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Frequency Encoding: An Examination of the Roles of Age and Depression

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FREQUENCY ENCODING: AN EXAMINATION OF THE ROLES OF AGE AND DEPRESSION

by

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VITA

The author, Holly Houston, is the oldest child of Wyatt J. Houston and Eloise (Compton) Houston. She was born on January 27, 1959, in Chicago, Illinois. She completed her elementary education at Huth Upper Grade Center in Matteson, Illinois. She graduated from Rich Central High School in 1976.

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CHAPTER I

INTRODUCTION

That there is a high incidence of depression among the elderly has been well documented. The criteria that have been used to assess the prevalence of depression in the older adult population are hospital admissions, psychiatric diagnosis of community samples, and comparisons of symptoms between young and old individuals in community as well as hospitalized samples (Zarit, 1980). In hospitals and community samples, Epstein (1976) estimates that 10-65% of the elderly display depressive symptoms. Raskin (1980) reports the incidence to be 50% and Gurland (1976) reports that the highest rates of depressive symptoms are found in the age group above 65. Among community based samples, Gurland (1976) found that between 2 and 10 percent of the elderly were sufficiently depressed to warrant a clinical diagnosis. Also, Blazer and Williams (1980) found that 14.7% of elderly suffer from dysphoric symptoms and 3.7% have symptoms of a major depressive disorder. Finally, when comparing samples of young and old, the diagnosis of depression is made most frequently among the young (Gurland, 1976). Thus, the elderly are diagnosed as depressed less often. However, when looking at geriatric diagnoses alone, Zarit (1980) estimates the range to be between 21% to 54%.

One of the chief complaints among people that suffer from depressive symptoms is that their thinking is slowed and they cannot remember

as well as they did when not depressed (Gray & Issacs, 1979). Several researchers have reviewed the literature on the cognitive decrements associated with depression and have provided considerable evidence that memory decrements indeed occur. Miller (1975) found studies reporting that depressives exhibited deficits on word learning tests, free recall tasks and serial learning tasks. McAllister (1980) also reviewed the literature, and found that depressive patients scored significantly lower than controls on tests assessing the immediate reproduction of previously learned material, and that there appears to be a correlation between the degree of depression and the extent of memory decrement.

Memory decrements in the elderly population have also been well documented. There is a sizeable literature that appears to support age-related deterioration in adult memory. There are several lines of memory research with the elderly. One approach involves making distinctions between primary and secondary memory stages. Craik (1977) found that there are small performance decrements for elderly subjects when compared to young subjects on tasks of primary memory. Further, Craik reports that when secondary memory functioning is assessed, elderly individuals again perform worse than young individuals, particularly when retrieval cues are not present.

Another line of memory research within the elderly has conceptualized memory based on a trichotomous distinction between encoding, storage and retrieval. Salthouse (1982) reports that encoding is the establishment of a neural code of the information, that storage refers

to the preservation of information over time, and that revrieval refers to the recovery and use of information. Recently, research has focused on encoding (e.g., use of mediational techniques) and it has been shown that in comparison to young individuals, elderly individuals remember fewer items (Salthouse, 1982). In regard to the storage stage, Salthouse (1982) found, based on a literature review, that with intervals greater than 24 hours, older invidiausl remember less than younger individuals. Finally, the available literature on retrieval functioning is inconclusive, with some researchers reporting age decrements (Craik, 1977) while others note the mixed results reported by others (Smith, 1980; Salthouse, 1982).

Another current line of memory research with the elderly involves the study of attention and memory processes historically listed by Broadbent's (1958) theory. Hasher and Zacks (1979) have proposed a theory of attention as it affects memory processes. Hasher and Zacks posit that there are two types of encoding processes. Automatic processes drain minimal energy from the attentional capacity, which has a finite amount of energy available for performing mental operations, and are not affected by age, mood state or intentionality. Automatic processes include the encoding of frequency, spatial location and time of events. Effortful processes require more energy from the attentional capacity and are affected by practice, mood state and age. Effortful processes include rehearsal, use of mnemonic devices, clustering, organization and imagery.

Several researchers, specifically Kausler (1980) and Greene

(1984) have questioned Hasher and Zacks' (1979) inclusion of encoding of frequency information judgments as an automatic process, each citing evidence that frequency is affected by intentionality.

The aim of this study is to examine the extent to which age, depression and the interaction between these variables affects memory for frequency. Further, it is hoped that the present study will provide evidence either for or against the inclusion of frequency processing as an automatic encoding function.

CHAPTER II

REVIEW OF RELATED LITERATURE

A. Incidence of Depression in the Elderly

The difficulty of defining exactly what is meant by the term "depression" presents a problem in epidemiological research. It can refer to a description of mood, a variation of a psychophysiological norm of varying duration or of a psychopathological symptom or disorder. Sartorius (1975) notes that even when only depressions that require medical intervention are considered, nosological difficulties remain. Hence, the difficulty in classifying depression leads to confusion surrounding it's prevalence.

While few would argue that depression represents a homogenous entity, there is no satisfactory and systematic scheme for classifying and measuring depression. Inconsistencies in the nomenclature are evidenced by the following classifications: endogenous vs. reactive, psychotic vs. neurotic, primary vs. secondary, and bipolar vs. unipolar. Confusion surrounding subtype and incidence, upon which treatment is predicted, continues to be a clinical drawback (Roth, 1976).

Because of the lack of criteria for what constitutes depression in general, and depression in old age, estimates of the incidence of depression among the elderly vary. Three criteria have been used to assess the incidence of depression in the elderly: hospital admissions, psychiatric diagnosis of community samples, and comparison of

symptoms between young and old in community and hospitalized samples (Zarit, 1980).

Epstein (1976) has reported the incidence of affective disorders in hospitals as well as communities to range from 10-65%. Raskin (1980) quoted Roth's estimate that approximately 50% of older persons admitted to mental hospitals have depression. In his review of epidemiological studies, Gurland (1976) found that when surveys based the definition of depression on psychiatric diagnosis, depression was most prevalent between the ages of 25 and 65. However, the author notes that there may be an extreme reluctance to hospitalize old people, and the actual number of depressed elderly may be vastly underrepresented. Further, in Epstein's report, he noted that when symptoms rather than diagnoses were used for analysis, most studies found the highest rates of depressive symptoms in the age group above 65.

Blazer and Williams (1980) reported that earlier estimates of depression in community based populations ranged from 5-44%. In an attempt to establish the true prevalence of depression among the elderly, Blazer and Williams surveyed 997 individuals using the operational criteria established by DSM-III. They found that 14.7% suffered from dysphoric symptoms, 3.7% had symptoms of a major depressive disorder, and 6.5% had depressive symptoms associated with impaired health. Gurland (1976) found that between 2% and 10% of the elderly that were surveyed in the community were sufficiently depressed to warrant a clinical diagnosis. In Newcastle upon Tyne, Kay, Beamish and Roth (1964) found that some 14% of the elderly surveyed in that community were

found to be suffering from disturbances of mood, particularly depression.

Although the above community estimates are fairly high, there is evidence suggesting that community surveys, like hospital diagnoses, may underrepresent the number of depressed elderly individuals. Zarit (1980) states that American doctors are more likely to diagnose a patient over the age of 60 as suffering from organic brain syndrome. In fact, many physicians mistake the symptoms of depression as natural concomittants of aging (Gurland, 1976).

In contrasting the samples of young and old individuals, the diagnosis of depression is made most frequently in younger persons (Gurland, 1976). When compared to other age groups, then, the elderly are diagnosed as depressed less frequently. However, when considering geriatric diagnoses alone, Zarit (1980) estimates the range to be between 21% and 54%, with depression being the most frequent diagnosis in the 60 and above age group. Similarly, Pfeiffer and Busse (1973) note that among first hospital admissions, depression is again the most common diagnosis for elderly patients.

Surveys of nonpatient samples indicate that there is a high prevalence of depressive symptoms in elderly individuals (Gurland, 1976). The prevalence of depressive symptoms is even higher among elderly persons with health problems. For instance, Zarit (1980) cites an estimate of 5% of depressive symptoms among elderly cardiac patients.

Depression in later life is due partly to a number of variables.

Biological factors are thought to greatly contribute to late life depression in that the changing biological process can sometimes produce depression. However, the impact of biological aging upon the emergence of depression is not fully known (Stenback, 1980). Other factors include: a) social factors - loss of spouses and friends through death, loss of social roles, lowered socio-economic status, b) cultural factors - cultural devaluation and neglect, and c) psychological factors - confronting guilt issues from the past, experience of bodily disolution (Butler, 1977; Jarnik, 1976; Stenback, 1980). When considering these and other stresses that impinge upon most elderly individuals, it is not surprising that the incidence of depression is high. As Jarvik (1976) notes "it is hard to conceive that there should be anyone in the upper age group without the clinical diagnosis of depression" (p. 326).

Symptoms and signs of depression may vary from mild to severe and may include at one end of the continuum anxiety, feelings of hopelessness, helplessness, self-acusation, self-depreciation and hypochondriacal preoccupations. At the other end of the continuum, symptoms include severe obsessive ideation, feelings of depersonalization, nihilistic delusions and suicidal ideation. Many elderly individuals show vegetative signs including weight loss, insomnia and metabolic abnormalities. Depression may also be manifested by behavioral disturbances such as withdrawal and apathy (Epstein, 1976). Gurland (1976) notes that depressed individuals may not admit to the symptoms of depression (i.e., I'm feeling down), but will complain instead of memory

loss, loss of concentration, anxiety or some combination thereof.

B. Cognitive Decrements Associated with Depression

The depressed often complain of memory decrements including slowed thinking, inability to recall, and feelings of stupidity (Gray & Issacs, 1979). Gray and Issacs also note that there is an apparent loss of memory and poor performance on mental tests. These authors posit that poor performance is due to inattention, preoccupation and retardation. The depressed person cannot attend to the matter at hand long enough to register information and respond within a given time frame.

In his review article, Miller (1975) provided considerable evidence that memory decrements are associated with depression. Support for this statement is based upon the results of several studies, among them Parboosingh and Post (1965) and Post (1966), who found that neurotic and psychotic depressives exhibited memory deficits on word-learning tests when compared to other non-organic psychiatric patients and normals.

Henry, Weingartner and Murphy (1971, 1973, cited in Miller, 1975) administered a serial learning task and a free recall task to patients diagnosed as having either bipolar or unipolar depressive psychosis. The investigators also assessed change in clinical state as measured by the Bunny-Hamburg word rating scale. Performance on the first trial of the serial learning task was seen as a measure of immediate recall, and performance increases on subsequent trials were assumed to assess shifting from short-term to long-term memory. The patients' performance

on the first trial of the serial learning task did not change significantly with levels of depression, indicating that depression is not associated with deficits in short-term memory. On later trials, when exhibiting depressive symptoms, patients demonstrated a decrease in performance on days when they were less depressed. Depression was associated with poor performance on the free recall test for bipolar patients only. This result was assumed to be due to the fact that the bipolar depressives were slightly less severely depressed than unipolar depressives. Henry et al. (1973) concluded that depression interferes with the transfer of information from short-term to long-term storage.

McAllister (1980) reviewed the recent literature studying the effects of cognitive functionin in the affective disorders. Several studies that he cited are pertinent here. First, Sternberg and Jarvik (1976) tested depressed patients on registration (defined as the immediate reproduction of previously learned material), retention and retrieval memory functions. These functions were assessed by the 15 word-pair test (learning of paired associates where reproduction is accomplished through "recall" of the learned response to the stimulus), the 15 figure test (examinee is required to find 15 objects, previously show, on a larger picture where they are mixed in with 15 other objects) and the 9 personal data test (showing photographs of 3 persons and fictitious personal data for each in succession with subjects required to reproduce information given), respectively,

The patients were tested before initiation of treatment. The results demonstrated a significantly lower registration score for de-

pressed patients compared to non-depressed controls. There was no significant decrement in other scores. The results of retesting after 26 days of antidepressant drug therapy demonstrated significant improvement in registration. Further, improvement in memory function was found to vary directly with clinical improvement of depressive symptoms.

Stromgren (1977, cited in McAllister, 1980) evaluated the degree of depression and memory function before ECT treatment began, after six ECT treatments, and following the last ECT treatment. The researcher used Weschler memory scale forms to evaluate memory functioning. Before treatment, significant correlation was found between the degree of depression and impairment of memory functioning. After ECT, the patients showed improvement in both depressive symptomology and in their overall memory quotient. Stromgen was able to demonstrate a correlation between the change in degree of depression and improvement in memory functioning.

McAllister was able to conclude, based on his review, that depression impairs both memory and verbal learning functions. He noted that 7 of the 10 articles he reviewed found significant results in these areas. Of the three that did not, two argued that the apparent memory deficit was due to the artifacts of the decision making process (Miller, 1977) and due to psychomotor retardation (Weckowicz, Nutter & Cruise, 1972). The third study did not find a significant difference between ill and well depressives on verbal learning, logical memory, or delayed recall (Whitehead, 1974).

Finally, Cohen, Weingartner, Smallberg, Puckur and Murphy (1982)

examined the proposition that a deficit in central motivational state accounts for memory impairment observed in depressives. The authors hypothesized that depressives have a reduced capacity to integrate external stimuli with the appropriate behavioral response, thus leading to an increasing decrement in cognitive performance as the amount of effortful processing increases. Cohen et al. utilized a motor task (squeezing a dynomometer) as a measure of effort, and recalling trigram presentations as the memory task. The subjects were psychiatric patients with major depressive disorders. Results of direct comparison between the effort and cognitive performance demonstrated deficits in the performance of both tasks for the depressed individuals proportionate to the severity of depression. Further, impairment on both tasks was most noticeable on those subtasks requiring most effort. Cohen et al. concluded that in depression there is a general deficit in the capacity to maintain effort or motivation.

C. Memory Loss in Old Age

There is a sizeable literature that seems to support evidence of age-related deterioration in adult memory (Craik, 1977; Craik & Simon, 1980; Salthouse, 1982; Smith, 1980). One approach to understanding age decrements in aging involves making distinctions among various memory stages. Categorization of this type differentiates between primary and secondary memory (Waugh & Norman, cited in Craik, 1977). According to Waugh and Norman, primary memory is a temporary holding store through which all information that is subsequently remembered must pass. Primary memory is involved when the information that is

received is being actively and consciously rehearsed. Without rehearsal, it is assumed that the information decays or is displaced from primary memory. Secondary memory refers to the store in which long-term knowledge exists. The information held in secondary memory does not require attention or rehearsal for its endurance, nor is the store as limited as the primary memory store.

It has been argued by several authors (Craik, 1977; Salthouse, 1982) that age differences in primary memory are negligible. According to Watkins (1974, cited in Craik, 1977), free recall is a paradigm which gives a fairly pure measure of primary memory. Utilizing this paradigm, subjects are given several practice lists to learn, and typically are asked to recall the last 3-5 words first, thus measuring a recency effect. The rationale for this is that words that are presented most recently should still be in immediate consciousness and can serve as an estimate of primary memory functioning (Salthouse, 1982).

Employing the free recall paradigm, several studies (Craik, 1968; Raymond, 1971, both cited in Craik, 1977) reported no age differences in primary memory functioning. However, two later studies (Arenberg, 1976; Salthouse, 1980) found statistically significant age differences in free recall tasks, with older subjects scoring less than the younger subjects. Robertson-Tchabo and Arenberg (1976, cited in Salthouse, 1982) report that this measure of primary memory correlates -.24 with age. That is, the estimates of primary memory storage decreases with age between 20 and 80 years. Horn, Donaldson and Engstrom (1981, cited in Salthouse, 1982) report a correlation of -.15. In

addition, a study by Walsh (Walsh & Baldwin, 1977, cited in Salthouse, 1982) found that young adult subjects had higher estimated primary memory capacities than older adult subjects.

The immediate memory span for letters, digits and words is most often regarded as the longest string of items that can be reproduced in serial order. Digit and word spans (seven and five items, respectively) often exceed primary memory capacity which is estimated by Watkins (1974, cited in Craik 1977) to be between 2.6 and 3.4 words (no estimate was given for numbers). Craik (1977) argues that some tasks of immediate memory span may involve retrieval of several items from secondary memory. As such, Craik suggests that in such cases there should be a slight performance decrement with age, although not as much as would be found in tasks which reflect only secondary memory functioning. In his review, Craik notes that several authors (Botwinik & Storandt, 1974; Friedman, 1974; Gilbert, 1941; Gilbert & Lence, 1971; and Taub, 1973, cited in Craik, 1977) have found slight but statistically significant performance decrements for elderly subjects.

From the work cited above, Craik (1977) was able to conclude that there may be small but minimal performance decrements in elderly subjects (that is, old subjects perform slightly worse than young subjects) on tasks involving primary memory. Further, when secondary memory is a component of these tasks, older subjects were reported to perform worse than their younger counterparts.

The single-trial free recall paradigm has been widely used to assess secondary memory functioning in the elderly. Usually, a list of

12-30 words is presented and the subject is asked to recall them in any order. Although no age differences have been found in the reporting of the last few words on the list (recency effect), older subjects have been able to recall fewer items from the beginning and middle portions (Craik, 1968b; Raymond, 1971, cited in Craik, 1977).

Lawrence (1967a, cited in Craik, 1977) studied free recall in the elderly utilizing two conditions. Under one condition, a 12-word list was composed of words from one conceptual category. In the other condition, words that comprised the 12-word list were chosen from several conceptual categories. The author found a slight age difference (elderly performed slightly worse) in recalling items from the single category list, but a much greater age decrement in the recall of words from the list of words belonging to several categories. One explanation for these findings is that older subjects can recall more words when they can group the words under a single concept and use this concept to aid memory. Thus, the use of a retrieval cue may ameliorate age decrements in recall tests.

Other investigators have compared recall and recognition scores in subjects of varying ages. For instance, Schoenfield and Robertson (1966, cited in Craik, 1977) presented subjects with a 24-word list to learn. Following this, subjects were given either a recognition or free recall task. The recognition test was a forced-choice task in which the critical items were embedded among four distractor words. Schoenfeld and Robertson found a large, systematic drop in performance with increasing age, but no age decrement in recognition. They concluded

that retrieval from secondary memory storage presented a problem for the elderly subjects. Further, since recognition does not emphasize retrieval, this accounts for the lack of age differences on this task.

Although Schoenfield and Robertson reported no age differences in recognition, other researchers have found significant age decrements on recognition tasks (Botwinik & Storandt, 1974; Erber, 1974, cited in Craik, 1977; Perlmutter, 1978). Based on these studies, Craik (1977) was able to tentatively conclude that age deficits in memory can be interpreted in terms of retrieval failure in the elderly.

Another conceptualization of memory that has guided memory research with the elderly is based on a trichotomous distinction between encoding, storage and retrieval. According to Salthouse (1982) encoding refers to the establishment of a neural code of the information, storage refers to the preservation of information over time, and retrieval refers to the recovery and use of information.

Recent research in human memory stresses the encoding stage. It is a generally accepted conclusion that the encoding stage presents particular problems for older adults. Research on several modes of encoding processing supports this notion. One manifestation of encoding difficulty among the elderly is evidenced in their use of visual imagery and other mnemonic devices used to establish a link between to-be-remembered items, or between those items and information in the long-term memory store (Salthouse, 1982). A consistent finding with older adults is that they tend to use mediators less than younger subjects (Hulicka & Grossman, 1967; Hulicka, Sterns & Grossman, 1967).

Several investigators found that when elderly subjects were instructed to use mediational techniques, their attempts at remembering items improved (Canestrari, 1968; Poon & Walsh-Sweeney, 1981; Reese, 1976, cited cited in Salthouse, 1982).

Another aspect of encoding that has been found to attribute to age decrements in memory is when organizational constraints are imposed on memory tasks. That is, older subjects have been found less able to engage in organizational structuring of to-be-remembered material and consequently perform worse than younger subjects. Heron and Craik (1964, cited in Salthouse, 1982) found that young and old subjects matched for memory span with meaningless material (Finnish Digits) demonstrated age differences with more meaningful material (English Digits). The authors posited that the young subjects were able to organize the material better than older subjects. Relatedly, Friedman (1966, cited in Salthouse, 1982) and Kinsbourne (1973, cited in Salthouse, 1982) reported that there was a greater difference between the performance of older and young subjects (older subjects performed worse) when recall was tested with respect to serial ordering then when compared to unordered recall. An explanation for this finding is that it is harder for older adults to maintain the original organization of the material.

Salthouse (1982) states that problems in the storage stage have been difficult to investigate because age differences in acquisition of material is suspected. He notes that if older persons do not acquire the material to-be-tested to the same degree as younger subjects,

it is not possible to attribute poorer recall performance to a problem of storage. In his review, Salthouse (1982) cites several studies that equate subjects in terms of acquisition. Three studies (Hulicka & Rust, 1964; Hulicka & Weiss, 1965; Wimer & Wigdor, 1958, cited in Salthouse, 1982) found no age differences with retention intervals of 15-20 minutes. Wimer (1960b, cited in Salthouse, 1982) and Hulicka and Rust (1964, cited in Salthouse, 1982) found an age impairment with a retention interval of 24 hours. Four studies (Belkin & Downs, 1964, 1965; Harwood & Naylor, 1969; Hulicka & Rust, 1964, cited in Salthouse, 1982) found age impairments at retention intervals of three days to one month. Also, Poon and Walsh-Sweeney (1981, cited in Salthouse 1982) looked at retention of paired-associates that had been perfectly learned at intervals of 45 minutes, 1 day, 1 week and 1 month. These researchers found that as the time interval progressively increased, the elderly subjects rememberd the paired associates less well when compared to younger subjects. Based on these studies, Salthouse (1982) concluded that there seems to be no age deficit in short-term storage over 15-30 minutes, but in intervals greater than 24 hours, older individuals may remember less than younger individuals.

Examination of the literature on retrieval functioning in the elderly reveals that some researchers have argued that it is a source of particular difficulty for older adults (Craik, 1977). However, others (Smith, 1980; Salthouse, 1982) argue that the findings, at best, are inconclusive. One line of research examining retrieval functioning in the elderly involves employment of both recall and recognition

tasks. One argument is that if the item cannot be recalled but can be recognized, it can be inferred that the problem lies in retrieval stage. Recall tests are presumed to require more of a retrieval component than recognition tests do (Craik, 1977). Salthouse (1982) takes exception to this line of reasoning and calls attention instead to the phenomenon of recognition failure, when this occurs, individuals who learn words in the context of other strongly associated words fail to recognize the critical words in a recognition test, but can often recall them if cued with the strong associate. Salthouse notes that recall without recognition should be impossible if the difference between them is that recall involves retrieval and recognition does not. Salthouse cites the Shaps and Nilsson (1980) study in which this phenomenon was demonstrated with older adults.

Another body of research that appears to shed light on the type of age decrement found in memory is the role of divided attention. Craik and Simon (1980) suggest that divided attention and aging have similar effects on information processing and memory. Both age (Craik, 1977, as cited in Craik & Simon, 1980) and divided attention (Murdock, 1965, cited in Craik & Simon, 1980) in free recall tasks were found to contribute to memory decrements in secondary memory. Craik and Simon (1980) conclude that both effects may lead to a reduction in processing resource leading in turn to less elaborate encoding.

Current interest in the study of attention can be traced back to Broadbent's bottleneck model of information processing in which there is a particular stage in which selective attention is operative

(Broadbent, 1958). Later theorists disagreed as to where the selective-filtering mechanism was in the sequence of information processing (Deutsch & Deutsch, 1963; Triesman, 1964; cited in Lachman, Lachman & Butterfield, 1979). However, the theorists agreed that a permanent storage of information and overt responding necessitated the use of this mechanism.

More recently, the prevalent view of attention has followed Kahneman's (1973) model. Kahneman posited a capacity model of attention, meaning that there is a limit on the energy available for performing mental operations. He argued that mental operations differ in the amount of attentional capacity that they require. The farther along the sequence of stages the operation moves (that is, closer to the response end) the more capacity is needed.

Over the past decade or so, many theorists that elaborated Kahneman's idea. It has been argued that some complex operations drain minimal energy from our limited capacity and are called automatic (Hasher & Zacks, 1979; Posner & Snyder, 1975; Shriffrin & Schneider, 1977). These researchers agree that automatic processes do not require intention or awareness and do not interfere with other information processing. Hasher and Zacks (1979), and Shiffrin and Schneider (1977), state further that when activated, automatic processes run to completion, and are difficult to suppress once they are aroused. However, Hasher and Zacks (1979) disagree with Shiffrin and Schneider's position that all automatic processes do not independently result in the storage of new information and develop if given enough practice.

Hasher and Zacks (1979) argue that these characteristics are true of "learned" automatic processes, an issue that will be discussed shortly. Finally, Hasher and Zacks further state that automatic processes are relatively unaffected by motivational status, education, early experience, culture and intelligence.

Hasher and Zacks (1979) discuss two sources for the origin of automatic processes: heredity and practice. In regard to heredity, they believe that the nervous system is constructed such that the automatic encoding of certain information is maximized. In regard to the second source of origin, practice, it is thought that under some circumstances (which are not fully understood) large amounts of practice will enable the automatic encoding of some information. Automatic processes do not permit the cognitive system to become overloaded when demands (i.e., stress) are placed upon it. Thus, they insure that certain information enters the long-term store. They can also serve as retrieval cues for further processing. The encoding of frequency of events, spatial location, and time of events are examples of information that is automatically processed (Hasher & Zacks, 1979).

At the other end of the encoding processing continuum are effortful processes (Hasher & Zacks, 1979) or controlled processes (Posner & Snyder, 1975; Shiffrin & Schneider, 1977). Posner and Synder assert that controlled processes require conscious attention. Shiffrin and Schneider have elaborated that idea and state that controlled processes regulate the flow of information in and out of the short-term memory store. Shiffrin and Schneider identify two types of controlled pro-

cesses: accessible and veiled. Accessible control processes are slow, are capable of being perceived by the individual and are established and changed by instruction. Veiled processes are those that occur quickly and may not be open to awareness. According to Hasher and Zacks' formulation, effortful processes are analogous to Posner and Snyders definition of controlled processes as well as to the accessible effortful processes defined by Shiffrin and Snyder. For Hasher and Zacks, effortful processes require substantial cognitive energy and may drain attentional capacity such that little or none is left for other effortful processes. Effortful processes can improve with practice and their use is voluntary.

Not much is known about the origin of effortful processing. Hasher and Zacks (1979) cite several possible origins including explicit training from parents and teachers, learning derived from problem solving activities (allowing for more efficient learning attempts) and modeling the attempts of others to remember. Effortful processing serves to increase learning speed (e.g., through the use of mnemonic devices) and allows novel information to be flexibly processed. Effortful processes that are most often studied in memory research include rehearsal, use of mnemonic devices, clustering, organization and imagery (Hasher & Zacks, 1979).

Hasher and Zacks propose a concept of attention consistent with the attentional capacity view of Kahneman (1973). That is, attentional capacity is necessary for performing various cognitive tasks, but its supply is limited. The authors state that attentional capacity can

vary within and between individuals. As such, limits on the attentional capacity are partially responsible for cognitive deficits. Automatic processes should not be affected by altered cognitive capacity because their drain on the attention resource is minimal. However, variables that alter cognitive capacity, such as age and depression, have major effects on effortful processing and leads to deficient memory performance. The results of Hasher and Zacks' (1979) experimentation and literature reviews provide support for the claims and will be reviewed below.

While the classification of depression is under considerable controversy, the cognitive deficit associated with it has reached consensus. The experimental data supports the notions that: a) individuals who are depressed often complain of memory loss, and b) the nature of the cognitive deficit is in line with the hypothesis that the deficit is due to a reduction in capacity.

Hasher and Zacks (1979c) examined differences in frequency judgments in depressed and non-depressed adults. Sixteen subjects aged 19-40 were given the Beck Depression Inventory to assess mood state and were divided into depressed and non-depressed groups. Subjects were asked to study and imagine pictures of common objects across a sequence of trial types and then asked to judge the number of times they had seen, rather than imagined, each picture The results indicated that there were no differences between the depressed and non-depressed subjects on their judgements of frequency as a function of imagination or actual presentation. Thus, it is suggested that the

automatic task of frequency prccessing is a task that is done as well by depressed as it is by non-depressed individuals.

Other types of information that are assumed to be automatically encoded (spatial location, temporal information and activation of word meaning) were not tested by Hasher and Zacks (1979) nor did these authors find other studies looking at these processes in depressed individuals. This line of research clearly warrants further investigation.

While the literature on automatic encoding in depressed persons is scarce, somewhat more is available on effortful processing. Russell and Beekhuis (1976) examined lexical store organization in psychotic depressives. Subjects were presented cards, sorted into categories, upon which 30 nouns, from six conceptual categories (i.e., birds, kinds of cloth, sports, animals, precious stones and occupations) were printed. Following self-paced presentation, subjects were asked to recall as many of the words as possible. Next, the nouns were sorted in subject-determined categories after which multi-trial free recall tasks were again completed. On the first free-recall trial (in which the cards were presorted), normal subject's recall was significantly greater than that of the depressives. However, during subsequent free-recall trials, when nouns were sorted by the subjects, depressives demonstrated poorer recall when compared to normals. Results of the Adjusted Ratio of Clustering (measuring the degree to which the subjects sorting categorization was reflected in the order of recall) indicated that the normals' first trial and average subjective scores

were higher than those for depressives, though not statistically significant. The results indicate that depressives are basically aware of semantic or lexical properties but these properties are not fully utilized when recall is attempted. It is suggested that the lexical properties of the words are inadequately encoded and inhibit recall performance in depressed individuals. Thus, this study lends support to the Hasher and Zacks' claim that organization and clustering, which are effortful tasks, are effected when cognitive capacity is altered, in this case due to depression.

A study by Levy and Maxwell (1968) similarly lends support to this claim. Adult subjects were auditorally presented as set of 16-word lists of English text, proceeding from those with the lowest contextual contraint (words selected randomly with no relation to each other) to those with high contextual constraint (made up of words closely associated to one another). After the presentation of each list, subjects free recalled the words. It was found that the depressed individuals performed significantly worse (recalled fewer words) than normal controls. It was demonstrated that although recall scores improved as contextual constraint increased, depressed individuals' scores did not improve as well as those of the normal controls. The researchers concluded that depressed invidiausl are not able to make as much use of contextual cues in comparison to normal individuals.

Imagery and rehearsal are the other types of effortful encoding processes that were examined by Hasher and Zacks (1979), but their review of the literature failed to locate any studies investigating the

use of these encoding processes in depressed persons. Hasher and Zacks (1979) note, however, that imagery facilitates learning and instructions to use imagery facilitates performance of subjects relative to that of uninstructed subjects (Paivio, 1971). In regard to rehearsal, Hasher and Zacks cite Rundus (1971) who found that recall of an item on a test of immediate memory is partially a function of the number of rehearsals it receives during the study phase.

Hasher and Zacks (1979c) conducted an experiment to examine rehearsal processes in depressed persons. In this study, adult subjects were given the Beck Depression Inventory to assess mood and then were categorized into depressed and non-depressed groups based on median score of 8.5. Next, subjects were informed of the subsequent memory test. Subjects were visually presented a 40-word list after which a recognition test was given. The recognition task was a four-alternative, forced-choice test with three distractor items (a high-frequency associate of the target, an acoustically similar word, and a neutral, unrelated word) and the target word itself. The results indicated that the depressed and non-depressed subjects, although equivalent in recognition performance, differed in the kinds of recognition errors they made. The depressed subjects were less likely to select as the targeted item a word that is a frequent associate of it. Hasher and Zacks concluded that depressed individuals engaged in less active rehearsal during word presentation than did non-depressed individuals.

Hasker and Zacks' (1979) theoretical claims and experimental results regarding effortful processing and mood state have been sup-

ported by Ells, Thomas, and Rodrigues (in press) who explored the effects of experimentally induced depressed mood state on recall of information that is elaborately encoded, semantically processed and when recall cognitive effort is varied. In all three of their experiments, depressed mood state was induced by having subjects read 60 cards containing depressive self-reference statements that became progressively more intense. Neutral mood state was induced in the same manner, although all statements were equally emotionally neutral. Following this, all subjects completed the Depression Adjective Check List which required individuals to indicate all of the presented adjectives descriptive of their present feelings. Assessment of the DACL scores indicated that mood state induction was successful in all experiments.

Experiment 1 explored the ability of depressed mood individuals to encode information more elatoratively. Following the mood induction procedure described above, subjects were visually presented either base sentences (simple, understandable sentences) or elaborated sentences (those containing words that served to emphasize characteristic properties of the target word) for a duration of either 7 to 10 seconds. Mood condition, sentence condition and duration time were combined factorially, producing eight experimental conditions. Next, during the presentation phase, subjects completed arithmetic problems for 1 minute after which they were presented the same sentences originally shown with the target word removed. The recall task was to write the missing word on an answer sheet. The results indicated that the depressed mood sub-

jects recalled fewer target words than neutral subjects. Further, depressed mood subjects were less able to benefit from elaboration relative to neutral mood subjects. The effect of presentation time was not reliable. The results support the view of Hasher and Zacks that depressed mood may function to impair memory when encoding demands are greater.

Experiment 2 (Ellis et al. in press) examined the effects of depressed mood state on free recall of a word list following semantic versus non-semantic orienting instructions, producing four between-subject conditions. After the mood induction technique, subjects were shown 24 nouns. In the non-semantic condition, subjects counted the number of times the Letter "e" appeared in each word, and in the semantic condition, subjects rated each word in regard to pleasantness on a seven-point continuum. Subsequent to this, subjects free-recalled the list. The results indicated that depressed subjects recalled significantly fewer words than non-depressed subjects on both semantic and non-semantic conditions. Within the depressed mood condition, subjects who participated in the semantic orienting task recalled more words than those who engaged in the non-semantic task. The interaction between mood state and task condition was not significant.

Finally, Experiment 3 examined the effects of mood state and cognitive effort on recall. Subjects were again randomly assigned to mood state conditions and subsequently presented a 24-item list. The list was composed of simple sentences in which the object noun was missing. Two nouns followed each sentence and the subject was directed

to select the one that best fit the sentence. Half (12) of the items were low effort (those that obviously fit the sentence) and the others were high effort (not easily implied by the sentence). An incidental recall task followed the sentence-completion portion of the experiment. The results indicated that total recall was greater for subjects in the neutral mood condition than for subjects in the depressed mood condition. Again, depressed mood state was shown to reduce overall recall. However, there were no differences reported in depressed subjects' ability to recall high versus low effort words, whereas subjects in the neutral condition recalled more high than low effort words. Ellis et al. reasoned that subjects may shift their processing resources when in a depressed mood. That is, depressed subjects apportion enough capacity to process low effort tasks and may allocate less capacity to process high effort tasks. These findings lend support to those of Hasher and Zacks (1979).

In their review, Hasker and Zacks (1979) noted that no research had been conducted on spatial location and temporal information in elderly individuals, both of which are assumed to be automatically encoded. However, they conducted an investigation of frequency encoding with elderly subjects. Old and young subjects were visually presented with a word list 70 slots long. Some subjects were informed of the subsequent frequency estimation test (intentional condition) and others were simply told of a memory test (incidental condition). After presentation of the words, subjects recorded their estimation of the occurrence of each word. It was found that for both age groups esti-

mates of frequency of occurrence of each word increased as actual frequency increased. Also, both age groups increased their estimate of occurrence as the frequency increased, although the elderly did so at a slower rate. The latter finding was explained in terms of a conservative response bias in the decision making process characteristic of elderly individuals. That is, when elderly individuals are asked to make frequency judgments, they tend to underestimate the occurrence of their presentations. Thus, Hasher and Zacks concluded that the two groups were equally sensitive to frequency differences. Further, instructional set was not found to be significant.

In regard to effortful processing, several studies support Hasher and Zacks (1979) claim that the elderly are at a disadvantage when encoding information effortfully. First, Hulicka and Grossman (1967) provided evidence that elderly subjects use mediational techniques less frequently than younger subjects. Young subjects (mean age 16) and old subjects (mean age 74) were instructed to learn paired-associates under one of four conditions: a) no instructions, b) self-image (subjects were asked to form an image that included both items of the pair), c) experimenter image (linking word or phrase was provided and subject was asked to form an image), d) verbal instructions (same linkage given as under experiments image, but subjects were not asked to form an image). A total of 30 pairs for the old and 60 pairs for the young subjects were visually presented. The results indicated that regardless of instructional condition, young subjects' performance was statistically superior to that of old subjects. Further, unless

specifically instructed to do so, older subjects reported less use of mediational techniques than younger subjects. When mediational techniques were used, scores for both age groups increased. Hulicka and Grossman noted that the age-related decrement in paired-associate recall was reduced under instruction to employ mediational techniques or mnemonic devicies.

The above findings were substantiated in another study by Hulicka, Sterns and Grossman (1967). Old and young subjects were again asked to learn paired associates under various paced and self-paced conditions. The paired-associate lists were comprised of 40 pairs for the old and 80 pairs for the young subjects. All subjects were told that learning would be simpler if an image or phrase was selected to link the words together. Again, the results demonstrated that the young subjects performed significantly better than old subjects under all conditions. However, both age groups performed better under self-paced conditions. Older subjects reported using mediational techniques less often than young subjects and many elderly had difficulty selecting an appropriate association between the words.

Several studies suggest that elderly persons are at a disadvantage when dealing with highly meaningful material. Craik and Mansini (1967) presented orally to subjects (20-70 years of age) three lists of words: English text, color names, and proverbs in scrambled order. After each presentation, subjects were asked to serially recall the words. An age decrement was found in the ability to recall text and scrambled proverbs but not color names. These findings were interpret-

ed as being due to an inability for the elderly to chunk verbal material that is meaningful (text and proverbs). Thus, there is an age-related deficit in the ability to make use of the structure and redundancy in meaningful material.

Hultsch (1971) studied organizational differences in three age groups: 20-29, 40-49, and 60-69. English nouns were visually presented to subjects under one of two conditions. In the sorting condition, subjects were instructed to sort the words into categories. In the non-sorting condition, subjects were told to simply look at the words one-at-a-time. All subjects were self-paced. Results of the free recall tests indicated that in the sorting condition the youngest group recalled significantly more words than the oldest group. No other differences under this condition were noted. Under the non-sorting condition, the youngest group recalled more words than both of the other age groups. The author summarized that there is a greater age-related decrement on memory tasks that minimize rather than maximize the ability to meaningfully organize word groupings.

The last effortful process to be reviewed is rehearsal. Lair, Moon and Kausler (1969) compared middle-aged and old subjects for the effects of interference on rote learning. At both age levels, one group was tested on a paired-associate list high in response competition and one low in response competition. Interference was induced by repairing the words demonstrated to have a high relationship. Subjects were asked first to learn and recite the list to completion and then to provide the first word of the pair after the second was given.

The results indicated that the elderly were more susceptible to response competition than younger subjects. That is, they showed a reduced ability to learn the repaired words due to the interference of predominating habits of previously learned associations. Thus, as Hasher and Zacks (1979) posit, there is some evidence that elderly individuals may have reduced ability to remember due to the effects of interference which prevents adequate rehearsal of new associations.

Some of Hasher and Zacks (1979) assertions have been questioned by other investigators. For example, Kausler (1982) cites evidence questioning the inclusion of frequency encoding as an automatic task. He notes that age differences have been found repeatedly for frequency encoding when absolute rather than relative frequency judgments have been utilized (Attig & Hasher, 1979; Freunde & Witte, 1978; Warren & Mitchel, 1980, cited in Kausler, 1980).

Greene (1984) also questions the inclusion of frequency as an automatic task. According to Hasher and Zacks (1979), automatic processing should not be affected by intentionality. Greene conducted two experiments testing the effect of intentionality on frequency estimates. In the first experiment, subjects were tested under conditions of incidental and intentional learning. They were shown a series of five digit sequences and after each a distractor word. Both the digits and the words were said out loud immediately after their presentations. Rehearsal time for the words occurred after their presentation under 4-second or 12-second conditions. After completion of the presentation trials, subjects were asked to estimate both the duration and frequency

of the words, and to recall the digits. Results for this experiment indicated that intentionality of learning had large effects in the frequency judgment and digit recall tasks.

In the second experiment, Greene divided subjects into three groups: one group was tested under incidental learning conditions; another was told of a subsequent unspecified memory test; a third group was told that there would be a test of frequency estimation. In order to examine the cause of the difference between incidental and intentional learning, Greene had each subject perform an orienting task. Before rehearsal of each word (and after the presentation of the digit sequence as in Experiment 1) each subject had to answer a question about the word. The questions were either perceptual (does this word contain a certain letter) or semantic (is this word a member of a particular category) in nature. The results indicated that the intentional-learning and frequency-learning groups were about equal, in terms of the accuracy of frequency judgments and both were more accurate than the incidental group. Further, the semantic orienting task led to better frequency estimation than did the perceptual orienting task. However, the orienting task was not shown to interact with instructional set. Finally, the incidental learning group recalled more digit sequences than both of the other groups. Thus, Greene concluded that there is not strong evidence that frequency encoding meets the criteria of automaticity as proposed by Hasher and Zacks.

The aim of this study is to determine the extent to which depression and age affects frequency estimation. Hasher and Zacks

(1979) assert that frequency judgment is an automatic process that drains only minimal amounts of energy from the attentional capacity, and is therefore not affected by eithermood state or position in the developmental span.

However, it has been noted above that other researchers question the inclusion of frequency encoding as an automatic process. One of the criteria of automaticy, as outlined by Hasher and Zacks (1979), is that it should not be affected by intentionality. Greene (1984) found that frequency estimation was better under intentional as opposed to incidental learning conditions. Also, Kausler (1982) cites research that found differences due to age when absolute rather than relative frequency estimates were used. Thus, Hasher and Zacks findings are not definitive. The present study seeks to provide further information regarding the automaticity of frequency estimates.

Utilizing an incidental learning condition, the orienting tasks used by Greene (1984) were employed. Specifically, subjects were required to process words either semantically (a task requiring more attentional capacity) or perceptually (requires less attentional capacity) subsequent to their original presentions. It is hypothesized that: a) elderly individuals are less accurate when judging the frequency of words that are semantically processed when compared to their frequency judgments about words that are perceptually processed relative to young individuals, and b) depressed elderly are less accurate when judging the frequency of words that are semantically processed relative to non-depressed elderly.

CHAPTER III

METHOD

Subjects

The 42 subjects were all unpaid volunteers who agreed to participate in the research. The 28 elderly subjects were between the ages of 64 and 96. The average age was 75.70 years. All of the elderly subjects except one, were female. They were grouped into depressed and non-depressed categories based on Beck Depression Inventory scores. The mean score for the 14 depressed elderly subjects was 14.36 (SD = 4.36). For the non-depressed elderly, the mean score was 3.00 (SD = 2.40).

The elderly subjects were recruited from the Devon-Sheridan Jewish Community Center's Senior Program in Chicago. This day program offers the seniors an opportunity to participate in various classroom activities (such as arts and crafts, current events, exercise) and take organized field trips. Some of the older adults lived in the senior citizen's apartment building which housed the community center while others travelled there from their homes.

The 14 younger subjects were undergraduate students from colleges in the Chicago area, 8 of whom received credit in their summer session psychology course for their participation. They ranged in age from 18 to 24 and the average age was 20.30 years. Among this group, 3 of the subjects were male and the remaining 11 were female.

Materials

Word List

A pool of 42 nouns were randomly formed a list of nouns which had been previously rated as high in imagery (> 5 on a 7-point scale) (Paivio, Yuille & Madigan, 1968). The words were picked in such a way as to minimize the number of words that shared the first letter and to include equal numbers of words from each quartile of the alphabet. The mean imagery rating of the words was 6.41.

List Structure

The list that was presented to subjects was comprised of 70 slots. The first 10 and last 4 served as primacy and recency buffers so that critical items did not occur before the 11th slot or after the 67th slot. In the primary buffers, there were five words presented once, one word presented twice and one word presented three times. In the recency buffers, two words were presented one time each, and one word was presented two times. Thus, very early in the presentation, the multiple occurrence of items was evident to all subjects.

Within the middle 56 slots comprised of critical items, each of the levels of the frequency variable (1, 2 and 4) occured four times. The counter-balancing procedure, employed to distribute error effects across frequency levels, was as follows: the 56 slots were divided in half and each of the three levels of the frequency variable were represented by four words in each portion. The 28 slots in each half were filled with critical items utilizing the following constraints: no repeated item ever immediately followed itself; the number of interven-

ing items between repeated and non-repeated items ranged from four to seven so that a) words presented once were separated by five to nine intervening items, b) words presented twice were separated by five to seven intervening items and c) words presented four times were separated by four to seven intervening items. No other constraints were imposed.

Physical Characteristics of List

The words and questions were typed on 5 x 8, unlined index cards using an IBM Correcting Selectric II typewriter and the 10 pitch orator element. The words were typed in the center of the upper 2/3 of the card. The questions were typed on the lower 1/3 in such a way that the bottom of the card could be folded upward, forming a flap to conceal the question. When the question was presented, the flap was unfolded in order to reveal it.

Assignment of Words and Questions

Words were assigned in the list in the following manner. From the pool of 42 words, a group of 24 was selected as critical items, a group of 10 was selected as buffers and the remaining 8 were selected for use on the frequency estimation test list as never-presented distractors. The words serving as buffers and critical items were allocated to positions in the list on a random basis. The 24 critical items were subdivided into three groups such that the words in each grouping represented one of the three frequency levels (1, 2, or 4). The critical items were further divided so that half of the words in each grouping were represented in the first half of the list and the remaining were represented in the second half.

Questions were assigned to each word from one of two categories: perceptual or semantic. The perceptual questions were as follows: Does this word a) contain a certain number of letters? b) a particular letter? c) a certain number of syllables? and d) have a particular letter which follows another? The semantic questions were comprised of questions from four general categories: categorical (e.g., is this a type of food?), size (e.g., is this smaller than a dime?), location (e.g., would one find this in a kitchen?), use (e.g., is this used for cleaning?), or sense (e.g., does this substance feel hard?). Questions were assigned such that half of the questions associated with the words allocated to each frequency level were perceptual and half were semantic. Each word was assigned either a semantic or perceptual question (See Appendix A).

The questions were designed in order to enable either "yes" or "no" responses. Within each frequency level, response type was alternated for repeated words. For instance, if a word was presented four times, two responses were "yes" and two were "no." In addition, response type was alternated from word to word so that within each frequency level, the first (or only) presentation of four of the words were correctly answered "yes" and the other four were correctly answered "no." In this way, possible confounding of the order of response type was controlled.

In order to ensure that frequency estimates were not affected by words chosen to serve at various experimental frequencies or various positions in the list, another form of the original list was made. On

the second form, words were assigned in such a way that words having semantic questions on the first form now had perceptual questions and vice-versa. The other constraints employed when constructing the original list were also employed.

Frequency Estimation Test List

Two forms of the frequency test were constructed - one for each of the two lists. Each test list included the critical items for each list as well as the eight never-presented distractor items. The words were listed in alphabetical order, each with a blank space for the subject to record a frequency estimate.

Beck Depression Inventory

The Beck Depression Inventory (BDI) (Beck, 1961) is composed of 21 categories of symptoms and attitudes. Each category describes a specific behavioral manifestation of depression and consists of a graded series of four self-evaluative statements. The statements are ranked to reflect the range of severity of symptoms from neutral to maximal severity. Subjects are instructed to read each statement in each category and chose the one(s) that best describes their current feelings. Older subjects were categorized into depressed and non-depressed group based on the following criteria: a score of 6 and below was designated as non-depressed; a score of 9 and above was designated as depressed. All of the young subjects, who served as a control group, received a score of 8 or below and were classified as non-depressed.

Demographic/Activity Level Questionnaire

The function of this questionnaire was to first collect various

demographic data about the subjects. Subjects were asked to provide information about their formal education, parents' occupation, health status as well as their current living arrangements (see Appendix). The Activity Level questionnaire asked subjects to report the frequency with which they performed various activities such as hobbies (sewing, cooking, arts and crafts etc.), social outings (moviegoing, attending concerts and church groups, etc.) as well as participation in sports and exercise (see Appendix B). It has been shown that health status (Siegler, Nowlin & Blumenthal, 1980) and activity level (Birren, Woods & Williams, 1980) may be influential in determining the performance of various cognitive abilities in late life.

Procedure

The researchers met with prospective volunteers in order to introduce themselves and to explain the purpose and requirements of the research. Subjects were informed that they would be required to fill out several questionnaires as well as participate in tasks of verbal judgment and verbal recall. For those willing to serve as volunteers, experimental times were arranged.

Subjects, all of whom were individually tested, were asked to read and sign the consent form which also generally described the requirements of the experiment (see Appendix B). Next, subjects were asked to fill out the demographic/health status and activities level questionnaire and finally the Beck Depression Inventory. General instructions were given for each task and further direction was supplied by the researcher as was necessary.

Subsequent to filling out the questionnaire and BDI, the subjects received instructions for the presention of the word list. The instructions that all subjects received for the list presentation were as follows: "I'm going to show you a list of words. After I show you the word, I want you to say it out loud. Then, after a short time, I will show you a question about that word to which you are to answer either yes or no." The examiner sat across from the subject and displayed the index card, upon which the words were typed, held in the subject's visual field. During a 5-second presentation of each word of the 70-slot list, the subject was required to read the word and say it out loud. Next, the examiner displayed the associate question by unfolding the flap, and subjects answered either the semantic or perceptual question by verbally responding either "yes" or "no." The examiner recorded whether or not the subject answered correctly. Subjects were not informed of the eventual frequency test.

Finally, immediately after the presentation of the word list, subjects were asked to estimate the frequency of occurence of the words in the list by filling out the frequency estimation test list. Subjects were directed to place their estimates in the blank space next to each word. They were also told that some words were distractor items not presented in the list and should be assigned a zero. Following completion of the experimental requirements, all subjects were debriefed.

The two forms of the word lists were assigned such that each was used an equal number of times. Of the 6 experimenters, 3 used word

list #1 when running the first half of their assigned subjects and the remaining 3 used word list #2 in the same manner. Then, the experimenters switched lists in order that those who originally experimented with list #1 now had list #2, and vice versa. Further, both forms were used an equal number of times with the elderly and young groups.

CHAPTER IV

RESULTS

Two 3 x 2 x 3 factorial ANOVAs with repeated measures on the last two factors were conducted on the data. The first factor consists of the three groups (elderly depressed, elderly non-depressed and the young controls). The second factor is the orienting task (semantic and perceptual) and the last factor consists of the frequency of the word presentation (once, twice or four times). Analyses were done on the accuracy of frequency judgments (the unsigned deviations) and on the frequency estimates themselves. The results of each will be considered separately.

The means and standard deviations of the unsigned deviations from the actual frequency are summarized in Table 1. The analysis of variance summary is presented in Table 2. The results of the ANOVA on the unsigned deviations failed to support the experimental hypotheses. First, it had been hypothesized that the elderly, as a group, are less accurate than the younger control group. It was hypothesized further that the depressed elderly subjects are less accurate than their non-depressed cohorts. The main effect for age was not significant, $F(2,39) = .318$. Thus, none of these predicted group differences were found.

In addition to general group differences, it had also been hypothesized that both elderly groups would not estimate frequency as

Table 1

Group Means and Standard Deviations of the Means of the Means of the Unsigned Deviations

	Semantic Orientation			Perceptual Orientation		
Frequency Level	1	2	4	1	2	4
GROUPS						
Depressed Elderly						
M	.61	.93	1.53	.77	.96	1.87
SD	.34	.35	.61	.46	.38	.67
Non-Depressed Elderly						
M	.41	.62	1.50	.84	.89	1.86
SD	.47	.44	.54	.95	.39	.61
Young						
M	.32	.77	1.50	.75	.94	2.08
SD	.36	.36	.56	.63	.38	.93

Table 2

Analysis of Variance Summary Table of the Unsigned Deviations

Source	SS	df	MS	F	p
Between	21.89	41			
Age	.35	2	.18	.32	n.s.
Subjects within Groups	21.54	39	.55		
Within	124.76	210			
Orienting Task	5.85	1	5.85	36.56	$p < .001$
Age x Orienting Task	.45	2	.22	1.37	n.s.
Orienting Task x subjects within Group	6.46	39	.16		
Frequency Level	58.05	2	29.02	70.78	$p < .001$
Age x Frequency Level	.75	4	.18	.44	
Frequency Level x Subjects within Group	31.99	78	.41		
Orienting Task x Frequency Level	.05	2	.03	.11	n.s.
Age x Orienting Task x Frequency Level	.85	4	.21	.80	n.s.
Orienting Task x Frequency Level x Subjects	20.67	78	.26		

accurately as the younger group under the more effortful semantic orienting task. The means of the semantic orienting task are as follows: depressed elderly, M = 1.02; non-depressed elderly, M = .84; non-depressed young, M = .86. For the perceptual condition, the means are: depressed elderly, M = 1.20; non-depressed elderly, M = 1.19; non-depressed young, M = 1.25. However, the interaction of age and orienting task was not significant, $F(2,39) = 1.38$, $p > .05$. Thus, there does not appear to be group differences in the accuracy of frequency estimates as related to orienting task.

This analysis yielded two variables that were significant. First, the main effect for orienting task was significant, $F(1,39) = 36.46$, $p < .001$. This indicates that the subject's frequency accuracy was affected by the orienting task. Observation of the computational totals indicates that subjects were more accurate in judging frequency when the information was semantically processed. The main effect for the frequency level variable was also significant, $F(2,78) = 70.78$, $p < .001$. A subsequent Neuman-Keuls test was performed on the means (.61, .85, 1.73) and revealed that at the .01 level, the highest frequency level (words presented four times) had a significantly higher frequency deviation than either of the two other frequency levels (words presented one and two times). At the .05 level of significance, the testing indicated that the words presented twice had higher mean deviations than words presented one time. In short, these results suggest that as a group, the subjects differentiated between the frequency levels, and the larger the frequency level, the more deviant the

frequency estimates were.

The second ANOVA analyzed means of the frequency estimates as the dependent variable. The means and standard deviations are presented in Table 3. The analysis variance summary appears in Table 4. Again, this analysis failed to support the hypotheses. The means of the semantic orienting task are: depressed elderly, M = 1.98; non-depressed elderly, M = 1.91; non-depressed young, M = 2.16. Under the perceptual condition, the means are: depressed elderly, M = 1.78, non-depressed elderly, M = 1.59; non-depressed young, M = 1.98. The main effect for age was not significant, $F(2,39) = 1.7$, indicating there were no differences among the groups in their actual frequency estimates. Also, there was no significant interaction between age and orienting task, $F(2,39) = .34$. This indicates that there were no group differences in the frequency estimates of words that were either semantically or perceptually processed.

In this analysis, the main effect variables of orienting task and frequency level were again significant, $F(1,39) = 8.83$, $p < .005$ and $F(2,78) = 77.8$, $p < .001$, respectively. The significant main effect for orienting task indicates that the type of processing that was done affected the subjects' estimation of frequency. Observation of the computational totals revealed that when words were perceptually processed, subjects made more errors in the direction of underestimation. A Neuman-Keuls test was completed on the means of the frequency level variable (1.11, 1.73 and 2.88). The results showed that at the .01 level of significance, the highest frequency level (words presented

Table 3

Group Means and Standard Deviations of the Means of the Means of the Actual Frequency Estimates

	Semantic Orientation			Perceptual Orientation		
Frequency Level	1	2	4	1	2	4
GROUPS						
Depressed Elderly						
M	1.09	1.62	3.21	1.10	1.64	2.60
SD	.43	.61	1.23	.58	.63	1.02
Non-Depressed Elderly						
M	1.12	1.87	2.76	.87	1.50	2.39
SD	.48	.44	.90	.43	.48	.86
Young						
M	1.14	2.01	3.35	1.32	1.70	2.93
SD	.26	.72	1.06	.66	.65	1.74

Table 4

Analysis of Variance Summary Table of the Actual Frequency Estimates

Source	SS	df	MS	F	p
Between	55.32	41			
Age	4.42	2	2.21	1.70	n.s.
Subject within Group	50.09	39	1.30		
Within	266.96	210	1.27		
Orienting Task	3.62	1	3.62	8.83	$p < .005$
Age x Orienting Task	.28	2	.14	.34	n.s.
Orienting Task x subjects within Groups	15.9	39	.41		
Frequency Level	135.32	2	67.66	77.80	$p < .001$
Age x Frequency Level	1.48	4	.39	.45	n.s.
Frequency Level x subjects within Groups	67.85	78	.87		
Orienting Task x Frequency Level	2.08	2	1.04	2.08	n.s.
Age x Orienting Task x Frequency Level	1.22	4	.31	.61	n.s.
Orienting Task x Frequency Level x Subjects	39.41	78	.50		

four times) was significantly different than both of the lower frequency levels. In addition, the second highest frequency variable (words presented twice) significantly differed from the lowest frequency level (words presented once). Hence, the subjects were sensitive to the changes in frequency presentation across all frequency levels.

In addition to the main analyses, a one-way analysis of variance was conducted on the zero presented items (that is, words that appeared on the frequency estimation sheet that were not a part of the experimental list) across the 3 groups. The results indicated that there were no significant differences between the means of the elderly depressed (M = .18), the elderly non-depressed (M = .21), and young non-depressed (M = .09) groups, $F(2,39) = .49$. Thus, there were no differences in the subjects ability to recognize words that were not presented in the experimental list.

Another one-way analysis of variance was conducted on the subjects' self-reported activity level. The results indicated that there was a significant difference between the groups, $F(2,39) = 15.59$, $p < .01$. A subsequent Neuman-Keuls test was done on the means. The results showed that at the .01 level of significance, the non-depressed young group (M = 19.07) differed from both the non-depressed elderly (M = 12.07) and depressed elderly (M = 12.64) groups. However, there was no difference between the elderly depressed and elderly non-depressed groups. Therefore, the young individuals were more active (engaged in more social activities and outings etc.) than the elderly individuals.

CHAPTER V

DISCUSSION

The purpose of the present study was to examine the degree to which depression, age and their interaction affect frequency estimation. The results of the experimental analysis failed to support the hypotheses that a) elderly individuals are less accurate when judging the frequency of words that are semantically processed when compared to their frequency judgments about words that are perceptually processed, relative to young individuals and b) depressed elderly are less accurate when judging the frequency of words that are semantically processed relative to non-depressed elderly.

The results failed to show effects due to age or depression. That is, there were no differences between the experimental (elderly-depressed and nondepressed) groups and the control (young nondepressed) group in their ability to accurately judge frequency or between their actual frequency estimates. Further, there were no differential group effects when words were more effortfully processed relative to the less demanding processing required of words perceptually presented.

In addition, the analyses failed to show group differences in the ability to recognize never-presented items. However, analysis of the self-reported activity level showed that there were no significant differences between the activity levels of the depressed and non-depressed elderly groups, but the young non-depressed group was significantly more active than both elderly groups.

One possible explanation for the lack of group differentiation is that the dependent measures that were employed may not have been sensitive enough to detect group differences. However, this possibility is not supported by the results of the main effects (orienting task and frequency level), both of which were statistically significant. These findings suggest that the subjects, as a group, were sensitive to the experimental manipulations of the orienting task and frequency level conditions. Therefore, these variables were shown to have an impact on frequency judgment, but not between groups. Further, it was shown that subjects tended to make more judgment errors in the direction of under-estimation when words were perceptually processed than when semantically processed. This may have been because the nature of the perceptually oriented questions required subjects to focus on the characteristic components of the word rather than the word in its entirety. Thus, subjects may have only processed word parts, which prevented more accurate frequency estimation.

Another possible explanation for the lack of group differentiation is that the processing of frequency information is an automatic process. Hasher and Zacks (1979) defined an automatic encoding process as one that drains minimal energy from the attentional capacity, and as such should not be affected by variables like stress, age or depression. The findings of this study lend support to this claim as neither the depressed nor the non-depressed elderly performed worse than the younger controls. It appears that the attentional requirements of this frequency encoding task were minimal enough to allow all

subjects to perform them equally, regardless of age and/or mood state.

However, these findings do not prove that frequency encoding is indeed an automatic task. As Greene (1984) has pointed out, there are other conditions that Hasher and Zacks (1979) have outlined that must be satisfied before this claim can be made. For instance, Greene found that frequency estimation was affected by the manipulation of incidental and intentional learning conditions. According to Hasher and Zacks, automatic processes should not be affected by these learning conditions. On the other hand, Greene asserts that the fact that the intentionality of learning affects frequency estimation does not mean that frequency is not encoded automatically, because the effect may be due to the way this information is retrieved from storage.

Kausler (1982) also questions the inclusion and frequency estimation as an automatic task and notes that age differences have been found repeatedly for frequency estimates when absolute rather than relative frequency estimates have been used. As noted above, Hasher and Zacks (1979) assert that no developmental trends should be found for automatic encoding. In the present study, developmental trends were not found to affect the subjects' frequency estimations when actual estimates were analyzed.

In reference to the findings on the never-presented items, the old and young groups showed no difference in their ability to discriminate between words that had been experimentally presented and those that had not. Thus, neither age nor depression appears to affect this ability.

In regard to the analysis on activity level, there are several possible explanations. First, it was expected that the young group would be more active given their youth and vitality. Furthermore, many of the activities that were listed were activities that these undergraduate students would find readily available in a college campus enviornment and through planned social activities with college cohorts.

It was somewhat surprising that there was no difference between the elderly depressed and non-depressed groups. Since depressive symptoms can include a general slowing of physical activity (Epstein, 1976), it was expected that the depressed elderly would report engaging in fewer activities. However, all of the elderly persons sampled participated in the activities provided at the Devon-Sheridan Jewish Community center. Their involvement in this program may account for this lack of difference and, as such, these individuals may not be representative of the depressed elderly population at large. Further, because this may have been an atypical elderly depressed group, this may account for the lack of difference between the two elderly groups on the frequency judgment task. Future research in this area should include a more clinically depressed elderly group (that is a group whose behavioral manifestations match their psychometric manifestations).

An obvious limitation of this study is the small sample size. If more data had been gathered for each of the experimental and control groups, a more powerful testing would have been performed, thus detecting smaller group differences if they in fact exist.

There were also some minor problems with the word lists. First, the length of the word lists was 70 slots long, fashioned after those used by Hasher and Zacks (1979, Experiment 2). However, during the administration, it was observed that the subjects, both young and old, tired prior to the completion of the administration. Hence, the effects of fatigue may have been a confounding factor for some subjects. However, if fatigue was a confounding factor, elderly subjects should have been more influenced by it than the young subjects. This effect was not observed. While ceiling effects have to be avoided, especially for young subjects (Hulicka & Grossman, 1967), a shorter list may have been more useful.

Also, a few subjects found some of the semantic questions that were asked about the words to be ambiguous. As such, they tended to abstract to a point beyond which the researcher had intended. For instance, when asked if water could be used to illuminate a room, one subject responded yes, noting that water could make a room brighter. This problem may have been avoided if the word lists had been formally piloted.

In summary, no differences were found between age groups with regard to the accuracy of frequency estimates as well as the actual estimates themselves. The results substantiate Hasher and Zacks' (1979) claim that neither age nor depression affect frequency estimation. Nor were there group differences in the frequency estimation of words that were semantically as opposed to perceptually processed.

While this study is not definitive in terms of providing infor-

mation that settles the current controversy surrounding the automaticity of frequency judgments, it does support Hasher and Zacks (1979) proposition. That is, automatic processes, according to Hasher and Zacks, are not affected by age or mood. In the present study, neither mood nor age were found to significantly affect frequency judgments. Thus, these findings align with the notion that frequency information is automatically encoded. However, other criteria for automaticity with regard to frequency information, such as intentionality of learning, have been investigated resulting in mixed findings (Green, 1984; Hasher & Zacks, 1979). Future research should address this issue, utilizing methodology similar to what has already been employed in order to obtain a more definitive conclusion.

Although this study found no evidence of developmental trends in frequency estimation, Greene (1984) cites Ghatala and Levin (1973) who found improvement in frequency estimation as a function of age. Perhaps further investigation into frequency encoding across the developmental span is warranted. It would be important for studies of this type to have large enough sample sizes such that small, yet significant differences might be detected.

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APPENDIX A

SAMPLE QUESTIONS FROM WORD LIST

word: NAIL orienting task: perceptual

questions: Are there more than two letters in this word? (yes)
Does the letter "A" follow the letter "L?" (no)
Does this word contain only one syllable? (yes)
Does this word contain the letter "C?" (no)

word: UMBRELLA orienting task: semantic

questions: Is this used for writing? (no)
Does this shield one from rain? (yes)
Is this larger than an airplaine? (no)
Can this be bought in department stores? (yes)

APPENDIX B

SAMPLE OF QUESTIONNAIRES

TO ALL VOLUNTEER PARTICIPANTS

You have been asked to participate in a research project part of which includes taking a paper and pencil survey of various psychological characteristics. In addition, you will be asked to complete a task involving verbal judgment and verbal recall. The purpose of this research is to determine the relationship between these psychological characteristics and verbal performance (verbal judgment and verbal recall).

Before you begin, I wish to stress that your participation is entirely voluntary and that there is no connection between this research project and your status or privledges in the organization through which you were contacted. As such, you are free to withdraw your participation at any time. I also want to stress that any information that you give on this questionnaire or any other materials will be kept strictly confidential. It will be used only by those conducting the research and only for the purposes of research. Please do not put your name on this questionnaire; this will help ensure the confidentially of your answers.

Thank you for your participation in this project.

Holly Houston
Psychology Graduate Student

I have read the above and understand that my participation is purely voluntary. I understand that I may terminate my participation from this project at any time.

signed _____ witnessed _____

date _____ date _____

Questionnaire

In responding to this questionnaire, please do not put your name down. This is to ensure confidentiality.

Code number:___ ___ ___ ___

1. Sex: Male___ Female___ 2. Age___

3. What is your marital status?

Single ___
Married ___
Separated/Divorced ___
Widowed ___

4. Where do you live?

Own home ___
Apartment ___
Dormitory ___
Retirement home, hotel, building ___
Other(What) ___

5. With whom do you live?

Alone ___
Spouse ___
Friend(s) ___
Parents ___
Your children ___
Other relatives ___
Unrelated others ___
Other ___

6. Check to indicate the highest year of education completed.

No formal education ___
Grammar school-- 1 2 3 4 5 6 7 8
High School-- 1 2 3 4
College-- 1 2 3 4
Graduate or professional some__ Master's __
Doctorate __

What is/was your area of specialization?

_____

Have you had other educational experiences, such as trade, technical, or vocational courses, or other adult education? If so, please note what and when.

_____

_____

7. If you are a student, please give your parents' occupation. Give the title and describe work briefly if it is not clear from the title.

Father's occupation_____

Mother's occupation (including homemaker)_____

_____

8. Which best describes your current (past year) health or physical condition?

Excellent(scarcely ever ill; no problems) ___
Good (a few minor problems) ___
Fair (some problems; minor limitations) ___
Poor (frequent problems; somewhat incapacitating ___
Very Poor (chronic or acute condition(s); very limiting) ___

How would you describe your eyesight (with glasses if a correction is needed)?

OK, no problem___ Some problem___ Severe problem ___

How would you describe your hearing?

OK, no problem___ Some problem___ Severe problem____

Questionnaier A

ACTIVITIES AND HOBBIES

Indicate how often you engaged in each activity during the past year. Report as times per week, month, or year - whichever is most convenient.

	Wk.	Mo.	Yr.	Less Than Once a Year
1. Playing cards, video games, or board games.....				
2. Active sports as swim, tennis, golf, ski.....				
3. Exercise, physical fitness, jogging.....				
4. Walk.....				
5. Puzzles (as jigsaw).....				
6. Crossword, word or math puzzles.....				
7. Gardening.....				
8. Woodworking, carpentry, repair things.....				
9. Cooking as hobby.....				
10. Writing letters to family, friends.....				
11. Photography.....				
12. Crafts, painting, ceramics....				
13. Needlework, knitting.....				
14. Attend movies, theatre, concerts.....				
15. Attend sports events.....				
16. Visit library, museums.....				
17. Travel.....				
18. Take naps or just rest.....				
19. Attend classes, discussion groups.....				
20. Participate clubs, organizations.....				
21. Play musical instrument, sing.....				
22. Attend church, church groups..				
23. Visit friends or invite over..				
24. Reading newspaper.....				
25. Reading magazines.....				
26. Reading books.....				

How many hours per week do you watch TV?_____

ACTIVITIES AND HOBBIES con't.

What are your favorite programs (or types of programs)?

_____

How many hours per week do you listen to the radio?

_____

What are your favorite programs (or types of programs)?

_____

Instructions: This is a questionnaire. On the questionnaire are groups of statements. Please read the entire group of statements in each category. Then pick out the one statement in that group which best describes the way you feel today, that is, right now! Circle the number beside the statement you have chosen. If several statements in the group seem to apply equally well, circle each one.

Be sure to read all the statements in each group before making your choice.

A.
0 I do not feel sad
1 I feel sad
2 I am sad all the time and I can't snap out of it
3 I am so sad or unhappy that I can't stand it

B.
0 I am not particularly discouraged about the future
1 I feel discouraged about the future
2 I feel I have nothing to look forward to
3 I feel that the future is hopeless and that things cannot improve

C.
0 I do not feel like a failure
1 I feel I have failed more than the average person
2 As I look back on my life all I can see is a lot of failures
3 I feel I am a complete failure as a person

D.
0 I get as much satisfaction out of things as I used to
1 I don't enjoy things the way I used to
2 I don't get real satisfaction out of anything anymore
3 I am dissatisfied or bored with everything

E.
0 I don't feel particularly guilty
1 I feel guilty a good part of the time
2 I feel quite guilty most of the time
3 I feel guilty all of the time

F.
0 I don't feel I am being punished
1 I feel I may be punished
2 I expect to be punished
3 I feel I am being punished

G.
0 I don't feel disappointed in myself
1 I am disappointed in myself
2 I am disgusted with myself
3 I hate myself

H.
0 I don't feel I am any worse than anybody else
1 I am critical of myself for my weaknesses or mistakes
2 I blame myself all the time for my faults
3 I blame myself for everything bad that happens

I.
0 I don't have any thoughts of killing myself
1 I have thoughts of killing myself but I would not carry them out
2 I would like to kill myself
3 I would kill myself if I had the chance

J.
0 I don't cry any more than usual
1 I cry more now than I used to
2 I cry all the time now
3 I used to be able to cry but now I can't cry even though I want to

K.
0 I am no more irritated now than I ever am
1 I get annoyed or irritated more easily than I used to
2 I feel irritated all the time now
3 I don't get irritated at all by the things that used to irritate me

L.
0 I have not lost interest in other people
1 I am less interested in other people than I used to be
2 I have lost most of my interest in other people
3 I have lost all of my interest in other people

M.
0 I make decisions about as well as I ever could
1 I put off making decisions more than I used to
2 I have greater difficulty in making decisions than before
3 I can't make decisions at all any more

N.

0 I don't feel I look any worse than I used to
1 I am worried that I am looking old or unattractive
2 I feel that there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly

O.

0 I can work about as well as before
1 It takes extra effort to get started at doing something
2 I have to push myself very hard to do anything
3 I can't do any work at all

P.

0 I can sleep as well as usual
1 I don't sleep as well as I used to
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
3 I wake up several hours earlier than I used to and cannot get back to sleep

Q.

0 I don't get any more tired than usual
1 I get tired more easily than I used to
2 I get tired from doing almost anything
3 I am too tired to do anything

R.

0 My appetite is no worse than usual
1 My appetite is not as good at it used to be
2 My appetite is much worse now
3 I have no appetite at all any more

S.

0 I haven't lost much weight, if any, lately
1 I have lost more than 5 pounds
2 I have lost more than 10 pounds
3 I have lost more than 15 pounds

I am purposely trying to lose weight by eating less
Yes____
No ____

T.

0 I am no more worried about my health than usual
1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation
2 I am very worried about physical problems and it's hard to think of much else
3 I am so worried about my physical problems, I cannot think about anything else

U.

0 I have not noticed any recent change in my interest in sex
1 I am less interested in sex than I used to be
2 I am much less interested in sex now
3 I have lost interest in sex completely

APPROVAL SHEET

The thesis submitted by Holly O. Houston has been read and approved by the following committee:

Dr. James E. Johnson, Director
Associate Professor, Psychology, Loyola

Dr. Eugene B. Zechmeister
Professor, Psychology, Loyola

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts.

December 3, 1984
Date

James E. Johnson
Director's Signature