures on the last two factors. Results showed significant interaction at the .05 level of significance between competition and age implying thereby that both age and competition jointly produced decrement in memory. Analysis of simple effects, however, indicates that competition was a more dominant factor than ageing in producing decline in memory.

In other analyses also interactions between competition and sex and between competition and passage of time were found to be significant at the .05 level of significance indicating that competition interacts with sex and passage of time to produce decrement in the performance of the subjects. Though main effects of competition, sex and passage of time were significant implying the importance of these factors influencing the performances of the subjects but

the analyses of the simple effects indicate that competition was more dominant factor in influencing the performances of the subjects when compared with sex and passage of time. Results therefore, indicate that both of the hypotheses were confirmed. Moreover, when Newman-Kuels multiple comparisons of the means were done it has also been found that efficiency in recalling decreased with increase in the degree of competition lending thereby further support to the importance of the factor of competition in producing decline of memory.

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APPENDIX A

List of Paired Associates

<u>Stimulus</u>	<u>Response</u>
* কাকুতি	খিনতি
x আকুতি	পুণতি
o বিনতি	আনত
* মেঘন	ভেঘন
x এঘন	বারণ
o কেঘন	কারণ
* অঘ্যাত	বিঘ্যাত
x দুঘ্যাত	পুঘ্যাত
o সুঘ্যাত	দকতা
* অবোধ	নির্বোধ
x নুবোধ	বিপদ
o সুবোধ	দুপদ

* Highly associated pairs

x Weakly associated pairs

o Pairs having no association

APPENDIX B
Instruction to the Subjects

for learning :

আপনার সাধনের বোর্ডটার দিকে লক্ষ্য করে দেখুন এটার মাঝখানে খানিকটা জায়গা জ্ঞানান্যায় হত খোলা । আপনাকে আমি এই খোলা জায়গাটার মধ্যে দিকে কতগুলো জোড়া শব্দ দেখাব । আপনি শব্দগুলো গড়ে মনে রাখতে চেষ্টা করবেন । সম্পূর্ণ নিঃশব্দে গড়া হচ্ছে সেজে আমি আপনাকে প্রত্যেকটা জোড়ার প্রথম শব্দটা দেখাব । আপনি ওর জোড়া শব্দটা আদ্যাক্ষে বনবেন । এমনি করে আপনাকে একবার সুবিস্ময় করবার সুযোগ দেব আর তারপরেই আপনি কতখানি মনে রাখতে পারেন সেটা দেখব ।

for recall session after 5 minutes ;

একটু আগে আপনি কতগুলো জোড়া শব্দ সুবিস্ময় করলেন । এখন আমি দেখতে চাইছি যে তার মধ্যে কতগুলো জোড়া শব্দ আপনার মনে আছে । আগের মতই আমি আপনাকে প্রত্যেকটা জোড়ার প্রথম শব্দটা এই খোলা জায়গাটা দিয়ে দেখাব । আপনি আদ্যাক্ষে ওর জোড়া শব্দটা বনবেন ।

for recall session after 24 hours ;

আপনার হৃদয়টা মনে আছে গতকাল আপনি কতগুলো জোড়া শব্দ সুবিস্ময় করেছিলেন । আমি আবার দেখতে চাইছি তার মধ্যে কতখানি আজ আপনি মনে করতে পারেন । ঠিক গতকালের মতই প্রত্যেকটা জোড়ার প্রথম শব্দটা আপনাকে দেখাব আমি আদ্যাক্ষে ওর জোড়া শব্দটা বনবেন ।

APPENDIX C
Data from Final Study

TABLE 18

Total Number of Errors Committed by Different Groups
in Recalling the graded Competitive Pairs in the Recall
Session after 5 minutes

Groups	N	Total Number of Errors		
		Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
Old	100	16	161	190
Children	100	13	51	95
Males	100	19	133	175
Females	100	10	79	110

TABLE 19

Total Number of Errors Committed by Different Groups
in Recalling the Graded Competitive Pairs in the Recall
Session after 24 hours

Group	N	Total Number of Errors		
		Noncompetitive Pairs	Somewhat Competitive Pairs	Competitive Pairs
Old	100	29	195	239
Children	100	21	72	127
Males	100	31	162	214
Females	100	19	107	150

TABLE 20

Errors Committed by Different Groups in Recalling
the Noncompetitive Pairs in the two Recall Sessions

Groups	N	Total Number of Errors	
		Short-term Memory	Long-term Memory
Old	100	16	29
Children	100	13	21
Males	100	19	31
Females	100	10	19

TABLE 21

Errors Committed by Different Groups in Recalling
the Somewhat Competitive Pairs in the Two Recall
Sessions.

Groups	N	Total Number of Errors	
		Short-term Memory	Long-term Memory
Old	100	161	195
Children	100	51	72
Males	100	133	162
Females	100	79	107

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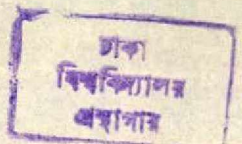


TABLE 22

Errors Committed by Different Groups in Recalling
the Competitive Pairs in the Two Recall Sessions

Groups	N	Total Number of Errors	
		Short-term Memory	Long-term Memory
Old	100	190	239
Children	100	95	127
Males	100	175	214
Females	100	110	150