1

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

National Library
of Canada

Bibliothèque nationale
du Canada

Canadian Theses Service

Service des thèses canadiennes

Ottawa, Canada
K1A 0N4

NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

THE RELATIONSHIP BETWEEN
METAMEMORY AND MEMORY
THROUGH ADULTHOOD

Ann Pirolli

Thesis submitted to
Graduate Studies and Research
in partial fulfillment of the requirements
for the Master's degree in Psychology

Carleton University

National Library
of Canada

Bibliothèque nationale
du Canada

Canadian Theses Service Service des thèses canadiennes

Ottawa, Canada
K1A 0N4

NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

ISBN 0-315-60469-7

The undersigned recommend to the Faculty of Graduate Studies
and Research acceptance of the thesis

"The relationship between
metamemory and memory
through adulthood"

submitted by Ann Pirolli, B.Sc.
in partial fulfillment of the requirements for
the degree of Master of Arts

Thesis Supervisor

Chair, Department of Psychology

Carleton University
September 20, 1990

INDEX

	PAGE
I. Introduction.....	1
1. Estimation Research.....	3
2. Questionnaire Research.....	11
II. Study I (Estimation)	
1. Method.....	19
2. Results.....	23
III. Study II (Questionnaire)	
1. Method.....	42
2. Results.....	47
IV. Discussion	
1. Study I Discussion.....	69
2. Study II Discussion.....	76
3. Summary.....	79
V. References.....	85
VI. Appendix A.....	89
VII. Appendix B.....	103
VIII. Appendix C.....	110

List of Figures

PAGE

Study I

1.	Mean scores for all trials of the list task.....	24
2.	Mean scores for all trials of the PA task.....	24
3.	Mean estimates for all trials of the list task.....	24
4.	Mean estimates for all trials of the PA task.....	24
5.	Mean scores and estimates for all trials of the list for young subjects only.....	30
6.	Overall mean percent of over- and underestimations for list task.....	34
7.	Mean percent of over- and underestimations for each trial of the list task.....	36
8.	Overall mean percent of over- and underestimations for the PA task.....	38
9.	Mean percent of over- and underestimations for each trial of the PA task.....	39

Study II

10.	Mean scores for all trials of the list task.....	48
11.	Mean scores for all trials of the PA task.....	48
12.	Mean scores for all trials of the paragraph task.....	48
13.	Mean scores for all trials of the simple figure task....	48
14.	Mean scores for all trials of the complex figure task...	48
15.	Mean scores for the digit span task.....	48
16.	Mean Geriatric Depression scores.....	52
17.	Mean anxiety scores from the Schmidt questionnaire.....	52
18.	Mean memory complaint scores from the Schmidt questionnaire.....	52

Appendix B

19. Mean list scores for each six age group division
for trials 1, 5, and delay (Study I).....105
20. Mean PA scores for each six age group division for
trials 1, 4, and delay (Study I).....105
21. Mean list scores for each three age group division
for trials 1, 5, and delay (Study I).....107
22. Mean PA scores for each three age group division for
trials 1, 4, and delay (Study I).....107
23. The interrelationship of memory beliefs and memory
performance81

List of Tables

Study I

	PAGE
1. Demographic information for the subjects participating in Study I.....	20
2. Correlations between estimates and scores for the list and PA task.....	28
3. Perfect estimations in percentages at each trial and over all trials of the list and PA task.....	32

Study II

4. Demographic information for the subjects participating in Study II.....	43
5. Means for each point on the 4-point likert scale of the memory complaint section of the Schmidt questionnaire.....	54
6. Correlations between memory complaints, task scores, and depression and anxiety levels.....	56
7. Multiple regression with memory compliant scores as the dependent variable and trial 1 scores, age, WAIS-R vocabulary scores, and depression and anxiety scores as the independent variables.....	59
8. Multiple regression with memory compliant scores as the dependent variable and last trial scores, age, WAIS-R vocabulary scores, and depression and anxiety scores as the independent variables.....	60
9. Multiple regression with memory compliant scores as the dependent variable and delay trial scores, age, WAIS-R vocabulary scores, and depression and anxiety scores as the independent variables.....	62
10. Multiple regression with memory compliant scores as the dependent variable and summed trial scores, age, WAIS-R vocabulary scores, and depression and anxiety scores as the independent variables.....	64
11. First two factor loadings of the Schmidt questionnaire for all age groups together and separate...	66

Abstract

Metamemory (knowledge, awareness, and beliefs about memory) was evaluated and compared across three age groups (20-39, 40-59, 60-80) using both an estimation procedure and a memory complaint questionnaire. With 200 community-based adults, estimations concerning performance on two memory tasks (list learning and paired associative (PA) learning) were obtained prior to and following feedback on several trials. Using a separate group of 350 community-based subjects, memory complaints were compared to actual memory performance on several memory tasks from the Learning and Memory Battery (LAMB) and to measures of depression and anxiety. Results demonstrated that, prior to feedback, the younger and older subjects differed in their estimation responses. Following feedback, all age groups responded in similar fashion and adjusted their estimations in accordance with performance. In experiment 2, no relationship was found between complaints and performance or age. Differences and similarities between the younger and older adults are discussed in reference to general versus specific metamemory.

INTRODUCTION

As the population over 65 increases, there is growing interest, from researchers and the public alike, in the changes that occur in normal aging. Of particular concern is memory functioning. It is important for researchers and clinicians to understand the differences between normal and abnormal memory changes that accompany aging. It is also important for the elderly to have realistic expectations about their memory abilities. Over-expectations or under-expectations may detrimentally affect performance and/or self-esteem.

It has been repeatedly demonstrated that on certain tasks elderly individuals perform more poorly than do younger adults (for reviews see Craik, 1977; Poon, 1986). These differences are primarily in the acquisition of information and its retrieval from secondary memory. Explanations for these memory deficits have focused on various aspects of cognitive processing as well as on personal attributes. Representative examples include implicit memory, explicit memory, working memory, attention, experience and practice, motivation, anxiety, need achievement, self-knowledge and self-evaluation (for reviews, Birren & Schaie, 1990). For the present study, the focus will be on the latter areas -- self-knowledge and self-evaluation of memory capabilities.

These constructs are encompassed by the term "metamemory". Flavell (1971) originally coined the term and defined it as "the

individual's knowledge of and awareness of memory, or of anything pertinent to information storage and retrieval." (p.4). The concept of metamemory is important because it implies performance may be shaped by one's knowledge and perceptions of memory performance as well as by one's actual skills and natural ability. The awareness of one's own personal strengths and weaknesses in various types of memory situations will result in the successful selection and implementation of memory strategies which promote optimum performance, and recognition of those mnemonic characteristics that are similar or different to those experienced in the past (Flavell & Wellman, 1977).

Two main paradigms have been employed in metamemory research. One paradigm uses an estimation procedure. Subjects are asked to predict or estimate their performance on a specified task. The estimations are then compared to their actual scores on the task to obtain an indication of their metamemory capability. The reasoning underlying this procedure is that an efficient and precise memorizer will accurately analyze the task at hand, self-evaluate storage and retrieval capacities, and then select an appropriate strategy (if needed) to optimize performance. The past research has focused on two questions. The first has been concerned with whether the accuracy of prediction varies as a function of age. The second question has dealt with response bias -- a person's inclination to be overly confident or cautious in their response tendencies. That is, when individuals do not predict exactly the score obtained on a

task, do they over- or underestimate their performance and does such a response bias differ with age?

The second metamemory paradigm uses questionnaires where subjects evaluate their memory abilities in various situations. Questions have ranged from general inquiries ("How is your memory?") to specific problems ("How often do you have to look up a friend's phone number?"). The assumption behind this procedure is that the number of complaints on the questionnaire should reflect the actual level of performance that occurs in these situations. A major impetus for this research was a desire to develop a self-rating scale which could be used to quickly evaluate a person's capabilities and problems without resorting to series of lengthy neuropsychological tests.

Estimation Research

Literature Review

Estimation procedures for studying metamemory in the aged were originally introduced by Perlmuter (1978). She asked young (20-25 years) and old (60-65 years) subjects to perform a series of immediate (word learning and recall) and remote (general information) memory tests. For the word recall tasks, subjects were asked to predict their actual scores on a single recall trial. For the general information task, they were asked to estimate how many previously incorrectly answered questions

they would be able to identify in a recognition test. In terms of actual performance measures, older subjects remembered fewer words but scored higher on the general information test than younger subjects. Estimation accuracy, the amount of difference between estimated and actual performance, was comparable for both age groups for both tasks. Thus, metamemory abilities were equivalent in younger and older adults, at least in terms of estimation accuracy. Lachman, Lachman, and Thronesbery (1979) replicated the findings from the remote memory task with a wider age range (19-22, 44-53, 65-74) thereby reinforcing the conclusion from Perlmutter's (1978) study.

Murphy, Sanders, Gabriesheski, and Schmitt (1981) examined the relationship between study time and estimation accuracy. The researchers reasoned that if metamemory capacities were comparable across ages, then the amount of study time needed to optimize performance should also be comparable. Estimation accuracy and study time were measured separately in two different tasks. Although the young (17-29) and old subjects (60-80) achieved the same level of estimation accuracy, the direction of error was different. The young underestimated and the old overestimated. In terms of study time, the young adults devoted more time to studying various lists of words and obtained higher test scores than the older subjects. Additionally, the older adults increased their study time to a lesser degree than the younger adults as the difficulty of the task increased.

To further investigate the differences in study time, older

subjects were taught strategies that were relevant to the list learning tasks (Murphy et al., 1981). This was to determine if a deficit in such strategies contributed to the elderly subject's shorter study time. Murphy et al. (1981) hypothesized that older subjects who did not know which strategy was appropriate for the tasks may have stopped studying sooner. One group of elderly subjects was trained in two specific strategies -- chunking and rehearsal. A second group was merely encouraged to study the same amount of time as the younger subjects did in the previous study. A third group was simply told to study the lists and that accurate recall was important. The only effective technique for improving performance was the second procedure where elderly subjects were "forced" to study longer. This suggests that elderly adults can access appropriate strategies if they take the time to do so or that the strategies are more useful if time enough time is spent on them.

Coyne (1985) also examined differences in study time between young and old adults. He suggested that a study-time discrepancy could be due to age specific knowledge about the relationship that exists between the duration of study time and memory performance. Coyne proposed that older adults studied for less time because they failed to realize that recall performance was a function of the amount of time that a list was available. Young (18-27) and old (62-83) subjects were asked to predict how many words they would be able to recall from a list after studying the words for various lengths of time. Thus, subjects were asked how

many words could they recall with 5 seconds of exposure to each word; how many with 10 seconds exposure, 20, 40, 60, and 120 seconds. Recall performance was assessed in a single trial. Young adults were more accurate in their predictions than the older adults. There was, however, no significant interaction between age, estimation accuracy, and presentation time. This suggests that older adults, like the younger adults, adjusted their recall predictions on the basis of presentation time and these adjustments paralleled their actual recall. Interestingly, both groups tended to overestimate their performance with the older adults overestimating their abilities to a greater degree than younger adults (young predicted 8.2, actual was 7.8; old predicted 7.6, actual was 5.5). In conclusion, Coyne (1985) suggested older adults do not have less accurate knowledge of their memory abilities than younger adults and both were capable of adjusting recall predictions on the basis of the amount of study time available.

Bruce, Coyne, and Botwinick (1982) tested the ability of different age groups (18-31, 60-69, 70-79) to predict the number of words they could recall from various lists made up of words that differed in frequency of occurrence and level of imagery. Prior to making their estimates, each participant was shown 4-item examples of each type of list. Recall performance was assessed using a single trial. In terms of actual performance, scores decreased as a function of age. The researchers emphasized that although the performance levels were different,

the prediction scores were the same for all age groups. That is, as age increased recall predictions progressively exceeded performance (i.e., overestimation by the elderly). The finding that younger adults have superior estimation accuracy is inconsistent with the conclusions advanced in the previous studies. This study, though, did not present any statistical analyses of the differences between estimated and obtained scores for the two age groups. As well, there were no correlations presented between estimates and scores. The lack of such data makes the results less persuasive.

Lachman and Jelalian (1984), asked younger (18-22) and older (64-91) subjects to predict performance before and after two recall trials. The researchers not only investigated the ability of different age groups to estimate their performance but also the subjects' ability to monitor changes in performance due to practice (i.e., trial 1 to trial 2) and alter their performance accordingly. In other words, the investigators were interested in the role of implicit feedback in the development of accurate estimations in the two age groups. The younger subjects performed at a higher level than the older subjects on both trials. Correlations between the estimated and actual scores were low on the first trial and subsequently increased on the second trial with both age groups responding to implicit feedback in the same manner. Even though the two age groups were comparable in estimation accuracy, older adults overestimated more than younger adults.

Hertzog, Dixon, and Hultsch (1990) asked subjects spanning the ages 20-79 to predict their performance on several trials of a list recall task and a story recall task. Prior to each test, subjects were told how the "average" person would score. Estimation accuracy was high for all ages and over several trials subjects improved their accuracy. For the list task, all subjects underestimated their performance while for the story task, all subjects overestimated. No differences emerged between the age groups concerning accuracy levels or their ability to improve this accuracy over trials. These findings re-affirm that metamemory (i.e., estimation ability) is equivalent in the different age groups. The data also support Lachman and Jelalian's study that demonstrated that all age groups can effectively utilize feedback to modify their predictions in accordance with their performance.

To summarize, the majority of estimation studies have shown that young and old adults are equivalent in their estimation accuracy with older adults tending to overestimate their performance abilities more than younger adults. Recent experience with a task and exposure durations to the stimulus material have also been demonstrated to be important variables in the development of estimation accuracy.

Study I

Beyond methodological inconsistencies in the past studies (e.g., subject selection, definitions of age categories, etc.),

there are certain issues which need to be further addressed.

1) Past research has only employed tests of immediate memory (e.g., immediate recall) or remote memory (e.g., general information of historical facts). Immediate recall is frequently more associated with learning rather than memory. Moreover, no study has investigated estimation accuracy for the retrieval of recently learned material after an intervening period of time. Inclusion of a retention test is important because the majority of the memory problems associated with the elderly are more pronounced with delayed testing. However, it is predicted that elderly and younger adults will demonstrate equivalent levels of estimation accuracy on both learning (immediate free recall) and memory (delayed recall) trials. This hypothesis is based on previously cited findings that estimation accuracy for immediate and remote memory is comparable for young and old adults. It is anticipated that this "comparability" will also be evident on a short-delay retrieval task.

2) Data from several studies have suggested that experience with a task is important in developing estimation accuracy in the elderly. Practice effects have also contributed to the ability of subjects to effectively monitor their performance throughout a task. These "experience" and "practice" variables actually represent feedback factors, albeit implicit feedback. If feedback from performance is an important variable, it would be of interest to investigate the effects of explicit feedback on estimation accuracy throughout a learning and memory task. Such

an investigation would involve measuring estimation accuracy on each of several trials (immediate and delayed recall) of a task. Because the majority of the previous studies have used only one trial to ascertain memory performance and estimation accuracy, there is little information available on the effects which feedback has on estimation accuracy. The present study was designed to provide this information.

It is predicted that the elderly subjects, like the young, will successfully utilize explicit feedback from their performance to adjust their estimations. This is based on previous findings that young and old subjects are similar in their metamemory capabilities and on the findings of Lachman and Jelalian (1984) and Hertzog et al. (1990) who demonstrated that older and younger subjects altered their estimations according to implicit feedback on their performance.

3) The majority of estimation studies have reported that elderly adults tend to overestimate their performance. However these findings, in part, may be an artifact of ceiling effects, particularly for the younger adults. That is, if subjects were obtaining high or perfect scores (e.g., 14/15 or 15/15) there would be little opportunity for overestimating. On the other hand, if subjects were scoring in the mid- to low range (e.g., 6/15 or 9/15) there would be more room to overestimate. In Lachman and Jelalian (1984), for example, older but not younger subjects overestimated. Younger subjects, though, had an average of 14/15 on the first trial and 14.5/15 on the second

trial, leaving little or no room for overestimation. In fact, 73% of the young subjects obtained a perfect score on the second trial. The old subjects, on the other hand, scored 5/15 on the first trial and 6/15 on the second trial providing more room for overestimation.

If younger and older adults do have similar metamemory capabilities, there is no reason to suspect one age group to over- or underestimate more than another group as long as ceiling effects are controlled. Responcy tendencies will be further explored in the present study. The results will also be relevant to the commonly held notion that the elderly are more conservative than younger adults.

Questionnaire Research

Literature Review

The use of questionnaires in metamemory research developed out of findings from two converging areas. Results from the first area, memory performance research, demonstrated that older adults perform more poorly on certain memory tasks (for reviews see Craik, 1977; Poon, 1986). Aging produces a decline in acquisition and retrieval from secondary memory but does not affect registration, primary memory, or remote memory. Memory tasks which require spontaneous organization or elaboration also demonstrate age-related decrements in performance. The second

research area is related to self-evaluation of memory abilities and was stimulated by the finding that memory complaints increased throughout adulthood. Using various methods of inquiry (e.g., diaries, questionnaires), investigators have consistently demonstrated that older adults complain more about their day-to-day memory than do younger adults (e.g., Cutler & Grams, 1988; Perlmutter, 1978; Zelinski, Gilewski, & Thompson, 1980). Because independent studies have shown that older adults have lower scores in objective memory tests and express more complaints about memory than younger adults, scores from memory complaint questionnaires should predict memory test performance. Such a relationship would show one's awareness of memory capabilities and illustrate a relatively high level of metamemory functioning. Evidence of such a relationship would also permit using a brief memory questionnaire to evaluate a person's level of memory capabilities. In fact, this was one of the reasons for the development of such questionnaires (Albert & Kaplin, 1980; Poon & Walsh-Sweeny, 1980; Zelinski et al., 1980).

Unfortunately, demonstrating a relationship between memory complaints and performance has been a difficult task. Few studies have shown the predicted relationship (Rabbitt, 1982; Riege, 1983). Many other studies, using a variety of different questionnaires and memory tasks, have found either no relationship (Lowenthal, Berkman, Buehler, Pierce, Robinson, & Trier, 1967; McGlone, Gupta, Humphrey, Oppenheimer, Mirsen, & Evans, 1989; Sunderland, Watts, Baddeley, & Harris, 1986;

Zelinski, Gilewski, & Thompson, 1980) or a mixture of positive and negative correlations (Dobbs & Rule, 1985).

These results may indicate that no correspondence exists between memory complaints and performance and, thus, memory complaints are not an appropriate measure of memory ability. Conversely, the relationship may exist but has not been demonstrated due to methodological problems in the research. Several methodological factors could account for the inconsistent results from the studies on memory complaints and performance. For instance, the age of the subjects varied among the studies as did the operational definitions of the terms "young" and "old". For example, Perlmutter (1978) defined "young" as those aged 20-25 while Zelinski et al. (1980) included subjects up to the age of 40 in their young group. Sixty-five years of age was considered "old" by some investigators (e.g., Perlmutter, 1978) while others included subjects up to the age of 99 (e.g., Dobbs & Rule, 1985). The inclusion of "middle aged" subjects has also been neglected in the majority of the studies (e.g., Cutler & Grams, 1988; Lowenthal et al., 1967; McGlone et al., 1989; Rabbitt, 1982; Riege 1983; Sunderland et al., 1986; Zelinski et al., 1980).

The sampling procedures used to select the subjects varied from study to study. While some researchers included subjects from the community in all age groups (e.g., Dobbs & Rule, 1985) others recruited young subjects from a university population and old subjects from the community (e.g., Zelinski et al, 1980).

Other researchers either have not reported such demographics or have been vague about them (e.g., Riege, 1983). The frequent testing experienced by university students provides them with regular and objective feedback of their memory capabilities which is not available for adults from the community. Because monitoring of feedback increases people's awareness of their memory capabilities and limitations (Hermann, 1983; Schlechter & Hermann, 1981), university students have an advantage over their same-aged peers who are not in an academic environment. Thus, studies may have confounded age and environmental experience.

Other uncontrolled variables relate to various aspects of the memory questionnaires employed. For example, questionnaires have varied in the number and specificity of questions. Some researchers have used only one general question ("How good do you think your memory is?"; Lowenthal et al., 1967) while others have used specific questions which tap a variety of memory problems (e.g., "How often do you have to look up a frequently called phone number?", "How often do you forget items at the grocery store?"; Reige, 1982). Answer formats have varied from open-ended questions (e.g., Lowenthal et al., 1967) to 7-point Likert scales (e.g., Zelinski et al., 1990).

Finally, the types of tasks employed to measure memory have differed in the questionnaire studies. There appears to have been no theoretical basis for the choice of many of the tasks and little consideration given as to how they relate to the types of questions being asked on the metamemory questionnaires. Various

types of memory tests have been employed with most studies employing only one or two of the following: digit span, general information, prospective memory tasks, paired associates, story recall, list, and prose recall. These various memory tasks not only differ in content but also on the type of memory being tapped (e.g., short term memory vs. long term memory; verbal vs. visual). Rarely has a study included all of the above types of memory tasks, making comparisons from study to study difficult.

With all these inconsistencies, one could claim that the lack of correspondence between memory performance and complaints has been due to methodological problems. Recent studies, though, have demonstrated that even when the above mentioned variables are controlled, complaints and performance still do not correlate (e.g., Hultsch, Hertzog, Dixon, & Davidson, 1988; Tombaugh & Faulkner, 1990).

Some researchers wondered whether the questionnaires were actually measuring something other than subjective estimates of memory. As with any self-assessment procedure, one must be wary of factors such as depression, anxiety, acquiescence, and motivation. Investigators soon discovered that these questionnaires often reflected affective states rather than knowledge of memory capabilities. For instance, it has been consistently demonstrated that depression is highly correlated with the scores from memory complaint questionnaires (Cavanaugh, Grady, & Perlmutter, 1983; Humphrey, McGlone, Gupta, & Evans, 1989; Kahn, Zarit, Hilbert, & Niederehe, 1975; Niederehe & Yoder,

1989; O'Hara, Hinrichs, Kohout, Wallace, & Lemke, 1986; Popkin, Gallagher, Thompson, & Moore, 1982; Zarit, Gallagher, & Kramer, 1981). One case in point, Popkin, Gallagher, Thompson, and Moore (1982) compared pre-psychotherapy memory performance and complaints in normal and depressed elderly. Subjects were asked to rate a series of memory problems in terms of severity, effort and frequency. Objective memory measures included immediate and delayed free recall and recognition of a word list as well as free recall of a paragraph. The results demonstrated that the two groups did not differ on any of the objective memory tests, but the depressed subjects reported significantly more complaints on all three indices. Post-therapy, comparison showed there were no significant differences in performance measures between those who did or did not respond to the psychotherapy. However, those who responded favorably to psychotherapy complained significantly less on all three indices as compared to those who did not respond favorably to treatment. Therefore, improvement in affective status resulted in changes in complaints about memory but not actual memory performance.

It has also been suggested that anxiety is related to scores on memory questionnaires, although only one study has been conducted thus far. West, Boatwright, and Schleser (1984) measured life satisfaction, depression and anxiety in subjects between the ages of 65 and 90. Objective memory tests included free recall of related words (grocery store items), unrelated words (high frequency concrete nouns), digit span (WAIS-R), and

an "ecologically valid" digit span test (e.g., "I'm going to say a zip code...telephone number..."). Memory complaints relating to specific instances of memory problems were measured by a questionnaire. No correlations existed between affective measures and memory performance or between memory complaints and memory performance. There was, however, a significant correlation between the memory complaints and the affective measures. Of the three affective measures, life satisfaction was related most highly to memory complaint scores, followed by anxiety, and then by depression. Thus, although this is the only study to investigate the influence of anxiety, there is a suggestion that it, too, plays an important role in the determination of memory complaint questionnaire scores.

Study II

1) One purpose of the present investigation was to further investigate the influence of anxiety on the scores obtained from a memory complaint questionnaire. Understanding the influences of depression and anxiety on subjective memory evaluations may prove to be clinically useful. While memory complaint questionnaires may never replace traditional assessment techniques of memory capabilities, they may provide a useful tool in the clinical setting. For instance, many older adults may notice day-to-day changes in memory and become worried that they are suffering from some type of dementing disorder such as Alzheimer's disease. When an older individual approaches a

physician with such concerns, it would be useful to ascertain whether perceived problems were due to actual memory problems (e.g., organic problems) or to emotional reactions produced by a self-perceived decline in memory ability. Knowing such information, the patient could be appropriately informed as to the nature of the problem and provided with information on how to cope with the normal memory changes that occur with aging.

2) A second purpose of the present study was to investigate the psychometric properties of a newly developed questionnaire which was designed to measure memory complaints and anxiety. Presently, this questionnaire is being used on a preliminary basis in a hospital setting and knowledge of its effectiveness to measure complaints and anxiety would be beneficial for its further use.

STUDY I

Method

Subjects

The present investigation constituted a subset of a larger study designed to provide normative data for a series of learning and memory task (Learning and Memory Battery or LAMB). Of the 850 community-dwelling volunteers taking part in the LAMB study, 332, aged 20-80, randomly selected subjects participated in the estimation task. All subjects were community-dwelling adults from the Ottawa-Carleton region and were recruited through various forms of advertising. Demographic information for the participants is presented in Table 1.

Insert Table 1 about here

Materials

The LAMB represents a comprehensive test of both visual and verbal memory performance (Appendix A). From this battery, two tests were chosen for the estimation procedure: List Learning and Paired Associative (PA) Learning. Instructions for these tasks can be found in Appendix A.

Procedure

All subjects were informed that they were taking part in a study concerned with memory performance through adulthood. Upon

Table 1: Demographic information for the subjects participating in the estimation study.

	AGE RANGE	MEAN AGE	ESTIM'D IQ a	GENDER		MEAN EDUCATION b	N
				M	F		
YOUNG	20-39	30.9	11.0	.29	.71	5.0	82
MIDDLE	40-59	49.5	11.7	.28	.72	4.5	103
OLD	60-80	68.3	11.8	.38	.62	4.0	147

a IQ was estimated with the scores from the vocabulary subtest of the WAIS-R with a mean score of 10 and standard deviation of 3.

b 1 = some grade school
 2 = grade school completed
 3 = some high school
 4 = high school completed
 5 = some university
 6 = university graduate
 7 = post-graduate

arrival, subjects were asked to provide demographic information (e.g., age, birth date). Prior to the presentation of the LAMB, subjects were given the Mini-Mental Status Exam (Folstein, Folstein, & McHugh, 1975) as a screening for impaired cognitive functioning or dementia. The experimenter then presented the LAMB in its structured format (as presented in Appendix A). Following this, subjects were given four subtests of the Wechsler Adult Intelligence Scale (WAIS-R -- Block Design, Similarities, Vocabulary, and Digit Symbol). Finally, the Geriatric Depression Scale (GDS) (Brink, Lum, Heersema, Adey, & Rose, 1982) was administered. This depression scale was selected for its high reliability in distinguishing depressed and non-depressed elderly adults (Brink et al., 1982; Yeasavage, Brink, Rose, Lum, Huang, Adey, & Leirer, 1983). The entire procedure took approximately 2 hours.

The only changes made to the standard administration of the LAMB were for the List Learning and PA tasks. Before the first trial of List Learning subjects were given the following instructions:

"Before I begin I want you to estimate how many of the 15 words you will be able to remember. Please tell me this number."

Following each trial subjects were told how many correct answers were achieved without help (free recall) and with help (cued recall). Before each additional trial, subjects were asked:

"How many words do you think you can get by yourself the next time?"

The delay trial was introduced by:

"Remember the first list of 15 words. I want you to estimate how many of the words you will remember. Now tell me as many of the words as you can."

For the PA task the following instructions were made:

"Before you begin I would like you to estimate the number of pairs you will be able to remember. Please tell me this number."

After each response subjects were told if they were correct or incorrect. Before each subsequent learning trial subjects were asked to estimate how many of the word pairs they thought they would successfully recall. The delay trial was introduced with the following:

"Remember the list of 14 pairs of words. I want you to estimate how many of the word pairs you can remember."

In both learning tasks, subjects had the right to refuse to estimate at any trial and, if so, their refusal was recorded.

Results

All significant effects are reported at the $p < .001$ level unless otherwise noted.

Learning/Memory Performance and Age

Subjects were divided into three age categories: young (20-39), middle (40-59), and old (60-80). These divisions were decided on the basis of perceived clinical relevance (i.e., "How do younger, middle aged and old individuals compare to each other?").¹

List. The mean number of correct responses for each group on all trials are shown in Figure 1. These data demonstrate

 Insert Figures 1 through 4 about here

that performance increased as a function of age. A mixed between (age) x within (learning trials) ANOVA (calculated using SPSSx MANOVA) confirmed that the differences between these three age groups were significant ($F(2,320)=62.43$). There was also a general increase in performance over the five learning trials ($F(4,317)=441.28$). No interaction occurred between age and trials. A one way ANOVA calculated on the scores for the delay trial demonstrated that performance decreased as age increased

¹ Calculations over ten year periods and comparisons between the three created age groupings (to ensure the adequacy of such a categorization scheme) can be found in Appendix B.

FIGURE 1: Mean scores for all trials of the list task for young, middle, and old subjects.

FIGURE 2: Mean scores for all trials of the PA task for young, middle, and old subjects.

FIGURE 3: Mean estimates for all trials of the list task for young, middle, and old subjects.

FIGURE 4: Mean estimates for all trials of the PA task for young, middle, and old subjects.

($F(2,320)=34.13$). The relationship between the last learning trial and the delay trial is illustrated by the following "percent forgotten" scores ($\{1 - \text{delay trial}/\text{last learning trial}\} \times 100$): young group 1 %, middle group 1%, and old group 5%. Therefore, while there was a significant difference between the three age groups at the delay trial, the forgetting scores show that little information was forgotten. Thus the delay scores appear to reflect the continuation of the performance observed on the last learning trial.

PA. Performance on the PA task was similar to that observed on the list task. The mean scores for all trials are shown in Figure 2. These data demonstrate that the young group outperformed the middle aged group who performed better than the old group, over all trials. A mixed between (age) within (learning trials) ANOVA demonstrated that the differences between the three age groups were significant ($F(2,310)=31.49$). There was a general increase in performance over the learning trials ($F(3,308)=277.47$). A significant interaction was found between age groups and learning trials ($F(6,618)=2.31$, $p<.05$) which resulted from a slower rate of learning from trial 2 to 3 for the middle aged group. A one-way ANOVA calculated for the delay trial scores demonstrated a significant difference between the age groups ($F(2,310)=31.51$) with performance decreasing as age increased. Small decrements in performance occurred from the last learning trial to the delay trial with percent forgotten as follows: young 3%, middle 6%, and old 7%.

Estimates for Task Performance and Age

List. The mean estimates for each learning trial and the delay retention trial of the list task are shown in Figure 3. Inspection of this figure shows that the level of estimates decreased as a function of age. Interestingly, this relationship paralleled the previously discussed relationship between age and performance scores. A mixed between (age) x within (learning trials) ANOVA confirmed that the age ($F(2,320)=36.96$) and trials effects ($F(4,317)=290.99$) were statistically significant. There was also a significant interaction between age and learning trials ($F(8,636)=2.99$, $p<.01$) due to the different rates of increase that occurred between trial 1 and 2. A one-way ANOVA demonstrated there were significant differences between the three age groups on the delay trial ($F(2,317)=7.44$) with estimates decreasing as age increased.

PA. The relationship between age and estimates for the PA task was similar to that of the list learning task. As demonstrated in Figure 4, performance estimates progressively decreased as a function of age ($F(2,312)=33.63$). Estimates generally increased over learning trials ($F(3,310)=300.23$). There was a significant interaction between age and trials ($F(6,662)=6.62$) with the three age groups increasing at different rates from trials 1 to 2. A one-way ANOVA demonstrated there were significant differences between the three age groups in the estimates given on the delay trial ($F(2,323)=12.17$) with

estimates increasing as age decreased.

Correlations Between Estimation Accuracy and Age

The following sections include analyses of estimation accuracy. This measure of metamemory represents the degree of correspondence that exists between estimates and scores. An average estimation accuracy score for acquisition was calculated in the following manner. First, Pearson-product correlations were individually computed for each learning trial. These were then summed together, and divided by the number of learning trials.²

Individual trial correlations were also computed to examine the influence which feedback or experience had on patterns of estimation accuracy.

List. As shown in Table 2, all age groups demonstrated

Table 2 about here

significantly high correlations averaged over all trials. Trial-by-trial correlations showed the following pattern. Low correlations occurred for all three age groups on trial 1. However, following trial 1, all correlations increased with the greatest gain observed for the older group. The only exception to this general trend occurred for the young group on trial 5

² Note: All the subsequent data averaged over trials were calculated in the same manner.

TABLE 2: Correlations between estimates and scores for the list and PA task for all age groups (young, middle, and old).

TRIAL	LIST			PA		
	YOUNG	MIDDLE	OLD	YOUNG	MIDDLE	OLD
1	.07	.23 ***	-.03	.21 *	.42 ***	.17 *
2	.50 ***	.37 ***	.51 ***	.69 ***	.66 ***	.75 ***
3	.67 ***	.54 ***	.52 ***	.73 ***	.77 ***	.79 ***
4	.64 ***	.58 ***	.52 ***	.74 ***	.81 ***	.78 ***
5	.34 ***	.67 ***	.61 ***			
OVERALL	.44 ***	.48 ***	.43 ***	.59 ***	.67 ***	.62 ***
DELAY	.44 ***	.61 ***	.52 ***	.50 ***	.72 ***	.63 ***

* $p < .05$

** $p < .01$

*** $p < .001$

where a substantial decrease occurred. This was due to a truncated distribution produced in the following manner. While the estimates increased in a linear function over the learning trials, the actual performance scores increased in a curvilinear trend due to a ceiling effect on trials 4 and 5 (see Figure 5).

Figure 5 about here

This reduced performance range resulted in a lower correlation even though the young were actually very accurate in their predictions, as will be shown below.

PA. As shown in Table 2, all age groups demonstrated significantly high correlations averaged over all trials. The same trial-by-trial trend occurred for the PA task as previously shown for the list task. Low correlations occurred on the first trial and increased on the second and subsequent trials.

Distributions of Inaccurate Estimations

Even though estimation accuracy has been used to represent metamemory it may not always be the best measure. First, it may not always reflect the degree of correspondence that exists between performance and estimations, such as occurred for the young group on trial 5 of the list task. Secondly, even if it does provide an accurate measure of the correspondence between estimates and performance, it does not provide any information concerning "response bias" or the direction of error. That is,

FIGURE 5: Mean scores and estimates for all trials of the list task for the young subjects.

if the subjects did not predict their exact score, estimation accuracy would not tell us whether their estimations were "over" or "under" their actual performance. To examine potential response biases, difference scores were employed (estimated score - actual score). A correct estimation yielded a difference of zero while underestimation and overestimation produced negative (-) and positive (+) scores, respectively. Analyses were undertaken to determine the degree to which different age groups 1) differed in their ability to make perfect estimations and 2) how their estimation response dispositions were affected by feedback. Consequently, perfect scores were analyzed separately from the error scores. This was accomplished by calculating the proportion of under- and overestimations after the perfect scores were excluded. This procedure overcomes any biasing effect that may be due to differences in the number of perfect scores among the three age groups.

Perfect Estimations -- List. Percentages of perfect scores for the list task are shown in Table 3. Chi square analyses

Table 3 about here

demonstrated that the three age groups were equivalent in the proportion of perfect estimations averaged over trials.

On trials 1 and 2, all age groups obtained essentially the same number of perfect scores. However, beginning at trial 3, the number of perfect scores began to increase for the younger

TABLE 3: Perfect estimations in percentages at each trial and over all trials of the list and PA task for all age groups (young, middle, and old).

TRIAL	LIST			PA		
	YOUNG	MIDDLE	OLD	YOUNG	MIDDLE	OLD
1	14.6	16.5	13.0	9.8	13.0	8.6
2	15.9	18.4	20.1	27.7	12.7	19.4
3	34.1	20.4	14.4	40.5	19.6	25.9
4	28.0	26.2	18.7	50.6	31.4	25.0
5	30.5	34.0	17.3			
OVERALL	24.6	23.1	16.7	32.2	19.2	19.7
DELAY	11.1	11.7	11.7	4.8	8.8	11.4

group more than for the other two age groups. A similar trend began for the middle aged group on trial 4. However, Chi square analyses failed to demonstrate any difference between the three age groups on any trial.

Perfect Estimations -- PA. Chi square analyses demonstrated that the three age groups obtained essentially the same proportions of perfect estimations for the PA task averaged over trials (Table 3). Trial-by-trial investigation revealed that on trial 1, all age groups obtained the same number of perfect estimations. The number of perfect scores increased on trial 2 for the young group and by trial 3 all age groups had increased their perfect scores.

Chi square analyses comparing the three age groups demonstrated there were no significant differences on any trial except the delay trial ($\chi^2(2, n=29)=7.49, p<.05$).

Under-/Overestimation Bias -- List. The percentage of estimation error averaged over all list learning trials for the three age groups is shown in Figure 6. As indicated in this

Figure 6 about here

figure, there was a strong tendency for all age groups to underestimate. A two (under- vs. overestimation) x three (age group) Chi square analyses demonstrated no significant differences occurred in the response bias patterns for the three

FIGURE 6: Overall mean percent of over- and underestimations for the list task for young, middle, and old subjects.

age groups.

Trial-by-trial evaluations of the estimation difference scores showed the following results. The list data displayed in Figure 7 show that the young and middle aged groups demonstrated

Figure 7 about here

a bias for underestimation on trial 1 while the old group displayed an equal distribution of over- and underestimation. These patterns of distributions were found to be significantly different between the 3 age groups ($\chi^2=12.68(2, n=276)$, $p<.01$). Post hoc Chi squares within each age group demonstrated that the young and middle aged groups had a highly significant bias towards underestimation (young: $\chi^2(1, n=70)=23.62$, middle: $\chi^2(1, n=86)=13.84$) while no significant differences existed for the old group. However, on trial 2 the old group shifted from an equal distribution of over- and underestimation to a tendency to underestimate, thus becoming more similar to the two younger groups. This pattern continued for the remaining trials (2-5). Chi square analyses demonstrated there were no differences between the 3 age groups on trials 2-5.

Analysis of the error distribution on the delay trial demonstrated that all three age groups had a strong bias for underestimation (Figure 7). Chi square analyses revealed a significant difference between the three age groups ($\chi^2(2, n=285)=6.55$, $p<.05$). Comparing under- vs. overestimation

FIGURE 7: Mean percent of over- and underestimations for each trial of the list task for young, middle and old subjects.

within each age group revealed that although all three groups were highly biased towards underestimation the old group had the lowest bias (young $\chi^2(1, n=72)=79.2$; middle $\chi^2(1, n=92)=79.56$; and old $\chi^2(1, n=121)=51.56$).

Under-/Overestimation Bias -- PA. Percentages of estimation bias averaged over all PA trials for the three age groups are shown in Figure 8. There was a tendency for all age

Figure 8 about here

groups to underestimate, as on the list task. Chi square analyses demonstrated there were no differences between the three age groups.

As shown in Figure 9, the young and middle groups displayed

Figure 9 about here

a strong tendency to underestimate on the first trial while the old group demonstrated an equivalent degree of over- and underestimation. Chi square analyses confirmed there was a significant difference between the three age groups in their patterns of response bias ($\chi^2(2, n=286)=11.96$, $p<.01$). Post hoc Chi squares conducted within each age category demonstrated that the young and middle aged groups had highly significant biases towards underestimation (young: $\chi^2(1, n=74)=39.18$, middle: $\chi^2(1, n=87)=16.16$) while no significant difference between the two

FIGURE 8: Overall mean percent of over- and underestimations for the PA task for young, middle, and old subjects.

FIGURE 9: Mean percent of over- and underestimations for each trial of the PA task for young, middle and old subjects.

response tendencies occurred for the old group. At trial 2, the old group shifted to a stronger tendency to underestimate, becoming more similar to the two younger groups. Chi square analyses demonstrated there was no difference in the patterns of estimation response bias for the three age groups.

Chi square analyses demonstrated that by the third and fourth trials the young subjects were displaying an equal distribution of under- and overestimations. The middle and old groups, on the other hand, still tended to underestimate. Chi square analyses comparing under- vs. over- estimation patterns between the 3 age groups demonstrated there were significant differences between the age groups on both trials 3 ($\chi^2(2, n=235)=10.57, p<.01$) and 4 ($\chi^2(2, n=216)=12.87, p<.01$). Post hoc Chi square analyses comparing over- vs. underestimation within each age group demonstrated that no significant difference existed between over- and underestimation for the young group while significant differences were observed for the old and middle aged subjects (trial 3: middle, $\chi^2(1, n=82)=13.4, p<.01$ and old, $\chi^2(1, n=103)=25.6$; trial 4: middle, $\chi^2(1, n=70)=18.66$ and old, $\chi^2(1, n=105)=12.68, p<.01$).

Analysis of the error distribution on the delay trial demonstrated that all three age groups had a strong bias for underestimation. A Chi square analysis comparing the three groups in terms of their over- vs underestimation distributions demonstrated there were no differences in their patterns.

In summary, the response bias data show that young and

middle aged subjects tended to underestimate their scores throughout all learning trials. Although older subjects initially distributed their responses equally between under- and overestimations, feedback from performance on trial 1 altered this response tendency so it became more similar to the other two age groups.

Refusals

One final interest was the percentage of people within each age group who refused to estimate their performance on any or all trials of either task. These data may provide an indication of cautiousness or unwillingness to take risks. It was found that 1% of the young, 2% of the middle and 8% of the old group refused to make an estimation of their performance on either task. The difference between the three age groups was found to be significant ($\chi^2(2, n=15)=14.8$).

STUDY II

METHOD

Subjects

Of the 850 community-dwelling volunteers taking part in the LAMB study, 200 randomly selected subjects completed the memory questionnaire. All subjects were from the community of the Ottawa-Carleton area and were recruited through various forms of advertising. These subjects did not participate in the estimation study. Demographic information for the participants is presented in Table 4.

Insert Table 4 about here

MaterialsMemory and Anxiety Self-Assessment: (Schmidt Questionnaire).

The Schmidt Questionnaire consists of two scales: a memory scale and an anxiety scale.

In order to assess frequency of complaints for memory problems, a 24 item memory scale was used (Schmidt, 1989). Questions represent memory problems most often encountered in everyday life and were rated on a four-point Likert scale of "almost always", "often", "sometimes", and "almost never".

The Schmidt questionnaire also included the State scale from the State-Trait Anxiety Inventory (STAI -- Spielberger, Gorsuch, and Lushene, 1970). The state scale consists of 20 questions

Table 4 Demographic information for the subjects participating in the questionnaire study.

	AGE RANGE	MEAN AGE	ESTIM'D IQ a	GENDER		MEAN EDUCATION b	N
				M	F		
YOUNG	20-39	28.7	9.0	.80	.20	4.0	44
MIDDLE	40-59	52.5	10.0	.53	.47	4.0	62
OLD	60-80	69.6	9.9	.49	.51	4.0	94

a IQ was estimated with the scores from the vocabulary subtest of the WAIS-R with a mean score of 10 and standard deviation of 3.

b 1 = some grade school
 2 = grade school completed
 3 = some high school
 4 = high school completed
 5 = some university
 6 = university graduate
 7 = post-graduate

focusing on how the person feels at a particular moment and was rated with the same 4 point Likert scale used with the memory portion of the questionnaire. This scale was chosen because it has been found to be a highly reliable and valid measure of anxiety (Metzger, 1976).

Memory and anxiety questions were presented in an alternating fashion. A copy of the questionnaire is presented in Appendix C.

Memory Tasks

Several tasks from the LAMB (Appendix A) were used to assess memory performance in the present study.

- 1) Paragraph Learning involved having subjects listen to and immediately recall a short paragraph over two trials. Following a twenty minute delay, recall of the paragraph was again tested.
- 2) List Learning required the immediate recall of 15 verbally presented words over 5 trials. Recall was again tested following a twenty minute delay.
- 3) Paired-Associate Learning involved the presentation of a list of 14 pairs of words and required the subject to recall the 2nd word of a pair after the first word was presented. Four trials were presented. Following a 20 minute delay, cued recall was again tested.
- 4) Simple Figure was a test using 4 geometric designs which were presented for 15 seconds and then were reproduced from memory. After three trials, there was a 20 minute delay before a 4th

retention trial was given. A copy trial concluded the test.

5) For the Complex Figure test subjects were asked to observe the Taylor figure (Taylor, 1969, 1979) for 30 seconds and then were asked to reproduce it from memory within 2 minutes. This was performed for 4 trials and was followed, 15 minutes later, by a retention test. A copy trial concluded the test.

6) Digit Span measured the longest series of digits that a person could recall following a single presentation and was similar to the Digit Span subtest of the WAIS-R. Progressively longer lists were presented until the subjects could no longer recall the digits after two trials. Forward digit span required the subjects to recall the digits in order of presentation. Backward digit span required the subjects to recall the digits in the reverse order of presentation.

Depression.

Depression was assessed using the Geriatric Depression Scale (GDS) (Brink, Yeasavage, Lum, Heersema, Adey, and Rose, 1982). The scale consists of 30 questions answered in a yes/no format. A total score out of 30 represents the level of depression with 0-10 representing no depression, 11-20 mild depression, and 21-30 moderate or major depression. This scale was chosen because the GDS was developed for, and standardized with, elderly subjects (e.g., Zung, 1975; Hamilton, 1967). The GDS has high reliability for distinguishing between depressed and non-depressed elderly adults (Brink et al, 1982; Yeasavage, Brink, Rose, Lum, Huang, Adey, and Leirer, 1983). Research has

demonstrated that it has both high sensitivity (84%) and specificity (95%) (Brink, Curran, Dorr, Janson, McNulty, and Messina (1982)).

Procedure

The same procedure outlined for the estimation study was used except that the subjects completed the Schmidt questionnaire at the end of the LAMB testing session.

Results

All significant results are reported at the $p < .001$ level unless otherwise noted.

The subjects were divided into three age groups following the same logic as in Study I: young (20-39), middle (40-59), and old (60-80).

Age and Performance

List. Figure 10 shows the mean scores obtained on the list

 Figures 10 through 15 about here

task over all trials for the three age groups. Performance for all age groups increased over trials and at each trial an age-related decrement in performance was observed. The age and trial effects were found to be statistically significant with a mixed between (age) x within (learning trials) ANOVA computed using the SPSSx MANOVA program (age: $F(2,195)=32.35$, trials: $F(4,192)=306.46$). There was also a significant interaction between age and trials ($F(8,386)=2.68$, $p < .01$) probably resulting from differential rates of increases from trial 1 to trial 3. A one way ANOVA was calculated for the delay scores for the three age groups demonstrating a significant difference ($F(2,194)=21.40$) with the young obtaining the highest scores and the old, the lowest. The middle and old groups demonstrated

FIGURE 10: Mean scores for all trials of the list task for young, middle, and old subjects.

FIGURE 11: Mean scores for all trials of the PA task for young, middle, and old subjects.

FIGURE 12: Mean scores for all trials of the paragraph task for young, middle, and old subjects.

FIGURE 13: Mean scores for all trials of the simple figure task for young, middle, and old subjects.

FIGURE 14: Mean scores for all trials of the complex figure task for young, middle, and old subjects.

FIGURE 15: Mean scores for all trials of the digit span task for young, middle, and old subjects.

slight decreases from the last learning trial (3% and 5% loss respectively) while the young group demonstrated a slight increase (1%). The forgetting scores demonstrate that little information (if any) was forgotten. Thus the delay trial appears to reflect the continuation of the performance observed on the last learning trial.

PA. Figure 11 shows the mean scores for the PA task over all trials for all three age groups. From this figure, it can be seen that scores decreased as a function of increasing age and all age groups improved their scores over the learning trials. A mixed between (age) within (learning trials) ANOVA showed these effects as significant (age: $F(2,195)=21.90$, trials: $F(3,193)=181.60$). There was no significant interaction between age and trials. A one-way ANOVA of delay scores demonstrated there was a significant difference between the three age groups ($F(2,193)=20.10$) with the young obtaining the highest score and the old, the lowest. At the delay trial all groups demonstrated slight decreases in performance (young 5%, middle 6% and old 8% loss) and maintained the age-related trend in performance observed on the last learning trial.

Paragraph. Figure 12 shows the mean recall scores for all trials of the paragraph task for all three age groups. Scores on each trial decreased as a function of increasing age. A dramatic increase in performance occurred from trial 1 to 2 for all ages. A mixed between (age) x within (learning trials) ANOVA confirmed the age and trial effects as significant (age:

$F(2,195)=13.66$, trials: $F(1,195)=1128.25$). There was no interaction between trials and age. A one-way ANOVA confirmed a significant difference between the three age groups at the delay trial ($F(2,195)=21.13$) with the young group obtaining the highest score and the old, the lowest. Increases in performance were observed at the delay trial for the young and middle groups (10% and 3% gain respectively) and a slight decrease for the old group (3% loss).

Simple Figure. Figure 13 shows the mean scores over all trials for the simple figure task for all age groups. From this figure it can be seen that scores increased as age decreased. Over trials, all subjects increased their performance level. A mixed between (age) x within (learning trials) ANOVA confirmed the age and trials effect as significant (age: $F(2,140)=25.59$, trials $F(2,139)=68.96$). A one way ANOVA confirmed the differences between the age groups were significant ($F(2,178)=20.71$) with the young obtaining the highest scores and the old, the lowest. There was essentially no change in the scores from the last learning trial to the delay trial for the young and middle groups. There was a slight decrease at the delay trial for the old group (1% loss).

Complex Figure. The mean scores for the complex figure over all trials are displayed in Figure 14. From this figure it can be seen that scores decreased as a function of increasing age and all age groups improved their scores over the learning trials. The age and trial effects were confirmed as significant (age:

$F(1,175)=36.18$, trials: $F(3,173)=345.87$) while there was no age x trials interaction. A one-way ANOVA confirmed the differences between the three age groups ($F(2,175)=26.16$) with the young obtaining the highest scores and the old the lowest. At the delay trial, there were slight decreases in scores for the young and middle groups (1% and 3% respectively) and no change in scores for the old group.

Digit Span. The mean raw scores from the digit span task are shown in Figure 15. The middle aged group obtained the highest scores followed by the young group and then the old group. A one way ANOVA demonstrated there were significant differences between the three age groups ($F(2,192)=5.42$, $p<.01$).

Age and Depression

The mean GDS scores for the three age groups are presented in Figure 16. A one way ANOVA demonstrated there were

Figures 16 through 18 about here

significant differences between the age groups ($F(2,171)=3.47$, $p<.05$) with the young displaying the highest GDS scores and the old, the lowest. All GDS scores fell within the non-depressed range (Brink et al., 1982).

Age and Anxiety

The mean anxiety scores from the anxiety portion of the

FIGURE 16: Mean Geriatric Depression scores for young, middle, and old subjects.

FIGURE 17: Mean anxiety scores from the Anxiety scale of the Schmidt questionnaire for young, middle, and old subjects.

FIGURE 18: Mean memory complaint scores from the Memory scale of the Schmidt questionnaire for young, middle, and old subjects.

Schmidt questionnaire for the three age groups are presented in Figure 17. Scale scores ranged from no anxiety (20 points) to high anxiety (80) with a median score of 50. The scores from all subjects were below the median. A one-way ANOVA demonstrated there were significant differences between the age groups ($F(2,195)=6.93$) with the young producing the highest anxiety scores and the old producing the lowest.

Age and Metamemory (Complaints)

The mean scores from the metamemory portion of the Schmidt questionnaire for the three age groups are presented in Figure 18. The scores ranged from 24 (no complaints) to 96 (high level of complaints) with a median score of 60. As it can be seen from Figure 18, the scores for all age groups were below the median. A one-way ANOVA confirmed there were no differences between the three age groups. It was also of interest to look at the mean scores produced at each point on the Likert scale (1, 2, 3, & 4) for each age group. Such data would provide information concerning differences in response tendencies. The means for each of the 4 points on the scale for each age group are presented in Table 5. As it can be seen, all groups produced

Table 5 about here

very similar mean scores for each point on the scale.

Table 5: Means for each point on the 4-point likert scale of the memory complaint section of the Schmidt questionnaire for each age group (young, middle, and old).

	Likert Scale			
	1	2	3	4
YOUNG	25.5	48.5	19.3	6.5
MIDDLE	27.2	45.7	16.5	9.2
OLD	24.2	47.0	19.3	8.5

Metamemory Correlates

Metamemory and Performance.

Correlations between the memory complaint scores from the Schmidt questionnaire and each performance task were calculated for all age groups. The first trial (initial learning), the last trial (asymptotic learning), the delay trial (memory), as well as a total acquisition score (all learning trials summed) were employed. A total acquisition score was included to provide a general measure of learning comparable to that reported in other studies.

The correlations between metamemory and each of the learning and memory tasks are presented in Table 6. Most of the

 Table 6 about here

correlations were non-significant and essentially no patterns occurred in these correlations for the three age groups.

Metamemory and Depression.

Correlations between the GDS scores and the metamemory scores are presented in Table 6. From this table it can be seen that all correlations were significantly high with the highest occurring for the old group.

Metamemory and Anxiety.

Table 6 also presents the correlations between the

Table 6: Correlations between memory complaints, task scores, and depression and anxiety levels for all age groups (young, middle, and old).

	Trial	Memory Complaints			Depression			Anxiety		
		Y	M	O	Y	M	O	Y	M	O
<u>List</u>										
1		-.1	-.2	-.2	.0	-.1	-.0	.1	.1	-.0
5		-.1	-.3 *	-.1	.2	-.0	-.2	.3 *	-.2	-.0
Overall		-.0	-.3 *	-.1	.1	.0	-.1	.3 *	-.1	.0
Delay		-.0	-.2	-.1	.0	-.1	-.1	.0	.0	-.0
<u>PA</u>										
1		-.1	-.3 *	-.0	-.2	-.1	-.1	-.0	.0	-.1
4		-.3	-.2	-.1	-.2	-.0	-.4 ***	-.2	-.2	-.2 *
Overall		-.2	-.2	-.0	-.2	-.1	-.3 **	-.1	-.1	-.1
Delay		-.4 *	-.2	-.0	-.2	-.1	-.2 *	-.1	-.2	-.1
<u>Paragraph</u>										
1		-.2	-.3 *	-.2	-.1	-.2	-.3 *	-.2	-.0	-.1
2		-.2	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1
Overall		-.2	-.3 *	-.1	-.1	-.2	-.2 *	-.1	-.1	-.1
Delay		-.3 *	-.2	-.1	-.1	-.0	-.1	-.1	-.1	-.1
<u>Simple Figure</u>										
1		-.2	-.1	-.0	-.0	-.1	-.1	-.1	-.2 *	-.1
3		-.1	-.1	-.1	-.1	-.0	-.0	-.1	-.0	-.0
Overall		-.2	-.0	-.1	-.1	-.1	-.1	.0	-.0	-.1
Delay		-.2	-.0	-.0	-.2	-.1	-.1	-.1	-.0	-.1
<u>Complex Figure</u>										
1		-.1	-.2	-.1	-.1	-.0	-.1	-.0	-.0	-.0
4		-.3 *	-.1	-.1	-.2	-.1	-.1	-.3	.0	-.0
Overall		-.2	-.2	-.1	-.2	-.1	-.0	-.2	-.0	-.0
Delay		-.2	-.1	-.1	-.3	-.1	.0	-.4 *	-.0	-.1
<u>Digit Span</u>		-.0	-.2	-.1	-.1	-.2	-.2	-.0	-.2	-.2
<u>Memory Complaints</u>					.5 ***	.5 ***	.5 ***	.5 ***	.4 ***	.4 ***

* p<.05
** p<.01
*** p<.001

metamemory and anxiety scales of the same questionnaire. Correlations were significantly high with the highest occurring for the young group.

Anxiety and Depression Correlates

The anxiety and depression measures were correlated with performance scores to investigate the extent to which performance and emotions were related. Correlations were computed for each learning trial, the delay trial and a sum learning trial score (each learning trial score summed together). The sum trial score was included since past research has often only reported a summed over trials correlation.

As shown in Table 6, many of the correlations between the affective measures and the learning and memory tasks were non-significant and essentially no patterns occurred in these correlations for the three age groups.

Predictors of Memory Complaints

Although, memory complaints did not increase as a function of age, it was decided to conduct a standard multiple regression to investigate the predictors of such complaints. Independent variables included depression, anxiety, age, and the scores from all of the memory tasks. Independent multiple regressions were calculated for first trial, last trial, delay trial and summed trial scores from the memory tasks.

For the regression including trial 1 scores, Table 7

 Table 7 about here

displays the correlations between the variables, the unstandardized and standardized regression coefficients, the semipartial correlations, and R , R^2 , and adjusted R^2 . The R for regression was significantly different from zero ($F(10,108)=5.0$). Two regression coefficients differed significantly from zero, anxiety ($F(1,108)=6.08$, $p<.05$) and age ($F(1,108)=5.92$, $p<.05$). All the independent variables contributed another .24 in shared variability to the prediction of memory complaints. Altogether, 32% (25% adjusted) of the variability in memory complaints could be predicted by knowing the independent variables. Two important correlation sets should be noted. Depression was highly correlated with anxiety ($r=.759$) and age was highly correlated with all of the performance scores (refer to Table 7). Because these sets of variables were intercorrelated it was difficult to interpret the unique contribution of each to the prediction of the memory complaint scores.

The regression analyses including the last trial scores is summarized in Table 8. The R for regression was significantly

 Table 8 about here

different from zero ($F(10,118)=5.50$). Three regression

Table 7: Multiple regression with memory complaint scores as the dependent variable and trial 1 task scores, age, WAIS-R vocabulary scores, and depression and anxiety levels as the independent variables.

[illegible]

coefficients differed significantly from zero, anxiety ($F(1,118)=4.39$, $p<.05$), age ($F(1,118)=7.77$, $p<.01$) and the scores from the paragraph task ($F(1,118)=4.98$, $p<.05$). All the independent variables contributed another .22 in shared variability to the prediction of memory complaints. Altogether, 32% (26% adjusted) of the variability in memory complaints could be predicted by knowing the independent variables. Two important correlation sets should be noted. Depression was highly correlated with anxiety ($r=.72$) and age, and the paragraph scores were highly correlated with all of the performance scores (refer to Table 8). Again, the inter-correlations of these variables made it difficult to interpret the unique contribution of each to the prediction of the memory complaint scores.

The regression analyses for the delay trials is summarized in Table 9. The R for regression was significantly different

 Table 9 about here

from zero ($F(10,114)=5.12$). Four regression coefficients differed significantly from zero, anxiety ($F(1,114)=5.73$, $p<.05$), age ($F(1,114)=5.43$, $p<.05$), the scores from the paragraph task ($F(1,114)=6.93$, $p<.01$) and the scores from the complex figure ($F(1,114)=5.04$, $p<.05$). All the independent variables contributed another .17 in shared variability to the prediction of memory complaints. Altogether, 31% (25% adjusted) of the variability in memory complaints could be predicted by knowing

Table 9: Multiple regression with memory complaint scores as the dependent variable and the delay trial task scores, age, WAIS-R vocabulary scores, and depression and anxiety levels as the independent variables.

[illegible]

the independent variables. Two important correlation sets should be noted. Depression was highly correlated with anxiety ($r=.69$) and age, the paragraph scores and the complex figure scores were highly correlated with all of the performance scores (refer to Table 9).

The regression analyses for the sum trials scores is summarized in Table 10. The R for regression was significantly

Table 10 about here

different from zero ($F(10,93)=4.15$). Two regression coefficients differed significantly from zero, anxiety ($F(1,93)=7.86$, $p<.01$), and age ($F(1,93)=4.95$, $p<.05$). All the independent variables contributed another .21 in shared variability to the prediction of memory complaints. Altogether, 31% (23% adjusted) of the variability in memory complaints could be predicted by knowing the independent variables. Again, two important correlation sets should be noted. Depression was highly correlated with anxiety ($r=.73$) and age, was highly correlated with all of the performance scores (refer to Table 10).

Reliability and Validity of the Schmidt Questionnaire

Cronbach's alpha, an estimate of internal-consistency, was calculated for the memory and anxiety portions of the Schmidt questionnaire. For the memory scale, the standardized

Table 10: Multiple regression with memory complaint scores as the dependent variable and the overall summed trial scores, age, WAIS-R vocabulary scores, and depression and anxiety levels as the independent variables.

[illegible]

alpha was .76 while for the anxiety scale it was .92.

To test the construct validity of the Schmidt questionnaire, a factor analyses was conducted with all age groups combined. Table 11 shows the loadings of variables on the first two factors

Table 11 about here

extracted. Using varimax rotation, 14 factors were extracted following 30 iterations. Only the first factor was well defined accounting for 22% of the variance in the data. Comrey (1973) suggests that loadings in excess of .71 (50% variance) are considered excellent, .63 (40%) very good, .55 (30%) good, .45 (20%) fair, and .32 (10%) poor. The majority of the anxiety questions loaded fair or better on the first factor. The second factor extracted accounted for 8% of the variance in the data and some of the memory complaint questions loaded fair or better on this factor. The remainder of the memory complaint questions were scattered among the remaining 12 factors. Only one variable was found to be complex (i.e., loading .45 on more than one factor), in this case loading on factors 1 and 2. This was the anxiety question pertaining to worrying over irrelevant matters.

Factor analyses were also conducted on each age group separately. This was done to see if the factors changed from age group to age group. This would be another measure of construct validity (i.e., is the questionnaire measuring what it was

Table 11: First two factor loadings of the Schmidt questionnaire for all age groups together and separately.

Question	ALL AGE GROUPS		YOUNG		MIDDLE		OLD	
	Factor		Factor		Factor		Factor	
	1	2	1	2	1	2	1	2
①								
2	.79		.79		.76		.77	
③								
4			.57					
⑤								
6	.48		.51		.59			
⑦								
⑧								
9	.54		.81					
⑩								
11	.52						.61	
⑫								.57
13	.60				.62		.70	
⑭								
⑮								
16	.68		.51		.67		.80	
⑰				.76				.53
18					.46			
⑱		.74				.83		
20	.49	.50			.56			
⑳								
22	.77		.88		.85		.86	
㉑								
24	.56		.68		.56			
㉓								.72
26	.57		.77		.53			
㉕								.47
28	.75		.76		.75		.79	
㉗				.57				.84
30								
㉙						.68		
32	.72		.72		.69		.61	
㉛		.63		.65				
34	.88		.84		.94		.89	
㉝								
36	.57		.47				.56	
㉟								
38	.72		.62		.58		.63	
㊱				.65				.54
40	.72		.72		.59		.81	
㊳		.51				.59		
42	.70				.72		.69	
㊵			.51					
㊶								
㊷								
㊸				.65				
㊹								
㊺								

Circled numbers = memory complaint questions
Uncircled numbers = anxiety questions

supposed to measure regardless of the age grouping of the participant?). Loadings of the variables on the first two factors extracted for the young group are presented in Table 11. Using varimax rotation, 14 factors were extracted following 33 iterations. Only the first factor was well defined accounting for 25% of the variance in the data. The majority of the anxiety questions loaded fair or better on this factor and, in general, these were the same questions which loaded on the first factor with all age groups combined. The second factor extracted accounted for 8% of the variance and a few of the memory complaint questions loaded fair or better on this factor. The remainder of the memory complaint questions were scattered amongst the remaining 12 factors. The memory complaint questions that loaded on the second factor were different from those which loaded on the second factor with all age groups combined. No complex variables were found.

For the middle group, the loadings of the variables on the first two factors extracted are presented in Table 11. After 21 iterations, there was only one well defined factor of the 14 extracted. This factor accounted for 21% of the variance in the data and the majority of the anxiety questions loaded fair or better on it. Again, these loadings were similar to those extracted for the first factor with all age groups combined. The second factor accounted for 9% of the variance in the data and had a few memory complaint questions loading on it (but not the same questions as those which loaded for factor 2 with all

age groups combined). No complex variables were found.

The first two factors extracted for the old group after 57 iterations are presented in Table 11. Again, the first factor was well defined with anxiety questions as with all age groups combined. This factor accounted for 24% of the variance in the data. The second factor, accounting for 9% of the variance, had only a few of the memory complaint questions loading fair or better (again, different questions from those for all age groups combined). No complex variables were found.

DISCUSSION

Study I Discussion

The present results demonstrated the following relationships:

- 1) Performance on the memory task decreased with increasing age.
- 2) The ability to estimate performance was similar for all age groups.
- 3) A common response bias of underestimating performance was observed for all age groups.
- 4) The ability to utilize feedback was similar across ages.

The first two relationships were consistent with previous literature findings. It is commonly reported that performance on memory and learning tasks declines with age (see Craik, 1977; Poon, 1986 for reviews). More over, past research, using a variety of learning and memory tasks, has demonstrated estimation accuracy is equivalent for different age groups (Lachman & Jelalian, 1984; Lachman, Lachman & Thronesbery, 1979; Murphy et al., 1981; Perlmutter, 1978).

The present study also investigated the extent to which performance changed trial-by-trial. Explicit feedback was given to the subjects to ensure that they were aware of their performance. Prior to feedback, the three age groups had low levels of estimation accuracy on both tasks. After receiving

information concerning their performance, all age groups produced equally high levels of estimation accuracy. This accuracy increased throughout the learning trials (i.e., with repeated feedback on performance). These findings demonstrate that all groups had comparable metamemory ability. The results also support the findings of Lachman & Jelalian (1984) and Hertzog, Dixon, & Hultsch (1990) which demonstrated that implicit feedback was effectively utilized by all age groups to modify estimates according to performance. Interestingly, the subjects in the Hertzog et al. study used the implicit feedback of their own performance rather than explicit information concerning what the "average" person would score on the task.

While the past research demonstrated equivalent levels of estimation accuracy occurred for all age groups, the majority of studies have found that the older adults tended to overestimate their performance. The younger subjects, on the other hand, either overestimated to a lesser degree than the older subjects or, in some cases, they underestimated (Bruce et al., 1982; Coyne, 1985; Lachman & Jelalian, 1984; Murphy et al., 1981). The present study found that, overall, all subjects presented similar patterns of responding and all subjects underestimated. Thus, this finding contradicts much of the past research. The previously reported overestimation by elderly subjects was probably due to a methodological problem which commonly occurs in most of the past research. This problem relates to a ceiling

effect in the performance of the younger subjects. The high level of performance by the younger subjects reduced the range available for their estimations and biased their estimations towards underestimation. Such a pattern probably did not exist for the older subjects due to their lower level of performance. This effect was clearly evident in the Lachman and Jelalian study in which the younger subjects obtained an average score of 14.5/15 by the second trial while the older subjects scored 6/15. Subsequently, the researchers reported the younger subjects did not overestimate their performance while the older subjects did.

Although the present data do not demonstrate older subjects overestimating, they do provide some indication of how ceiling levels affect the appearance of over- and underestimations. Once initial feedback was received, the three age groups displayed similar patterns of over- and underestimation. These similarities continued until the latter trials. Once the younger subjects began to achieve optimal performance, though, the response patterns of the younger subjects differed from the older groups. This difference was due to the more limited range of estimates available from which the younger subjects could "select".

The trial-to-trial data on the response tendencies also provided some interesting information concerning the effects of explicit feedback. On the first trial (prior to feedback) the three age groups presented different response tendencies. The younger and middle aged subjects displayed a bias towards

underestimation while the older subjects equally distributed their responses "over" and "under" their true performance levels. The older subjects, in fact, appeared to simply guess. Therefore, the older and younger subjects apparently entered the tasks with different perspectives about how they would perform. Following feedback, the older subjects modified their response tendencies and were estimating in the same manner as the younger and middle aged subjects. All three age groups continued to underestimate their performance throughout the learning trials although the younger subjects began to obtain more perfect predictions on the later trials.

A delay trial was also included in the present study because past research has focused only on immediate memory and remote memory tasks. Inclusion of a retention trial was felt to be of importance since many of the memory problems observed in the elderly are more pronounced following a delay period (Craik, 1977; Poon, 1986). Because past research has demonstrated that all age groups display equivalent levels of estimation accuracy, it was expected that such accuracy would also be present on the delay trial. On the other hand, if the delay trial was viewed as a novel situation with new demands (as with trial 1) it would be expected that estimation accuracy should be low. The results supported the first prediction. The estimation accuracies remained equivalent in all age groups, but they were not as high as on the last learning trial before the delay period.

Response patterns were also investigated at the delay trial.

Again, if the three age groups were equivalent in metamemory it would be expected that the same response patterns would be found on the delay trial as in the learning trials. On the other hand, if the delay trial was viewed in the same manner as the initial learning trial (a novel task) then we would expect differences between the three age groups. The results demonstrated that all age groups responded in the same manner but with a greater degree of underestimation than occurred on the last learning trial. However, it should be noted that the older subjects did not revert to the same type of response bias which previously occurred on the first trial.

In concert, the results suggest two things which initially appear conflicting. First, prior to feedback, the three age groups were different in their response patterns with the elderly appearing to have been guessing their performance abilities. This suggests that the older subjects are different in comparison to younger subjects in metamemory capabilities. Following feedback, though, all age groups responded in a similar manner and adjusted their estimations in accordance to their performance trial to trial. This second finding suggests intact and equivalent metamemory abilities in all age groups.

This apparent contradiction can be clarified and interpreted within the formal theory proposed by Hertzog et al. (1990). These researchers suggested that metamemory can be divided into

two levels of memory self-efficacy 1) global and 2) specific. Global memory self-efficacy encompasses beliefs of one's memory divorced from a temporal or physical context. Such self-efficacy can be measured using metamemory questionnaires which tap a wide variety of memory situations and provide an overall evaluation of memory beliefs. On the other hand, specific memory self-efficacy refers to beliefs concerning memory performance on a specific memory task. Therefore, an estimation paradigm would tap specific self-efficacy because it would involve beliefs concerning that particular task and that moment.

It is presently proposed that the age differences observed in the estimation measures prior to feedback were due to differences in global self-efficacy. This relates to findings from the past research which has focused on attributions made by both younger and older individuals concerning performance abilities of older adults. For instance, it has been shown that both younger and older adults perceive older adults' failure due to lack of ability and their success due to chance (e.g., Levin & Levin, 1980). Such negative perceptions may have detrimental effects on the subject's participation and effort in memory tasks. If the older subjects' global self-efficacy was based on these negative views, then they may have simply guessed their performance ability due to lack of effort or the feeling of having no control over memory situations and their performance ability. This would support the findings of Hertzog et al. where metamemory questionnaires (i.e., measuring global self-efficacy)

correlated most highly with the first trial (prior to feedback) of a task and much less with subsequent trials. Negative global self-efficacy may also explain why the majority of those who refused to provide estimations in the present study were in the older age group. A similar finding was reported in the Hertzog et al. study where 60% of the prediction omissions were by those aged 60 or older.

Once the subjects received information concerning their performance, they could implement specific memory self-efficacy in the formation of their predictions. In terms of specific self-efficacy then the younger and older adults can be considered equivalent.

At the delay trial, both specific and global metamemory could have influenced the estimations. Performance on this trial may be influenced by global metamemory since it was unlike the previous learning trials where recall was immediate. On the other hand, performance may be influenced by specific metamemory in that all subjects had some indication of how they could perform on that particular task. The results support the latter speculations. Estimation accuracies decreased somewhat but were still high and all age groups underestimated. The elderly subjects continued to benefit from the previous feedback and continued to perform in a similar manner as the younger subjects. Therefore, it is suggested that negative global self-efficacy exerts its greatest influence on the elderly in entirely novel situations.

Study II Discussion

The Schmidt questionnaire, employed in the present study, contained two scales. The first measured anxiety and consisted of the State scale from the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970). The second scale measured memory complaints. The questions were selected from various metamemory questionnaires according to their perceived relevance to daily memory problems.

In terms of actual performance on the memory tasks, all subjects increased their scores over the learning trials of all tasks. Scores slightly decreased, if at all, on the delay trials. Performance decreased as a function of age and the results are consistent with those demonstrated in the aging and memory literature (Craik, 1977; Poon, 1986).

However there was no relationship between memory complaints and either memory performance or age. The memory complaint scores did not correlate with the memory performance scores on any task. Therefore, the memory complaints were not representative of actual memory knowledge possessed by the subjects. This finding is consistent with the past literature (e.g., Lownethal et al., 1967; McGlone et al., 1989; Sunderland et al., 1986; Zelinski et al., 1980). On the other hand, it has been repeatedly demonstrated that as age increases, so does the number of complaints (e.g., Cutler & Grams, 1988; Perlmutter, 1978; Zelinski, Gilewski, & Thompson, 1980). This finding was not supported in the present study.

Research has shown that depression is more often correlated with memory complaint scores than actual performance. In addition, one study has suggested that anxiety also contributes to the scores obtained on such complaint questionnaires (West et al., 1984). It was expected that the measures of anxiety and depression in the present study would also be related to the memory complaint scores. Both affective measures were highly related to memory complaints. Unfortunately, the measures for both depression scores and anxiety scores were highly inter-correlated and therefore it was difficult to separate the unique contributions of either scale. It would appear, though, that a person's affective status played a significant role in the production of memory complaints.

Factor analysis demonstrated that the questions from the STAI reliably loaded on one factor (ANXIETY). Unfortunately, the questions selected for the memory complaints scale did not load consistently on any factor and were widely dispersed among 13 factors. This demonstrates that while the questionnaire was suitable for the measurement of anxiety, it was not useful for the measurement of metamemory (or memory complaints). The Schmidt questionnaire has not had extensive psychometric testing and this may be a contributing factor to the lack of an age effect in the complaint scores. This further supports the view of such investigators as Gilewski & Zelinski (1986) who discourage the use of questionnaires with no examined psychometric properties to measure memory complaints in the elderly.

A second problem is that the memory complaint questionnaire only represents a unique dimension of metamemory. In questioning the utility of metamemory questionnaires researchers have concluded that metamemory must be operationally defined as a multidimensional construct (e.g., Dixon and Hultsch, 1983). The problem in the past has been the lack of consideration for the complexity of metamemory. As Dixon and Hultsch (1983) proposed, metamemory must be thought of as a multidimensional construct which encompasses both knowledge of memory (general and personal) and perceptions and beliefs of memory performance. A questionnaire which could encompass many of the dimensions of metamemory could be extremely useful in several ways. It would help distinguish those individuals who had problems specific to memory knowledge (e.g., lacking useful mnemonic strategies) from those whose problems resided in misperceptions of their own abilities (e.g., over-exaggerating normal memory problems). Such a questionnaire should also be able to distinguish between general affective states and those related specifically to memory.

Summary

Flavell and Wellman (1977) originally defined metamemory as knowledge and awareness of memory. They suggested that anything other than a rough outline of the concept at the time was premature. Since then, the research in the area has expanded with a refinement of that simple definition into a complex multidimensional construct.

The first studies conducted in the field of metamemory research were focused on the development of metamemory in children. Using children of various ages, researchers were interested in the relationship between awareness of memory processes and actual memory performance. Building on this assumption of a link between metamemory and memory performance, researchers became interested in investigating the role metamemory played in the commonly observed performance differences found between younger and older adults. From the two research directions (estimation and questionnaire) a large number of interesting findings have emerged. It is not until the two areas of information are combined that the researcher can truly appreciate the complexity of metamemory.

The questionnaire research originally assumed a simple connection between complaints expressed about memory and actual memory performance. Although this assumption was found to be too elementary, the research contributed a great deal to our appreciation of the inter-relatedness of actual knowledge of memory and perceptions of memory ability. The definition

proposed by Flavell and Wellman was therefore expanded to include beliefs about memory. One such model, suggested by Herrmann (1982), is presented in Figure 23. This model shows that

 Figure 23 about here

beliefs about memory performance develop from two sources: firsthand and secondhand information. Firsthand information comes from the observations made of one's own performance while secondhand information comes from reports from others. The concepts of firsthand and secondhand information are similar to the recently forwarded theory of specific and general memory self-efficacy (refer to Figure 23). Both sources of information are proposed to affect memory beliefs at the time of the episodes or for future episodes in general.

This model of metamemory is further exemplified in the findings of Dixon and Hultsch (1983). These researchers and their associates, through extensive psychometric investigation, developed the Memory in Adulthood (MIA) questionnaire. This questionnaire includes questions organized into 8 factors: a) knowledge of memory strategies; b) knowledge of memory tasks and processes; c) knowledge of memory capacities; d) attitudes toward own memory; e) activities supporting memory; f) memory and state anxiety; g) memory and achievement motivation; and h) locus of control in memory abilities. Using this questionnaire, Dixon and Hultsch demonstrated the links between metamemory and memory

FIGURE 23: The interrelationship of memory beliefs and memory performance (modified from Herrmann, 1982, p. 435).

performance are different throughout the age groupings. While both younger and older adults' performance could be predicted by the knowledge dimensions of the MIA, the performance of the older adults was also predicted by affective dimensions. These findings further support the notion of differences between the age groups in terms of general (affective components) and specific (knowledge elements) metamemory.

It is apparent from the research to date that the aged have different belief systems concerning their memory than younger adults. As proposed above, these findings are representative of general metamemory and therefore demonstrate that at one level elderly individuals differ from younger individuals. These differences could be due to the way our culture views the elderly. The elderly are seen as thinking and moving more slowly, physically inactive, socially and sexually inactive, conservative, behind the times, unproductive, and lacking friends, influence, status, and power. Studies have demonstrated that these stereotypes are endorsed by groups of physicians, undergraduate and graduate students, ministers, nurse, middle-aged children of elderly parents, institutionalized older adults, and even gerontologists (Levin & Levin, 1980). We are taught these stereotypical views from childhood in everything from nursery rhymes to television. Belief in such stereotypes may lead a person to believe that because they are getting older, they are also losing their memory and they may find a lot of self-confirming evidence for such an idea (i.e., self-fulfilling

prophecy). Although it may be expected that these views are changing in our society there are still overriding, negative perceptions of the elderly. For instance, when identical memory failure situations are presented to both younger and older adults, the age of the person involved in the memory situation influences the judgments of that person. If the target is older, the memory failure is seen as more of a trait of the person and more severe than younger targets (e.g., Erber, Szuchman, & Rothberg, 1990).

While the questionnaire research has contributed to our understanding of the importance of affective factors in one's memory evaluation, estimation research has been valuable in providing information more representative of actual memory knowledge. Because it involves evaluating memory for a particular task within a certain context, this research area has demonstrated the comparability of specific metamemory in the different age groups. Estimation research has demonstrated that younger and older adults are equivalent in such metamemory capabilities.

While the questionnaire data in the present study did not provide the expected information, the estimation data provided important and interesting information concerning the differences and similarities between younger and older adults. The most important finding was that what the two age groups brought into a novel memory situation in terms of attitudes and beliefs may have

differed. The elderly individuals appeared to be less confident in their estimations and were more likely to refuse to provide an estimation than younger adults. While the attributions brought into the novel memory situation differed for younger and older adults, metamemory capabilities within the task context were equivalent. This was evident in the present study with the finding that feedback resulted in the older adults adjusting their responses to become more similar to the younger adults. The use feedback also demonstrated that all age groups were able to monitor their performance and adjust their predictions according to their performance. This demonstrates that metamemory within a specific context is intact in older adults.

The research in metamemory is important in understanding what does and does not affect memory performance. Such information could be utilized at both a theoretical level and the practical level (e.g., in providing information to the elderly on the factors which could influence their day-to-day memory). Future research should further explore the influences of attributions in influencing memory beliefs for novel and common memory encounters. A study comparing a well developed metamemory questionnaire to estimations for various memory tasks prior to and following feedback, and inclusion of indicators of attributions would contribute to our understanding of the interplay of these factors in metamemory and memory performance.

References

- Albert, M. & Kaplin, E. (1980). Organic implications of neuropsychological deficits in the elderly. In L. Poon, J. Fozard, L. Cermak, D. Arenberg, and L. Thompson (Eds.). New Directions in Memory and Aging: Proceedings of the George A. Talland Memorial Conference (pp.403-432). New Jersey: Erlbaum.
- Birren, J.E., & Schaie, K.W. (1990). Handbook of the psychology of aging. San Diego: Academic Press, Inc.
- Brink, T., Curren, P., Don, M., Janson, E., McNalty, U., & Messina, M. (1982). Geriatric Depression Scale reliability: Order, examiner, and reminiscence effects. Clinical Gerontologist, 1, 57-59.
- Brink, T., Yeasavage, J., Lum, O., Heesema, P., Adey, V., & Rose, T. (1982). Screening tests for geriatric depression. Clinical Gerontologist, 1, 37-44.
- Bruce, P., Coyne, A., & Botwinick, J. (1982). Adult age differences in metamemory. Journal of Gerontology, 37, 354-357.
- Cavanaugh, J., Grady, J., & Perlmutter, M. (1983). Forgetting and use of memory aids in 20 to 70 year olds everyday life. International Journal of Aging and Human Development, 17, 113-122.
- Comrey, A.C. (1973). A first course in factor analyses. New York: Academic Press, Inc.
- Craik, F.I.M. (1977). Age differences in human memory. In J. Birren & K. Schaie (Eds.). Handbook of the Psychology of Aging (pp. 384-420). New York: Van Nostrand Reinhold.
- Cutler, S. & Grams, A. (1988). Correlates of self-reported everyday memory problems. Journal of Gerontology, 43, 882-90.
- Dobbs, A. & Rule, B. (in press). Prospective memory and self-reports of memory abilities in older adults. Canadian Journal of Psychology.
- Flavell, J. (1971). First discussant's comments: What is memory development the development of? Human Development, 14, 272-278.
- Flavell, J. & Wellman, H. (1977). Metamemory. In R. Kail &

- J. Hagan (Eds.). Perspectives on the Development of Memory and Cognition (pp. 3-33). New Jersey: Erlbaum.
- Folstein, M., Folstein, S., & McHugh, P. (1975). Mini-Mental State: A practical method of grading the cognitive state of patients for the clinician. Journal of Psychiatry Research, 12, 189-198.
- Gilewski, M., & Zelinski, E. (1986). Questionnaire assessment of memory complaints. In L. Poon (Ed.), Handbook for Clinical Memory Assessment of Older Adults (pp. 93-107). Washington: American Psychological Association.
- Hamilton, M. (1967). Development of a rating scale for primary depressive illness. British Journal of Social and Clinical Psychology, 6, 278-296.
- Hermann, D. (1982). Know they memory: The use of questionnaires to assess and study memory. Psychological Bulletin, 92, 434-452.
- Hermann, D. (1983). Questionnaires about memory. In J. Harris & P. Morris (Eds.), Everyday Memory, Actions, and Absent-mindedness (pp. 133-151). New York: Academic Press.
- Hertzog, C., Dixon, R.A., & Hultsch, D.F. (1990). Relationships between metamemory, memory predictions, and memory task performance in adults. Psychology and Aging, 5, 215-227.
- Hultsch, D.F., Hertzog, C., Dixon, R.A., & Davidson, H. (1988). Memory self-knowledge and self-efficacy in the aged. In Howe, M.C. & Brainerd, C.I. (Eds.), Cognitive Development in Adulthood: Progress in Cognitive Research (pp.65-92). New York: Springer-Verlag.
- Humphrey, D., McGlone, J., Gupta, S., & Evans, D. (1989). The development of the Memory Observation Questionnaire-2 (MOQ2) with community elderly. Personal communication.
- Kahn, R., Zarit, S., Hilbert, N., & Niederehe, M. (1975). Memory complaint and impairment in the aged: The effect of depression and altered brain function. Archives of General Psychiatry, 32, 1569-1573.
- Lachman, M.E. & Jelalian, E. (1984). Self-efficacy and attributions for intellectual performance in young and elderly adults. Journal of Gerontology, 39, 577-582.
- Lachman, J., Lachman, R., & Thronesbery, C. (1979). Metamemory through the adult lifespan. Developmental Psychology, 15, 543-551.

- Levin, J. & Levin, W. (1980). Ageism: Prejudice and discrimination against elderly. California: Wadsworth Publishing Co.
- Lowenthal, M., Berkman, P., Buehler, J., Pierce, R., Robinson, B., & Trier, M. (1967). Aging and Mental Disorder in San Francisco. San Francisco: Jossey-Bass, INC.
- Metzger, R. (1976). A reliability and validity study of the trait-state anxiety inventory. Journal of Clinical Psychology, 32, 276-278.
- McGlone, J., Gupta, S., Humphrey, D., Oppenheimer, S., Mirsen, T., & Evans, D.R. (1989). Screening for early dementia via memory complaints. Personal communication.
- Murphy, M., Sanders, R., Gabriesheski, A., & Schmitt, F. (1981). Metamemory in the aged. Journal of Gerontology, 36, 185-193.
- Niederehe, G. & Yoder, C. (1989). Metamemory perceptions in depressives of young and older adults. The Journal of Nervous and Mental Disease, 177, 4-14.
- O'Hara, M., Hinrichs, J., Kohout, F., Wallace, R., & Lemke, J. (1986). Memory complaint and memory performance in the depressed elderly. Psychology and Aging, 3, 208-214.
- Perlmutter, M. (1978). What is memory aging the aging of? Developmental Psychology, 14, 330-345.
- Poon, L. (1985). Differences in human memory with aging: Nature, causes, and clinical implications. In J. Birren & K. Schaie (Eds.). Handbook of the Psychology of Aging (pp. 427-462). New York: Van Nostrand Reinhold.
- Poon, L., & Walsh-Sweeny, L. (1980). Memory skill training for the elderly: Salient issues on the use of imagery mnemonics. In L. Poon, J. Fozard, L. Cermak, D. Arenberg, & L. Thompson (Eds.). New Directions in Memory and Aging: Proceedings of the George A. Talland Memorial Conference (pp. 427-460). New Jersey: Erlbaum.
- Popkin, S., Gallagher, D., Thompson, L., & Moore, M. (1982). Memory complaint and performance in normal and depressed older adults. Experimental Aging Research, 8, 141-145.
- Rabbitt, P. (1982). Development of methods to measure change in activities of daily living in the elderly. Alzheimer's Disease: A Report of Progress, vol. 19. New York: Raven Press. (PP. 127-131).

- Riege, W. (1982). Self-report and tests of memory aging. Clinical gerontologist, 1, 23-36.
- Schlechter, T.M. & Herrmann, D.J. (1981). Multimethod approach to investigating everyday memory. Paper presented at the meeting of the Eastern Psychological Association, New York.
- Schmidt, J. (1989). Memory/Anxiety Questionnaire. Personal Communication.
- Speilberger, P., Gorsuch, R., & Luschene, R. (1970). State-Trait Anxiety Inventory Manual. Palo Alto: Consulting Psychologists Press.
- Sunderland, A., Watts, K., Baddeley, A., & Harris, J. (1986). Subjective memory assessment and test performance in elderly adults. Journal of Gerontology, 41, 376-384.
- Taylor, L.B. (1969). Localization of cerebral lesions by testing. Clinical Neurosurgery, 16, 269-287.
- West, R., Boatwright, L., & Schleser, R. (1984). The link between memory performance, self-assessment, and affective status. Experimental Aging Research, 10, 197-200.
- Yeasavage, J., Brink, T., Rose, T., Lum, O., Huang, O., Adey, V., & Leirer, V. (1983). Development and validation of a geriatric depression screening scale: A preliminary report. Journal of Geriatric Research, 17, 37-49.
- Zarit, S., Gallagher, P., & Kramer, N. (1981). Memory training in the community aged: Effects of depression, memory complaint and memory performance. Educational Gerontology, 6, 11-27.
- Zelinski, E., Gilewski, M., & Thompson, L. (1980). Do laboratory tests relate to self-assessment of memory ability in the young and old? In L. Poon, J. Fozard, L. Cermak, D. Arenberg, & L. Thompson (Eds.). New Directions in Memory and Aging: Proceedings of the George A. Talland Memorial Conference (pp.519-544). New Jersey: Erlbaum.
- Zung, W. (1965). A self-rating depression score. Archives of General Psychiatry, 12, 63-70.

WORD PAIRS - LEARNING TRIALS

First Trial. "This is a test of your ability to learn pairs of words. I am going to read to you a list containing several pairs of words. You are to learn each of the word-pairs so that when I say the first word of each pair you will be able to tell me the second word that goes with it. It is somewhat like learning a person's first and second names. Before beginning I am going to give you a short practice list. Ready? UP-DOWN; DOG-CLOUD; SCHOOL-CANDY. What word went with DOG? with UP? with SCHOOL? (Continue until all the words are correct).

I will now read a list containing 14 pairs of words. I will be giving you several chances to learn these word-pairs. Some of the pairs are easy to remember and you can learn them quickly, such as UP-DOWN. It also contains some pairs that are more difficult and will require more time to learn, such as DOG-CLOUD; SCHOOL-CANDY. These pairs do not go together in a natural or obvious way. Your task is to find some way to learn them.

The first time I will read all 14 pairs. This is the only time I will read the complete list. The rest of the times I will read only the word-pairs you answered incorrectly or did not know. Any questions?" One sec. interval between 1st and 2nd word: 2 sec. interval between each pair)

Free-recall. "Tell me what word went with ..." After each response say each "correct" or "incorrect" but do not provide the correct answer.

Remaining Trials (2-4 or 2 consecutive errorless trials).

"If the persons score is less than 14 (less than 100%) give the following instructions. "This time I will read only the pairs that were incorrect on the last trial. After I have finished reading these word pairs I will again read the first word of all the pairs, including the ones you previously answered correctly. You will give me the word that goes with it."

If person's score is 14 (100%) then give the following instructions: "Since you did not miss any words, I will not read any word pairs this time. Please tell me again what word goes with each of the following words".

WORD-PAIRS

LIST	Trial 1			Trial 2		
	E	M	H	E	M	H
KING-QUEEN	1. East (West)	—		1. King (Queen)	—	
ARM-SKY	2. Interest (Spirit)		—	2. Pencil (Chair)		—
CATTLE-HOTEL	3. Earth (Dress)			3. Flag (Carpet)		—
EAST-WEST	4. King (Queen)	—		4. Fate (Style)		—
FATE-STYLE	5. Shoe (Stone)			5. Arm (Sky)		—
FLAG-CARPET	6. Fire (Sugar)			6. Fire (Sugar)		—
FIRE-SUGAR	7. Cattle (Hotel)			7. Shoe (Stone)		—
MIND-FAME	8. Pencil (Chair)			8. Black (White)	—	
BLACK-WHITE	9. Mind (Fame)		—	9. Mind (Fame)		—
COFFEE-CIRCLE	10. Arm (Sky)			10. Coffee (Circle)		—
EARTH-DRESS	11. Flag (Carpet)			11. Cattle (Hotel)		—
SHOE-STONE	12. Black (White)	—		12. Interest (Spirit)		—
PENCIL-CHAIR	13. Coffee (Circle)			13. East (West)	—	
INTEREST-SPIRIT	14. Fate (Style)		—	14. Earth (Dress)		—
	SUM	—	—	SUM	—	—

APPENDIX A

GENERAL LEARNING AND MEMORY BATTERY (General-LAMB)

Tom N. Tombaugh
Carleton University

Jim P. Schmidt
Vancouver General Hospital

Tester _____
Name _____
Age _____
Gender _____
Address _____
Town _____
Gender _____

Date administered _____
First Language _____
Second Language _____
Profession _____
Education _____
Reading glasses Yes No
Hearing Aid Yes No

MEDICAL HISTORY

PARAGRAPH

TRIAL	FR	CR	REC	TOTAL
1	_____	_____	_____	_____
2	_____	_____	_____	_____
Delay	_____	_____	_____	_____

LIST LEARNING

TRIAL	FR	CR	REC	TOTAL
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
Delay	_____	_____	_____	_____

FIGURES

TRIAL	SIMPLE SCORE	TIME	COMPLEX SCORE	TIME
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
Delay	_____	_____	_____	_____
Copy	_____	_____	_____	_____

WORD PAIRS

TRIAL	EASY	MOD	HARD	REC	TOTAL
1.	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____
4.	_____	_____	_____	_____	_____
Delay	_____	_____	_____	_____	_____

DIGIT SPAN

SUPRA SPAN (N=)

FORWARD _____
BACKWARD _____
TOTAL _____

TRIAL 1 _____
DELAY 1 _____
DELAY 2 _____

GENERAL INSTRUCTIONS

"The following test measures your ability to learn and remember information. A variety of different types of information will be presented such as a short paragraph, a list of 15 words, different types of geometric designs and so on. First, you will be given several times to learn the information. Then, sometime later in the test, you will be asked how much of the material you can remember. Any questions?"

PARAGRAPH -- LEARNING TRIALS

First Trial: "This is a test to see how well you can remember a short paragraph. You will be given two chances to learn it. This is the first time. Listen carefully to the paragraph I am going to read. When I am done I want you to tell me all you can remember." After the paragraph is read ask the person to "Tell me all you can remember".

1 Tom/ 2 Wellington/, 3 aged 63/, 4 is an electrician/ at Brighton/ University/. He lives in a
7 gray/ 8 room house/ on Beach Avenue/ Every day at 7:45 A.M./ he takes his white/ six
11 speed/ motorcycle/ from under the porch/. Then he drives over the Walnut Street/ Bridge/
17-18 to the University/ Cafeteria/ for his morning muffin/ and cup of tea/. On Tuesdays/
he leaves his second floor/ office/ at 1:30 /to visit Ted's/ Restaurant/. Here he has a glass
27-28 of red/ wine/, 29 plays checkers/ and reads the Northern/ Vista magazine/. 30-31 SUM _____

Cued-Recall. "I am going to give you some help on the ones you didn't know or left out". Read only questions either incorrectly answered or not answered during free-recall. After each response say "correct" or "incorrect" but do not provide correct answer.

1. Person's first name? _____
2. Person's last name? _____
3. Person's age? _____
4. Person's occupation? _____
- 5-6. a. Type of employer he worked for? _____
b. Name of employer he worked for? _____
7. Color of his house? _____
8. Number of rooms in his house? _____
9. Name of the street where he lived? _____ (either avenue or street is correct)
10. Time he left for work? _____ (7:45, 7:45 A.M. or 7:45 in the morning is correct)
11. Type of vehicle he drove to work? _____ (motorbike, motorcycle is correct, bike is incorrect)
12. Color of the vehicle he drove to work? _____
13. Number of gear speeds on his vehicle? _____
14. Location of his vehicle? _____ (key word is porch, "under" is not necessary)
- 15-16. a. Type of structure he drove over going to work? _____
b. Name of the bridge he drove over going to work? _____
- 17-18. a. Type of place he ate breakfast? _____
b. Location of the place he ate breakfast? _____
19. Type of food he ate for breakfast? _____
20. Type of beverage he drank for breakfast? _____
21. Day of the week he left work early? _____
- 22-23. a. Place from which he left early on Tues. afternoon? _____
b. Floor where his office was located? _____
24. Time he left his office on Tues. afternoon? _____
- 25-26. a. Type of place he visited on Tues. afternoon? _____
b. Name of place he visited on Tues. afternoon? _____
- 27-28. a. Type of beverage he drank on Tues. afternoon? _____
b. Type of wine he drank on Tues. afternoon? _____
29. Name of the game he played? _____
- 30-31. a. First name of the magazine he read? _____
b. Second name of the magazine he read? _____

Cued-Recall SUM _____

Second Trial. "I'm going to read the paragraph a second time. When I am finished please tell me all you can remember." After the paragraph is read ask the person to "Tell me all you can remember"

1 Tom/ 2 Wellington/. aged 3 63/. is an electrician/ 4 at Brighton/ University/. He lives in a 5--6
7 gray/ 8 room house/ on Beach Avenue/ 9 Every day at 7:45 A.M./ he takes his white/ 10 six 12--13
11 speed/ motorcycle/ from under the porch/ 14 Then he drives over the Walnut Street/ Bridge/ 15--16
17--18 to the University/ Cafeteria/ for his morning muffin/ 19 and cup of tea/ 20 On Tuesdays/ 21
22--23 he leaves his second floor/ office/ at 1:30/ to visit Ted's/ 24 Restaurant/. Here he has a glass 25--26
27--28 of red/ wine/. plays checkers/ 29 and reads the Northern/ 30--31 Vista magazine/. SUM _____

Cued-Recall: "I am going to give you some help on the ones you didn't know or left out". Read only questions either incorrectly answered or not answered. After each response say "correct" or "incorrect" but do not provide correct answer.

1. Person's first name? _____
 2. Person's last name? _____
 3. Person's age? _____
 4. Person's occupation? _____
 - 5-6. a. Type of employer he worked for? _____
b. Name of employer he worked for? _____
 7. Color of his house? _____
 8. Number of rooms in his house? _____
 9. Name of the street where he lived? _____ (either avenue or street is correct)
 10. Time he left for work? _____ (7:45, 7:45 A.M. or 7:45 in the morning is correct)
 11. Type of vehicle he drove to work? _____ (motorbike, motorcycle is correct, bike is incorrect)
 12. Color of the vehicle he drove to work? _____
 13. Number of gear speeds on his vehicle? _____
 14. Location of his vehicle? _____ (key word is porch. "under" is not necessary)
 - 15-16. a. Type of structure he drove over going to work? _____
b. Name of the bridge he drove over going to work? _____
 - 17-18. a. Type of place he ate breakfast? _____
b. Location of the place he ate breakfast? _____
 19. Type of food he ate for breakfast? _____
 20. Type of beverage he drank for breakfast? _____
 21. Day of the week he left work early? _____
 - 22-23. a. Place from which he left early on Tues. afternoon? _____
b. Floor where his office was located? _____
 24. Time he left his office on Tues afternoon? _____
 - 25-26. a. Type of place he visited on Tues. afternoon? _____
b. Name of place he visited on Tues. afternoon? _____
 - 27-28. a. Type of beverage he drank on Tues. afternoon? _____
b. Type of wine he drank on Tues. afternoon? _____
 29. Name of the game he played? _____
 - 30-31. a. First name of the magazine he read? _____
b. Second name of the magazine he read? _____
- Cued-Recall SUM _____

LIST LEARNING -- LEARNING TRIALS

First Trial. "This is a test to see how well you can remember several words. I am going to read you a list of 15 words. After I am finished I want you to tell me all of the words you can remember. The order you remember them does not matter.

"Each word represents a different type of word grouping or category. For example, if I said "waltz" and "trout", "waltz" would represent a type of dance, and "trout" comes from the fish category. Each of the 15 words I will read comes from one of the categories on this list. Present the category list. Read each category, then remove list.

You will be given 5 times to learn the 15 words. The first time I will read all 15 words. This is the only time I will read the complete list. The rest of the time I will say only the words you omitted or said wrong. Then I'll ask you to tell me the complete list just as you did the first time." Read list of words -- 2 sec. interval between words.

Categories	Words	TR 1		TR 2		TR 3		TR 4		TR 5		Words
		FR	CR	FR	CR	FR	CR	FR	CR	FR	CR	
Weapon	Pistol	—	—	—	—	—	—	—	—	—	—	Pistol
Profession	Dentist	—	—	—	—	—	—	—	—	—	—	Dentist
Vegetable	Potato	—	—	—	—	—	—	—	—	—	—	Potato
Part of Body	Foot	—	—	—	—	—	—	—	—	—	—	Foot
Animal	Elephant	—	—	—	—	—	—	—	—	—	—	Elephant
Kitchenware	Dish	—	—	—	—	—	—	—	—	—	—	Dish
Clothing	Coat	—	—	—	—	—	—	—	—	—	—	Coat
Musical Instr.	Trumpet	—	—	—	—	—	—	—	—	—	—	Trumpet
Part of Building	Floor	—	—	—	—	—	—	—	—	—	—	Floor
Fruit	Banana	—	—	—	—	—	—	—	—	—	—	Banana
Unit of Time	Month	—	—	—	—	—	—	—	—	—	—	Month
Vehicle	Truck	—	—	—	—	—	—	—	—	—	—	Truck
Furniture	Bed	—	—	—	—	—	—	—	—	—	—	Bed
Color	Yellow	—	—	—	—	—	—	—	—	—	—	Yellow
Family Relative	Brother	—	—	—	—	—	—	—	—	—	—	Brother
SUM		—	—	—	—	—	—	—	—	—	—	

Free-Recall. "Tell me all of the words you can remember".

Cued-Recall. "I am going to give you a little help with the words you missed. Tell me the word that goes with the category _____, which word was a type of _____, etc."

For each answer respond with correct or incorrect, but do not provide the correct answer.

Memory Feedback. Tell person how many correct answers were achieved without help (free-recall), and with help (cued-recall), then go on to next trial.

Remaining Trials (2-5 or 2 consecutive errorless FR trials).

If a person's combined FR and CR recall was less than 15 (less than 100%) give the following instructions: "I am going to tell you the words you missed on the preceding trial. When I am through I want you to tell me ALL of the words you can remember from the entire list, including those you previously recalled correctly." Read only words that were incorrect on both FR or CR portion of previous trial (i.e. do not read word that was correct on either FR or CR). Give feedback before reading words for next trial.

If a person's combined FR and CR recall was 15 (100%), give the following directions: "Since you remembered all of the words, I will not read you any words this time. Please tell me again all of the words you can remember from the list".

SIMPLE FIGURE -- LEARNING TRIALS

Trial 1. "This test measures how well you can remember a drawing containing 4 geometric figures. After I have given you 15 sec. to look at it, I'll take it away and ask you to draw it from memory. Draw it as accurately as possible. You will have up to 1 min. to do this. To help you keep track of time, I'll tell you when 30 sec. are left. I'll show you the drawing three separate times. Here is the first time." The figure must be presented for 15 sec. even if person wishes to look at it for less time. If this occurs, say "Please continue to look at it even if you feel you know it". During each Inform person when 30 sec. are left. Record amount of time required to complete the drawing.

Trial 2 and 3. "Look at this drawing again for 15 sec. and when I take it away I will give you 1 min. to draw it from memory".

Trial 1: Score	_____	Time	_____	(sec.)
Trial 2: Score	_____	Time	_____	(sec.)
Trial 3: Score	_____	Time	_____	(sec.)

Remember the paragraph I previously read. Please tell me as much as you can remember.

Tom/ Wellington/, aged 63/, is an electrician/ at Brighton/ University./ He lives in a
gray/ 8 room house/ on Beach Avenue./ Every day at 7:45 A.M./ he takes his white/ six
speed/ motorcycle/ from under the porch./ Then he drives over the Walnut Street/ Bridge/
to the University/ Cafeteria/ for his morning muffin/ and cup of tea./ On Tuesdays/
he leaves his second floor/ office/ at 1:30 /to visit Ted's/ Restaurant./ Here he has a glass
of red/ wine/, plays checkers/ and reads the Northern/ Vista magazine./ SUM _____

Cued-Recall: "I am going to give you some help on the ones you didn't know or left out". Read only questions relating to items either incorrectly answered or not answered in free-recall. After each response say "correct" or "incorrect" but do not provide correct answer.

Recognition. The recognition test is administered after cued-recall is finished and should be used for cued-recall questions that were incorrectly answered. "I'm going to give you some more help. I will read you a question about the parts you missed and then give you four choices. Tell me which is correct". Circle answers.

CUED RECALL AND RECOGNITION

1. Person's first name? _____ (Tom, Tim, Matthew, Ted)
2. Person's last name? _____ (Davis, Schmidt, Wellington, Sanders)
3. Person's age? _____ (36, 54, 61, 63)
4. Person's occupation? _____ (professor, electrician, accountant, plumber)
- 5-6. a. Type of employer he worked for? _____ (contractor, university, restaurant, garage)
b. Name of the employer he worked for? _____ (Brighton, York, Dunrobin, Glendale)
7. Color of his house? _____ (red, white, blue, gray)
8. Number of rooms in his house? _____ (2, 5, 8, 11)
9. Name of the street where he lived? _____ (Bronson, Kenwood, Beach, Riverdale)
10. Time he left for work? _____ (6:45, 7:15, 7:45, 7:30)
11. Type of vehicle he drove to work? _____ (motorcycle, bus, car, bicycle)
12. Color of the vehicle he drove to work? _____ (white, grey, blue, red)
13. Number of gear speeds on his vehicle? _____ (3, 5, 6, 10)
14. Location of his vehicle? _____ (porch, basement, garage, shed)
- 15-16. a. Type of structure he drove over going to work? _____
(viaduct, bridge, ramp, causeway)
b. Name of the bridge he drove over going to work? _____
(Walnut Street, Clearview Street, Main Street, West Street)
- 17-18. a. Type of place he ate breakfast? _____
(drug store, cafeteria, donut shop, coffee shop)
b. Location of the place he ate breakfast? _____
(house, university, department store, apartment building)
19. Type of food he ate for breakfast? _____ (toast, muffin, donut, cereal)
20. Type of beverage he drank for breakfast? _____ (milk, coffee, juice, tea)
21. Day of the week he left work early? _____ (Monday, Tuesday, Thursday, Friday)
- 22-23. a. Place from which he left early on Tues. afternoon? _____
(gym, library, classroom, office)
b. Floor where his office was located? _____
(1st, 2nd, 4th, 5th)
24. At what time did he leave his office? _____ (12:30, 1:00, 1:30, 2:00)
- 25-26. a. Type of place he visited on Tues. afternoon? _____ (cafe, bistrot, bar, restaurant)
b. Name of the place he visited on Tues. afternoon? _____ (Mark's, Ted's, Jack's, Mike's)
- 27-28. a. Type of beverage he drank on Tues. afternoon? _____ (coffee, tea, wine, beer)
b. Type of wine he had on Tues. afternoon? _____ (sweet, white, dry, red)
29. Name of the game he played on Tues. afternoon? _____ (cribbage, checkers, poker, chess)
- 30-31. a. First name of the magazine he read? _____ (Northern, Mountain, South, National)
b. Second name of the magazine he read? _____ (Vista, Inquirer, Winds, News)

Cued recall _____

Recognition _____

LIST LEARNING -- RETENTION TRIAL

Delayed Free-Recall. "Remember the first list of 15 words? Tell me as many of the words as you can." If person cannot get started say "Remember one word was a type of weapon".

Delayed Cued-Recall. "I'm going to give you some help. What word goes with the category of _____?"

Recognition The recognition test is administered after cued-recall is finished and should be used for any cued-recall questions not answered correctly. "I am going to read the category name of the word you missed and give you 4 alternative answers. Tell me which is correct". Circle answers.

Categories	Words	FR	CR	Recognition
Weapon	Pistol	—	—	Weapon (knife, pistol, gun, sword)
Profession	Dentist	—	—	Profession (doctor, engineer, dentist, lawyer)
Vegetable	Potato	—	—	Vegetable (potato, corn, pea, carrot)
Part of Body	Foot	—	—	Part of Body (leg, foot, arm, hand)
Animal	Elephant	—	—	Animal (elephant, tiger, dog, cat)
Kitchenware	Dish	—	—	Kitchenware (knife, dish, spoon, bowl)
Clothing	Coat	—	—	Clothing (shirt, sock, hat, coat)
Musical Instr.	Trumpet	—	—	Musical Instr. (guitar, trumpet, piano, drum)
Part of Building	Floor	—	—	Part of Bldg. (door, ceiling, floor, window)
Fruit	Banana	—	—	Fruit (banana, apple, peach, orange)
Unit of Time	Month	—	—	Unit of Time (day, month, minute, hour)
Vehicle	Truck	—	—	Vehicle (car, bus, train, truck)
Furniture	Bed	—	—	Furniture (chair, bed, table, sofa)
Color	Yellow	—	—	Color (red, blue, orange, yellow)
Family Relative	Brother	—	—	Family Rel. (brother, aunt, uncle, sister)
SUM (Recall)		—	—	SUM (Recognition) —

SIMPLE FIGURE -- RETENTION TRIALS

Delayed Recall. "Remember the first drawing which contained 4 geometric figures? Please draw as much of it as you can remember. Draw it as accurately as possible. You will have up to 1 min. to do this". Inform person when 30 sec. are left. Record amount of time required to finish drawing.

Copy Trial. "This time I am going to show you the drawing. I want you to copy it while looking at the figure. You should not try to use your memory to do this but you should look at the figure to make sure you are copying it accurately. You will have up to 2 minutes to do this". Present figure. Every 30 sec. inform person of the amount of time remaining. Record amount of time required to finish copying the drawing.

Delayed Trial: Score — Time — (sec.)
Copy Trial: Score — Time — (sec.)

WORD PAIRS -- LEARNING TRIALS

First Trial. "This is a test of your ability to learn pairs of words. I am going to read to you a list containing several pairs of words. You are to learn each of the word-pairs so that when I say the first word of each pair you will be able to tell me the second word that goes with it. It is somewhat like learning a person's first and second names. Before beginning I am going to give you a short practice list. Ready? UP-DOWN; DOG-CLOUD; SCHOOL-CANDY. What word went with DOG? with UP? with SCHOOL? (Continue until all the words are correct).

I will now read a list containing 14 pairs of words. I will be giving you several chances to learn these word-pairs. Some of the pairs are easy to remember and you can learn them quickly, such as UP-DOWN. It also contains some pairs that are more difficult and will require more time to learn, such as DOG-CLOUD; SCHOOL-CANDY. These pairs do not go together in a natural or obvious way. Your task is to find some way to learn them.

The first time I will read all 14 pairs. This is the only time I will read the complete list. The rest of the times I will read only the word-pairs you answered incorrectly or did not know. Any questions?" One sec. interval between 1st and 2nd word; 2 sec. interval between each pair)

Free-recall. "Tell me what word went with ..." After each response say each "correct" or "incorrect" but do not provide the correct answer.

Remaining Trials (2-4 or 2 consecutive errorless trials).

"If the persons score is less than 14 (less than 100%) give the following instructions. "This time I will read only the pairs that were incorrect on the last trial. After I have finished reading these word pairs I will again read the first word of all the pairs, including the ones you previously answered correctly. You will give me the word that goes with it."

If person's score is 14 (100%) then give the following instructions: "Since you did not miss any words, I will not read any word pairs this time. Please tell me again what word goes with each of the following words".

WORD-PAIRS

LIST	Trial 1			Trial 2		
	E	M	H	E	M	H
KING-QUEEN	1. East (West)	—	—	1. King (Queen)	—	—
ARM-SKY	2. Interest (Spirit)	—	—	2. Pencil (Chair)	—	—
CATTLE-HOTEL	3. Earth (Dress)	—	—	3. Flag (Carpet)	—	—
EAST-WEST	4. King (Queen)	—	—	4. Fate (Style)	—	—
FATE-STYLE	5. Shoe (Stone)	—	—	5. Arm (Sky)	—	—
FLAG-CARPET	6. Fire (Sugar)	—	—	6. Fire (Sugar)	—	—
FIRE-SUGAR	7. Cattle (Hotel)	—	—	7. Shoe (Stone)	—	—
MIND-FAME	8. Pencil (Chair)	—	—	8. Black (White)	—	—
BLACK-WHITE	9. Mind (Fame)	—	—	9. Mind (Fame)	—	—
COFFEE-CIRCLE	10. Arm (Sky)	—	—	10. Coffee (Circle)	—	—
EARTH-DRESS	11. Flag (Carpet)	—	—	11. Cattle (Hotel)	—	—
SHOE-STONE	12. Black (White)	—	—	12. Interest (Spirit)	—	—
PENCIL-CHAIR	13. Coffee (Circle)	—	—	13. East (West)	—	—
INTEREST-SPIRIT	14. Fate (Style)	—	—	14. Earth (Dress)	—	—
	SUM	—	—	SUM	—	—

Trial 3				Trial 4			
	E	M	H		E	M	H
1. Flag (Carpet)		—		1. Mind (Fame)			—
2. Fate (Style)			—	2. Cattle (Hotel)		—	
3. Arm (Sky)		—		3. Interest (Spirit)			—
4. King (Queen)	—			4. Flag (Carpet)		—	
5. Earth (Dress)		—		5. King (Queen)	—		
6. Coffee (Circle)		—		6. Fire (Sugar)		—	
7. Interest (Spirit)			—	7. Fate (Style)			—
8. Shoe (Stone)		—		8. Pencil (Chair)		—	
9. Mind (Fame)			—	9. Black (White)	—		
10. Black (White)	—			10. Earth (Dress)		—	
11. Cattle (Hotel)		—		11. Coffee (Circle)		—	
12. Fire (Sugar)		—		12. Shoe (Stone)		—	
13. East (West)	—			13. Arm (Sky)		—	
14. Pencil (Chair)		—		14. East (West)	—		
SUM	—	—	—	SUM	—	—	—

COMPLEX FIGURE -- LEARNING TRIALS

Trial 1. "This is a test of how accurately you can remember a complex design. I am going to show you a design which has lots of parts. After I have given you 30 sec. to look at it. I'll remove it and ask you to draw it from memory. You will be given up to 2 minutes to draw it as accurately as possible, but do not use a ruler. To help you keep track of time, every 30 sec. I will tell you how much time is left.

I'll be showing the drawing to you 4 times. This is the first time. Remember, don't start drawing until I take it away." The figure must be presented for 30 sec. even if person wishes to look at it for less time. If this occurs say "Please continue looking at it even if you feel you know it" Every 30 sec. inform person of amount of time left to complete the drawing. Record amount of time required to complete drawing.

Trials 2, 3 and 4. "Look at this figure for 30 sec. and when I take it away I will give you up to 2 min. to draw it from memory." Every 30 sec. inform person of amount of time left to complete the drawing. Record amount of time required to complete the drawing.

Trial #1: Score	_____	Time	_____	(sec.)
Trial #2: Score	_____	Time	_____	(sec.)
Trial #3: Score	_____	Time	_____	(sec.)
Trial #4: Score	_____	Time	_____	(sec.)

DIGIT SPAN

Forward

I am going to read some numbers to you. When I am finished I want you to say them in the same order. For example, if I said 2-8-6, what would you say? (Read both numbers at the same level. Discontinue after two consecutive errors at the same level) -- 1 sec. interval
(Correct = 1; Incorrect = 0)

Forward

6-1-4 _____	_____ (3)
3-7-2 _____	_____ (3)
2-9-1-8 _____	_____ (4)
4-7-5-1 _____	_____ (4)
3-1-7-5-9 _____	_____ (5)
4-2-8-6-7 _____	_____ (5)
7-9-5-1-3-8 _____	_____ (6)
3-6-4-9-2-7 _____	_____ (6)
1-5-2-6-9-7-3 _____	_____ (7)
4-9-3-8-6-1-2 _____	_____ (7)
1-4-8-5-2-6-9-7 _____	_____ (8)
2-5-3-9-4-7-1-6 _____	_____ (8)
1-3-8-6-2-4-9-7-5 _____	_____ (9)
7-3-9-6-1-8-2-5-4 _____	_____ (9)

SUM _____

Backward

I am going to read some more numbers. This time when I finish I want you to say them in the reverse order. If I said 2-4, what would you say? (Read both numbers at same level. Discontinue after 2 consecutive errors at same level) -- 1 sec. interval
(Correct = 1; Incorrect = 0)

Backward

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

SUM _____

SUPRA-SPAN DIGIT LEARNING -- LEARNING TRIALS

"This test measures how well you can learn a long string of numbers when you are given many trials to learn. I am going to read you a number that has _____ figures. When I am finished I want you to tell me as much of the number as you can remember. I will read the number 12 times or until you get it correct on 3 consecutive tries. If you find you are having trouble with this task you might want to use the following strategy. Don't try to learn the whole number at one time. Try to learn and remember the first few numbers and then add more numbers on later trials." After each trial tell the person if the answer was "correct" or "incorrect".

Forward digit span		3	4	5	6	7	8	9			
Supra-span number	3	7	5	4	2	8	6	5	1	4	6

(Length of the supra-span number is 2 longer than forward digit-span. As shown above, the 1st digit of the supra-span number is always 3. The last digit is located directly below the number representing forward digit span. For example, if a sequence of 7 numbers represents forward digit span, then the supra-span number would be a 9 digit number starting with 3 and ending with 1 (3-7-5-4-2-8-6-5-1).

(1 sec presentation interval -- discontinue after 12 trials or 3 consecutive perfect trials)
(Scoring: 2 pts if correct; 1 pt if single digit is reversed, omitted, substituted but not added. Add 2 pts for each post-criterion trial. Perfect score is 24 pts)

1. _____	5. _____	9. _____
2. _____	6. _____	10. _____
3. _____	7. _____	11. _____
4. _____	8. _____	12. _____

SUM _____

WORD PAIRS -- RETENTION TRIALS

Delayed-recall. Earlier you learned 14 pairs of words. I will read the first word of each pair and I want you to tell me the word that goes with it." Say either "correct" or "incorrect" but do not provide the correct answer.

Recognition. The recognition test is administered after delayed-recall is completed and should be used for any incorrect answer. "I'm going to give you some help with the words you missed. I will say the word and then give you 4 choices. Tell me which is correct." Circle answers.

RECOGNITION

	E	M	H		
1. East (West)	—			EAST	(orient. north. song. west)
2. Interest (Spirit)	—		—	INTEREST	(bored. spirit. ghost. attention)
3. Earth (Dress)		—		EARTH	(moon. quake. dress. blouse)
4. King (Queen)	—			KING	(kong. prince. queen. ruler)
5. Shoe (Stone)		—		SHOE	(stone. boot. brown. rock)
6. Fire (Sugar)		—		FIRE	(sugar. smoke. secret. salt)
7. Cattle (Hotel)		—		CATTLE	(house. hotel. sheep. narrow)
8. Pencil (Chair)		—		PENCIL	(pen. table. wooden. chair)
9. Mind (Fame)			—	MIND	(soul. renown. brain. fame)
10. Arm (Sky)		—		ARM	(leg. cloud. light. sky)
11. Flag (Carpet)		—		FLAG	(small. banner. carpet. rug)
12. Black (White)	—			BLACK	(green. dark. white. color)
13. Coffee (Circle)		—		COFFEE	(tea. circle. square. court)
14. Fate (Style)			—	FATE	(fashion. luck. style. half)
SUM	—	—	—		SUM

SUPRA-SPAN DIGIT LEARNING -- RETENTION TRIALS

Delayed-recall. "Remember the number which had ___ figures. Tell me as many of the numbers as you can in the same order they were given." If person cannot remember any of the numbers, prompt with the first two digits. Indicate if a prompt was used.

Forward digit span					3	4	5	6	7	8	9
NUMBER	3	7	5	4	2	8	6	5	1	4	6

SUM 1 _____

If the number is correct, Sum 1 = 2 and Sum 2 = 12 (full credit). If number is incorrect or partially correct (Sum 1 = 1 pt) give the following instructions: "I'm going to say the number again. When I am finished tell me as much of it as you can remember. I will read the number 6 times or until you get it correct on 2 consecutive tries." Scoring: 2 pts if correct; 1 pt if single digit is reversed, omitted, or substituted but not added. Add 2 pts for each post-criterion trial. Perfect score is 12 pts.

1. _____	_____	3. _____	_____	5. _____	_____
2. _____	_____	4. _____	_____	6. _____	_____
				SUM 2 _____	

COMPLEX FIGURE - RETENTION TRIALS

Delayed-Recall. "Remember the complex figure that you saw earlier in the test. I would like you to draw as much of it as you can remember. You will have up to 2 minutes to do this." Every 30 sec. inform person how much time is left to complete the drawing. Record the amount of time required to finish drawing.

Copy Trial. "This time I am going to show you the figure and I want you to copy it while looking at it. You should not try to use your memory to do this but you should look at the figure to make sure you are copying it accurately. You will have up to 4 minutes to do this." Every minute inform person of amount of time remaining. Record amount of time required to finish the drawing.

Delayed Recall Trial: Score _____ Time _____ (sec.)

Copy Trial: Score _____ Time _____ (sec.)

CATEGORY LIST

PROFESSION	VEGETABLE
PART OF BODY	ANIMAL
KITCHENWARE	CLOTHING
MUSICAL INSTRUMENT	PART OF BUILDING
FAMILY RELATIVE	UNIT OF TIME
VEHICLE	FURNITURE
COLOR	FRUIT
WEAPON	

TOP

APPENDIX B

Six Age Group Division

ANOVA's were computed for the scores from the first and last learning trials and the delay trial for the list and PA task throughout a six age group division (20-29, 30-39,70-80). The first trial was included to represent initial learning level while the last learning trial represented asymptotic learning. The delay trial, on the other hand, represents memory rather than learning. All results were significant at the $p < .001$ level unless otherwise noted.

List. The mean list scores for trials 1, 5 and delay over the six age groups are shown in Figure 19. For trial 1, the

 Figures 19 and 20 about here

one-way ANOVA revealed a significant decline in scores with age, $F(5,317)=14.29$. Post-hoc t-tests were conducted to illuminate where the differences in decline in successive age categories occurred. The only significant decline was between the 50-59 group and the 60-69 group, $t(103)=3.24$, $p < .01$.

There was also a significant decline in scores with age on trial 5, $F(5,317)=16.95$. Again, the only significant decline between successive age categories was between the 50-59 and 60-69 group, $t(115)=2.62$.

A significant decline in scores on the delay trial occurred with increasing age ($F(5,317)=16.32$). Post hoc t-tests revealed

FIGURE 19: Mean list scores for each six age group division for trials 1, 5, and delay.

FIGURE 20: Mean PA scores for each six age group division for trials 1, 4, and delay.

a significant decline from 50-59 to 60-69 ($t(98)=2.28$, $p<.05$) and between the 60-69 and 70-80 groups ($t(85)=2.502$, $p<.05$).

PA. The mean PA score for trial 1, 4, and delay across the six age groups are shown in Figure 20. For trial 1, there was a significant decline in scores with increasing age, $F(5,307)=15.81$. Post-hoc t-tests revealed a significant decline from the 60-69 group to the 70-80 group, ($t(123)=3.47$).

Trial 4 also demonstrated a significant decline in scores with age ($F(5,307)=10.56$). There was a significant decline between the 20-29 and 30-39 groups ($t(70)=3.08$, $p<.01$).

For the delay trial there was a significant decline in scores with increasing age ($F(5,307)=15.30$). Significant differences were found between the 30-39 and 40-49 groups ($t(85)=2.43$, $p<.05$) and between the 60-69 and 70-80 groups ($t(110)=2.538$, $p<.05$).

Three Age Group Division

To ensure there were differences between the three age categories (young, middle, old), one-way ANOVA's were calculated for the list and PA scores for trials 1, 5 (4) and delay with the three age group division (these trials were chosen for the same reasons as stated above).

List. The mean list scores for trials 1, 5, and delay across the three age groups are shown in Figure 21. For trial

Figures 21 and 22 about here

FIGURE 21: Mean list scores for each three age group division for trials 1, 5, and delay.

FIGURE 22: Mean PA scores for each three age group division for trials 1, 5, and delay.

1, the decline in scores over the three age groups was significant ($F(2,320)=33.23$). Post-hoc t-tests revealed significant differences between all age groups:

young versus middle	$t(173)=2.38, p<.05$
middle versus old	$t(223)=5.56$
young versus old	$t(172)=7.65$

For trial 5 the decline with age was significant ($F(2,320)=39.59$). T-tests revealed significant differences between all age groups:

young versus middle	$t(182)=4.00$
middle versus old	$t(238)=5.17$
young versus old	$t(218)=9.50$

The decline in score over the age groups was significant at the delay trial ($F(2,320)=34.12$). T-tests revealed significant differences between all the groups:

young versus middle	$t(182)=2.35, p<.05$
middle versus old	$t(238)=5.71$
young versus old	$t(218)=8.36$

PA. The mean PA scores for trials 1, 4, and delay across the three age groups are shown in Figure 22. For trial 1, there was a significant decline over the three age groups ($F(2,310)=30.82$). Post-hoc t-tests revealed significant differences between all age groups:

young versus middle	$t(175)=4.33$
middle versus old	$t(209)=3.46$
young versus old	$t(177)=8.12$

At trial 5, the decline in scores was significant ($F(2,310)=22.40$). All groups were significantly different from each other:

young versus middle	$t(169)=3.60$
middle versus old	$t(219)=3.28$
young versus old	$t(212)=7.64$

There was a significant decline in scores at the delay trial ($F(2,310)=31.50$). Again, all groups were significantly different from each other:

young versus middle	$t(162)=5.09$
middle versus old	$t(216)=3.20, p<.01$
young versus old	$t(211)=9.42$

APPENDIX C

MEMORY QUESTIONNAIRE

Subject # _____

Please rate how often each item is true for you, using the following scale:

A=Almost Always

o=Often

s=Sometimes

N=Almost Never

HOW OFTEN DO YOU: (circle one letter)

A o s N Have to look up phone numbers you often call.

A o s N Feel pleasant.

A o s N Find your way to a place you've only been once or twice before

A o s N Tire quickly.

A o s N Have difficulty finding something you had just a minute ago.

A o s N Feel like crying.

A o s N Remember a phone number without checking again while dialing

A o s N Go into a room, then forget what you were going there to get

A o s N Wish you could be as happy as others seem to be.

A o s N Remember to deliver messages you take (e.g., tell family members about phone call messages you took).

A o s N Feel like you're missing out on things because you can't make up your mind soon enough.

A o s N Have trouble remembering someone's name while introducing them to someone else.

A o s N Feel rested.

A o s N Remember special days, like birthdays or anniversaries.

A o s N Recognize your waiter in a restaurant when it's time to ask for the bill.

A o s N Feel "calm, cool and collected."

A o s N Fail to recognize people you know but haven't seen for awhile.

A o s N Feel that difficulties are piling up so that you cannot overcome them.

A o s N Forget the punchline or end to a joke or story you are telling

A o s N Worry too much over something that really doesn't matter.

A = ALMOST ALWAYS
O = OFTEN

S = SOMETIMES
N = ALMOST NEVER

112

- A o s N Remember people's names after being introduced just once.
- A o s N Feel happy.
- A o s N Forget what you were going to say just as you were about to say it.
- A o s N Find yourself inclined to take things hard.
- A o s N Hear a name that seems familiar but that you can't place.
- A o s N Lack self-confidence.
- A o s N Find that a word or name is "on the tip of your tongue" but not be able to recall it.
- A o s N Feel secure.
- A o s N Meet people you know you've met but not remember where or when.
- A o s N Try to avoid facing a crisis or difficulty.
- A o s N Forget something at the store if there are more than four or five things to buy.
- A o s N Feel blue.
- A o s N Start saying something and then realize you've already said it.
- A o s N Feel content.
- A o s N Remember appointments you have.
- A o s N Be bothered by an unimportant thought running through your mind.
- A o s N Remember the times of television or radio programs.
- A o s N Take disappointments so keenly that you can't put them out of your mind.
- A o s N Forget the name of a favorite author or television actor.
- A o s N Feel like a steady person.
- A o s N Have to reread something because you forgot what you just read.
- A o s N Become tense and upset when you think about your present concerns.
- A o s N Remember four or five errands without having to make a list.
- A o s N Find you have to ask people to repeat themselves because your mind was wandering.
- A o s N Find it difficult to concentrate on a book or television show.
- A o s N Get so involved in something you're doing that you're completely unaware of what's going on around you.

END

1 2 0 4 9 1

FIN