MEMORY PERFORMANCE IN THE ELDERLY AS A FUNCTION OF ENCODING AND RETRIEVAL FACTORS

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CHAPTER I

INTRODUCTION

Common beliefs, theory, and research all generally suggest that there are cognitive decrements associated with old age, typically defined as 65 and older. There is empirical evidence demonstrating that the elderly perform less well than their counterparts in a variety of experimental situations. At least with regard to cross-sectional research,

> . . . nearly all studies dealing with the age factor in adult performance have shown that most human abilities, in so far as they are measurable, decline progressively, after reaching a peak somewhere between the ages of 18 and 25. The peak age varies with the ability in question, but the decline occurs in all mental measures of ability . . . (Wechsler, 1958, p. 135).

As compared with younger individuals, older individuals learn more slowly (Kay, 1951; Thorndike, Bregman, Telton & Woodyard, 1928); perform poorly when tested under speeded or paced conditions (Arenberg, 1965; Canestrari, 1963); are more handicapped when presented with novel material (Ruch, 1934); and are more likely to make logical errors and experience greater difficulty in solving problems (Arenberg, 1968; Botwinick, 1967).

Much of the literature on learning and memory in relation to age involves verbal materials. This is probably due to the fact that verbal abilities are an important aspect of cognitive functioning.

Both early (e.g., Jerome, 1959; Ruch, 1934) and more recent (e.g., Botwinick, 1970; Craik, 1977) reviews of the experimental literature support the view that aging is accompanied by a decline in verbal-learning ability. The earlier studies tended to be of a more descriptive nature and demonstrated impaired learning performance per se (see Botwinick, 1967; Jerome, 1969). More recently the focus has changed to an investigation of possible sources of variation that might be related to impaired performance. Various task and instructional variables have been shown to result in a disproportionately improved performance in the aged, such as instructions to organize or form mediators (Hulicka & Grossman, 1967; Laurence, 1967); slowing the rate of presenting stimulus items and/or increasing the time to respond (Canestrari, 1963; Monge & Hultsch, 1971); providing reinforcement contingencies (Leech & Witte, 1971); and increasing the associative strengths of the paired-associates or item concreteness in paired-associate learning (Kausler & Lair, 1966; Rowe & Schnore, 1971). Examples of the noncognitive organismic variables contributing to the age-related learning and memory deficit are such factors as anxiety level (Eisdorfer, Nowlen & Wilkie, 1970); health (Hulicka, 1967); and I.Q. (Eisdorfer & Wilkie, 1973). This more analytic approach has the benefit of providing implications for intervention and the possibility of reducing the competence-performance gap by modifying non-cognitive variables (Labouvie-Vief, 1976). The isolation of various component processes and factors influencing and involved in learning and memory is also necessary for a greater theoretical understanding of these processes.

Thus far the terms learning and memory have been utilized.

For the most part, these two processes have been confounded in the experimental research. As Botwinick (1967) points out,

> The processes of learning and memory are so interrelated and so interdependent that is it often difficult to determine whether or not they are distinct. For example, if a man does not learn, he has nothing to remember. Conversely, if he cannot remember, there is no sign of his having learned (p. 107).

It is thus, recognized that learning and memory are different aspects of one basic phenomenon and most probably rely on the same underlying mechanism (Craik, 1977). In the present study an assessment of memory was made utilizing a paired-associate verbal learning task.

Traditionally the age-associated decrements in memory were accounted for in terms of anatomical and physiological changes (e.g., Ruch, 1934; Welford, 1958). These theories assumed that the bulk of the decrement is due to changes in the structural features of memory as a function of age. More recently increasing attention has been paid to another dimension of memory, the control processes (Atkinson & Shiffrin, 1968). The control processes, such as mediation, organization, rehearsal operations and search strategies, are constructed and utilized at the discretion of the individual. More research is indicating that modifiable factors (i.e., control processes) account for significant proportions of the observed learning and memory deficits in the elderly (Hultsch, 1974; Schaie, 1974). In the past 15 years investigations of the role of mediational processes in associative learning have become increasingly predominant. A strong positive relationship has been found between reported mediation and recall performance (Bugelski, 1974; Paivio, Yuille &

Smythe, 1966). Instructions to form mediators result in better recall performance than rote memorization instructions or no instructions (Yuille & Paivio, 1968). Whereas young subjects often spontaneously employ mental images or verbal phrases to facilitate their retention, the elderly infrequently use such mnemonic devices spontaneously (Hulicka & Grossman, 1967; Hulicka, Sterns & Grossman, 1967; Rowe & Schnore, 1971). In addition, the elderly tend to use verbal mediators as opposed to imagery mediation (Hulicka & Grossman, 1967; Hulicka et al., 1967; Rowe & Schnore, 1971). Thus, the well-documented decrement observed in paired-associate learning in the elderly can be accounted for, at least, in part by inactive control processes. It is important to know whether this relative inactivity of control processes in the elderly can be modified, thus resulting in improved learning and memory performance. In addition, the aging process and its effects vary from individual to individual. That is, many individuals remain healthy, mentally alert and physically active throughout their entire lives. Thus, another relevant issue involves further clarifying the relationship between physical health, physical and mental activity, and cognitive functioning (i.e., the use of control processes and resulting effect on memory).

A new information-processing framework for conceptualizing memory was developed by Craik and Lockhart in 1972. These researchers have argued that it is the type of mental operation that the individual performs on the material that determines the durability of the memory trace. An elaborate, semantic analysis results in better retention than a structural analysis (e.g., attending to certain letter configurations). The Levels of Processing research of Craik and

Lockhart has typically utilized an incidental learning paradigm for a list of single words. Subjects are required to perform certain orienting tasks which necessitate peripheral or structural encoding or more elaborate, semantic encoding.

Another aspect of the Levels of Processing view is that the initial encoding sets an upper limit on memory but the extent to which this upper limit is realized is determined by the retrieval environment (Moscovitch & Craik, 1976). Thus, more elaborate initial encoding will be more fully realized with the provision of additional retrieval cues than will be initial encoding that was peripheral.

It has been suggested (Arenberg & Robertson-Tchabo, 1977) that since control processes, such as the way in which an individual initially encodes information, have such a great effect on retention, it might prove to be informative to compare older subjects who differ in performance on a learning task with respect to their use of control processes. In addition, if the encoding operations were controlled through the utilization of an orienting task and incidental learning paradigm, then differences in retention could be attributed to other sources (Craik, 1977).

The purpose of this study was to investigate the elderly's use of one type of control process, imagery mediation. A basic question is "can the relatively inactive control process of imagery mediation be modified through utilization of an orienting task?" How will memory performance as a function of imagery mediation compare with memory performance as a function of an orienting task that leads the subject to process the material in a less elaborated way? If the elderly are not given a specific orienting task that "forces" them to process the material to be remembered in a certain way, but are simply told to learn the material, what techniques will they adopt spontaneously? How will the memory performance of these latter subjects compare with that of the subjects whose encoding was controlled by the experimenter through specific instructions? Does intention to learn, where subjects are provided with a specific orienting task result in superior memory performance than in an incidental learning paradigm, where subjects are provided with the orienting task, but are not aware of the subsequent memory requirement? Finally, various organismic variables (e.g., verbal I.Q. measures of functional age, and performance on certain basic processes) were investigated in order to account for additional sources of variance.

CHAPTER II

REVIEW OF THE LITERATURE

Discovering and understanding the physical structure of memory is still an unsolved challenge. Both biological and psychological theories of memory have still not really progressed beyond the stage of description through analogy (Blakemore, 1977). This type of theorizing, although valuable, is constrained by the technological development and knowledge of the time. Today there exist many complex mathematical and computor simulation models of memory (see Baddeley, 1976; Norman, 1969). It is often difficult to compare these models with one another because they make different assumptions and have different purposes. The present study is based on one of many possible analogies for the complex process of memory, the information processing conceptualization.

The review of the literature will begin with a general discussion of the Levels of Processing framework (Craik & Lockhart, 1972) and the related research will be presented. Factors affecting paired-associate performance in the elderly will be discussed. This will be followed by a short historical account of imagery and an abbreviated review of the mnemonic effects of imagery. The major theoretical views relating imagery to the memory system will be summarized. Particular attention will be given to the Dual-Coding Theory

(Paivio, 1969) and how it relates to the Levels of Processing framework. Research regarding the elderly's use of mediational strategies in general, and imagery in particular, will be discussed. Finally, additional factors such as health, activity, and reaction time, and their relation to memory performance will be summarized.

Levels of Processing

The works of Hebb (1949), Broadbent (1958), and Welford (1958), have influenced the information-processing views, which are a major force in current theories of human learning and memory.

> The human mind is viewed as an information processor that accepts environmental input and transforms these informational units by such processes as coding, storage, elaboration, retrieval, and concatenation to produce cognitive behavior (Chiang & Atkinson, 1976, p. 661).

Thus, the information-processing viewpoints all generally distinguish between storage and retrieval, between memory structures and control processes, between short and long-term memory and between semantic and episodic long-term memory (e.g., Anderson & Bower, 1973; Atkinson & Shiffrin, 1968).

A relatively new information-processing framework for conceptualizing memory is becoming increasingly predominant in the literature. The paper by Craik and Lockhart (1972) on Levels of Processing is probably the most influential single force leading to the loosening of the rigid conceptions of multiple-store theories of memory (Peterson, 1977). Arguing against multi-store models (e.g., separate sensory, short-term and long-term stores) Craik and Lockhart proposed that memory be considered as a continuum. It is the type of mental operation that the individual performs on the material that determines the durability of the memory trace. Atkinson and Shiffrin (1968) categorized the memory system along two major dimensions: the structural features and the control processes. The structural features or memory structure, include the physical system or permanent features of memory and the built-in processes that do not vary from situation to situation. Control processes however, do vary from one situation to the next and are constructed and utilized at the discretion of the individual. Examples of control processes are coding procedures (e.g., mediational processes, organization, mnemonic devices), rehearsal operations and search strategies.

> The use of a particular control process in a given situation will depend on such factors as the nature of the instructions, the meaningfulness of the material, and the individual subject's history (Atkinson & Shiffrin, 1968, p. 90).

In discussing the type of mental operation that an individual performs, Craik and Lockhart were referring to these control processes. For example, a stimulus may be processed according to its physical or sensory features, such as its color, angles or loudness. The input may also be processed semantically, such as matching it against stored abstractions from the past. According to this view,

> Analysis proceeds through a series of sensory stages to levels associated with matching or pattern recognition and finally to semantic associative stages of stimulus enrichment (Craik & Lockhart, 1972, p. 675).

The Levels of Processing research has typically utilized an incidental learning paradigm for a list of single words. In an incidental learning situation the experimenter, by requiring the subject to perform certain orienting tasks, has more control over the processing activities of the subject and the memorial consequences of these activities can be assessed (Craik, 1977). Orienting tasks have been devised that necessitate either peripheral, structural encoding or more elaborate encoding. For example, in going through a list of words a subject may be required to make judgments as to whether a word contains the consonant "r" (structural task) or whether the word fits in a certain sentence (semantic task). Recall is expected to be better in the latter case. Craik and Lockhart (1972) thus conceptualized the various types of processing (structural to semantic) as comprising a hierarchy, where semantic analysis implies a greater depth of processing. The greater the depth of encoding the better the resulting retention.

Stimuli can also be retained by maintaining or recirculating at one level of processing. This is referred to as primary memory (PM), similar to short-term memory and involves a repetition of analyses already performed. According to Craik and Lockhart (1972) this type of processing (Type I) does not lead to a more permanent memory trace but merely prolongs an item's accessibility. An elaborative, semantic type of rehearsal (Type II) does lead to improved memory performance. Craik and Watkins (1973) found that neither the prolonged maintenance of an item in short-term storage (PM) nor increasing the number of overt rehearsals improved final recall performance. They did acknowledge that there are situations in which more rehearsal, increased learning time and more repetitions lead to better retention. Nelson (1976) showed that recall did improve with an increased number of repetitions at the phonemic depth of processing.

These considerations have led Craik and his collaborators (e.g., Craik & Tulving, 1975) to de-emphasize the ridigidly determined hierarchy of levels. Craik and Tulving (1975), in modifying the notion of "depth" of processing, suggested that it is the degree of stimulus elaboration or "breadth" of processing that determines retention. Several researchers (e.g., Eysenck, 1978; Nelson, 1977) make the important point that the notion of a hierarchy of depth of processing is circular in that the various kinds of processing are ordered in terms of their effect on memory. Thus, the principle that deeper processing leads to better memory cannot really be tested. Until a separate ordering for depth of processing and for the ordering of memory performance is established, one can only say that "different kinds" of processing result in differential memory performance.

More recently (Moscovitch & Craik, 1976) it has been proposed that the level of processing determines the qualitative nature of the trace and may set an upper limit on recall and recognition. The retrieval environment determines to what extent this upper limit is realized. Retrieval is conceptualized as a process of reconstructing the original encoded event and the retrieval cue, and the degree to which the event and its encoding context form an integrated encoded unit (Moscovitch & Craik, 1976). Thus, overall retention is viewed as a joint function of trace information and retrieval information. Elaborate encodings will be more fully realized with the provision of more adequate retrieval cues. What is stored determines what retrieval cues are effective in providing access to the encoded event (Tulving & Thomson, 1971). Lockhart and Craik (1978) acknowledge that depth of processing by itself is insufficient to give a complete characterization of memory. Many other factors, such as interference and type of retrieval cue need to be examined more fully. They note that their model is designed to provide a framework for research rather than a complete theory of memory.

In summary, the important aspect of the Levels of Processing framework is that the focus is on the various component processes involved in remembering, such as attention, encoding, rehearsal and retrieval. Thus, memory can be conceptualized as an epiphenomenon of various cognitive activities (Meacham, 1972). There are other researchers who also advocate the formulation of a description of memory in terms of its constituent activities (e.g., Cermak, 1972; Hyde & Jenkins, 1969, 1973; Kolers, 1973; and Paivio, 1971).

Basic Processes

There are basic component processes, such as attention, rehearsal, concentration, processing speed, imagery and concurrent processing speed, that are believed to relate to memory. Birren (1964) has suggested that the age changes in memory might be related to deficits in perception, set, or attention. Craik (1977) has also argued that part of the age-related deficiencies in memory are related to inadequacies in attentional processes at initial encoding. Factors such as activation and arousal have been related to memory (Craik & Blankstein, 1975). In addition, speed of information processing has been found to be correlated with various cognitive abilities (Hunt, Lunneborg & Lewis, 1970). For example, Schaie and Strother (1973) studied a group of retired professors to determine the limits of optimal functioning for an elderly population. They concluded that the

> . . . decrement from peak performance is most likely related to a physical decrement particularly of a sensory nature and probably to the general slowing down of response speed, as well (p. 307).

One task that seems to relate to central processing and that does not involve a gross motoric component is the rate of speech production. A simple index of speech production would be to require the subject to say the alphabet out loud as quickly as possible (e.g., Weber & Castleman, 1970). A comparison between overt speech production and rate of internal processing can be made by requiring the subject to say the alphabet covertly. Finally, requiring the subject to go through the alphabet as quickly as possible alternating between saying one letter aloud and the next letter covertly would provide an index of speed of processing as well as cognitive flexibility or control. These speech rates would seem to be important in determining rehearsal and thereby learning rates. The ability to switch back and forth between relatively overt and covert processing is probably important in most learning situations. These tasks were designed to tap a simple aspect of such switching by measuring the time it takes to occur.

Visual imagery is now recognized as an important variable in learning and memory. Thus, it is appropriate to obtain data on the rate at which imagery occurs. This rate may also be compared with the rates of perceptual processing and information translation in informationally similar tasks. Visual imagery has been found to require more time and results in more subjective fatigue than speech imagery

(Weber & Castleman, 1970). This is especially related to the present study in that the encoding orienting task involves imagery mediation.

In addition, most learning situations involve several processes going on at once, i.e., concurrently. Therefore, assessing concurrent performance on two different asks (e.g., saying the alphabet and writing numbers) in comparison to performance on each task separately would provide information on this type of basic process.

Finally, the Digit Span Test of the Wechsler Adult Intelligence Scale (WAIS) is believed to relate to factors such as anxiety level, attention and concentration, and mental control (Wechsler, 1958). Special difficulty with this task could also be indicative of organic diseases or mental impairment. There is also considerable face validity for believing that digit span might predict performance on more complex memory tasks.

Incidental Learning

If memory is conceptualized as being a function of the component activities, it then follows that a common mechanism underlies both incidental and intentional learning. The difference between these two situations is in the relative emphasis on the various mental operations that the subject performs. However, as Craik (1977, p. 412) points out, most studies of incidental and intentional learning are different types of learning. In addition, few of these studies required the subject to process the incidental material in a specific way through an orienting task. There are several reviews of the literature on incidental learning (e.g., McLaughlin, 1965; Postman, 1964) thus, they will not be reviewed comprehensively here. The few incidental learning studies involving elderly subjects will be discussed briefly with particular attention given to those incidental learning studies conducted within the Levels of Processing framework.

One of the first studies of incidental learning in the elderly was reported in two parts by Willoughby (1929, 1930). He administered a version of the Digit Symbol subtest of the Wechsler Intelligence Test to subjects ranging in age from 6 to 68. In the Digit Symbol text subjects are provided with a display of nine symbols, each associated with a different number. Below this display the numbers are presented with a space to write in the symbols that are associated with them. The subject's task is to write in the symbols as quickly as possible. Upon completing the Digit Symbol task, Willoughby asked subjects to recall the number symbol associations from memory without forewarning. He found a decline in incidental recall in the elderly group.

Bromley (1958) after administering the eleven subtests of the Wechsler-Belleview Intelligence Scale asked subjects to describe the subtests. He found that the recall scores were significantly different for subjects of mean ages in the 20's, 40's and 60's with the elderly performing the worst. This result was similar to Willoughby's.

In paired-associate learning the subject, given the stimulus term, must supply the response term (S-R). Kausler and Lair (1963) conceptualized R-S paired-associate recall as a type of incidental learning where the subject learns this reversed association simultaneously with the S-R association. Kausler and Lair predicted that older subjects would be inferior to younger subjects in the incidental learning of the R-S associations. They found that older subjects were not statistically significantly inferior to younger subjects in learning the usual paired associates (S-R) under slower pacing but they were inferior in learning the R-S associations. Kausler and Lair suggested that older subjects need to spend more rehearsal time on S-R practice because of their difficulty in learning, thus, this limits the attention allotted to incidental components.

In a study reported by Botwinick (1967, p. 125) Hulicka (1965) showed two groups of subjects, ages 30 to 39 and 60 to 75, pictures of seven men, each paired with a name and a city. The subjects were required to learn the associations between the pictures of faces and the names. The subjects were tested on these intentionally learned associates (face-name) as well as incidental learning of associations between pictures of faces and the cities. Although his results were statistically non-significant, he found age differences in the predicted direction with the elderly performing inferior to the younger group under both conditions.

The conclusion that can be drawn so far from these studies is that there is an age decrement in incidental learning. In general, age decrements in intentional learning have been well-documented (the Kausler and Lair, 1963 study being an exception). Because subjects were not required to process the incidental material in any certain way, one would expect to find age differences of at least the same magnitude that are found in studies of intentional learning.

Wimer (1960) compared incidental and intentional learning in a group of young (mean age = 20.3 years) and old (mean age = 71.9

years) subjects. He showed the subjects six printed words in different colors. Half of the subjects were told to simply read the word as quickly as possible. The other half were told they would be tested on knowledge of in what color the word had appeared. Wimer found no difference in incidental learning between the young and elderly groups. However, the performance of the young subjects improved under the intentional condition. Wimer attributed this result to either a difference in motivation or attention, but these factors were not assessed.

One important way that Wimer's (1960) study differs from the studies of Willoughby (1929, 1930), Bromley (1958), Kausler and Lair (1963), and Hulicka (1965) is that he controlled what the subjects did in the incidental learning condition (i.e., subjects read the word as quickly as possible). By doing this he equated acquisition between the two age groups. In the intentional learning condition it might be speculated that the younger subjects performed further operations on the material that led to their superior retention, such as forming a semantic association or mediating.

Craik (1977) reports additional incidental learning studies in which young and elderly subjects were required to perform specific orienting tasks. The first study reported by Craik (p. 412) was conducted by Johnson (1973). Johnson required younger and older subjects to classify words as nouns or verbs. In an unexpected subsequent memory test, he found no age differences in free recall, cued recall or recognition following the incidental learning task. Younger subjects showed a disproportionate improvement in their free recall scores under intentional learning conditions. As in Wimer's (1960) study, acquisition was equated in the incidental learning condition.

The improved performance of the younger subjects can again, be attributed to the possibility that the younger subjects performed additional operations on the material whereas, the elderly group did not carry out these additional operations.

The second study reported by Craik (1977, p. 412) was conducted by White (unpublished). White presented young and old subjects with a series of single words under four conditions which varied in orienting tasks. For one-fourth of the words the subject was required to judge whether the word was in capital letters. The second condition involved determining whether the stimuli rhymed with another word. In the third condition the subject had to determine whether the stimuli belonged in a certain category and finally, subjects were told to simply learn (intentional learning) one-fourth of the words. The subjects were required to recall as many words as they could from all conditions. Following the recall task they were given a recognition task. An age decrement was found under three of the four conditions (except rhyme) for the free recall data. Because acquisition was assumed to be equivalent, this is suggestive of a retrieval deficit. With adequate retrieval information (as in the recognition test) the age decrements were eliminated in all conditions except intentional learning. In this condition an age decrement was found suggesting that again, the younger subjects further processed the words or the older subjects adopted less efficient learning strategies. This study also supported the notion that the more semantic analyses (i.e., condition three) result in better retention than the structural analyses (i.e., conditions one and two).

Eysenck (1974) hypothesized that young subjects are able to process to-be-remembered information to a greater depth than old subjects. He referred to this as the processing deficit hypothesis. This hypothesis predicts that any age-related recall decrements should increase in extent as the depth of processing (from structural to semantic) required by the orienting task increases. The subjects, comprising two age groups (18 to 30 years and 55 to 65 years), were randomly assigned to one of five conditions representing four "levels" of processing (letter counting, rhyming, adjective, and imagery) and an intentional learning group. The two semantic tasks (adjective and imagery) resulted in higher levels of recall for both the elderly and young subjects, with lower recall in the nonsemantic tasks. In general, younger subjects performed better than older subjects in all conditions. However, the greatest age-difference was found when the orienting task was more semantic. The recall performance of old subjects under intentional learning did not differ from their recall under the imagery, or adjective conditions.

Eysenck's (1974) data is similar to the recall data of White (reported by Craik, 1977), which showed a recall deficit in the elderly group. However, as Craik (1977, p. 413) points out, White's recognition data, showing no age decrement when acquisition is equated and retrieval information is provided, is discrepent with Eysenck's processing deficit interpretation. More research is needed to clarify these issues.

The general conclusion that can be drawn thus far is that at least part of the disproportionately greater decrement in the elderly's intentional versus incidental learning is a function of a difference in the way in which younger subjects treat the material in the intentional learning paradigm. White's (reported by Craik, 1977) recognition data for the elderly showed that, with the provision of additional cues, the incidental category group demonstrated superior memory performance as compared with the intentional learning condition. Thus suggests that the elderly did not process to the same extent under intentional learning as they did when given a specific orienting task (category).

Paired-Associate Learning

Another line of research, the paired-associate task, has been utilized frequently as the vehicle to study various potential processes and factors contributing to the differential performance between the young and elderly. The determination of these factors contributes to the theoretical understanding of age differences in cognitive functioning and has implications for rehabilitation and educational programs for the elderly.

Several earlier investigations have documented the age decrement in paired-associate learning in the elderly (Gilbert, 1941; Korchin, & Basowitz, 1957; Rush, 1934). Extensive reviews of paired-associate learning in the elderly can be found (e.g., Arenberg & Robertson-Tchabo, 1977; Botwinick, 1967; Witte, 1975).

Regardless of whether a task or activity is simple or more complex, it takes time for it to be initiated and it endures for some interval. One of the most well-documented findings in gerontological research is that of a general slowing of behavior in the aged (Birren, 1959; Botwinick, 1967). The main sources of this slowing seems to lie in the central mechanisms (see Welford, 1977 for a review) and possibly, age changes in strategy, such as cautiousness (Taub, 1967). Various researchers have sought to determine the extent to which the observed decrement with age in paired-associate learning is due to time factors, such as the presentation rate or time to make the response. Witte (1975) reviews the literature relating time factors to paired-associate learning in young adult and elderly subjects thus, these studies will not be reviewed extensively. The primary issue in most of these studies is whether the age related decrement in paired-associate performance reflects the effects of learning factors or performance factors.

Canestrari (1963) was probably the first to examine the effects of presentation rate on paired-associate learning. He found the largest age difference in trials to criterion under the fastest pacing. In the self-pacing condition the older subjects used more time than the younger subjects and used the time to make the response rather than in studying the stimulus-response pairs. Canestrari concluded that a large proportion of the performance deficit can be accounted for by a loss of speed with age. However, even under the self-paced condition the young still performed better than the elderly so insufficient time to respond can only account for part of the deficit.

Arenberg (1965) in two studies varied the anticipation interval (presentation of stimulus word alone) and study interval (stimulus and response words presented together) independently. The results of study I supported Canestrari's (1963) conclusion that performance factors rather than learning factors account for a greater proportion of the age-related decrement in paired-associate learning. In study II Arenberg alternated paced and self-paced trials and found an age decrement even under the self-paced trials. Arenberg interpreted his results as indicating that the age-related paired-associate decrement is a learning deficit rather than due predominantly to speed factors.

Other investigators have also concluded that the elderly as compared to the young are deficient in learning. Kinsbourne and Berryhill (1972) held the total time constant but varied the inspection intervals (2, 4, or 6 seconds). Subjects had either 192 seconds, 384 seconds or 576 seconds to learn the pairs. The difference in pacing did not significantly affect the amount learned in either the old or young. However, the elderly learned disproportionately less when the total time available for learning was decreased.

Witte and Freund (1976) found that the elderly have difficulties in both the response learning phase as well as in the associative stage, where the response is associated with an aspect of the stimulus. They performed worse than the young under a recall, multiple choice and associative matching procedure. The greatest magnitude of the age difference was under the recall procedure.

Hulicka and Wheeler (1976) manipulated the registration interval between a self-selected study period and presentation of the next pair to be learned. After the subject indicated that he had learned the items in the pair, an extra interval was added to allow for additional registration, encoding, or transfer to more permanent storage. The subjects were told to take a bit more time to "fix the pair" in their minds. This additional interval benefited the elderly but had no effect on the recall of the young subjects. The two age groups did not differ significantly in their self-selected study times.

In summary, the age-related decrement in paired-associate learning is due to some extent to pacing factors. The elderly do need more time to respond (Arenberg, 1967; Canestrari, 1963). The faster the rate of presentation, the greater the age difference in acquisition. Other factors such as confidence (Taub, 1967), anxiety (Monge, 1968 reported by Witte, 1975) and reluctance to respond (Leech & Witte, 1971) account for at least a part of the performance deficit in the elderly. However, the elderly do not learn as well as the young in a given amount of time. Whether this learning deficit is due to rehearsal factors (Cooper & Pantle, 1967), response learning, or associative learning (Canestrari, 1968; Hulicka & Grossman, 1967) remains to be clarified. In addition, there are conflicting data on whether the poor performance of the elderly is a function of storage (e.g., McNulty & Caird, 1967) or retrieval (e.g., Schonfield, 1967) deficits.

The type of material to be learned has been shown to differentially affect the performance of the aged. For example, Davis (1960) reported by Botwinick (1967, p. 85) investigated the difficulty of the associates to be learned. He found that greater age decrements occurred in the elderly with the more difficult group of paired-associates.

Zaretsky and Halberstam (1968) investigated the effects of three different levels of associative strength on the paired-associate learning and relearning of elderly and young subjects under lengthened time intervals. The older subjects took more trials to learn and relearn the paired-associates. For both groups, acquisition was positively related to the degree of associative strength. The effect of low associative strength was greatest for the elderly, where they needed increasingly more trials to criterion for learning and relearning, recalled fewer words and were significantly slower in responding.

Rowe and Schnore (1971) wanted to determine whether the effect of item concreteness observed in younger subjects (e.g., Paivio, 1969) would be obtained in an elderly population. Using both abstract and concrete words, subjects (young, middle-age, and elderly) were run under a self-paced study and test schedule without instructions to use mediators. The subjects learned the paired-associates to a criterion of two successive perfect trials or to eight trials (whichever occurred first). All age groups made more correct responses for the concrete pairs, with the elderly benefiting disproportionately. One important conclusion that these researchers draw is that the use of concrete words in studies of verbal learning and memory tends to underestimate the age differences.

Therefore, the type of material to be learned is another variable that differentially affects the paired-associate performance of the elderly. Factors such as increased susceptibility to interference, cognitive rigidity or the difficulty in forming mediators could account for these results. Of these factors, mediation has been studied extensively and has been shown to influence paired-associate learning in the young (e.g., Bower, 1971; Paivio, 1969). The fact that mediators are used spontaneously by young adults in a paired-associate task is well-documented (Underwood & Schultz, 1960). Mediational techniques in general and specifically imagery mediation is one form of elaborative encoding that is known to influence memory (e.g., Craik, 1977).

In the following section, a brief historical account of imagery as an associative mediator will be presented along with research supporting the effectiveness of imagery as a mnemonic technique. The major theoretical views relating imagery to the memory system will be discussed with particular emphasis placed on Paivio's Dual-Coding Theory. This theory will be related to the Levels of Processing framework (e.g., Craik & Lockhart, 1972). Finally, the use of mediators in general and imagery mediation by the elderly will be discussed and related research presented.

Imagery

The notion of the image as an associative mediator can be traced back 2500 years to a mnemonic system that was developed by a Greek poet, Simonides and which was described by Cicero in De Oratore (see Yates, 1966). This technique, known as Loci et Res, or the "method of Loci" involved forming images of items to be remembered and then relating them to a series of familiar, well-ordered memory places, such as parts of a well-known building or familiar locations encountered on a journey. To retrieve the items, one mentally retraced the locations which then served as a reminder of the items imagined.

In psychology imagery was an area of interest around the turn of the century (e.g., Galton, 1883). However, with the emergence of behaviorism, imagery was rejected as a psychologically appropriate field of study by Watson (1913). It was virtually ignored by psychologists for almost 50 years but has recently re-emerged as a topic of experimental investigation (e.g., Bower, 1972; Bugelski, 1974; Holt, 1964; Paivio, 1969, 1971; Richardson, 1969). It is now recognized that the investigation of mental imagery may contribute to a greater understanding of the processes of learning and memory (Bugelski,1970; Holt, 1964). Extensive historical and theoretical reviews can be found (see Holt, 1964; Paivio, 1971; Pylyshyn, 1973).

The value of mnemonic techniques for the acquisition of associations between verbal units is well-documented (see reviews by Bower, 1972; Paivio, 1971). The various mnemonic strategies all involve some form of elaboration. Other than through instructions, most studies do not report the criterion used to make the distinction between a visual image and verbal mediator. A visual image is typically defined as a link that is descriptive of a picture or image, whereas a verbal mediator is defined as a link based on the formal syntactical characteristics of the words (e.g., grammar, sentence or connecting phrase).

Mnemonic elaborative techniques have been shown to be facilitative in serial learning recall tasks (e.g., Bugelski, 1968, 1974; Bugelski, Kidd & Segman, 1968; Groninger, 1971); single list free recall (Manning & Bruning, 1975; Morris & Reid, 1970; Morris & Stevens, 1974); learning a second-language vocabulary (Atkinson, 1975; Raugh & Atkinson, 1975); and in paired-associate tasks (Bower, 1972; Sandalla & Loftness, 1972; Wallace, Turner & Perkins, 1957 reported by Wood, 1967; Wood & Bolt, 1970).

In general, imagery mediation instructions are more effective for remembering concrete words, while verbal mediation instructions result in better retention for abstract words (Paivio & Foth, 1970; Rimm, Alexander & Elias, 1969; Yuille, 1973). Other researchers have found sentence mediation to be as effective as imagery instructions with concrete words (Paivio & Yuille, 1969; Wood & Bolt, 1970; Yarmey & Csapo, 1968; Yuille & Paivio, 1968) and imagery instructions have also been found to be facilitative in the recall of low imagery words (Groninger, 1974). For the most part, the discrepancies between these studies can be accounted for in terms of procedural differences, such as variations in tasks, pacing, materials or instructions.

There are many theoretical viewpoints regarding how imagery relates to models of the memory system.

> The main factors associated with memory effects of imagery variables appear to be dual coding, organization of information, and decoding or retrieval confusions (i.e., interference) (Paivio, 1975, p. 77).

In general, the evidence suggests that the effects of imagery, defined by instructions to form a mental picture or interactive scene, occur at the encoding stage rather than during the retrieval stage (i.e., response availability) (Bower & Winzenz, 1970; Groninger, 1974). Bower (1970) further isolated the encoding effectiveness of imagery in a paired-associate task. He found that the effects of imagery occurred during the relational associating part of the paired-associate learning process rather than in stimulus encoding (response learning) alone. In support of this notion, Winograd, Karchmer and Russel (1971) found that subjects asked to form an interactive image including a target word and context word had superior recognition of the target word only when it was accompanied by the context word at test time.

Other researchers have found that the formation of images which link items together improves the subject's organization of the material and subsequent recall (Bower, Lesgold & Treman, 1969; Morris & Stevens, 1974; Santa, Ruskin & Han Yio, 1972). Begg (1972, 1973) has proposed that images that are aroused by discrete verbal stimuli can be combined into complex images which are "functionally unitary, intergrated memory structures"(1972, p. 431). His redintegration hypothesis assumes that the integrated image takes up no more memory space than each of its components, and each separate component can serve as a cue to redintegrate the entire image.

The theory that has probably received the most attention is the Dual-Coding theory (Paivio, 1971, 1972). Briefly, this theory distinguishes between imaginal and verbal processes, where the imaginal system is specialized for processing non-verbal information stored as images and the verbal system is specialized to deal with linguistic units. These two processes are assumed to be independent, but partially interconnected systems for the encoding, storage, organization and retrieval of stimulus information. The assumption of independence of the two processes implies that either one of the codes can be available and activated, depending on the characteristics of the stimulus materials, instructions and dispositional habits or skills of the individual. "One statistical consequence of such independence is that the two codes should have additive effects on memory performance" (Paivio, 1975, p. 183). The notion of interconnectedness suggests that one code can be transformed into the other. Both processes might be activated by tasks where the items are easily coded in either form. Thus, storage and/or retrieval can be mediated by either images or words.

The Dual-Coding theory incorporates the notion of levels of information processing, where levels refers to the degree of elaborative processing. At the representational level, images are activated by concrete stimulus events and are activated from linguistic events. This representational level is a relatively superficial level of encoding. At the referential level the activation of one system by the other occurs through an established connection. For example, words can elicit an image. There is a semantic relation between a word and its object. This level is considered "deeper" than the representational level because two codes are involved. The associative level involves associations between representational units within each system. For example, with the imaginal system, images that are aroused activate other images. Paivio (1975) does not specify the associative level as being "deeper" than the referential, but both of these levels are "deeper" than the representational level.

The Dual-Coding theory differs from the Levels of Processing theory (Craik & Lockhart, 1972) in that the latter does not include a reference to specific structural or functional differences between memory codes at any certain level (Paivio, 1975, p. 185).

> Whereas the depth hypothesis attributes effects to the hypothetical depth or level variable, dual coding attributes effects to the number of codes activated in a given task and to functional distinctions between imaginal and verbal codes (Paivio, 1975, p. 185).

Thus, the depth theory leaves unstated the possibility that distinct codes may exist and may contribute differentially to memory. Paivio (1975) acknowledges that the superiority of the nonverbal image over the verbal code is still a theoretical puzzle. Reviews of the research supporting the Dual-Coding theory may be found elsewhere (e.g., Bower, 1972; Paivio, 1969, 1971), and will not be reviewed here.

Regardless of whether the effectiveness of imagery is a result of dual-encoding or an elaborative, semantic type of processing it is a well established research finding that imagery enhances recall. In accordance with the Levels of Processing view superior retention under imaginal elaboration does not depend on intention to learn. Bower (1972) instructed two groups to form interactive scenes for pairs of words. One group was told that they had to remember the words for a later recall test. The other group (incidental learning) was not told to learn the words and was unaware of the subsequent memory test. The two groups did not differ significantly in the number of words recalled. Bower concludes,

> . . . intent to learn is superfluous if the cover story orients the subject to the relevant material and requires him to make differential responses to it. For later recall, the cognitive or imaginal elaboration itself is the important ingredient, not his motivation to remember (p. 68).

Yarmey and Ure (1971) also found no difference between incidental and intentional learning when subjects were instructed to form interactive images for pairs of words. Finally, Ernest and Paivio (1969) found better recall of the irrelevant components of compound high imagery stimuli.

In summary,

> . . . imagery appears to be a useful mode of learning and remembering at all ages, its functional role probably being determined by the nature of the learning task and by the subject's experience in dealing with them (Paivio, 1970, p. 391).

Memory is limited by the amount of information that is initially encoded, and the initial encoding of information determines retrieval. The use of mediation is an elaborative, semantic type of encoding that results in superior retention. It is thus, important to examine the use of mediational strategies in the elderly. In the section on paired-associate learning in the elderly it was concluded that only a portion of the age differences in performance could be accounted for by pacing factors. Learning factors, such as encoding processes, might account for the differential performance.

Mediation in the Elderly

Hulicka, Sterns and Grossman (1967) were probably the first to examine mediation in the elderly. They gave subjects one trial to learn each pair of words. These investigators utilized a group of older (mean age = 70.2 years) and younger (mean age = 15.5 years) subjects matched for education. Each subject served in four different pacing conditions involving a factorial combination of two different anticipation intervals (3 seconds or self-paced) and two study or association intervals (3 seconds or self-paced). They found that the two age groups under self-pacing had the same study time but different anticipation latencies. The best performance of the elderly was under the totally self-paced condition but was still inferior to the worst performance of the young. The elderly did not demonstrate relatively more improvement than the young from the total paced to the totally self-paced condition. Hulicka, et al. concluded that it is the time for making the association that is important. The additional time to make the response was beneficial only if the association time had been long enough.

Hulicks, Sterns and Grossman (1967) questioned their subjects about the techniques they had used to learn each pair. The elderly reported the use of imagery less frequently than the young (34% vs. 60%) and verbal mediators more frequently (38% vs. 20%). Both groups performed better on those pairs where mediation had been reportedly used. The elderly also reported that the pairs were too odd to form a connection much more frequently than the young subjects did. The infrequent spontaneous use of mediators was due in part to this inability to find an appropriate association. Hulicka, et al. suggested that this inability in the elderly was due to a lack of plasticity or lack of practice in formal learning situations.

Hulicka and Grossman (1967) studied the use of mediators in paired-associate learning in the elderly more directly. They had four groups that were given different instructions: self-image, where subjects generated their own imaginal mediator; experimenter-image, where the experimenter provided a phrase that was suggestive of an image; verbal instructions, where the subjects were given the connecting phrase but not told to form an image; and finally a control group that received no special instructions. Following the paired-associate task subjects were questioned as to what method they used to learn the word pairs.

Regardless of the type of instructions, young subjects performed better than the elderly. Instructions to use mediators resulted in slightly greater improvement in the old than in the young subjects. Hulicka and Grossman (1967) found that self-image instructions resulted in the best performance, followed by experimenter supplied and verbal instructions. In the control condition the older subjects reported the use of mediators half as often as the young. The elderly also found more pairs too odd to form a connection. Performance was best when subjects reported using mediators and formed their own associations, thus possibly utilizing prior knowledge.

Canestrari (1968) wanted to see if the deficit in paired-associate learning in the elderly could be attenuated by aiding the elderly in developing more effective visual mediators by presenting them with an image along with the word pair to be learned. In a second condition the subjects were presented the word pairs along with a phrase that contained both words. The dependent measure was the number of errors made in reaching the criterion of one perfect performance on the list. The errors were broken down into errors of omission and commission.

Canestrari (1968) found that the young made fewer errors than the old in all conditions. The two mediators had a greater effect in reducing errors in the old group than in the young group. There was no significant difference between the verbal and visual conditions for the elderly. The two types of mediators had a greater effect of reducing errors of omission in the older group. Therefore, providing subjects with mediators resulted in a differentially greater improved performance in the elderly. Canestrari suggested that experimental factors, such as less frequent practice or disuse could account for the older subjects' impaired ability for form mediators. He also suggested that part of this loss in ability could be due to physiological changes in the central nervous system. The relative contributions of these factors remain to be determined.

In Rowe and Schnore's (1971) study involving item concreteness in paired-associate learning as a function of age, they also investigated reported mediation strategies. Rowe and Schnore found that the elderly made more errors of omission than commission, and had the lowest recall scores overall. They tended to use verbal mediators more often than imagery, even for the concrete pairs. In the other two age groups (middle and young), imagery mediation was more frequently reported for the concrete words. Unlike previous investigators (e.g., Hulicka & Grossman, 1967; Hulicka, Sterns & Grossman, 1967; Paivio, Yuille & Smythe, 1966; Paivio, Smythe & Yuille, 1968) who found that imagery was more effective for learning concrete words, Rowe and Schnore found that imagery and verbal mediation were about equally effective. There was an overall trend for the younger subjects to report the use of mediation more frequently than the elderly.

The possibility that the elderly do not use imagery as frequently as the young because of the length of time they need to transform the verbal information usually presented in memory experiments into a pictorial representation was investigated. Nebes (1976) utilized an ingenius method to determine the speed with which verbal stimuli are recoded into pictorial representations in a group of elderly (ages 63-78) and young (ages 17-25) subjects. He showed subjects a pair of stimuli and they had to determine as quickly as possible whether the stimuli were the same or not. One stimulus was either a picture or a verbal description of a picture, while the other stimuli was always a picture. The stimuli appeared either simultaneously or with a 1, 2, or 3 second delay between them. If the elderly do not utilize imagery as effectively as the young, then the time needed to match a description to a picture will always be longer than the time needed to match two pictures regardless of the inter-stimulus delay. If the elderly do form images, but at a slower rate than younger subjects, then they will require delays of 2, 3, or more seconds to produce equivalent description-picture and picture-picture matching times.

Nebes (1976) found that with an inter-stimulus delay of one second or more the description-picture and picture-picture matching times were equal for older and younger subjects. He found that old subjects were significantly slower than young subjects but the pattern of reaction time differences across conditions was almost identical. Nebes suggests that the relative disuse of imagery mediators by the elderly in paired-associate tasks may not be due to the slowness of image formation. Rather, the disuse of imagery could be a function of the difficulty the elderly have in finding a realtionship between the words and in forming an adequate image of this relationship.

It is also possible that the elderly do not spontaneously adopt elaborative encoding strategies because they initially increase the storage load and possibly overload the central processing system (Arenberg & Robertson-Tchabo, 1977). The elderly also may not adopt more efficient encoding strategies because of their inexperience with this type of learning situation or their relative disuse of their cognitive abilities.

In summary, imagery and elaborative encoding strategies have been found to result in superior retention in paired-associate learning tasks. Whether the effect of imagery is due to increased organization, dual-coding, increased "depth" or "spread" of encoding or a combination of these factors remains an unanswered question. It has been found that the elderly do not utilize elaborative encoding spontaneously and even when instructed to do so they have difficulties. Various possibilities have been suggested to account for why the elderly do not adopt elaborative encoding strategies in a paired-associate learning paradigm.

Additional Variables

It is recognized that there is a relationship between psychological, biological, social and calendar age (Fozard & Thomas, 1975). However, most of the studies of verbal learning and memory in the aged have only measured level of verbal ability or verbal IQ in an attempt to match or control the young and old groups with respect to this factor. In general, it has been found that initial intellectual ability relates to later functioning (Blum & Jarvik, 1974; Eisdorfer & Wilkie, 1973); that health factors influence cognitive functioning in the aged (Schaie & Strother, 1973; Wilkie & Eisdorfer, 1973); and factors such as education, activity level, social interaction, and life satisfaction measures relate to cognitive functioning (Birren & Morrison, 1961; Botwinick & Birren, 1963). Thus, a whole realm of factors that are not purely "cognitive" relate to intellectual performance, and the contribution of these psychological, biological and social factors has not been investigated in the more typical memory or learning studies.

Statement of the Problem

It has been well-documented that the elderly do not perform as well as the young in a variety of learning and memory situations and a significant proportion of the difficulty has been found to lie in the initial encoding stage. Various possibilities have been suggested to account for why the elderly do not adopt elaborative encoding strategies. One important question that has not been fully explored relates to the elderly's ability to utilize elaborative encoding techniques. If given an orienting task to insure that they will process the material in a specified (elaborated) manner in an incidental learning paradigm, will the memory performance of the elderly be better than if they are instructed to simply learn the material (i.e., intentional learning). The utilization of an incidental learning paradigm allows the encoding strategy to be more adequately assessed. In addition, an assessment of the reported strategies utilized by subjects instructed to simply learn would provide additional information regarding the relationship between reported strategy and memory performance, as well as information on the elderly's use of various encoding strategies. It is possible that the elderly may lack or have forgotten important aspects about how their memory operates (i.e., their metamemory as studied by Flavell, 1971).

Subjects were presented ten word pairs. The effects of instructional set (incidental or intentional learning) and encoding task (imagery, nonsemantic, or no instructions) was assessed by three memory tasks that varied in the amount of retrieval information they provided. The three memory tasks were free recall, paired-associate, and recognition. Subjects in the group that received no encoding instructions were questioned about the techniques they had employed to try to remember the words.

If it is the encoding operation that determines memory performance, rather than intention to learn, especially if the elderly do not spontaneously engage in additional encoding techniques, then memory performance under intentional learning should not differ from performance under an incidental learning paradigm with the corresponding encoding instructions. It was also expected that the provision of an imagery orienting task will lead to better overall memory performance than the nonsemantic orienting, task and than intentional learning, where no specific encoding instructions were provided. If the elderly are mediationally deficient (i.e., do not spontaneously utilize elaborative encoding to the same degree that young subjects do), then under this latter condition they will report utilizing more inefficient strategies, such as rote memorization or no specific strategy, than mediational techniques. Relating to this notion of a mediational deficiency is the expectation of observing more variability in memory performance in the intentional learning condition. That is, some subjects may report utilizing elaborative encoding and their memory performance will be equivalent to the memory performance of the incidental imagery group. Because of the well-documented retrieval deficit in the elderly (e.g., Schonfield & Robertson, 1966) it is expected that memory performance under free-recall will not be significantly different for the three groups. However, because of the hypothesized more elaborate encoding in the incidental imagery group, it is expected that with the provision of additional retrieval cues (e.g., paired-associate and recognition task), this group will benefit disproportionately.

In addition, through the questionnaire data, the contribution of factors such as physical health, physical activity, mental activity and self-reported indices of life functioning and memory to memory performance was assessed. Finally, there are basic processes that are believed to relate to several component processes involved in memory such as rehearsal, attention, concentration, processing speed, imagery and concurrent processing. Tasks were designed to assess a subject's performance on these basic processes and an attempt was made to predict memory performance from these variables.

In summary, the major comparisons made were between two types of instructional sets and three levels of encoding instructions, and how initial encoding relates to retrieval cues and memory performance Additional variables contributing to memory performance were also investigated to further isolate how these processes operate in the elderly.

The relatively new Levels of Processing conceptualization of memory has not been adeuqately extended and tested with an elderly population. It is also felt that the elderly's use of imagery mediation has not been fully explored. In addition, there have been very few learning and memory studies that have utilized a single age group and focused on individual differences and variability of memory performance within an elderly population. Also, virtually no studies in the area of memory and the aged have attempted to explore what more simple basic processes are involved and that might predict memory performance. Nor have there been systematic studies that have attempted to relate the biographical and organismic variables of aging to memory.

It is hoped that this study will provide additional theoretical support for the Levels of Processing framework as well as contribute to a further understanding of conditions under which the memory performance of the elderly might be enhanced. It is also hoped that memory in the elderly might be more fully understood through an examination of basic component processes and organismic variables.

CHAPTER III

METHODOLOGY

Subjects

A total of 80 subjects participated in the experiment. The experimenter spent time visiting a senior center in West Chester, Pennsylvania and recruited volunteers. In addition, the president of the Retired Teacher's Association in West Chester and a retired teacher acquaintance of the experimenter's in the Chicago area also assisted in recruiting volunteers. A request for participants sent out with the West Chester Senior Center news letter resulted in minimal responses. The subjects were all 65 years of age or older and all were living independently. They were free from uncorrected visual or auditory defects that would affect their participation in the experiment. A brief test for their ability to read using corrected vision was administered. Subjects were asked to read a series of letters from a card held in front of them. A brief hearing test was also administered, where subjects repeated a short sentence after the experimenter. One subject had to be disqualified from participation because of poor vision. The subjects' ages ranged between 65 and 91 with a mean age of 72. The subjects were all volunteers and there were 11 males and 69 females.

General Procedure

All subjects participated individually in one experimental session. The experimenter first described the general nature of the study and administered the questionnaire. The subject was then administered the paired-associate encoding-test procedure. Each subject was randomly assigned to one of five conditions: intentional learning without encoding instructions (Intentional None), intentional learning with imagery encoding instructions (Intentional Imagery), intentional learning with nonsemantic encoding instructions (Intentional Spell), an incidental learning imagery encoding condition (Incidental Imagery), and an incidental nonsemantic encoding condition (Incidental Spell). Table I depicts the design.

TABLE I

EXPERIMENTAL DESIGN

		Instructional Set	
		Incidental	Intentional
	Imagery	Incidental Imagery	Intentional Imagery
Encoding Task	Non-semantic	Incidental Spell	Intentional Spell
	No Instructions	______	Intentional None

All five groups received three retention measures: free recall, paired-associate, and recognition. The subject was then administered the Vocabulary subtest of the Wechsler Adult Intelligence Scale (WAIS). Finally, a series of nine basic process tasks were completed.

Biographical-Life Functioning Data

Each subject completed a questionnaire that covered a wide range of areas relating to basic biographical information, occupational and educational history, health, current use of time, social, intellectual and physical activity and self-reported memory functioning. The questionnaire took approximately 15 minutes to complete and it can be found in Appendix A.

Paired-Associate Procedure

The subjects were randomly assigned to one of five groups. Subjects in the three intentional learning conditions were told that they would be required to remember the words under a one-trial study-test procedure. In the Intentional None condition subjects were not provided with encoding instructions. Subjects in the Intentional Imagery condition were told that the experimenter was also interested in their ability to form an image of the referents of the two words interacting together in some way. Several examples with two practice trials were provided. For instance, for the pair "baby-ship" a subject might say, "I see a tiny baby holding up a large ship." In the Intentional Spell condition subjects were given the task of re-spelling each word in terms of the letters alphabetically following the original spelling. For example, if the word was "frog," the subject would say, "g, s, p, h." Again, subjects were provided with examples and two practice trials. In the two incidental encoding conditions, Incidental Imagery and Incidental Spell, subjects were required to perform the encoding tasks, but were not told of the subsequent memory test. The imagery encoding instructions and nonsemantic encoding instructions and procedures were identical for the Incidental Imagery and Incidental Spell groups to those given to subjects in the Intentional Imagery and Intentional Spell conditions. The specific instructions for the encoding phase appear in Appendix B.

A self-paced schedule was used for both the study and test trials. The stimulus items consisted of ten word pairs typed on individual index cards. The subjects were handed one card at a time containing a pair of words and they requested the next word pair at their own rate. If a subject utilized more than 30 seconds for any pair the experimenter was to encourage the subject to go on to the next pair. However, this did not occur. The total encoding time was recorded for all five groups.

The test phase consisted of three parts. First all subjects were tested in a variation of free recall. They were asked to write down as many words as they could remember in any order (both stimulus and response terms). The paired-associate task was then administered. A list consisting of a series of 10 stimulus items was presented. The subject's task was to supply the term that had initially appeared with each word. Finally, subjects were given a recognition task where all the original words, stimulus and response items appeared with an equal number of distractors. Subjects were required to circle the original words. Appendix C contains the instructions for the memory tasks and samples of the paired-associate and recognition tests.

Following the retention tests, the Intentional None group was shown each pair of words again and asked about the method they had employed to learn or remember the words. Previous research (e.g., Rowe & Schnore, 1971) has found that subject strategies can be classified according to several categories; (a) verbal mediation, which involves the use of a connecting word, phrase or sentence, (b) imagery, (c) repetition or rote learning, (d) no method used, (e) words too odd to connect, and (f) miscellaneous strategies. The six categories with examples were explained and subjects were handed a sheet of paper listing the categories with their definition and examples. Appendix D contains the instructions and the list of categories that was handed to the subjects. The subject was handed each study card, one at a time, and chose one of the six alternatives used to learn each word pair. If any questions arose, the experimenter assisted the subject in deciding upon a category, although the experimenter's involvement was kept at a minimum.

Subjects in the Incidental Imagery and Incidental Spell conditions were asked whether they had suspected that recall would be requested. No subjects in these two groups suspected that they would be required to remember the words.

<u>Verbal Intelligence</u>

All subjects were administered the Vocabulary Subtest of the WAIS to obtain an index of verbal intelligence.

Basic Processes

A series of nine tasks were administered. Some of these tasks and procedures were those utilized by Weber and Bach (1969), Weber and Castleman (1970), Weber, Kelley and Little (1972), and Weber and McManman (1977). They were designed to allow for comparisons between overt and covert processing, visual imagery and speech imagery, concurrent processing, and attention. It is believed that these tasks relate to such functions as rehearsal rate, speed of perceptual processing, image production, processing flexibility or control, and concentration or attention.

For each of the nine tasks subjects were given instructions and a brief practice trial to insure that the task was understood. Before beginning these tasks the subjects were checked for their familiarity with the alphabet and if necessary, given a chance to relearn. The instructions for the tasks appear in Appendix E.

Speech Processing. In the Explicit Speech (SE) condition subjects were told to say the letters of the alphabet out loud as quickly as possible without stopping. In the Speech-mouth (SM) condition, subjects were told to mouth the letters of the alphabet as quickly as possible without stopping. The Alternate (A) condition involved subjects going through the alphabet alternating between saying one letter aloud and mouthing the next letter. These three tasks were timed with a stopwatch, and subjects were not given information on their response times.

Visual Properties Processing. Individual lower-case, typed letters can be classified as being large vertically (e.g., b, f, h . . . y) or small vertically (e.g., a, c, o, . . . z), resulting in a total of 12 large and 14 small letters. In the Percept (P) condition subjects were required to classify the letters of the alphabet along this dimension as the letters were visually displayed in lower-case typed letters. In the Translation (T) condition the subjects looked at the alphabet in upper-case typed letters and had to translate and classify each letter according to its vertical size as if the letter were lower-case. In the Visual Imagery (VI) condition subjects were instructed to close their eyes and try to see or imagine the letters of the alphabet in lower-case letters successively passing before them in the same spot and classify them according to size. These tasks were timed, and subjects were not permitted to see their times.

Concurrent Processing. Subjects were first required to say the letters of the alphabet as many times as possible within a ten second period. They were then required to write the numbers zero through nine as many times as possible within a ten second period. Finally, subjects were told to say the alphabet and concurrently write the numbers at the same time, as many times as possible within a ten second time period.

Digit Span. Subjects were administered the Digit Span subtest of the WAIS (digits foreward and backward). Subjects received the standard instructions.

Materials

The stimulus materials employed in this study for the paired-associate task consisted of ten noun pairs. The 20 nouns were selected from a pool of 925 nouns for which imagery (I), concreteness (C), meaningfulness (M), and frequency of occurrence ratings were available (Paivio, Yuille & Madigan, 1968; Thorndike & Lorge, 1944). Nouns of moderate imagery ratings were chosen. All 20 words were of high frequency (AA or A by the Thorndike-Lorge count) and of high values with respect to meanginfulness and concreteness. The nouns were paired randomly with the restriction that any obvious associations between the words of a pair be minimized. An additional 20 words of similar values were selected from this same pool as distractor items for the recognition test.

Design

The subjects were randomly assigned to one of five conditions that varied in terms of whether they knew of the subsequent memory tasks (intentional or incidental learning) and type of encoding instructions (no instructions, imagery or nonsemantic). This resulted in a modified 2 x 3 factorial design with one cell missing. One cell was missing because there was no condition for incidental learning without encoding instructions. Each type of retention task (free recall, paired-associate recall, and recognition) was treated as a different dependent variable. In addition, the basic process tasks were all within subject variables.

The proportion of words correctly recalled in each condition as a function of encoding task and instructional set was analyzed by a factorial experiment with a single control group (Winer, 1971,

p. 468). There are essentially two parts to this type of analysis; a 2 x 2 analysis of variance that is augmented by Nunnett's Test, where a single control group is compared with all other group means. In addition, analyses of variance for proportion of errors of commission and proportion of errors of omission were run. Inspection of the data led the investigator to suspect that arcsine transformations for proportional data would not be effective. A priori _t_-tests were run between the Intentional Imagery and Incidental Imagery conditions and between the Intentional Spell and Incidental Spell conditions. Pre-planned orthognal comparisons were also conducted between the Intentional None, Incidental Imagery and Incidental Spell conditions for the retention tasks. For the Intentional None condition percentage of pairs for which subjects reported use of a particular learning strategy and percentage of these pairs which were correct were computed for the three memory tasks. A correlational analysis was run on the questionnaire data, verbal I.Q., basic process performance and memory. In addition, multiple regression analyses were conducted for memory performance as a function of the basic process variables, and verbal I.Q. for subjects in the Intentional None, Incidental Imagery and Incidental Spell conditions.

CHAPTER IV

RESULTS

In this section the major hypotheses of the study will be restated, accompanied by the rationale, and the results pertinent to each will be presented.

Because the encoding operations rather than intention to learn determines memory, it was hypothesized that intention to learn would not result in better memory performance.

> Hypothesis 1: There will be no significant differences between incidental and intentional learning.

This hypothesis was supported by the data. Table II shows the descriptive statistics. A priori *t*-tests revealed that the mean proportion correct for subjects in the Incidental Imagery condition did not differ significantly from the mean proportion correct of subjects in the Intentional Imagery condition for the free recall, paired-associate and recognition tasks. In addition, a priori *t*-tests indicated that the mean proportion correct for subjects in the Incidental Spell condition did not differ significantly from the mean proportion correct of subjects in the Intentional Spell condition for the free recall, paired-associate and recognition tasks.

The overall analyses of variance for proportion correct are presented in Tables V, VI, and VII in Appendix F and indicate no

TABLE II

MEANS AND STANDARD DEVIATIONS FOR FREE RECALL, PAIRED-ASSOCIATE, AND RECOGNITION--PROPORTION CORRECT

Group	n	Mean	Standard Deviation
		Free Recall Test	
Incidental Learning			
Imagery	16	.3750	.1461
Spell	16	.1312	.0750
Intentional Learning			
None	16	.3188	.1879
Imagery	16	.4031	.1372
Spell	16	.1157	.1248
		Paired-Associate Test	
Incidental Learning			
Imagery	16	.5125	.2705
Spell	16	.0125	.0342
Intentional Learning			
None	16	.3438	.3265
Imagery	16	.5438	.2529
Spell	16	.075	.2017
		Recognition Test	
Incidental Learning			
Imagery	16	.8687	.1078
Spell	16	.55	.1663
Intentional Learning			
None	16	.7156	.2271
Imagery	16	.8844	.0769
Spell	16	.6062	.2428

significant main effects for incidental and intentional learning under the free recall, paired-associate and recognition tasks. Included in the analyses of variance tables are the adjusted F values for unequal variances (Box, 1954). The data for proportion of errors of commission were not significant (see Tables VIII, IX, X, and XI in Appendix G). The data for proportion of errors of omission, essentially the converse of proportion correct, did not yield significantly different results from the data for proportion correct. The data for these two measures will not be discussed further. The a priori t-tests for incidental versus intentional learning for proportion correct for the Imagery and Spell encoding conditions are presented in Table XII in Appendix H.

The next group of hypotheses relate to the effects of the orienting encoding tasks on memory performance. The critical comparisons were between the Intentional None condition, the Incidental Imagery condition and the Indicental Spell condition.

Because of the well-documented retrieval deficit in the elderly, no difference in free recall performance was expected.

> Hypothesis 2: It was hypothesized that the mean performance of the three encoding groups; Intentional None, Incidental Imagery, and Incidental Spell, would not differ significantly under the free recall task.

Subjects in both the Intentional None and Incidental Imagery conditions recalled approximately 35% of the words, as assessed by the free recall task, whereas, subjects in the Incidental Spell condition recalled only 23% of the words. Thus, the recall levels for all three groups were relatively low under free recall, as compared with the other memory tasks (see Table II). The analysis of variance for proportion correct (see Table V in Appendix F) indicated an overall significant effect, with $\underline{F}$ (1,75) = 58.49, $p < .001$. The pre-planned orthognal comparisons between the means of the Intentional None condition and the Incidental Spell condition indicated a significant difference with $\underline{t}$ (2,45) = 3.829, $p < .01$, where subjects in the Incidental Spell condition recalled fewer words (Table III). In addition, the pre-planned orthognal comparisons between the means of the Incidental Image and the Incidental Spell conditions revealed that subjects in the Incidental spell condition recalled significantly fewer words with $\underline{t}$ (2,45) = 4.976, $p < .001$.

As predicted, the planned orthognal comparisons between the means of the Intentional None and the Incidental Imagery conditions revealed no significant differences.

In summary, this hypothesis was partially supported in that the overall analysis of variance was significant with subjects in the Incidental Spell condition performing significantly worse than subjects in the other two conditions which did not differ from each other.

Elaborative encoding is believed to result in better memory and it is believed that the elderly do not spontaneously utilize elaborative encoding techniques. Therefore, it was expected that the paired-associate and recognition memory of subjects in the Incidental Imagery condition would be superior to the performance of subjects in the Incidental Spell and Intentional None conditions.

> Hypothesis 3: The memory performance of subjects in the Incidental Imagery condition will be superior to the memory performance of subjects in the Incidental Spell and Intentional None conditions as assessed by the paired-associate and recognition tasks.

TABLE III

A PRIORI ORTHOGNAL COMPARISONS FOR FREE RECALL, PAIRED-ASSOCIATE AND RECOGNITION--PROPORTION CORRECT

Comparison	t value	< p
Free Recall		
Intentional None, Incidental Imagery	1.147	N.S.
Intentional None, Incidental Spell	3.829	$p < .01$
Incidental Imagery, Incidental Spell	4.976	$p < .001$
Paired-Associate		
Intentional None, Incidental Imagery	2.033	$p < .05$
Intentional None, Incidental Spell	3.992	$p < .001$
Incidental Imagery, Incidental Spell	6.024	$p < .001$
Recognition		
Intentional None, Incidental Imagery	2.469	$p < .05$
Intentional None, Incidental Spell	2.671	$p < .01$
Incidental Imagery, Incidental Spell	5.140	$p < .001$

$t_{crit} = 2.02$, $p < .05$

This hypothesis was supported. The analysis of variance for proportion correct for the paired-associate task indicated an overall significant value with $\underline{F}$ (1,75) = 65.7426, $p < .001$. The analysis of variance for proportion correct for the recognition task indicated an overall significant effect with $\underline{F}$ (1,75) = 45.6763, $p < .001$. As predicted, the planned orthognal comparisons (Table III) revealed that for the paired-associate task, subjects in the Incidental Imagery condition recalled a greater proportion of words than did both subjects in the Intentional None condition with $\underline{t}$ (2,45) = 2.033, $p < .05$ and subjects in the Incidental Spell condition with $\underline{t}$ (2,45) = 6.029, $p < .001$. In addition, subjects in the Intentional None condition recalled a greater proportion of words than did subjects in the Incidental Spell condition with $\underline{t}$ (2,45) = 3.992, $p < .001$.

For the recognition task, again, subjects in the Incidental Imagery condition recalled a greater proportion of words than did both subjects in the Intentional None condition with $\underline{t}$ (2,45) = 2.469, $p < .05$, and subjects in the Incidental Spell condition with $\underline{t}$ (2,45) = 5.140, $p < .001$. Subjects in the Intentional None condition recalled a greater proportion of words than did subjects in the Incidental Spell condition with $\underline{t}$ (2,45) = 2.671, $p < .01$.

The next two hypotheses relate to the Intentional None condition. Because of the proposed mediational deficiency in the elderly, it was expected that subjects in the Intentional None condition would report using non-elaborative encoding techniques more frequently than elaborative techniques. Previous research (e.g., Hulicka & Grossman, 1967) has shown that the elderly use non-elaborative techniques more frequently than elaborative techniques (74% vs. 38% of the words). In addition, words reportedly learned by elaborative encoding techniques would be better remembered than those words that were processed nonsemantically, as predicted by the levels of processing theory.

> Hypothesis 4: Subjects in the Intentional None condition will report use of less efficient encoding strategies more frequently than utilization of elaborative encoding techniques.

This hypothesis was not fully supported by the data. Table IV contains the percentage of pairs for which subjects reported use of particular learning strategies and percentage of these pairs (or words) which were correct for the three recall tasks. For each of the ten word pairs an analysis of the encoding techniques used by all 16 subjects in the Intentional None condition was conducted. This analysis indicated that subjects reported using elaborative encoding techniques, such as imagery, verbal connection and miscellaneous strategies more frequently than inefficient encoding strategies, such as rote memorization, no particular strategy, or words too odd to connect (58.74% vs. 41.26% of the word pairs).

> Hypothesis 5: Words that were reportedly learned by elaborative encoding techniques will be remembered more often than those words that were learned by non-mediational strategies.

This hypothesis was confirmed by the data (see Table IV). For the free recall task 34.42% of the words that were learned by forming a verbal connection were recalled; 39.19% for imagery; and 65% for miscellaneous strategies. This was in contrast to 23.69% of the words being recalled when rote memorization was utilized; 14.28%

when no strategy was employed and 13.46% when the words were reportedly too odd to connect.

TABLE IV

PERCENTAGE OF PAIRS FOR WHICH SUBJECTS REPORTED USE OF PARTICULAR LEARNING STRATEGIES AND PERCENTAGE OF THESE PAIRS WHICH WERE CORRECT--FREE RECALL, PAIRED-ASSOCIATE, AND RECOGNITION

	Learning Strategy					
	Verbal	Image	Misc.	Rote	None	Too Odd
% Used	29.37	23.12	6.25	11.8	13.12	16.24
Free Recall % correct	34.42	39.19	65.00	23.69	14.28	13.46
Paired-Associate % correct	48.93	62.16	60.00	0	14.29	0
Recognition % correct	81.92	74.31	85.00	50.00	59.52	63.46

For the paired-associate task, word pairs that were learned by forming a verbal connection were correct for 48.93% of the pairs; 62.16% of the pairs were correct when imagery was reported, and 69% of the pairs were correct when miscellaneous strategies were utilized. In contrast, only 0% of the pairs were correct when rote memorization was reported, 13.125% when no particular strategy was used, and 0% correct when words were reported as being too odd to form a connection.

For the recognition task 81.92% of the words that were learned by forming a verbal connection were correct; 74.32% of the words were correct when imagery was used; and 85% of the words were correctly recognized when miscellaneous strategies were employed. When rote memorization was used 50% of the words were correct; 50.52% of the words were correct when no strategy was used and 63.46% correct when the words were too odd to connect.

Therefore, it appears that memory as assessed by all three recall tasks was facilitated when elaborative encoding techniques were utilized. Surprisingly, the most effective strategies were those that were unique (i.e., Miscellaneous Strategies). Examples of the miscellaneous strategies utilized to learn various word pairs are presented in Appendix I. It is difficult to form generalizations of strategy based on these idiosyncratic strategies. In general, the provision of one member from each word pair in the paired-associate task did not serve to cue memory when the words were encoded by non-elaborative techniques, although performance did imporve in the recognition task. In contrast, performance was enhanced in the paired-associate task, and again in the recognition task with additional cues, for those words encoded by elaborative methods.

Finally, because subjects in the Intentional None condition were free to use a variety of encoding techniques, it was predicted that their memory performance as assessed by the three memory tasks would be more variable than that of subjects in the Incidental Imagery and Incidental Spell conditions.

Hypothesis 6: Memory performance as assessed by the free recall, paired-associate, and recognition tasks

> will be more variable for subjects in the Intentional None condition than that of subjects in the Incidental Imagery and Incidental Spell conditions.

This hypothesis was supported by the data. In all three memory tasks the largest variance was in the Intentional None condition. The F max test for the free recall task resulted in an F max value of 6.30, which was significant ($p < .01$). For the paired-associate task the F max value was 88.83 ($p < .01$). The F max value was 4.45 ($p < .05$) for the recognition task. Table XIII in Appendix J contains the F max values and their level of significance.

Basic Process and Demographic Data

A secondary purpose of this study was to determine the relationship between presumably more basic memory processes and memory performance on the three recall tasks. In addition, the relationship between the questionnaire data and memory performance was assessed.

Multiple regression analyses for the basic process variables on the three memory tasks are presented in Appendix K. For the dependent variable, free recall, 45% of the variance was accounted for by the design variables. The Pure Imagery score accounted for an additional 3% of the variance in free recall memory with partial $\underline{R}$ (78) = −.2258, $p < .05$. The other variables did not significantly add to the amount of variance accounted for (see Table XIV in Appendix K).

For the dependent variable, paire-associate, 47% of the variance was accounted for the design variables. The five basic process variables did not account for a significant proportion of additional variance (see Table XV in Appendix K).

For the recognition task, the design variables accounted for 38% of the variance. The multiple regression analysis indicated that the variable Saving was significant and accounted for an additional 3% of the variance with partial R (78) = .2243, $p < .05$. The other variables did not add significantly to the accounted for variance (see Table XVI in Appendix K).

In summary, the hypothesis that variablility in memory performance could be accounted for in terms of more basic processes did not receive strong support. In all three memory tasks, a significant proportion of the variance in performance was accounted for by the design variables with the basic process tasks contributiong relatively little additional accounted for variability.

The relationship between memory performance on the three recall tasks and various organismic variables and the questionnaire data was also assessed by multiple regression analyses. The three multiple regression analysis summary tables for the memory tasks are presented in Tables XVII, XVIII, and XIX in Appendix L.

For the free recall task 45% of the variance was accounted for by the design variables. The total vocabulary score (VOC TOT) accounted for an additional 7% of the variance which was significant with with partial R (78) = .3831, $p < .05$. The next variable, AGE, accounted for an additional 4% of the variance and was significant with partial R (78) = -.2841, $p < .05$. Marital status (MARITAL) accounted for an additional 2% of the variance and was significant with partial R (78) = -.2292, $p < .05$. The other variables were not significant (see Table XVII in Appendix L).

For the paired-associate task 47% of the variance was accounted for by the design variables. The total vocabulary score (VOC TOT) was significant and accounted for an additional 9% of the variance with partial $\underline{R}$ (78) = .4141, $p < .05$. WELLNESS, a self reported measure of physical health, was significant and accounted for an additional 3% of the variance with partial $\underline{R}$ (78) = .2525, $p < .05$. The next variable, LOSS, a self report measure indicating the recent loss of a close friend or relative accounted for an additional 1% of the variance with partial $\underline{R}$ (78) = -.1897, $p < .05$. The other variables were not significant (see Table XVIII in Appendix L).

For the recognition task 38% of the variance was accounted for by the design variables. The variable VOC TOT was significant and accounted for an additional 6% of the variance with partial $\underline{R}$ (78) = .3179, $p < .05$. The variable CUR HSE, an index of how many people live in the current household, was significant and accounted for an additional 2% of the variance with partial R (78) = .18916, $p < .05$. The other variables were not significant (see Table XIX in Appendix L).

In summary, the total vocabulary score accounted for the most additional variance in memory performance for all three memory tasks. Although there were several variables that accounted for an additional significant proportion of the variance, none were consistent across the three memory tasks. Table XX in Appendix M contains the descriptive statistics (means and standard deviations) for the questionnaire and basic process variables.

CHAPTER V

DISCUSSION

Previous research has suggested that it is the encoding operation or processing activities that determines memory performance, rather than intention to learn (e.g., Craik & Lockhart, 1972). It has also been shown that elaborative (i.e., semantic or mediational) encoding results in superior memory compared to non-elaborative encoding techniques (e.g., Craik & Tulving, 1975). With regard to the memory functioning of the elderly, numerous researchers have suggested that at least part of the memory difficulties can be accounted for by the fact that the elderly do not spontaneously utilize mediational encoding strategies i.e., they are mediationally deficient (e.g., Hulicka & Grossman, 1967). In addition, it has been shown that the elderly have more difficulty with memory when retrieval cues are minimal, as in a free recall situation (e.g., White, reported by Craik, 1977).

The results of the present study supported the Levels of Processing view of memory performance as being a function of the processing activities rather than intention to learn. The hypothesis that no difference between incidental and intentional learning under all three memory tasks for the imagery encoding condition and for the nonsemantic (Spell) encoding condition was supported. Thus, even though subjects run under intentional learning knew of the memory requirement they did not spontaneously engage in additional encoding operations that were effective.

The hypothesized mediational deficiency was also supported by the finding that the memory performance of subjects in the Incidental Imagery encoding condition was superior to that of both subjects in the Incidental Spell condition and in the Intentional None condition under the paired-associate and recognition tasks. That is, subjects in the Intentional None condition, who were attempting to remember the words did not do as well as subjects in the Incidental Imagery condition, who merely performed an orienting task. This finding also supported the notion that more elaborate encoding results in superior recall; this hypothesis will be discussed under the heading "Effects of Elaborate Encoding."

To further clarify the proposed mediational deficiency an analysis of the encoding operations utilized by subjects in the Intentional None condition was conducted. The hypothesis that these subjects would report using elaborative techniques less frequently than non-elaborative techniques was not fully supported by the data even though these subjects did not perform as well as subjects in the Incidental Imagery condition. It was also hypothesized that the memory performance of subjects in the Intentional None condition would be more variable than that of subjects in the other two groups, whose processing activities were circumscribed by the orienting tasks. This hypothesis was supported.

The notion that elaborative encoding techniques result in memory superior to non-elaborative techniques was supported. First, for subjects in the Intentional None condition, those words that were reportedly learned by mediational techniques were remembered more frequently than words that were learned by non-elaborative techniques. In addition, as mentioned, the paired-associate and recognition performance of subjects in the Incidental Imagery condition who were essentially "forced" to encode the stimuli in an elaborative manner, was superior to that of the other groups.

Because of the proposed retrieval deficit in the elderly, it was hypothesized that the memory performance of subjects in the Intentional None, Incidental Imagery and Incidental Spell conditions would not differ significantly under free recall. This hypothesis was partially supported by the data, where no difference between the Intentional None and Incidental Imagery condition was found. However subjects in both of these groups performed significantly better than subjects in the Incidental Spell condition.

A secondary purpose of this study was to attempt to account for memory functioning in terms of more basic memory processes, such as processing speed, cognitive flexibility and reharsal rates. The tasks utilized in the present study to measure these processes did not predict memory performance. The suggestion is that memory is a set of abilities independent of the basic processed studied here.

In addition, the relationship between memory and various organismic variables, such as age and vocabulary score, and self-reported indicies (e.g., health, life satisfaction and memory functioning) was assessed. Other than vocabulary score, these measures had little predictive value. This leads to the important conclusion that over a fairly broad range of values, organismic variables, such as those studied here, are not important determinants of memory.

Incidental Versus Intentional Learning

The finding of no difference between incidental and intentional learning supports the Levels of Processing conceptualization of memory functioning. Within this framework, memory is conceptualized as being a consequence of the processing activities of the individual. Therefore, any difference between incidental and intentional learning is believed to occur as a function of the subjects performing different mental operations in these two situations. Research has shown that the elderly do not spontaneously carry out the additional encoding operations that young subjects do under intentional learning conditions (e.g., Johnson, 1973 reported by Craik, 1977; Wimer, 1960). However, no studies have examined intentional learning in the elderly where the encoding operations were controlled, at least in part, by an orienting task, as compared with incidental learning, where subjects simply performed the orienting task.

There are several plausible explanations as to why subjects in the present study run under intentional learning did not engage in additional processing activities. In the Intentional Imagery condition one might hypothesize that subjects felt that the imagery orienting task was sufficient for remembering the word pairs. In addition, other researchers have suggested that the elderly do not engage in elaborative encoding operations because of the additional memory load (Arenberg & Robertson-Tchabo, 1977). Therefore, it is possible that the task of forming an image connecting the word pairs required so much effort on the subject's part that they were simply unable to carry out additional activities.

It was somewhat surprising that subjects in the Intentional Spell condition, who knew of the memory requirement, did not engage in additional elaborative encoding techniques. Subjects were allowed to spend as much time as they needed to study the word pairs once they performed the orienting task. Therefore, the opportunity for more elaborate encoding was provided, but not utilized. When the memory tasks were presented several subjects in the Intentional Spell condition stated that they had been so involved in carrying out the orienting task that they forgot to try to remember the words. Other subjects appeared to be attempting to learn the stimuli. It is possible however, that the orienting task functioned as interference for either carrying out additional encoding operations or for later memory performance.

Mediational Deficiency

The hypothesized mediational deficiency in the elderly was tested further through an analysis of the encoding strategies utilized by subjects in the Intentional None condition. This hypothesis was not fully supported in that it was found that subjects reported using mediational strategies more often than non-mediational techniques (approximately 59% versus 41%) as contrasted with previous findings (e.g., Hulicka & Grossman, 1967). Thus, over half of the total word pairs were learned by elaborative encoding techniques.

Out of the 16 subjects in the Intentional None condition only three subjects reported using non-mediational strategies for all ten word pairs. The rest of the subjects used a variety of techniques that included both elaborative and non-elaborative methods. It therefore, appears that the elderly have knowledge of numerous encoding strategies and are capable of utilizing them. However, they do so inconsistently.

It is difficult to determine from the data why subjects do not consistently utilize mediation. The use of mediation requires some degree of cognitive flexibility and creativity, skills in which the elderly, as compared with young subjects, do not do as well. In addition, as mentioned, mediation may result in an additional memory load.

A hypothesis stemming from the prediction that the elderly utilize a variety of encoding techniques was that the memory performance of subjects in the Intentional None condition would be more variable than that of subjects in the Incidental Imagery and Incidental Spell conditions. This hypothesis was supported. The variability of performance of subjects in the Intentional None condition has already been discussed as relating to the variety of encoding strategies these subjects adopted. In addition, the encoding activities of subjects in the other two conditions were circumscribed by the requirements of the orienting tasks. That is, these subjects essentially were required to process the stimuli in an equivalent manner within conditions, which would result in less variability in memory functioning.

It is recognized that one of the assumptions for analysis of variance is homogeneity of variances. Numerous investigators have studied the consequences of violating this assumption (e.g., Boneau, 1960; Norton in Lindquist, 1953). Meyers (1973) concluded, ". . . if the independence and normality assumptions hold, and if the n's are equal, Type I error rates will generally be only slightly inflated above their nominal levels" (p. 75). In the present study the Box (1954) technique for adjusting for heterogeneity of variance was utilized. The test of significance with the adjusted degrees of freedom results were comparable to the original analysis of variance.

Effects of Elaborative Encoding

It has been proposed that elaborative encoding techniques will result in better memory than non-elaborative techniques (Moscovitch & Craik, 1976). An analysis of the encoding strategies of subjects in the Intentional None condition indicated that words that were reportedly learned by mediational strategies were correct more often in all three memory tasks than those words that were encoded by non-mediational strategies. Interestingly, the Miscellaneous Strategy category appeared to be the most efficient technique for the free recall and recognition tasks. Both imagery and miscellaneous strategies resulted in relatively better paired-associate recall than verbal connection. This differential effectiveness of encoding strategy might be explained by the nature of the miscellaneous techniques employed. As a whole, they tended to be highly unique and personalized. For example, for the word pair "lord-disease," two subjects said they remembered these words because they were incongruous. For the word pair "animal-speech," another subject stated that she remembered this pair because she had recently read an article on speech in animals.

In summary, the finding of a positive relationship between reported mediation and memory performance is consistent with previous research (e.g., Bugelski, 1962; Kiess & Mantague, 1965; Paivio, Yuille & Smythe, 1966).

In addition to an investigation of the relationship between reported mediation and memory performance, the effects of elaborative encoding was tested further through the use of orienting tasks in an incidental learning paradigm. It was found that the relatively inconsistent use of mediation could be modified through the use of an orienting designed to insure that the subjects process the material in an elaborated manner. This resulted in better memory than when subjects were simply told to learn the material or when the orienting task was nonsemantic. The memory performance of subjects in the Incidental Imagery condition was superior to that of subjects in the Incidental Spell and Intentional None condition as assessed by the paired-associate and recognition tasks.

Moscovitch and Craik (1976) have proposed that more elaborate initial encoding will be more fully realized with the provision of additional retrieval cues than will be initial encoding that was less elaborate. This accounts for the finding of a relatively greater improvement in memory under the paired-associate and recognition tasks for the Incidental Imagery group when additional cues were provided.

In contrast, the paired-associate performance of subjects in the Incidental Spell condition was worse under the paired-associate task than under free recall. Because the stimuli had not been encoded as a unit the provision of one member of each word pair did not cue memory. Subjects in this condition were able to recognize over half of the original stimuli in the recognition task. However, it must be remembered that the paired-associate and recognition tasks were not independent in that subjects were presented with half of the original stimuli in the paired-associate task. It is assumed that the recognition data was due, in part, to seeing one member of each word pair in the paired-associate task and having another opportunity for additional encoding.

It still remains an open theoretical question as to whether the effects of imagery are a function of dual-coding (e.g., Paivio, 1975) or a greater depth or breadth or processing (e.g., Craik & Lockhart, 1972). Both positions can account for the finding and, as previously discussed, the two positions are related.

Retrieval Deficit

As predicted, the free recall performance of the Intentional None group and Incidental Imagery condition did not differ significantly. But subjects in the Incidental Imagery encoding condition processed the material in a more elaborated way than subjects in the Intentional None condition, as indicated by their superior paired-associate and recognition performance. However, under free recall, in which retrieval cues were absent, the memory performance of these two groups did not differ significantly. Craik (1977) has suggested that one reason why older subjects have difficulty when no retrieval cues are provided is that the free recall situation requires that subjects rely on self-generated reconstructive activities. Therefore, as found in the analysis of the encoding strategies of subjects in the Intentional None condition, it is possible that the elderly are less intellectually flexible and creative in these reconstructive activities. In addition, this finding also supports the notion that the effects of imagery appear to occur at the encoding stage rather than during retrieval, particularly when there are minimal cues.

The free recall performance of subjects in the Incidental Spell condition was significantly worse than both that of subjects in the Intentional None and Incidental Imagery conditions. This can be explained by the nature of the encoding task for subjects in the Incidental Spell condition. Subjects were forced to focus on each individual letter which made it difficult to encode the material in an integrated fashion. In the other two conditions greater opportunity for more integrated encoding of each word pair, as well as of each individual word was provided.

Basic Process and Demographic Variables

None of the traditional paired-associate, imagery mediation or Levels of Processing research has attempted to examine more basic process variables such as imagery ability, rehearsal rates, cognitive flexibility and processing speed. It was hoped that an examination of these factors would shed new light on the memory functioning of the elderly. Unfortunately, the basic process variables included in the present study did not account for a significant additional proportion of the variance in memory performance. Those variables that were significant were not so across the three memory tasks. Therefore, it must be concluded that insofar as memory may consist of more elementary components they are not those measured by the tasks employed in the present study.

More research needs to be conducted to clarify the relationship between other basic process tasks and the component processes involved in memory. Part of the difficulty in selecting tasks for inclusion in the present study was the relative lack of research in this area. The different aspects of memory need to be further defined and tasks need to be designed to assess them more fully. Only then, can their relationship to memory be adequately assessed. The implication of this type of research is that specific areas of deficiency in the elderly can be determined. Furthermore, if deficits in memory can be found to occur in one or more specific components then the possibility of remediation or development of compensatory strategies seems greater.

As in previous research, the vocabulary score of subjects in the present study accounted for the most additional variance in memory performance when the effects of the design variables were controlled. This finding is not surprising in that verbal intelligence is known to relate to memory, particularly, verbal memory.

As a whole, the results of the demographic questionnaire did not contribute to the variance in memory performance. At least part of the lack of relationship between memory and the various areas of life functioning was due to the limitations of the questionnaire employed in the present study. It is recognized that this measure was quite general. The areas of functioning were assessed by relatively crude self-reported data that were not externally validated. In addition, the difficulty in relating self-reported measures to a performance criterion was apparent. However, at least in the present study, memory was a relatively robust process, apparently not influenced by the biographical and self-reported indices studied.

In conclusion, the purpose of this study was to assess the elderly's ability to utilize imagery as an encoding technique. It was found that the provision of an imagery orienting task leading to elaborative encoding resulted in superior performance than when subjects were told to simply learn the material. The elderly appear to have the skills necessary for elaborate encoding and can demonstrate these skills when specifically required to do so. However, they do not utilize mediational techniques consistently when no specific orienting task is provided. As in previous research subjects in the present study seemed to prefer verbal mediation rather than imagery mediation. It would be interesting to compare the relative effectiveness of these two technqiues in an incidental learning paradigm, where the experimenter would have optimal control over the encoding activities of the subjects. In support of the levels of processing view, more elaborate analysis of the stimuli resulted in better retention than a nonsemantic analysis. In addition, it was shown that the specific operations performed on the material determine memory rather than intention to learn. Support for a retrieval deficit in the elderly was also obtained. The comparison between the free recall, paired-associate and recognition tasks suggests that even when subjects had encoded the information efficiently, they were relatively deficient in their ability to retrieve when cues were minimal. However, the provision of additional cues resulted in greatly improved performance, particularly for those groups that had encoded the stimuli in an elaborated manner. Further research to clarify the nature of the retrieval deficit needs to be conducted. Specifically, if provided with various retrieval strategies, can retrieval in the elderly be enhanced?

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APPENDIX A

SUBJECT CONSENT FORM INTRODUCTION

AND QUESTIONNAIRE

SUBJECT CONSENT FORM

DATE_______________

NAME (Please print): PHONE:

_____________________ ____________________

ADDRESS:

____

You are being asked to participate in a study of memory. You will be asked to fill out a questionnaire and complete a series of tasks that are believed to be related to different aspects of memory.

You will not sign your name to any material to insure confidentiality. The information gathered will be compiled and examined, focusing upon group responses. We are not concerned with any particular individual's responses.

At no time will you be intentionally exposed to stressful procedures. Participation in this study is strictly on a voluntary basis. You are free to withdraw from participation in this study at any time.

This is to inform all concerned that I, _____________________ have read and understood the terms of the project described, that all my questions regarding the procedures have been satisfactorily answered, and that I freely consent to be employed as a research subject.

General Introduction

Hello. My name is Shelley Buntman. The purpose of my research is to learn more about the thought processes of older people. I will be meeting with many people and will be asking them to do exactly what I am going to be asking you to do. When I am done I will group all the information I collect together because I am interested in looking at group responses, not any one individual's response. In fact, I will ask you not to put your name on any of the papers and you have my assurance that anything you do or say is confidential. I will first give you a questionnaire to fill out. I will then give you some pairs of words to look at. Then I will ask you some questions about different words and finally give you a series of very short tasks to do. You may find that some of the tasks are very easy, while others are more difficult. It is important for you to know that you are not expected to do everything perfectly because nobody can.

Instructions for Questionnaire

I would like you to fill out this questionnaire as best as you can. Again, I want to remind you that I will be grouping everybody's responses together so please do not put your name on the questionnaire. All this information will remain confidential so answer the questionnaire honestly. If there is a question you do not understand please ask me to explain it. This should not take you too long and you need not spend too much time on any one question.

Questionnaire

Subject Code: ____________________

1. Sex (check one): ___ male ___ female

2. Your age to the nearest year: ______

3. Place of birth (specify): __________________________________

4. Religion (check one):

   ___ Nonreligious belief, atheist, or agnostic
   ___ Unitarian, Quaker
   ___ Protestant (Fundamentalist, Baptist, Pentecostal, etc.)
   ___ Protestant (Methodist, Presbyterian, Episcopalian, etc.)
   ___ Catholic
   ___ Jewish
   ___ Eastern Religions

5. Current Church Attendance:

   ___ Never
   ___ Occasionally (special holidays, etc.)
   ___ Bimonthly
   ___ Weekly
   ___ More than once a week

6. Present marital status:

   ___ single
   ___ separated
   ___ widowed
   ___ divorced
   ___ married

7. How long were you (or have you been married) (to closest year):

   ______

8. Please list the number of the following:

   ______ daughters ______ grandchildren
   ______ dons ______ great grandchildren

9. How often do you visit with our family (children, etc.):

   ___ Never
   ___ Occasionally (special holidays, etc.)
   ___ Bimonthly
   ___ Weekly
   ___ More than once a week

10. Members of current household (include everyone who lives with you):
<u>Sex</u> <u>Age</u> <u>Relationship to you</u>

11. Where do you live:

___ own home
___ own apartment
___ boarding room
___ home or apartment of relative or child
___ retirement community
___ other (explain): ______________________________

12. How satisfied are you with your current living arrangements: (circle a number)

1	2	3	4	5
very dissatisfied				very satisfied

13. Fill in the number of years attended at the <u>last</u> institution:

___ grammar school
___ high school Diploma: ___ no ___ yes
___ college B.A. or equivalent: ___ no ___ yes
___ graduate or professional school Degree: __________
___ other educational or career training (explain):

14. Self rating as a student (circle a number):

1	2	3	4	5
very poor				excellent

15. Preretirement work, occupation or profession (list):

16. Spouse's preretirement work, occupation or profession:

17. Are you currently working: ___ yes ___ no

18. If yes, explain type of work:

19. How many days in the last month have you worked:

___ None
___ 1 to 5 days
___ 6 to 10 days
___ 11 to 15 days
___ 16 or more days

20. How financially secure do you feel (circle a number):

1	2	3	4	5
very insecure				very secure

21. Have you had any of the following within the past 10 years (check all that apply):

    ___ fracture ___ head trauma ___ heart disease or heart attack

    ___ lung conditions (bronchitis, emphysema) ___ bladder, prostrate

    ___ diabetes ___ appetite problems ___ sleep problems

    ___ fainting or dizziness ___ breathing difficulties

    ___ fatigue ___ operations (explain):

    ___ other health problems (explain):

22. How do you rate your general health (check one):

    ___ poor ___ fair ___ average ___ good ___excellent

23. Within the past year have you experienced the loss of a close friend, relative, or spouse: ___ yes ___ no

24. Within the past year have you experienced the serious illness of a close friend, relative or spouse: ___ yes ___ no

25. Do you drive a car: ___ yes ___ no

26. Do you have access to someone who can drive you places:

    ___ yes ___ no

27. How easy or difficult is it for you to get places (circle a number):

1	2	3	4	5
very difficult				very easy

28. As compared to when you were 45 years old, how often to you get lost or disoriented when you are going someplace (circle a number):

1	2	3	4	5
often				rarely

29. As compared to when you were 45 how often do you forget names:

1	2	3	4	5
often				rarely

30. As compared to when you were 45 how often do you forget faces:

1	2	3	4	5
often				rarely

31. As compared to when you were 45 how often do you forget phone numbers:

1	2	3	4	5
often				rarely

32. As compared to when you were 45 how often do you forget appointments:

1	2	3	4	5
often				rarely

33. As compared to when you were 45 how often do you forget to take medication:

1	2	3	4	5
often				rarely

34. As compared to when you were 45 how often do you forget things you have just read or seen:

1	2	3	4	5
often				rarely

35. As compared to when you were 45 how often do you misplace things:

1	2	3	4	5
often				rarely

36. As compared to when you were 45 years old, how is your memory now:

1	2	3	4	5
much worse		same		much better

37. How does your memory seem to compare with the memory of your same age friends:

1	2	3	4	5
much worse				much better

38. Please describe any other memory difficulties you have:

39. Approximately how many hours a day do you spend watching television or listening to the radio:

____ None
____ 1 or 2 hours
____ 3 or 4 hours
____ 5 or 6 hours
____ more than 6 hours

40. Approximately how many hours a day do you spend reading the newspaper or magazines:

____ None
____ 1 hour
____ 2 hours
____ 3 hours
____ 4 or more hours

41. Approximately how many hours a day do you spend talking on the telephone:

____ None
____ 1 hour
____ 2 hours
____ 3 hours
____ 4 or more hours

42. Approximmtely how many hours do you nap during the day:

____ None
____ 1 hour
____ 2 hours
____ 3 hours
____ 4 or more hours

43. Approximately how many hours a day do you spend visiting with friends, family, or neighbors:

____ None
____ 1 hour
____ 2 hours
____ 3 hours
____ 4 or more hours

44. Approximately how many hours do you sleep each night:

____ 2 or 3 hours
____ 4 or 5 hours
____ 6 or 7 hours
____ 8 or 9 hours
____ 10 or more hours

45. How often do you attend movies, lectures, plays or concerts:

___ Never
___ Occasionally
___ Bimonthly
___ Weekly
___ MOre than once a week

46. How often do you play bridge or chess:

___ Never
___ Occasionally
___ Bimonthly
___ Weekly
___ More than once a week

47. How often do you play other card games, bingo, etc.:

___ Never
___ Occasionally
___ Bimonthly
___ Weekly
___ More than once a week

48. How many books per month do you read:

___ None
___ 1 book
___ 2 books
___ 3 books
___ 4 or more books

49. How often do you attend club meetings or other organized community or social activities:

___ Never
___ Occasionally
___ Bimonthly
___ Weekly
___ More than once a week

50. How often do you go on outings or visit with friends:

___ Never
___ Occasionally
___ Bimonthly
___ Weekly
___ More than once a week

51. How often do you spend time engaged in hobbies or handicrafts:

___ Never
___ Occasionally
___ 1 to 3 hours a week
___ 4 to 6 hours a week
___ More than 7 hours a week

52. How much time do you spend engaged in strenuous physical activities, such as tennis, jogging, golf or bowling, etc.:

___ Never
___ Occasionally
___ 1 to 3 hours a week
___ 4 to 6 hours a week
___ More than 7 hours a week

53. How much time do you spend engaged in less strenuous physical activities, such as walking, gardening, etc.:

___ Never
___ Occasionally
___ 1 to 3 hours a week
___ 4 to 6 hours a week
___ More than 7 hours a week

54. As compared to when you were 45 years old, how frequent are your social contacts (circle a number):

1	2	3	4	5
less frequent				more frequent

APPENDIX B

ENCODING INSTRUCTIONS

Instructions for Intentional None Condition

I am going to show you ten pairs of words, one pair at a time. I would like you to study each pair of words and try to learn them because later you will be asked to remember them. One thing I will do is show you a list containing one member of each of the pairs and you will write down the other word of the original pair. For example, here is the pair "baby-ship." You would try to learn and remember these words as best as you can. When you saw the word "ship" you would write down the word "baby." You will have as long as you need to study each pair. Do you have any questions?

Instructions for Incidental Imagery Condition

I am interested in your ability to form visual images or mental picture. I am going to show you ten pairs of words, one pair at a time. As you look at each pair I want you to try to picture the two words interacting together or in some sort of action together. Try to make this picture as vivid or unusual as possible. You might do this by exaggerating the size of one of the items, making it way out of proportion of picture the words together in some sort of impossible or unusual action. Once you have formed the image I will ask you to describe it to me. For example, for the pair "baby-ship" you might say "I see a tiny baby holding up a huge ship." You will have as long as you need to form each picture. Do you have any questions?

Instructions for Incidental Nonsemantic (Spell) Condition

I will be showing you ten pairs of words. For each word pair I would like you to spell each word. But instead of spelling the words as they are written I want you to re-spell them with the letters that immediately follow each of the letters in the alphabet. If you saw the word "cat" you would say "d," "b," "u" because "d" comes after "c," "b" follows "a" and "u" comes after "t." Here is the word pair "baby-ship." Show me how you would re-spell it. (c, b, c, z-t, i, j, q). You can have as long as you need for each pair. Do you have any questions?

Intentional-Imagery

I am going to show you ten pairs of words, one pair at a time. Later you will be asked to remember these words. One thing I will do is show you a list containing one word from each of the pairs and you will write down the other word of the original pair. I am also interested in your ability to form visual images or mental pictures. As you look at each pair I want you to try to create a snapshot or a picture of the objects represented by the words. Try to see these objects in some sort of action together, making the picture as vivid or unusual as possible. You might do this by exaggerating the size of the items, making it way out of proportion or picture the words together in some sort of impossible action. Once you have formed the image I will ask you to describe it to me. For example, for the pair "baby-ship" you might say "I see a tiny baby holding up a huge ship." You will have as long as you need to form each picture. Do you have any questions?

Intentional-Nonsemantic

I am going to show you ten pairs of words, one pair at a time. Later you will be asked to remember these words. One thing I will do is show you a list containing one word from each of the pairs and you will write down the other word of the original pair. I also want you to spell each word. But instead of spelling the words as they are written I want you to re-spell them with the letters that immediately follow each of the letters in the alphabet. If you saw the word "cat" you would say "d," "b," "u" because "d" comes after "c," "b" follows "a" and "u" comes after "t." Here is the word pair "baby-ship." you would re-spell it this way: c, b, c, z - t, i, j, q. You can have as long as you need for each pair. Do you have any questions?

APPENDIX C

INSTRUCTIONS FOR MEMORY TASKS

AND EXAMPLES OF THE TESTS

Instructions for Free-Recall

Please write down as many words as you can remember from the words previously presented to you. The words can be written down in any order and do not necessarily have to be recalled according to their initial pairings. You can take as long as you need. Do you have any questions?

Instructions for Paired-Associate Recall

You will be presented with a list of words that comprise one member of the original word-pairs previously presented to you. Please write down the word that had been originally paired with each word listed. You can take as long as you need. Do you have any questions?

Instructions for Recognition

I will show you a long list of words. Some of the words comprise the list of word-pairs previously presented to you. Other words are new words. Please circle all the words that had appeared on the study cards. You can take as long as you need. Do you have any questions?

PAIRED-ASSOCIATE

Subject Code: ______________________________ ________

Instructions: Opposite each printed word write in the word that had initially appeared on the study cards with the printed word.

air

avenue

animal

iron

teacher

gift

brain

disease

shadow

metal

RECOGNITION

Subject Code: ____________________ __________

Instructions: Circle all the words that you remember seeing on the study cards

market	air
iron	flesh
metal	corner
disease	author
product	committee
leader	artist
meeting	season
creature	avenue
journal	present
boulder	lord
troops	soil
gift	murder
teacher	speech
shadow	chief
coast	beast
colony	vegetable
world	property
animal	board
settlement	brain
material	industry

APPENDIX D

TYPES OF LEARNING STRATEGIES

Learning Strategies

There are many different ways that people try to learn these pairs of words. I am going to show you a list of some of the possible learning techniques and give you an example of each one. Then I will show you the list of word pairs again and for each pair I want you to tell me which technique you used to learn each pair. If you are not sure which category to choose we can discuss it together.

1. Rote memorization: This involves saying both words over and over to yourself.

2. Verbal connection: This involves trying to connect the words together with a verbal phrase or sentence. For example, for the pair "coat-bed" the phrase might be "the coat is on the bed."

3. Imagery: This involves forming a picture in your mind of the two words together. For example, for the pair "baby-ship" you might have pictured a baby on a ship or a baby holding a ship.

4. Miscellaneous: Any other method to try to learn and remember the words.

5. No method.

6. Was not able to connect the words together at all.

APPENDIX E

BASIC PROCESS TASKS INSTRUCTIONS

AND EXAMPLES

Instructions for Letter Processing

1. I have several short tasks for you to do. The first thing I want you to do is to say the alphabet as quickly as you can when I say begin. When you have finished, say "stop." So I will say "begin" and you say "abcd, etc. . . . stop." Do you have any questions?

2. Now I want you to do the same thing only this time I want you to say the alphabet to yourself silently. Remember to say "stop" when you are through. So I will say "begin" and you will say the alphabet silently to yourself and then say "stop" out loud when you are through. Do you have any questions?

3. Now I want you to alternate between saying one letter of the alphabet aloud and the next to yourself as quickly as you can. Again, when you have finished say "stop." So after I say "begin" I want you to go through the alphabet like this: "a, c, e . . . stop." Do you have any questions?

Instructions for Visual Properties Processing

1. When the letters of the alphabet are typed in lower case letters they can be classified as vertically tall or vertically small. Letters which are larger than half of a typed space, in either direction, are classified as tall. For each tall letter you are to say "yes" and for each letter which is not tall you are to say "no." As an example I will start at the end of the alphabet, however, you are to start at the beginning and say "stop" when you have finished. ". . . Stop" Do you have any questions?

2. Now I will show you a card with the letters all printed in capitals. I want you to classify them as you did before, as if they were printed in lower case. Please begin when I tell you, go as quickly as you can and say "stop" when you are through. Do you have any questions?

3. For this task I will <u>not</u> show you the card with the alphabet written on it. I want you to imagine or try to see each letter and classify it as "yes" for tall and "no" for small. Remember to say "stop" when you are through. Are there any questions?

Instructions for Concurrent Processing

1. I would like you to now say the alphabet as many times as possible when I say begin and keep going until I say stop.

2. Now I would like you to write the numbers 0 through 9 as many

times as possible when I say begin and keep going until I say stop.

3. I would like you to say the alphabet as many times as possible at the same time you write the numbers 0 through 9 as many times as you can.

Subject Code: ____________

Letter Processing

Speech Explicit (SE): ___

Speech Implicit (SI): ___

Explicit-Implicit (EI): ___

Switching Time=EI-(SE+SI)/2: ___

Visual Properties Processing

Classification (C): ___

Translation (T): ___

Visual Imagery (I): ___

Pure Translation=T-C: ___

Pure Imagery=I-T: ___

Concurrent Processing

Alphabet (A): ___

Numbers (N): ___

Alphabet-Numbers (AN): ___

Savings=AN-(A+N)/2: ___

Vocabulary Test

Subject Code: ______________________

4. Winter	
5. Repair	
6. Breakfast	
7. Fabric	
8. Slice	
9. Assemble	
10. Conceal	
11. Enormous	
12. Hasten	
13. Sentence	
14. Regulate	
15. Commence	
16. Ponder	
17. Cavern	
18. Designate	
19. Domestic	
20. Consume	
21. Terminate	
22. Obstruct	
23. Remorse	
24. Sanctuary	
25. Matchless	
26. Reluctant	
27. Calamity	
28. Fortitude	
29. Tranquil	
30. Edifice	
31. Compassion	
32. Tangible	
33. Perimeter	
34. Audacious	
35. Ominous	
36. Tirade	
37. Encumber	
38. Plagiarize	
39. Impale	
40. Travesty	

Subject Code: ______________

DIGIT SPAN	SCORE
5-8-2	3
6-9-4	3
6-4-3-9	4
7-2-8-6	4
4-2-7-3-1	5
7-5-8-3-6	5
6-1-9-4-7-3	6
3-9-2-4-8-7	6
5-9-1-7-4-2-8	7
4-1-7-9-3-8-6	7
5-8-1-9-2-6-4-7	8
3-8-2-9-5-1-7-4	8
2-7-5-8-6-2-5-8-4	9
7-1-3-9-4-2-5-6-8	9

2-4	2
5-8	2
6-2-5	3
4-1-5	3
3-2-7-9	4
4-9-6-8	4
1-5-2-8-6	5
6-1-8-4-3	5
5-3-9-4-1-8	6
7-2-4-8-5-6	6
8-1-2-9-3-6-5	7
4-7-3-9-1-2-8	7
9-4-3-7-6-2-5-8	8
7-2-8-1-9-6-5-3	8

F_____+B_____=_____

APPENDIX F

ANALYSIS OF VARIANCE FOR PROPORTION CORRECT

TABLE V

ANALYSIS OF VARIANCE--PROPORTION CORRECT--FREE RECALL

Source	Sum of Squares	df	Mean Square	F Ratio	< p
Between Cell	1.1872	4			
Control vs. all others	.05	1	.05	2.5907	NS
Encoding Task	1.1289	1	1.1289	58.49	.01
Instructional Set	.0006	1	.0006	.0311	NS
Encoding Task-Instructional Set	.0077	1	.0077	.3990	NS
Within Cell .9203 + .5294 =	1.4497	75	.0193		

TABLE VI

ANALYSIS OF VARIANCE--PROPORTION CORRECT--PAIRED-ASSOCIATE

Source	Sum of Squares	df	Mean Square	F Ratio	< p
Between Cell	3.8357	4			
Control vs. all others	.0428	1	.0428	.7496	NS
Encoding Task	3.7539	1	3.7539	65.7426	.01
Instructional Set	.0351	1	.0351	.9299	NS
Encoding Task-Instructional Set	.0039	1	.0039	.0683	NS
Within Cell 1.5994 + 2.6844 =	4.2838	75			

TABLE VII

ANALYSIS OF VARIANCE--PROPORTION CORRECT--RECOGNITION

Source	Sum Squares	df	Mean Square	F Ratio	< p
Between Cell	1.4541	4			
Control vs. all others	.0018	1	.0018	.0577	NS
Encoding Task	1.4251	1	1.4251	45.6763	.01
Instructional Set	.0207	1	.0207	.6635	NS
Encoding Task-Instructional Set	.0066	1	.0066	.2115	NS
Within Cell .7736 + 1.5623 +	2.3359	75	.0312		

APPENDIX G

DATA FOR ERRORS OF COMMISSION

TABLE VIII

ANALYSIS OF VARIANCE--PROPORTION OF ERRORS OF COMMISSION--FREE RECALL

Source	Sum of Squares	df	Mean Square	F Ratio	< p
Main Effects	.00352	3	.00117	2.043	NS
Instructional Set	.00327	2	.00163	2.842	NS
Encoding Task	.00035	1	.00035	.611	NS
Instructional Set-Encoding Task	.00035	1	.00035	.611	NS
Explained	.00387	4	.00097	1.685	NS
Residual	.04312	75	.00057		
Total	.0470	79	.00059		

TABLE IX

ANALYSIS OF VARIANCE--PROPORTION OF ERRORS OF COMMISSION--PAIRED-ASSOCIATE

Source	Sum of Squares	df	Mean Square	F Ratio	< p
Main Effects	.0818	3	.0273	1.231	NS
Instructional Set	.0468	2	.0234	1.057	NS
Encoding Task	.0352	1	.0352	1.587	NS
Instructional Set-Encoding Task	.0002	1	.0002	.007	NS
Explained	.0820	4	.0205	.925	NS
Residual	1.6619	75	.0222		
Total	1.7438	79	.0221		

TABLE X

ANALYSIS OF VARIANCE--PROPORTION OF ERRORS OF COMMISSION--RECOGNITION

Source	Sum of Squares	df	Mean Square	F Ratio	< p
Main Effects	.0215	3	.0072	2.544	NS
Instructional Set	.0198	2	.0099	3.517	NS
Encoding Task	.0006	1	.0006	.222	NS
Instructional Set-Encoding Task	.0014	1	.0014	.498	NS
Explained	.0129	4	.0057	2.033	NS
Residual	.2115	76	.0028		
Total	.2345	79	.0029		

TABLE XI

A PRIORI ORTHOGNAL COMPARISONS FOR FREE RECALL, PAIRED-ASSOCIATE AND RECOGNITION--PROPORTION OF ERRORS OF COMMISSION

Comparison	t Value	Significance of t
	Free Recall	
Intentional Learning, Incidental Imagery	.062	NS
Intentional Learning Incidental Nonsemantic	.1285	NS
Incidental Imagery, Incidental Nonsemantic	.1918	NS
	Paired-Associate	
Intentional Learning, Incidental Imagery	.753	NS
Intentional Learning, Incidental Nonsemantic	.765	NS
Incidental Imagery, Incidental Nonsemantic	.6771	NS
	Recognition	
Intentional Learning, Incidental Imagery	.4533	NS
Intentional Learning, Incidental Nonsemantic	.05	NS
Incidental Imagery, Incidental Nonsemantic	.403	NS

$t_{crit} = 2.02$, $p < .05$

APPENDIX H

A PRIORI ORTHOGNAL COMPARISONS FOR INCIDENTAL VERSUS INTENTIONAL LEARNING

TABLE XII

A PRIORI ORTHOGNAL COMPARISONS--INCIDENTAL VERSUS INTENTIONAL-- t VALUES

Memory Test	Incidental Imagery vs. Intentional Imagery df = 30	Incidental Spell vs. Intentional Spell df = 30
Free recall	.574	.318
Paired-Associate	.377	.753
Recognition	.253	.906

$t_{crit} = 2.04$, $p < .05$

APPENDIX I

EXAMPLES OF MISCELLANEOUS STRATEGIES

Examples of Miscellaneous Strategies Utilized

Word Pair	
metal-leader	"I thought of metal being one of the leaders of the government's industry."
	"Metal has lead in it so I remembered metal, lead(er)."
lord-disease	"I remembered these two because lord and disease are incongruous." (two subjects)
animal-speech	"I read an article on speech in animals."
world-air	"This could be the name of an airlines."
shadow-soil	"I remembered the first two letters were S." (two subjects)
vegetable-teacher	"I wondered if some teachers were vegetables."
world-air	"I thought that air is all around the world."
author-gift	"I thought of the book Humbolt's Gift."
iron-journal	"I thought of the alphabet; i comes before j."

APPENDIX J

F MAX TESTS

TABLE XIII

F MAX TESTS

Largest Variance / Smallest Variance	F_{max}	Level of Significance
	Free Recall	
Intentional Learning / Incidental Nonsemantic	6.304	$p < .01$
	Paired-Associate	
Intentional Learning / Incidental Nonsemantic	88.833	$p < .01$
	Recognition	
Intentional Learning / Incidental Imagery	4.448	$p < .05$

F_{crit} 3.54, $p < .05$

4.9, $p < .01$

APPENDIX K

MULTIPLE REGRESSION FOR BASIC PROCESSES

TABLE XIV

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--FREE RECALL
BASIC PROCESS TASKS

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6688	.4473	.5411	
Pure Imagery	.6896	.4755	-.2463	-.2258*
Swi Time	.6958	.4841	-.1964	-.1283
Saving	.6989	.4885	.1432	.0915

Critical value of $r = .1864$, $df = 78$, $p < .05$

TABLE XV

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--PAIRED-ASSOCIATE BASIC PROCESS TASKS

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6870	.4719	.5911	
Pure Imagery	.6936	.4810	-.1864	.1312
Translation	.6966	.4852	-.0402	-.0900
Saving	.6972	.4861	.0422	-.0405

Critical value of r = .1864, df = 78, p < .05

TABLE XVI

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--RECOGNITION
BASIC PROCESS TASKS

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6180	.3819	.5686	
Saving	.6427	.4130	.2019	.2243*
Swi Time	.6492	.4215	-.1743	-.1204
Translation	.6511	.4239	-.1048	-.0640
Pure Imagery	.6521	.4253	-.1550	-.0489

Critical value of $r = .1864$, $df = 78$, $p < .05$

APPENDIX L

MULTIPLE REGRESSION FOR ORGANISMIC AND DEMOGRAPHIC VARIABLES

TABLE XVII

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--FREE RECALL
ORGANISMIC/DEMOGRAPHIC VARIABLES

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6688	.4473	.5411	
Voc Tot	.7269	.5284	.3021	.3831*
Age	.7527	.5665	-.2472	-.2841*
Marital	.7676	.5893	-.2021	-.2292*
Loss	.7734	.5982	-.1123	-.1476

Critical value of r = .1864, df = 78, p < .05

TABLE XVIII

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--PAIRED-ASSOCIATE ORGANISMIC/DEMOGRAPHIC VARIABLES

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6870	.4719	.5911	
Voc Tot	.7500	.5625	.3146	.4141*
Wellness	.7684	.5904	.1740	.2525*
Loss	.7779	.6051	-.1119	-.1897*
Escape	.7859	.6177	-.0040	.1784
Age	.7930	.6289	-.1722	-.1710

Critical value of $r = .1864$, $df = 78$, $p < .05$

TABLE XIX

MULTIPLE REGRESSION SUMMARY TABLE--PROPORTION CORRECT--RECOGNITION
ORGANISMIC/DEMOGRAPHIC VARIABLES

Variable	Multiple-R	R-Square	Simple-R	Partial R
Design	.6180	.3819	.5686	
Voc Tot	.6666	.4444	.2632	.3179*
Cur Hse	.6814	.4643	.0609	.1892*
Satisfy	.6920	.4788	.0713	.1646
Remember	.7026	.4936	-.0861	-.1688

Critical value of $r = .1864$, $df = 78$, $p < .05$

APPENDIX M

SUMMARY STATISTICS FOR ORGANISMIC, DEMOGRAPHIC AND BASIC PROCESS VARIABLES

Scoring Key

1. 0=never; 1-occasionally; 2=bimonthly; 3=weekly; 4=more than once a week
2. 0=single; 1=separated; 2=widowed; 3=divorced; 4=married
3. 0=own home; 1=apartment; 2=boarding room; 3=friend/relative; 4=retirement community; 5=other
4. 1=very dissatisfied; 2; 3; 4; 5=very satisfied
5. 1=very poor; 2;3;4;5=excellent
6. 0=No   1=Yes
7. 0=none; 1=1-5 days; 2=6-10 days; 3=11-15 days; 4=16 or more
8. 1=very insecure; 2;3;4; 5=very secure
9. 0=poor; 1=fair; 2=average; 3=good; 4=excellent
10. 1=very difficult; 2;3;4; 5=very easy
11. 1=often; 2;3;4; 5=rarely
12. 1=much worse; 2; 3=same; 4; 5=much better
13. 0=none; 1=1-2 hrs.; 2=3-4 hrs.; 3=5-6 hrs.; 4=more than 6 hrs.
14. 0=none; 1=1; 2=2; 3=3; 4=4 or more
15. 0=2-3 hrs.; 1=4-5 hrs.; 2=6-7 hrs.; 3=8-9 hrs.; 4= 10 or more hrs.
16. 0=never; 1=occasionally; 2=1-3 hrs./wk.; 3=4-6 hrs./wek.; 4=7or more
17. 1=less frequent; 2;3;4; 5=more frequent

Means and Standard Deviations for Demographic/Questionnaire Data

Variable	Explanation of Variable	Scoring Key	Mean	Standard Deviation
AGE			72.90	5.25
CHURCH	How often attend	1	2.21	1.23
MARITAL	Marital status	2	2.46	1.39
DAUGH	How many daughters		.90	.99
SON	How many sons		.75	.88
GRAND	How many grandchildren		3.13	3.46
GREGRAND	How many great grandchildren		.49	2.37
FAMVIS	How often visit family	1	1.95	1.32
CURHSE	How many in household		.76	.78
LIVEHOW	Where do you live	3	.80	.95
LIVESAT	Satisfaction with living arrangements	4	4.06	1.35
SCHOOL	Years of schooling		14.64	5.44
SCHRATE	Self rating as student	5	3.60	.91
WORK	Do you work	6	.15	.45
WORKDAYS	Number of days worked in last month	7	.33	.92
FINANCES	Rating of financial security	8	3.81	1.07
HEALTH	Type (number) of health problems		2.55	2.16
HEALTHRATE	Self rating of health	9	3.58	1.01
LOSS	Has friend/relative died in past year	6	.48	.64
SICK	Has friend/relative been sick in past year	6	.46	.50
DRIVE	Do you drive a car	6	.60	.49
ACCESS	Access to someone who drives	6	.78	.57
GETEASY	Ease in getting places	10	4.13	1.19
LOSTWAY	Frequency of getting lost compared to when age 45	11	4.51	.97
LOSTNAME	Frequency of forgetting names compared to age 45	11	2.79	1.25
LOSTFACE	Frequency of forgetting faces compared to age 45	11	4.19	.92

Variable	Explanation of Variable	Scoring Key	Mean	Standard Deviation
LOSTTEL	Frequency of forgetting phone numbers compared to age 45	11	3.23	1.33
LOSTAPPT	Frequency of forgetting appointments compared to age 45	11	4.54	.90
LOSTMEDS	Frequency of forgetting medication compared to age 45	11	4.56	.88
LOSTSEE	Frequency of forgetting things read/seen compared to age 45	11	3.23	1.23
LOSTOBS	Frequency of losing objects compared to age 45	11	3.05	1.29
MEMORY	Memory now compared to when age 45	12	2.65	.94
MEMFR	Memory compared to friends	12	3.46	.78
TVRADIO	TV radio--hours per day	13	1.70	.97
READ	Reading newspapers or magazines--hours per day	14	1.65	.90
PHONE	Talking on phone--hours per day	14	.91	.58
NAPS	Napping--hours per day	14	.48	.60
VISIT	Visiting people--hours per day	14	1.56	1.12
SLEEP	Sleeping--hours per night	15	2.19	.60
MOVIE	Frequency of movie, lecture, concert attendance	1	1.24	.86
BRIDGE	Frequency of playing bridge	1	1.30	1.54
GAME	Frequency of playing other games	1	1.05	1.22
NBOOK	Number of books read per month	14	1.59	1.23
CLUB	Frequency of meeting, activities attendence	1	2.20	1.35
OUTING	Frequency of outings	1	1.96	1.12
HOBBY	Frequency spent engaging in hobbies	16	1.60	1.44
STRACT	Frequency spend in strenuous physical activity	16	.53	.98

Variable	Explanation of Variable	Scoring Key	Mean	Standard Deviation
NOSTRACT	Frequency spent in non-strenuous activity	16	1.96	1.17
SOCMEETS	Frequency of social contacts compared to age 45	16	3.31	1.23

Basic Process Data--Means and Standard Deviations

SE	6.01	1.66
SI	5.70	1.66
EI	21.23	8.26
SWTIME	14.78	7.49
CLASS	19.61	7.19
TRANS	32.84	13.47
IMAGE	42.72	15.28
PURETRAN	13.09	10.57
PUREIMAG	10.78	12.41
ALPHA	42.95	11.04
NUMBER	17.83	4.27
ALPHANUM	28.29	12.98
SAVING	-1.28	12.40
FORWARD	5.90	1.51
BAKC	4.55	1.26
TOTSPAN	10.54	2.28
DIGITS	9.28	3.24
VOCTOT	60.41	17.07
VOCAB	14.64	7.41

VITA

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