

**Age-Related Differences in the Effect of Prior
Knowledge on the Processing of Information**

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ABSTRACT

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This study explored the role of prior knowledge and repeated recall trials in determining age-related changes in memory for prose passages. Old (61 - 75) and young (19 - 30) heard and read three short segments of information describing each of four famous individuals. The segments were structured so that one contained very well known information critical to the identity of the individual, and the other two contained less well known information about the individual. For each subject, the segments for two individuals were presented with the best known information first (Information First Condition), and two with the best known information last (Information Last Condition). After each segment, the subjects guessed the identity of the individual, recalled the segment they just heard, and attempted to recall all information presented to date. Results indicated a significant age difference in correct recall with the young recalling more factual information than the old. As well, both age groups recalled more information in the Information First condition than in the Information Last condition. In general, old and young subjects did not differ in the importations they brought to recall. Over successive recall trials, old subjects forgot more items than young subjects. Younger subjects recovered more of the items they had not previously recalled when they were in the Information

Last condition than in the Information First condition, whereas for the older subjects, the trend was in the opposite direction. The findings of this study provide evidence for deficits in the memory abilities of older adults that cannot be attributed to differences in information processing style.

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Studies that assess memory and cognitive functioning throughout the lifespan generally show age-related declines in performance. There are two dominant theories that have been put forward to interpret these findings. One hypothesis suggests that the decline in cognitive performance in the elderly reflects some sort of deficit in the functioning of the central nervous system. The main research strategy within this theoretical framework is an attempt to identify the nature and locus of this biological deficit. An alternative theory suggests that the elderly are not so much deficient, as they are developmentally different, in their cognitive functioning as compared to the young. Older adults may be particularly rich in world knowledge because of their extensive life experiences, and this knowledge may cause them to process information differently than younger adults. These qualitative differences in the approach of the elderly to processing information may cause them to remember information that is different in kind and amount than the young. The present study attempts to investigate this alternative view through a detailed examination of how young and old adults integrate new information when they have, or do not have, access to a relevant knowledge base.

The Aging of Memory

In most studies comparing the memory of young and old adults, the elderly have been found to show deficits in their ability to remember as compared to the young. Multi-store information processing theories (Atkinson & Shiffrin, 1968) posit the existence of several storage

structures or locations through which information passes and where it may be acted upon by the individual (e.g., short-term memory, long-term memory). Researchers have investigated various storage structures and in general, have concluded that there is not a storage deficit in old age. Studies have been unable to locate age-related differences either at the level of short-term memory (a time dependent store of limited capacity) or in the storage component of memory (the interval between the input and retrieval of information (Drachman & Leavitt, 1972; Raymond, 1971; Smith, 1974; Smith, 1980).

There is substantial evidence for an age-related deficit in the retrieval of information from secondary or long-term memory, that is, in the accessing of stored information at time of test. This retrieval deficit on the part of the elderly has been demonstrated in numerous studies which show age differences in free recall to be attenuated by cued recall and recognition tasks (Erber, Herman & Botwinick, 1980; Perlmutter, 1979; Spilich & Voss, 1982). These studies indicate that the old are at a greater disadvantage relative to the young when less information is available to them at time of retrieval. Therefore, such studies would suggest that; although information may be learnt and stored effectively by the elderly, the old may be deficient in the skills required to access that information. Research, however, has indicated that the retrieval process cannot be considered in isolation, but is intimately tied to the encoding process, that is, the strategies utilized in the processing of information at time of input. The encoding specificity hypothesis (Tulving & Thomson, 1973) states that

retrieval is essentially a reconstruction of the encoding situation. The encoding specificity theory reflects a more recent formulation that views the memory process, not as a succession of passive storage tanks, but as an active manipulation of incoming stimuli. The concept of working memory (Baddely & Hitch, 1974) replaces the earlier notion of short-term memory and refers to a time limited workspace in which the individual actively encodes and processes information to be stored for longer periods.

Investigations of age differences in memory have found that encoding strategies do vary across the lifespan. One theory suggests that the elderly have a production deficiency (Hulicka & Grossman, 1967), in that they fail to produce verbal and visual mediators to facilitate recall of verbal stimuli unless specifically instructed to do so. Burke and Light (1981), however, in a review of research in this area, conclude that although the old tend to organize information less spontaneously than the young, providing the old with conditions that encourage organization does not necessarily eliminate age differences.

Other theories (Eybenck, 1974; Simon, 1979) point to a semantic processing deficit in the elderly. According to Craik and Lockhart's (1972) depth of processing theory, the more deeply or semantically one processes information, the more durable will be the memory for that information. Recall performance of the elderly compares favorably to the young when the experimental task is to attend to shallow or structural (e.g., orthographic, phonemic) aspects of the stimulus. Instructions to attend to the more semantic aspects of the stimulus,

however, do not improve the recall performance of the elderly to a great degree, while such instructions greatly enhance the recall performance of younger subjects. This suggests that the elderly experience difficulty in processing information to deep semantic levels.

A recent reformulation (Craik & Simon, 1980) of the processing deficit hypothesis proposes that the elderly can process to deep levels, but possess a production deficiency in the ability to use semantic information. Providing optimal guidance in semantic processing at both encoding and retrieval has been found to reduce age differences (Rabinowitz, Craik, & Ackerman, 1982; West, 1981). Investigations in this area have examined the differential effects of various kinds of semantic retrieval cues in their potential in attenuating age differences. The elderly are found to benefit more by general category semantic cues than specific contextual ones that require some integration of novel information (Craik & Simon, 1980; Rabinowitz et al, 1982). This finding suggests that the elderly can and do process information to deep semantic levels, but they fail to engage in rich qualitative analyses of stimuli at any particular level.

A related line of research (Craik & Byrd, 1982; Craik & Simon, 1980; Hasher & Zacks, 1979; Simon, 1979) has suggested that age differences in memory exist because the old suffer from a reduction of processing resource or mental energy. Older adults are particularly vulnerable to the deleterious effects of tasks that require division of attention, such as dichotic listening (Craik, 1977). It is thought the elderly are especially prone to performance decrements on such tasks

because their processing capacity is diminished. Consequently, it would follow that the elderly engage in inefficient encoding strategies because their limited resources may be taken up by more simple operations, such as those involved in deciphering the surface aspects of incoming information (e.g., listening, reading), leaving little capacity for elaborative processing. Some researchers (Rabinowitz et al, 1982; Simon, 1979) have demonstrated that young subjects, when required to divide their attention between tasks, perform in much the same manner on a later test of memory as older adults under undivided attention conditions.

Age-related differences in memory also are hypothesized to be caused by a biological slowing down of the speed at which older adults process information (Birren, Woods & Williams, 1980; Salthouse, 1980). Evidence for this slowing down process has been established by studies demonstrating age differences in reaction time and peripheral processing of visual images (Birren et al, 1980). Birren et al (1980) suggest that this slowness extends to all processes mediated by the central nervous system and may be responsible for the apparent reduction of processing resource found in experimental studies on memory on older adults.

To summarize, research that has attempted to localize the mechanisms involved in age-related memory deficiencies points to losses in the capacity of the elderly to effectively encode and retrieve information. It has been hypothesized that biological changes involved in the aging process may be responsible for memory loss by causing a

reduction in processing resource and/or a slowing down of information processing speed.

Discourse Processing in the Elderly

Much of the work in the area of memory and aging has used word lists as stimulus materials. Word lists have been criticized (Baltes, Reese & Lipsett, 1980; Labouvie-Vief, 1977) for their lack of ecological validity and for the fact that such stimulus materials capitalize on the educational status of the young. Young subjects in psychological experiments tend to be students and, therefore, may be more practiced at their word memorization skills than the elderly. Word lists in themselves constitute uninteresting and lifeless material. It also has been argued (Hartley, Harker & Walsh, 1980) that the older adult may not be motivated to excel at such meaningless tasks as memorizing a list of isolated words.

More recently, researchers in the field of aging and memory have turned their attention to the processing of discourse. Although remembering stories may be considered no more ecologically valid than remembering word lists, since the elderly may not have occasion to recall narratives in their everyday life, stories do provide a closer approximation to how language naturally occurs. Words are not usually encountered as isolated units, but occur together according to some thematic content or context.

In a study of discourse processing by the elderly, Cohen (1979) found that older subjects performed as well as younger subjects when answering verbatim questions about facts presented in a text, but the

young performed better than the elderly when the questions required the drawing of inferences from the text. The results of this study are in agreement with the semantic deficit hypothesis since it was found that the older subjects focused on the structured or explicit elements of the stimulus passage and failed to process the deeper and implicational meaning of the text.

A later study by Cohen (1981) confirmed the results of her earlier work. Younger subjects were found to be superior to older subjects in answering questions on texts that contained implicit information. Similarly, in a study comparing free recall with cued recall of young and old subjects, Till and Walsh (1980) found that the elderly failed to benefit from implicational cues when asked to recall sentences. Deficiencies in the inferential processing of the elderly have been found even when the passage is in full view (Light, Zelinski & Moore, 1982), which suggests that such a deficit cannot be attributed to poor fact memory.

In contrast to the above studies, Belmore (1981a) found that the elderly performed as well as the young in answering both inference and verbatim questions that immediately followed the stimulus passage. Walsh and Baldwin (1977) found that older subjects performed as well as younger subjects on Bransford and Franks (1971) tasks, which required subjects to integrate smaller units of semantic information into a larger whole. Camp (1981) demonstrated that the elderly engaged in more inferential processing than the young when asked to answer questions that retrieved information from semantic memory or general

world knowledge. Therefore, results are less than conclusive with regards to inferential processing of the aged.

In 1981, Blanchard-Fields replicated Cohen's (1979) study, but with a more detailed analysis of the responses made by the older subjects. She found that older subjects were not deficient at making inferences, but rather gave responses that went beyond the immediate surface logic of the story and applied the story to their world knowledge. As well, Light and Anderson (1983) found no difference between young and old subjects in the ability to integrate their world knowledge with new information. They emphasized the importance of distinguishing between inferential processing which requires the integration of new information with previously acquired world knowledge, and that which requires the integration of newly learned facts without reference to a generic knowledge base. Light and Anderson (1983) suggest that a global manner of processing based on world knowledge remains intact throughout the lifespan.

This global manner of processing is described by theorists who view the information processing by the elderly as developmentally different, and not necessarily deficient, as compared to the young (Baltes et al, 1980; Labouvie-Vief, 1977; Labouvie-Vief & Schell, 1982). A global manner of processing is one which involves the activation of prior knowledge in the learning of new information, and is in contrast to a focussed manner of processing which relates incoming information with the facts at hand without making reference to prior knowledge. The above "difference" theorists view cognitive development as continuing

throughout the lifespan and not ending at the stage of formal operations in adolescence. Cognitive development is conceptualized as not entirely dependent on the physical development of the nervous system, but shaped by the experiences accumulated during the lifetime of an individual. By late adulthood, the sheer breadth of these experiences may cause the elderly to process information in a more global manner, that is, in a way that relates incoming information to their vast store of knowledge. However, just as with earlier stages of development, gains are not made without accompanying losses (Piaget, 1972), so too, the elderly may fail to remain focussed on an incoming stimulus and consequently, suffer decrements in their ability to process information in a focussed manner. For example, the older adult may fail to make inferences which may require relating one fact of a story to another within that same story and instead, may relate the facts of a story to his or her real world knowledge.

According to the contextual or constructive theory of memory (Jenkins, 1974), what is remembered in any situation depends on the physical and psychological context of the situation, as well as the previous knowledge and experience that the subject brings to the context. Thus, memory is not considered to be dependent on the retention of a permanent, unaltered trace, but may involve a process of reconstruction, so that subjects introduce additions and distortions to their recall (Bartlett, 1932). Since the elderly possess a wide base of knowledge, having lived longer and experienced more than the young, the examination of discourse processing from this viewpoint should reveal

not only the quantitative, but also the qualitative differences in the recall of prose between younger and older adults. Qualitative differences may appear in the amount and nature of importations that subjects bring to recall, and may reflect discrepancies in which young and old process information along a focussed-global dimension. Accuracy of recall of details with importations consisting mainly of text-based inferences suggests a focussed style of processing, whereas recall that interjects prior knowledge regarding the information contained in the text, suggests a global style of processing.

Age Differences in the Recall of Text

Quantitative Differences

Research has presented contradictory results regarding age-related differences in recall of textual materials. Some studies report no significant age differences in recall of discourse, provided such recall is intentional and based on only one exposure to the passage (Arbuckle & Harsany, 1984; Mandel & Johnson, 1981; Meyer & Rice, 1981; Simon, Dixon, Nowak & Hultsch, 1982, Taub & Kline, 1978). Age differences have been found when the stimulus materials are based on newspaper articles (Dixon, Simon, Nowak & Hultsch, 1982), when recall is incidental (Simon et al, 1982), or when intentional recall involves more than one exposure to the text (Arbuckle & Harsany, 1984; Taub & Kline, 1978). These findings suggest that the elderly do not benefit as much from practice as do the young. As well, they suggest that the recall performance of the elderly tends to fall off as compared to the young when the stimulus materials are made more difficult.

Petros, Tabor, Cooney & Chabot (1983) have found that age differences do tend to increase as the level of reading difficulty of the passage becomes greater. Mandler & Johnson (1977) have proposed that narratives contain within them a story grammar or underlying structural organization which may aid recall. This story grammar consists of the essential elements that are understood to make up a story, such as the protagonist, the setting and various story episodes. The lack of such a story grammar in passages with a strictly informational content may contribute to age differences in recall. If the elderly are deficient at spontaneously producing mediators to organize incoming information, they would appear deficient as compared to the young in the recall of informational narratives. However, some studies have revealed age differences even when the constraints of difficulty are not apparent and the stimulus materials are simple stories (Gordon & Clark, 1974; Petros et al, 1983; Spilich, 1983).

In a review paper on discourse processing and aging, Hartley et al (1980) discussed some of the reasons for the contradictory findings in this area: the level of verbal ability of subjects, the presentation modality of the stimulus materials, and the scoring systems used. Studies (Gordon & Clark, 1974; Taub, 1979) have indicated that verbal ability, as measured by a vocabulary subtest, correlates significantly with the amount of information recalled from prose materials. Both Meyer and Rice (1981) and Taub (1979) found that age-related differences in recall failed to appear when older subjects scored highly on the WAIS vocabulary subtest.

The input modality of the stimulus materials also contributes to age-related differences in text recall; however, findings regarding this variable are mixed. On the one hand, Arenberg (1976) pointed to evidence favoring an auditory rather than a visual mode of presentation for older adults. On the other hand, Cohen (1979) reported that the elderly have difficulty with an oral presentation since listening requires the individual to decode the surface level of the incoming stimulus while simultaneously processing for meaning. As well, an oral presentation does not provide the opportunity for review. Taub and Kline (1978) found that the elderly recalled prose materials best when they read stories with the opportunity to review them, as compared to reading aloud or silently. Dixon et al (1982), however, found that older adults did not benefit from the advantage of reading with review, and on a delayed recall test performed more poorly when they read the materials than when they listened to them. As yet, no study has investigated the effect of method of recall, written or oral, on age-related comparisons of memory.

Results from studies investigating memory for textual materials also differ depending on the scoring method used. Typically, the protocols of subjects are divided into idea units or propositions and then scored for the presence or absence of these units. When idea units are long (10 words or more), studies tend not to find age differences in recall (Mandel & Johnson, 1981). As well, it has been demonstrated (Smith, Rebok, Smith, Hall & Alvin, 1983) that when protocols are scored for loose recall, rather than a strict matching of idea units,

performance differences between age groups disappear.

To summarize, studies differ in their findings regarding the accuracy of recall of prose materials of young and old adults, depending upon the conditions, materials, and scoring methods used. However, even if consistencies did exist in these variables among studies, research that investigates only quantitative differences in recall of text may fail to offer an explanation as to why, or even how, these age differences do occur. An examination of the qualitative differences in recall performance among different age groups, however, may reveal subtle age-related differences in the information processing styles of young and old adults which may be responsible for age differences in recall accuracy. If young and old subjects process information differently, that is, use different strategies to remember information, this difference may appear not only in the number of facts remembered, but also in the importance subjects assign to these facts and the importations they bring to recall.

Qualitative Differences

Aside from quantitative differences, as measured by the number of idea units recalled from a text, some researchers have investigated qualitative differences in prose recall in old age. This question has been approached from the point of view of hierarchical levels of meaning, as well as importations subjects bring to recall. Theories (e.g., Labouvie-Vief & Schell, 1982) which propose a more global style of processing in old age suggest that older subjects would be more efficient at remembering important themes (superordinate level

propositions) of a passage, and less able to retain the detailed information contained within it (subordinate level propositions). Such a formulation contrasts with the processing deficit hypothesis (Simon, 1979) which proposes that the elderly remember detailed information about a stimulus, but fail to integrate fully its semantic context.

Some studies (Petros et al, 1983; Smith et al, 1983; Spilich, 1983) have found that young and old adults are equally sensitive to the thematic structure of a text, with both age groups showing a preference for recalling superordinate level propositions. Similarly, Zelinski, Gilewski & Thompson (1980) found that age differences appear at the subordinate or detailed level of information and not at the superordinate level. In contrast, other researchers (Cohen, 1979; Dixon et al, 1982; Meyer & Rice, 1981) have found age differences appearing at the superordinate level with older adults remembering fewer propositions involving overall thematic content. Perhaps some of the variables discussed earlier, such as the difficulty level of the stimulus passages and/or the verbal abilities of the subjects, may be responsible for the contradictory findings among these various studies.

A few studies have examined importations in the recall protocols of subjects differing in age. Mandel and Johnson (1981), as well as Spilich (1983) found that young and old subjects made an equivalent number of additions and distortions in their recall of prose materials. Smith et al (1983) found that older subjects offered more additions in stories they recalled the best, while younger subjects offered more in stories they recalled the worst. The authors attribute their findings

to stylistic differences, suggesting that older adults tend to elaborate and enrich stories in order to present them in an entertaining fashion, while younger subjects prefer to concentrate on accuracy of recall. The positive relationship between additions and accuracy of recall for older adults also suggests that, for the elderly, making elaborations may represent an efficient elaborative mechanism that aids encoding and recall of factual material.

Hultsch and Dixon (1983) found that older subjects offered more elaborations than younger adults in their recall of descriptions of entertainment figures. Elaborations referred to accurate information about the person described that was not expressly stated in the passage. Hultsch and Dixon (1983), however, do not hold the view that elaborations represent an aid to encoding and recall for older adults, but suggest that elaborations represent decrements in the ability of older adults to differentiate between previously acquired knowledge and the facts presented. Consequently, elaborations may represent intrusions of old knowledge into the recall of experimental materials.

Arbuckle and Harsany (1984) assessed age-related differences in recall of a moral story by investigating the importations present in subjects' recalls. The categories of importations included inferences, responses that followed logically from the information contained in the experimental materials; and elaborations, additions brought to recall that were not derivable inferentially from the information explicitly stated in the passage. Older subjects produced a greater number of elaborations and inferences than younger subjects. As well, Smith,

Smith, Rebok & Brown (1981) found that older subjects offered as many inferences as younger subjects in a study involving the recall of a simple story. These findings signify that young and old adults are equally capable of offering inferences spontaneously while recalling a text, and are in contrast to earlier suggestions (Cohen, 1979; Fullerton, 1983; Light et al, 1982) which proposed that the elderly are deficient at inferential processing.

As well, the above studies (Arbuckle & Harsany, 1984; Hultsch & Dixon, 1983; Smith et al, 1983) suggest that the elderly tend to offer more elaborations in their recall than the young. These findings point to a more global manner of processing utilized by the old than the young, since the greater number of such importations in their recall reflects a greater activation of prior knowledge while processing information.

Recall Over Trials

Another distinction between young and old subjects with regards to remembering prose is in their difference in recall performance over trials. Arbuckle and Harsany (1984) examined changes in recall performance over three exposures to the passage. Verbatim recall performance between groups did not differ significantly on the first trial, but did so on the second and third trials. Although both groups improved recall performance over trials, the young subjects' recall improved more rapidly than that of the old subjects. Similar results were found in Taub and Kline's (1978) study where age-related differences in recall appeared only on the third trial.

Increments over recall trials have been observed in studies where subjects remember items in later trials that were not recalled in earlier ones. This phenomenon has been termed hypermnesia (Erdelyi & Becker, 1974) and occurs without benefit of repeated exposure to the original stimulus materials. Hypermnesia has been documented using both pictures and words as items to be remembered (Belmore, 1981b; Roediger, Payne, Gillespie & Lean, 1982).

If the recall of younger subjects improves at a faster rate over trials than the recall of older subjects, this discrepancy may be due to a possible lack of hypermnesic responses in the recall of older subjects. Hypermnesia has been related to the imaginal properties of a stimulus (Erdelyi & Becker, 1974). It has been demonstrated that the elderly are particularly disadvantaged when processing visual information (Mason & Smith, 1977; Winograd & Simon, 1980). It is possible that this problem with imaginal encoding on the part of the elderly may reduce their likelihood of hypermnesic activity. The studies in which the elderly were found to improve less than the young over trials (Arbuckle & Harsany, 1984; Taub & Kline, 1978) interspersed successive recall tests with repeated exposure to the stimuli. To evaluate the role that hypermnesia plays in any age-related difference in memory, it would be necessary to examine age-related differences over recall trials following only one exposure to the text.

Recall performance over trials may also vary due to decrements or losses of previously recalled items. It is possible that one effect of aging on memory is that older subjects may forget previously recalled

items more rapidly than younger subjects. Although not a true test of this hypothesis, a study was conducted by Taub (1979) where young and old subjects first answered comprehension questions while reading a passage, and then later answered the same questions when the passage was no longer in view. Although relatively few young subjects changed their responses over trials, over seventy-five per cent of the older subjects altered theirs. This finding suggests that the recall protocols of older subjects may show a similar variability of response over trials.

The Effect of Prior Knowledge

There is a considerable body of literature that suggests that performance on memory tasks is affected by the amount of relevant prior knowledge and experience that subjects possess. Manipulating the knowledge of the topic of a passage has been employed in studies of constructive memory with young subjects. Subjects typically recall ambiguous stories more accurately when they are informed of the story's topic before reading the passage, rather than after doing so (Bransford & Johnson, 1972; Dooling & Mullet, 1973). Subjects who are informed of the topic before reading the passage also offer significantly more thematic intrusion errors in their recalls (Dooling & Mullet, 1973).

Similar studies have involved recognition tests of memory of stories involving a main character who is either correctly identified as a famous person or given a fictitious identity (Dooling & Christiaansen, 1977; Sulin & Dooling, 1974). In these studies, knowledge of the main character's famous identity leads to poorer recognition memory due to false recognition of highly thematic foil sentences. In other words,

sentences that do appear in the stimulus passage, but draw upon the subject's knowledge of the famous person, are often incorrectly recognized as having occurred in the passage. Therefore, knowledge of the context of a passage helps subjects to recall that passage, but also introduces other known facts about a person or topic into subjects' recall protocols, or leads to confusion errors in recognition memory.

Activating prior knowledge while engaging in a cognitive task has been found to take up processing capacity (Britton & Tesser, 1982). It has been demonstrated in studies with young adults (Lewis & Anderson, 1976) that the more new facts one learns about a certain topic, the slower one is to retrieve information already known about that topic. Therefore, it is possible that recalling passages which provide a context that activates well learned information may represent a substantial load on processing capacity.

It may be expected that older adults, because of their extensive life experiences, may have more opportunities to integrate newly learned facts with previously learned knowledge. Therefore, older adults may be more likely than younger adults to offer intrusions involving this knowledge when recalling new information. As well, if activation of prior knowledge takes up processing capacity and slows down retrieval time, this global manner of processing may cause the elderly to appear deficient as compared to the young on recall tasks. However, it can be argued that if the elderly engage in a global manner of processing to a great degree, the manipulation of the availability of prior knowledge may be beneficial, since it may mobilize a familiar well-practiced mode

of processing.

In a study assessing age-related differences in the recall of well-learned stereotypical action sequences or scripts (Light & Anderson, 1983), it was found that younger subjects recalled more propositions from a text than older subjects. As well, no significant age-related differences were found in the number or nature of intrusions or importations brought to recall. In contrast to this study, however, Hultsch and Dixon (1983) found that older subjects offered more previously learned facts than younger subjects in recalls of passages describing famous entertainment figures. Passages describing figures especially familiar to old age groups were recalled better by old subjects than young subjects.

The former study suggests that the young do not differ qualitatively in the manner of integrating new and old information, but do differ quantitatively in the amount of information that they recall. The latter study, however, suggests an opposite trend. Old and young subjects differed in their recall intrusions, while activation of well-learned pre-experimental knowledge attenuated age-related differences of verbatim recall. More research is needed to clarify the nature of age-related differences in the learning of new information about old knowledge.

The Aim of the Present Study

The purpose of the present study was to investigate age-related differences in memory as a function of prior knowledge by examining the recall of descriptions of famous individuals by both young and old

adults. A secondary purpose of this study was to investigate age-related differences in forgetting and recovery (hypernesia) of information over successive trials without intervening presentation of the stimulus materials.

Young and old subjects were asked to recall passages describing the lives of famous individuals (e.g., Lincoln). Each passage was divided into three sections. The passage was written in such a manner that two of the three sections included obscure or little known facts about the famous individual (e.g., Lincoln's mother died when he was quite young), while a third section included the most well known facts about that individual (e.g., president assassinated in a theatre). Knowledge regarding the identity of the famous person was manipulated by either presenting subjects with the section that included the well known information first, with the two obscure information sections following it (Information First Condition); or, presenting the well known information section last, with the two obscure information sections preceding it (Information Last Condition).

The passages were presented both aurally and visually at the same time. An aural presentation offered the opportunity to control presentation time, with the assurance that all subjects have been exposed to the entire passage. Meanwhile, the visual presentation provided the opportunity for review of any words that may have been missed from the tape-recorded version of the passage.

In order to keep motivation at a high level throughout the task, and as well, to monitor the success of the experimental manipulation,

subjects were asked to guess the famous person's identity after presentation of each passage section. For the experimental manipulation to be valid, subjects should know the correct identity of the famous individual immediately upon exposure to the first section in the Information First Condition, and not before exposure to the last section of the Information Last Condition. Those subjects who expressed knowledge of the identity of the famous individual, but experienced difficulty in naming him or her, were cued by a recognition task. This task required subjects to identify the target famous individual from a list of twenty others who share common features with the target (e.g., for Lincoln, the list consisted of presidents of the United States).

After having made their guess as to the identity of the individual, subjects recalled the section of the passage that they had just heard. In the case of the second and third section of the passage, after recalling that particular section, subjects then recalled all the sections that they had heard up to that point. In this way, changes in recall performance over trials could be assessed.

Passages were divided into idea units and scored for both accuracy of recall of the original passage and importations brought to recall. The categories of recall responses were adapted from a study done by Frederiksen (1975), and included verbatim responses, overgeneralizations, pseudodiscriminations, inferences, and elaborations. Verbatim responses are close approximations of idea units; overgeneralizations, responses which are less specific than idea units from the original passage; pseudodiscriminations, responses which

are more specific than in the original story; inferences, responses that integrate information explicitly stated in the passage. Elaborations were scored as in the study by Hultsch and Dixon (1983) and consist of responses that give information that is accurate regarding the figure described but which is not present in the passage.

It was expected that age-related differences would appear in the number of verbatim responses offered by subjects. Although equivalent recall scores have been found when young and old subjects recall simple stories under intentional recall conditions (Meyer & Rice, 1981; Simon et al, 1982), this finding has not been replicated when the stimulus passage is highly informational in content. (Dixon et al, 1982; Hultsch & Dixon, 1983). Descriptions of the lives of famous people also involve a concentrated informational format. In Hultsch and Dixon's study involving descriptions of famous entertainment figures, age differences were found in immediate recall of passages about individuals who were equally well known by both age groups. The present study also used descriptions of famous people who are equally well known to young and old adults.

It was expected that young subjects would offer more verbatim responses when they had been presented the Information First Condition than the Information Last condition, since prior knowledge of the context of a passage has been demonstrated to enhance recall accuracy in young subjects (Dooling & Mullet, 1973). Previous work suggested that there would be an age by condition interaction, but two different bodies of literature led to two different predictions regarding the pattern of

this interaction. From the literature that proposes a developmentally different, or more global, mode of processing in the cognitive operations of the elderly, it might be expected that the recall of the elderly would benefit more than that of younger subjects from the context provided by the Information First condition. Since a global mode of processing may be more practiced by the elderly, they might benefit more from the activation of prior knowledge when informed of the identity of the individual described in the passage. However, if integrating new information with old knowledge does take up processing capacity, the activation of prior knowledge would then resemble a divided attention task. Theorists who propose a processing resource deficit in older adults would predict that the recall of elderly subjects would be impaired relative to younger subjects when recalling in the Information First condition, since the activation of prior knowledge may take up a greater proportion of their more limited processing capacity.

It was not possible to predict the incidence of inferences offered in recall under the conditions employed in this study, since no research to date has investigated this phenomenon. It was also unclear how the two age groups would perform on this measure. Some studies have found the inferential processing of the elderly to be deficient as compared to the young (Cohen, 1979; Cohen, 1981; Light, Zelinski & Moore, 1982; Till & Walsh, 1980). However, when inferential processing is assessed by measuring the amount of inferences spontaneously brought to recall (Arbuckle & Harsany, 1984; Smith et al, 1981), older adults are found to

offer as many, if not more, inferences as younger adults.

Elaborations can be considered a measure of the extent to which a subject relies on stored knowledge to remember information, or processes information on a global manner. If the elderly do process information in a global manner (Blanchard-Fields, 1981; Labouvie-Vief & Schell, 1982), older subjects should offer more elaborations in their recall under both conditions. Furthermore, both young and old subjects should offer more elaborations in the Information First condition than in the Information Last condition, since the facts known by the subjects about the famous individual, which have not been stated in the passage, would intrude in the subjects' recall.

Most studies on age effects in discourse processing have either not dealt with overgeneralizations and pseudodiscriminations in their scoring systems (Cohen, 1979; Spilich, 1983), or have classified these categories of recall as verbatim responses (Dixon et al, 1982, Hultsch & Dixon, 1983; Simon et al, 1982). No predictions were made for the incidence of pseudodiscriminations and overgeneralizations in this study, however, it was thought that the elderly might offer more overgeneralizations in their recall, since they have been found to do so previously (Arbuckle & Harsany, 1984).

Verbatim responses were also assessed in their pattern of change over successive recall trials in the protocols of both age groups under both conditions. Both losses, or forgetting of previously recalled items, and gains, or recovery of items not previously recalled (hypernesia), were considered. It was hypothesized that the recall

performance of the older subjects would be more variable over trials than that of younger subjects.

After recall of each passage, subjects were asked to rate their knowledge of the famous individual described in the passage on a prior knowledge provided for them. This rating was compared with the subject's score on verbatim responses to see whether there would be a positive association between knowledge of the target figure and accuracy of recall of the information.

To summarize, the main purpose of this study was to examine potential differences in information processing styles of young and old adults by manipulating the amount of the knowledge that the subjects had available to them. Having experienced a great deal throughout their lifetime, the elderly are often in the position of having accumulated abundant prior knowledge regarding the events or situations that they encounter. Therefore, manipulating the availability of prior knowledge and assessing resultant recall performance was expected to provide some clues to how the elderly remember information on a daily basis.

The constructionist point of view was taken in the assessment of recall performance because it allows for a more comprehensive picture of age-related differences in memory. By taking into account not only the subjects' fact recall, but also inferential and elaborative responses that subjects bring to recall, one can arrive at a better understanding of the strategies used by subjects of different ages to remember information.

Finally, the examination of performance over repeated recall trials

provided a means of evaluating any age-related differences in the retrieval of information over the retention period.

Method

Materials

Four passages, 101 to 121 words in length, describing famous individuals served as the stimulus materials. To arrive at the target individuals to be described in the passages, seven young (22 to 40 years) and seven old (65 to 82 years) pilot subjects were surveyed with the names of six male and six female famous individuals. Of these twelve famous persons, three males (Hitler, Lincoln, Dickens) and one female (Elizabeth Taylor) were selected. The bases for selection were the large number of facts recalled about these individuals from semantic memory; the subjective ratings of the amount of prior knowledge that those surveyed felt they had regarding the famous individuals; and, the fact that young and old individuals surveyed did not differ markedly on these two measures.

The passages describing the target individuals were divided into three sections, with thirteen idea units in each section, 39 units in all. One passage section described well known facts (the critical section) and two the passage sections described little known facts (non-critical sections) about the famous individual.

The passages were recorded by a male reader at a moderate rate (140 words per minute) on a BASF CC9100 cassette tape recorder. Passages were also printed with bold type on 8 1/2 x 11 inch paper, with each section of each passage appearing on a separate page.

Four recognition lists, one corresponding to each passage served as aids to subjects in guessing the identities of the target

individuals in the passages. Each recognition list consisted of twenty names of famous individuals in which the target individual appeared in a randomly assigned position, among nineteen others who shared common features with the target. (See Appendix 1)

A prior knowledge rating grid served as a subjective measure of the subjects' knowledge of the individual described in the passage. This grid consisted of a continuous line labelled with the number 0 on the left, and the number 10 on the right, on which subjects placed a mark indicating the extent of their prior knowledge of the famous individual. The left extremity of the grid, marked by 0, indicated no previous knowledge regarding the famous individual, and the right extremity, marked by 10, indicated an excellent knowledge of the famous individual.

To obtain information on the similarity of the two age samples, all subjects were given three pretests prior to the experiment. The first pretest involved a self-rating of health, as used by Maddox and Douglas (1973). Subjects were asked to rate their present health status as belonging to one of the following categories; excellent, good, fair, or poor. The vocabulary subtest of the Wechsler Adult Intelligence Scale-Revised (1981) was used to assess comparability of vocabulary comprehension between the two age groups. The final pretest consisted of a speech perception test, presented on the same recording device as the experimental passages, so as to ensure that all subjects heard the texts properly. This pretest consisted of a 25 word phonetic balancing list which was proposed by an audiologist at

the Montreal School for the Deaf. This list, which contains all the phonemes in the English language, is presented in Appendix 2. A five second pause separated each taped word of the list to allow the subjects to repeat each word verbally.

Subjects

Twenty-six young and 28 old adults participated in the study. The young and a few of the old subjects were recruited from the University student population; the remaining old adults from community groups in the area surrounding the university. All subjects were paid \$4.00 for their participation in the study. None of those individuals who served as pilot subjects in the preliminary survey conducted to choose the famous individuals to be used in the study, participated as subjects in the experiment.

Of the original sample of 54 subjects, 10 young and 12 old subjects were dropped from the study. The reasons for disqualifying subjects were: health ratings of fair or poor; inadequate hearing; guessing the identity of one or more characters before the critical information was presented; failing to guess the identity of one or more characters after the critical information was presented. The details concerning the subjects dropped are presented in Appendix 3.

Thirty-two subjects remained in the study. Of these, 16 were young adults, aged 18 to 30 years, with a mean age of 23 years; and 16 were old adults, aged 61 to 75 years, with a mean age of 67 years. There were 2 males and 14 females in each age group. The subjects either had English as their mother tongue or had done their schooling

in English. The old group included two individuals who were working full time and two individuals working part time, while the remainder had retired. All the individuals in the old group were living independently and were active, self-sufficient members of the community. The young group consisted of 13 individuals who were full time students and three individuals working full time.

The old and young subjects did not differ significantly in the years of formal education that they had received, $t(30) = .47$, $p > .10$, with the old having an average of 15.25 years, and the young, an average of 15.60 years. On the vocabulary test, old adults achieved a higher vocabulary score ($M = 60.81$) than the young adults ($M = 58.75$), but this difference was not significant, $t(30) = 1.20$, $p > .10$. As well, both groups did not differ significantly in their scores on the speech perception test, $t(30) = 1.59$, $p > .10$, with the old adults achieving a mean score of 22.56 and the young adults, a mean score of 23.31. The age, sex, occupation, education level, vocabulary and speech perception scores for young and old subjects are outlined in Tables 1 and 2 respectively.

Design

There were two experimental conditions, defined by the order of presentation of the critical and non-critical sections of the passage. In the Information First condition, the critical section containing the well known information about the famous individual preceded non-critical sections A and B, which contained the little known facts. In the Information Last condition, the two non-critical sections were

Table 1

Age, Sex, Years of Education, Occupation, Vocabulary Pretest
Scores and Speech Perception Scores of Young Subjects

Age	Sex	Years of Education	Occupation	Vocabulary Pretest Score	Speech Perception Pretest Score
22	M	15	student	62	23
24	F	15	student	57	25
24	F	14	student	61	25
21	F	16	student	63	23
22	M	16	student	57	24
20	F	14	student	61	24
25	F	18	research assistant	57	21
19	F	14	student	68	24
21	F	15	student	49	24
23	F	15	student	49	23
24	F	16	student	63	23
30	F	17	couturier	52	22
27	F	17	letter carrier	59	24
25	F	16	student	61	24
26	F	18	student	55	22
23	F	14	student	66	22
$\bar{X} = 23.5$		15.60		58.75	23.31
SD = 2.78		1.36		5.53	1.14

Table 2

Age, Sex, Years of Education, Occupation, Vocabulary Pretest
Scores and Speech Perception Scores of Old Subjects

Age	Sex	Years of Education	Occupation	Vocabulary Pretest Scores	Speech Perception Pretest Scores
69	M	18	retired school principal	56	23
64	F	18	full time librarian	68	23
70	F	11	part time bookkeeper	56	20
62	F	14	retired library clerk	64	23
67	F	17	retired teacher	60	21
71	F	16	retired nurse	56	24
61	F	20	retired school principal	67	24
67	F	13	retired bookkeeper	56	22
71	M	11	retired salesman	58	21
67	F	13	part time office clerk	63	25
66	F	14	owner of tutoring school	62	21
65	F	17	retired librarian	60	22
70	F	12	retired secretary	65	25
75	F	18	retired teacher	64	21
69	F	19	retired teacher	58	23
64	F	13	retired accounting clerk	60	23
\bar{X} =	67.38	15.25		60.81	22.56
SD =	3.69	2.96		4.04	1.50

always presented in the A - B order. (See Appendix 4 for the critical and non-critical sections of each passage under the Information First condition, and Appendix 5 for the passage sections under the Information Last condition.)

There were two experimental sessions with each subject being tested on two different passages per session, with one passage under each condition. The sequence of the two conditions was counter-balanced over the two sessions for each subject. Assignment of passages to conditions and order of conditions, and therefore of passages, was systematically balanced across subjects within age groups. A full description of these counterbalanced sequences is given in Appendix 6.

The order of presentation and test trials for each condition is given in Table 3. Presentation of each section was followed by an Initial Recall test for that section. The three Initial Recall tests thus represent tests of immediate recall of short passages. Following Initial Recall of Section 2, the subjects gave a Repeat Recall of Sections 1 and 2 combined. The Repeat Recall represents a measure of retention of information from Initial test to Second (repeat) test under conditions where the subject either knows (Information First) or does not know (Information Last) the identity of the person being described. Following Initial Recall of Section 3, the subjects gave a Final Recall of Sections 1, 2, and 3 combined. This Final Recall represents a measure of retention under conditions where all subjects know the identity of the person being described.

Table 3

Outline of Experimental Procedure

Section	Condition	
	Information First	Information Last
1	Present Critical paragraph Initial Recall 1 : Critical	Present non-critical paragraph A Initial Recall 1 : A
2	Present non-critical paragraph A Initial Recall 2 : A Repeat Recall : Critical + A	Present non-critical paragraph B Initial Recall 2 : B Repeat Recall : A + B
3	Present non-critical paragraph B Initial Recall 3 : B Final Recall : Critical + A + B	Present Critical paragraph Initial Recall 3 : Critical Final Recall : A + B + Critical

Different patterns of results for the Condition by Section interaction between Initial and Final recall would provide information on the ways in which knowledge of the identity of the person being described may affect retrieval of information. In the same manner, different patterns of results for the two age groups on Initial and Final recall would provide information on any differential benefits on retrieval for old and young adults of having knowledge of the identity of the person being described.

With respect to analyses of Initial and Final recall, the design was a 2 (Age levels) by 2 (Conditions) by 3 (Sections) factorial design with repeated measures on the second and third factors. For Repeat Recall, where only two sections were under consideration (Critical and Non-critical A for the Information First condition; Non-critical sections A and B for the Information Last condition), the design was collapsed across the two levels of section, reducing to a 2 (Age levels) by 2 (Conditions) factorial design with repeated measures on the second factor.

Procedure

All subjects were tested individually on two separate occasions. All young and 10 old subjects were tested at the university while six old subjects were tested in their homes. For those subjects tested at their homes, all efforts were made to replicate the quiet, undisturbed surroundings that were present at the university testing site.

Before beginning the experiment, general information was taken from each subject regarding his or her age, mother tongue, and years

of education. Subjects then were asked to rate their present health status and were administered the vocabulary pretest.

In the vocabulary pretest, subjects were asked to define each word. Responses were evaluated according to the WAIS-R (1981) scoring manual. In the speech perception test, subjects were asked to repeat each word immediately after they heard it. Subjects were disqualified if they failed to repeat correctly more than five words.

The subjects then were read the instructions regarding the experimental tasks. In the instructions subjects were told that their task was to guess the identity of the famous individual described in the passage and recall the information presented in the passage. Recall instructions indicated that subjects were expected to recall for gist, or "in their own words", and were not expected to remember the passages verbatim. The instructions used in the experiment are presented in Appendix 7.

The stimulus passages were presented to the subjects aurally and visually at the same time. After exposure to each section of each passage, the visual presentation of the passage section was taken away from the subjects. Subjects then guessed at the identity of the famous individual described. Subjects were expected to guess correctly the identity of the famous person after presentation of the Critical section, that is the section that contained the very well known information regarding the famous person. Subjects who failed to guess correctly the target individual at this time completed the remainder of the experiment, but their data are not analyzed here.

Five subjects (one young, four old) expressed knowledge of the identity of the famous individual after being presented with the critical section, but had difficulty naming him or her. These subjects were asked to identify the target individual from the recognition lists. Before being offered the list, subjects were asked to produce a confidence rating from 0 to 10, with the number 10 signifying absolute confidence, in their judgment that they would choose the correct individual on the list. The confidence rating served as a check on how well the subjects thought they knew the identity of the famous individual. Confidence ratings ranged from 8.0 to 10.0, with a mean of 9.5, and all five subjects correctly identified the famous target individual from the lists. Feedback regarding the accuracy of the subjects' guess and recognitions was offered by the experimenter. After guessing at the identity of the target individual, subjects then recalled the section of the passage that they had heard and read (Initial Recall). Following Initial Recall, subjects recalled all the sections of the passage they had heard previously (Repeat Recall).

All recalls and guesses were given orally and were taped on a Realistic Minisette IV cassette tape recorder. Following presentation of each passage, subjects rated their previous knowledge of the famous individual on the prior knowledge grid.

Measures and Scoring

Recall protocols were transcribed from the tapes and scored by the experimenter and one other judge. Transcribed protocols were

assigned random numbers so that both raters were blind to both the age of the subjects and the passage conditions.

Each stimulus passage was divided into 39 idea units, with 13 such units in each section. The subjects' protocols for Initial (first recall of each passage section immediately after its presentation) and Final Recall (last complete repeat recall of all three passage sections) were examined for the presence of verbatim responses, over-generalizations, pseudodiscriminations, inferences, and elaborations. Verbatim responses consist of verbatim or close approximations of idea units, (e.g. "he worked" for "he earned his living". Over-generalizations consist of subjects' responses that include the correct response as a subclass (e.g. "a medal" for "the Iron Cross"). Pseudodiscriminations consist of subjects' responses that represent a subset of the correct response (e.g. "House of Parliament" for "Parliament"). Inferences are concepts or relations between concepts not stated in the passage, but which can be directly inferred from it (e.g. from "he later remarried a widow with children of her own" to "she had children from her first marriage"). Elaborations consist of additions brought to recall that are derived from the subjects' prior knowledge of the famous individual and which are not stated in the passage (e.g. for the Elizabeth Taylor passage, "she starred in National Velvet").

Inter-rater scoring reliabilities for the above measures were derived by the percentage method which consists of the following formula: number of agreements / number of agreements + numbers of

disagreements. To achieve a high level of inter-rater agreement, four different subsets consisting of an average of 12 passages from the protocols of disqualified subjects were used for practice sessions. After each practice session, the judges compared their scoring and discussed and resolved scoring for those items that were discrepant. Inter-rater reliabilities for each of these sessions were the following: .79, .90, .91, and .93. Since a consistently high level of inter-rater reliability had been achieved, the judges then proceeded onto scoring protocols of subjects who qualified for the study. The final inter-rater agreement for these protocols was .89.

Recall over successive tests were scored by noting the correct presence (correct) or absence (not recalled) of verbatim responses of a particular idea unit over two successive recalls. Four patterns were possible: correct-correct (C-C), not recalled - not recalled (N-N), correct - not recalled (C-N), and not recalled - correct (N-C). The first two patterns represent no change over two successive repeated recalls; the third pattern (C-N) represents a forgetting of an item over two successive recalls; and, the fourth pattern (N-C) represents a recovery of an item over two repeated recalls. See Table 4 for an outline of these recall patterns.

From these four patterns, two proportional measures of Repeat Recall were derived: Forget, which consisted of the formula $\frac{CN}{CC + CN}$, that is the number of items forgotten on the second of two trials in proportion to the total number of items that could be forgotten (i.e. all items correct on the first trial); and Recover, which

consisted of the formula $NC / (NC + NN)$, that is the number of items recovered on the second of two trials in proportion to the total number of items that could be recovered, (i.e., all items incorrect on the first trial).

Table 4

Outline of Repeat Recall Patterns Over Two Successive Tests

First Recall (Section 1 Initial Recall or Section 2 Initial Recall)	Second Recall (Repeat Recall of Section 1 or repeat Recall of Section 2)	Pattern
Correct (C)	Correct (C)	CC
	Not recalled (N)	CN
Not Recalled (N)	Correct (C)	NC
	Not recall (N)	NN

Results

Recall Measures for Initial and Final Recall

Scores for the five recall measures for Initial and Final Recall were summed over the two passages presented to each subject under each condition. Separate multivariate analyses of variance were done for Initial and Final Recall followed in each case by univariate analyses of variance on each of the five response measures individually.

The multivariate analyses yielded identical results for both Initial and Final Recall and consequently, will be described together. There were some discrepancies between Initial and Final Recall in the analyses of variance of the individual measures and these will be noted accordingly. Complete sets of means for all measures for both Initial and Final Recalls are presented in Appendix 8. Source tables for the multivariate and univariate analyses of variance are, for Initial Recall, presented in Appendix 9; and for the multivariate and univariate analyses of variance for Final Recall in Appendix 10.

Multivariate analyses of Initial and Final Recalls both showed significant effects of age, Initial Recall, $F(5,26) = 3.29, p < .05$; Final Recall, $F(5,26) = 4.67, p < .01$. Subsequent univariate analyses on the different measures showed that older subjects produced fewer verbatim responses than younger subjects, Initial Recall, $F(1,30) = 14.11, p < .01$; Final Recall, $F(1,30) = 15.85, p < .01$. In addition, on Final Recall only, older subjects made more elaborations than younger subjects, $F(1,30) = 5.40, p < .05$. The means for the two age groups on all measures are presented in Table 5.

Table 5

Means for Young and Old Subjects for the Different
Response Measures on Initial and Final Recall

Measure	Recall	Age		p
		Young	Old *	
Verbatim Responses	Initial	17.70	14.31	<.01
	Final	16.86	12.90	<.01
Overgeneralizations	Initial	1.77	1.60	
	Final	2.29	2.29	
Pseudodiscriminations	Initial	0.23	0.19	
	Final	0.24	0.24	
Inferences	Initial	1.20	1.46	
	Final	1.39	1.71	
Elaborations	Initial	0.14	0.27	
	Final	0.23	0.42	<.05

Both multivariate analyses showed a main effect of condition, Initial Recall, $F(5,26) = 9.63, p < .01$, and Final Recall, $F(5,26) = 4.09, p < .01$. Subsequent univariate analyses showed that only verbatim recall varied significantly with condition, Initial Recall, $F(1,30) = 47.08, p < .01$, and Final Recall, $F(1,30) = 14.82, p < .01$. In both recall phases verbatim recall was greater for the Information First condition (Means of 17.30 and 15.81 for Initial and Final recall respectively) than for the Information Last condition (Means of 14.71 and 13.96 for Initial and Final recall respectively).

The main effect of section was also statistically significant in both multivariate analyses and on several of the univariate measures. Given the confounding of order of the sections that is inherent in the structure of the Information First and Information Last conditions, however, the main effect of sections is relatively meaningless. What is of interest is the Section by Condition interaction, since it is this interaction which reflects any effect of the experimental manipulation on the recall measures.

Both multivariate analyses showed the Condition by Section interaction to be significant, Initial Recall, WCP Likelihood Ratio (10,112) = 12.09, $p < .01$; Final Recall, WCP Likelihood Ratio (10,112) = 13.68, $p < .01$. (T Square values were also calculated and produced consistent results). In the subsequent univariate analyses of variance, because conditions and sections involved repeated measures, the effects of these factors were tested conservatively by multivariate, rather than univariate, tests. These multivariate tests revealed that the Condition

by Section interaction was significant for verbatim responses, Initial Recall, $WCP(2,60) = 27.47, p < .01$; Final Recall, $WCP(2,60) = 16.65, p < .01$; for inferences, Initial Recall, $WCP(2,60) = 53.85, p < .01$; Final Recall, $WCP(2,60) = 60.48, p < .01$; and for elaborations, Initial Recall, $WCP(2,60) = 9.50, p < .01$, Final Recall, $WCP(2,60) = 10.89, p < .01$. Post hoc Tukey tests were calculated for the interaction means for verbatim responses, inferences, and elaborations in each recall phase. The means for verbatim responses, inferences, and elaborations are presented in Tables 6, 7, and 8 respectively, with the results of the Tukey tests being indicated by the superscripts.

Tukey tests on verbatim responses showed that the pattern of the Condition by Section interaction was similar for Initial and Final Recall. For both recall phases, recall of the critical section and the first non-critical section (A) did not differ as a function of condition, Information First or Information Last, but recall of the second non-critical section (B) was significantly greater under the Information First than under the Information Last condition. Within the Information First condition, the critical paragraph was significantly less well recalled than either non-critical section on both Initial and Final Recall. Under the Information Last condition, the critical section was similarly less well recalled than the non-critical sections, but the only significant difference was between the critical section and the non-critical section A in Initial Recall.

Tukey tests on inferences showed an identical pattern of results in the Condition by Section interactions under both phases of recall. In

Table 6

Verbatim Response Means in Relation to Condition and
Section for Initial and Final Recall Phases

Initial Recall

Section	Condition			
	Information First		Information Last	
1st	Critical	14.69 ^{ab}	Noncritical A	16.20 ^{bc}
2nd	Noncritical A	18.02 ^{cd}	Noncritical B	14.38 ^{ab}
3rd	Noncritical B	19.19 ^d	Critical	13.55 ^a

Final Recall

Section	Condition			
	Information First		Information Last	
1st	Critical	13.30 ^a	Noncritical A	14.58 ^{ab}
2nd	Noncritical A	16.48 ^{bc}	Noncritical B	13.95 ^a
3rd	Noncritical B	17.64 ^c	Critical	13.34 ^a

Note: Within each recall phase, means differ significantly ($p < .05$) if their superscripts do not contain a common letter.

Table 7

Inference Means in Relation to Condition and Section
for Initial and Final Recall Phases

Initial Recall

Section	Condition	
	Information First	Information Last
1st	Critical 2.63 ^b	Noncritical A 0.66 ^a
2nd	Noncritical A 0.59 ^a	Noncritical B 0.95 ^a
3rd	Noncritical B 1.08 ^a	Critical 2.08 ^b

Final Recall

Section	Condition	
	Information First	Information Last
1st	Critical 2.94 ^b	Noncritical A 0.78 ^a
2nd	Noncritical A 0.78 ^a	Noncritical B 1.42 ^a
3rd	Noncritical B 1.09 ^a	Critical 2:30 ^b

Note: Within each recall phase, means differ significantly ($p < .05$) if their superscripts do not contain a common letter.

Table 8

Elaboration Means in Relation to Condition and Section
for Initial and Final Recall Phases

Initial Recall				
Section	Condition			
	Information First		Information Last	
1st	Critical	0.36 ^{ab}	Noncritical A	0.02 ^a
2nd	Noncritical A	0.23 ^{ab}	Noncritical B	0.08 ^a
3rd	Noncritical B	0.06 ^a	Critical	0.48 ^b
Final Recall				
Section	Condition			
	Information First		Information Last	
1st	Critical	0.58 ^{bc}	Noncritical A	0.06 ^a
2nd	Noncritical A	0.19 ^{ab}	Noncritical B	0.28 ^{abc}
3rd	Noncritical B	0.23 ^{abc}	Critical	0.59 ^c

Note: Within each recall phase, means differ significantly ($p < .05$) if their superscripts do not contain a common letter.

both Initial and Final Recall phases, recall of each of the three passage sections, the critical section and non-critical sections A and B, did not differ significantly as a function of condition. As well, under both conditions in each recall phase, inferences occurred significantly more often in the critical sections than in the non-critical sections (A and B).

Tukey tests on elaborations showed a similar, although not identical, pattern of results in the Condition by Section interaction in each recall phase. Recall of all three passage sections (critical and non-critical A and B) did not differ significantly as a function of condition in either the Initial or Final Recall phases. Within the Information First condition in both recall phases, the critical sections elicited more elaborations than either non-critical sections, although these comparisons were not found to be significantly different. Within the Information Last condition in the Initial Recall phase, the critical section elicited significantly more elaborations than either non-critical sections, while in the Final Recall phase, the critical section also elicited more elaborations than the non-critical sections, but the difference was significant only between the critical section and non-critical section A.

No other main effects or interactions were found to be significant in the multivariate analyses of Initial and Final Recall, nor were any other effects found to be clearly significant in the univariate analyses of variance of the recall measures. However, there were two instances where, by using two multivariate tests for the repeated measures in the

univariate analyses, a discrepancy was found such that one multivariate test indicated significance ($p < .05$), and the other, nonsignificance ($.05 < p < .10$). These marginally significant findings were on Section by Age interactions for elaborations in Initial Recall, $WCP(2,60) = 3.17$, $p < .05$, but $TSq(2,29) = 2.52$, $p < .09$; and a Section by Age interaction for pseudodiscriminations in Final Recall, $WCP(2,60) = 2.61$, $p < .08$, but $TSq(2,29) = 3.51$, $p < .05$. Since the other recall phase in each case revealed no evidence of any similar effect (all $p > .80$) these discrepant findings appear to be most reasonably attributed to sampling variability.

To summarize, the effects of interest that were found in the analyses of Initial and Final Recall were those of Age, Condition, and the Condition by Section interaction. Also of interest was the fact that, contrary to initial hypotheses, no Age by Condition interactions emerged on any of the multivariate or univariate analyses (both $p > .10$ for the two MANOVAs and all $p > .40$ for the 10 Anovas).

Forgetting and Recovery on Repeat Recall

To arrive at a measure of recall over successive recall tests, gains and losses of verbatim responses from first to second recall of the first and second sections presented to each subject were summed across the passages in each condition. These sums were transformed to Forget and Recover proportional measures of recall as described above in the Methods section. To assess forgetting and recovery of items over successive recall tests as function of age and condition, multivariate analyses of variance were performed, followed by univariate analyses of

variance for each individual response measure. The means of these response measures are presented in Tables 9 and 10. Source tables for the multivariate and univariate analyses of variance are presented in Appendix 11.

Multivariate analyses indicated a significant effect of Age, $F(2,29) = 14.15, p < .01$. Subsequent univariate analyses of variance revealed that the Age effect emerged for the Forget measure only, $F(1,30) = 29.80, p < .01$, with the old forgetting a greater proportion of items from first to second test than the young.

Multivariate analyses also revealed a significant Age by Condition interaction, $F(2,29) = 3.43, p < .05$. Subsequent univariate analyses of variance showed an Age by Condition interaction for the Recover measure only, $F(1,30) = 5.99, p < .05$. Post hoc Tukey tests indicated that for the young subjects, Recover scores were significantly greater in the Information Last condition than in the Information First condition, $p < .05$. In contrast, the Recover scores of the old were greater in the Information First condition than in the Information Last condition, although this difference was not significant. The Recover scores of the young in the Information Last condition differed significantly from the Recover scores of the old in this condition, $p < .05$, while there was no significant difference in Recover scores between age groups in the Information First condition.

Correlations Among All Variables

Total scores for all recalls of all sections for each of the five recall measures were calculated for each passage. Pearson product

Table 9

Means and Standard Deviations (in parentheses) For Forget
Proportional Measures in Relation to Age and Condition

Condition	Age		
	Young	Old	Mean
Information First	0.07 (.05)	0.20 (.10)	0.13 (.01)
Information Last	0.09 (.09)	0.17 (.11)	0.13 (.11)
Mean	0.08 (.07)	0.19 (.10)	0.13

Table 10

Mean and Standard Deviations (in parantheses) for Recover
Proportional Measures in Relation to Age and Condition

Condition	Age		
	Young	Old	Mean
Information First	0.08 ^a (.07)	0.11 ^a (.07)	0.09 (.07)
Information Last	0.14 ^b (.10)	0.08 ^a (.06)	0.11 (.09)
Mean	0.11 (.09)	0.09 (.07)	0.10

Note: Means differ significantly ($p < .5$) if their superscripts do not contain a common letter.

moment correlations were calculated among these scores and the education and vocabulary test scores of each subject. Table 11 presents the correlation matrix for young, and Table 12 for old subjects for all these variables.

For young subjects pseudodiscriminations correlated significantly and positively with inferences, $r(14) = .53$, $p < .05$. Otherwise no significant correlations were found. However, elaborations and inferences approached significance for young subjects, $p(14) = .48$, $p < .10$. As well, the correlations between vocabulary scores and verbatim responses $r(14) = .44$, $p < .10$ and between pseudodiscriminations and elaborations, $r(14) = .45$, $p < .10$ approached significance for older subjects.

Prior Knowledge Grid

To arrive at an understanding of how subjects' rating of their prior knowledge of the famous person described in the passage is related to recall, the following analysis was done. Initial recall scores for verbatim responses to non-critical sections (Sections 2 and 3 in the Information First condition; Sections 1 and 2 in the Information Last condition) were summed together for each passage for each subject and these totals then were correlated with the subject's prior knowledge grid score for that passage by means of Pearson product moment correlations.

Only Initial recall scores for non-critical sections were used in this analysis so as to arrive at a pure measure of recall of new information, that is, the little known information regarding the famous

Table 11

Correlations Among Education, Vocabulary test scores,
 Verbatim Responses, Overgeneralizations, Pseudodiscriminations,
 Inferences, and Elaborations for Young Subjects

	Ed	Voc	Verb	Over	Pseudo	Inf	Elab
Ed	1.00						
Voc	-.37	1.00					
Verb	.21	-.27	1.00				
Over	.15	.13	-.33	1.00			
Pseudo	.04	-.26	-.42	.11	1.00		
Inf	-.01	.05	-.29	.36	.53*	1.00	
Elab	-.31	.37	-.28	.10	.39	.48**	1.00

* $p < .05$

** $p < .10$

Table 12

Correlations Among Education, Vocabulary test scores,
Verbatim Responses, Overgeneralizations, Pseudodiscriminations,
Inferences, and Elaborations for Old Subjects

	Ed	Voc	Verb	Over	Pseudo	Inf	Elab
Ed	1.00						
Voc	.27	1.00					
Verb	-.10	.44*	1.00				
Over	.08	.39	-.16	1.00			
Pseudo	-.05	-.27	.26	-.07	1.00		
Inf	.05	.03	-.12	.38	.15	1.00	
Elab	.13	-.18	.10	.23	.45*	.42	1.00

* $p < .10$

individual. Since the critical sections contain well known information regarding the famous individual, Initial recall scores of these sections may not represent a pure measure of new learning, but perhaps may reflect retrieval of information that had been learned previously. Therefore, critical sections were not included in this analysis.

Correlations were calculated separately for each age group, condition, and passage. See Table 13 for the resultant correlation matrix of these variables. Prior knowledge grid scores correlated significantly and positively with verbatim responses in the young subjects' recall of the passage describing Lincoln under the Information First condition, $r(6) = .75, p < .05$. As well, grid scores correlated significantly and negatively with correct reproductions of young subjects' recall of the Lincoln passage in the Information Last condition, $r(6) = -.79, p < .05$. No other correlations were found to be significant.

Analyses were also performed on the Prior Knowledge Grid to assess whether young and old subjects differed in the ratings they assigned to the passages under both conditions. These analyses indicated that young and old subjects did not significantly differ in their prior knowledge grid ratings to Passage 1, $t(30) = -1.10, p > .05$; Passage 2, $t(30) = -0.19, p > .05$; Passage 3, $t(30) = -.62, p > .05$; or Passage 4, $t(30) = -1.21, p > .05$.

Table 13

Correlations Between Prior Knowledge Grid Ratings and Initial
Recall Scores of Verbatim Responses in Non-Critical Sections

		Grid Ratings of Passages			
Verbatim Responses		Hitler	Lincoln	Dickens	Taylor
Age	Condition				
Young	Info First	.52	.75*	.06	.37
	Info Last	.38	-.79*	.06	.21
Old	Info First	-.32	-.11	-.42	-.31
	Info Last	.44	-.38	-.11	.32

* $p < .05$

Discussion

The purpose of this study was to investigate age-related differences in recall under conditions that manipulated the activation of prior knowledge. Contrary to expectations, the manipulation of prior knowledge did not differentially affect the two age groups, although age and condition alone each had a separate influence under recall performance. As well, results indicate that recall performance for the various passage sections differed as a function of the experimental manipulation.

As predicted, the elderly performed less well on verbatim recall than the young on both Initial and Final Recall phases. This was expected since the stimulus materials were descriptive rather than narrative in content. Although several previous studies have failed to find age differences in recall when the experimental materials consisted of simple stories (Arbuckle & Harsany, 1984; Mandel & Johnson, 1981; Simon et al, 1982), studies involving recall of newspaper articles (Dixon et al, 1982) and descriptions of famous individuals (Hultsch & Dixon, 1983) tend to reveal age differences.

The task of remembering descriptions of famous individuals may be more difficult than remembering simple stories. Descriptive passages may be more densely packed with information. As well, they do not contain within them an underlying organizational structure or story grammar. Given the hypothesized (Hulicka & Grossman, 1967) deficiency of the elderly in their ability to impose spontaneously an organizing structure onto stimulus materials to facilitate later recall, and

considering the fact that descriptive passages do not contain an underlying story structure, the production deficiency hypothesis may offer a partial explanation for the discrepant findings regarding the recall of descriptive and narrative passages by older adults. However, since the present study did not directly compare the recall of stories and descriptions, this can be considered only a tentative hypothesis in interpreting these results.

Pilot work had indicated that the famous individuals described in the passages in this study were equally well known to both age groups. The lack of any significant differences between young and old subjects in the ratings they assigned to their prior knowledge of the individuals described confirms the assumption that the famous individuals were equally well known to both age groups. Therefore this study replicated the findings of the Hultsch and Dixon (1983)' study which also found age differences in recall performance when the figures described in stimulus passages were equally well known to both age groups.

Both age groups were found to benefit equally well from the context provided by the Information First condition. It was expected that the recall of young subjects would improve when they knew the identity of the famous person described in the passage, since similar findings have been generated by previous studies (Bransford & Johnson, 1972; Dooling & Mullet, 1973). For the older adults, two possible age by condition interaction possibilities were considered: that the older subjects would benefit more than younger subjects by the context provided by the Information First condition, or that they would benefit less than

younger subjects by this condition.

The hypothesis that the opportunity to access previously acquired information would differentially enhance the recall of the elderly as compared to the young was based on the idea that being informed about the subjects of the passage would mobilize a global mode of processing, which is considered typically used, and therefore well practiced, by the elderly. The absence of such a facilitation in the data suggests that if the elderly do typically relate new information to their accumulated world knowledge, this style of thinking may not differentially enhance their recall of factual information as compared to the young. However, the results indicate that such a global mode of processing does not necessarily interfere with the recall of the elderly either. Labouvie-Vief and Schell (1982) have suggested that a global manner of thinking, although offering the individual some gains, may also involve some losses, particularly in the ability to focus and remember details. Results from this study indicate that activating prior knowledge had a beneficial effect on the recall of new specific factual information and not a deleterious one for both young and old subjects. As well, young subjects in this study presumably also engaged, at least temporarily, in a global mode of processing, since they also had the opportunity to access prior knowledge stores under the Information First condition. Thus, it would seem that global processing can be engaged by both young and old adults with the same beneficial effects. These findings would suggest that global processing does not seem to account for the age related differences typically found in studies of aging and memory.

It can be argued, however, that an experimental manipulation involving knowledge of famous individuals may not represent a true test of accessing world knowledge. World knowledge perhaps should be considered to be based on an accumulation of everyday experiences and not on a mass of trivial facts about famous people. This argument may indeed be valid. However, it is interesting to note that Light and Anderson, (1983) also found age differences in the recall of scripts, or everyday action sequences, such as writing a letter or going shopping. Their findings also lend support to the notion that an accumulation of world knowledge may not particularly enhance recall.

The second hypothesis that was considered regarding a differential effect of the experimental manipulation on the two age groups suggested that the opportunity to activate prior knowledge may have a deleterious effect on the recall performance of older subjects, since it may represent an increased load on processing capacity. Under the Information First condition, working memory would be taken up not only with the task of processing incoming information, but also with the work of accessing and temporarily storing facts from previous knowledge. This hypothesis was derived from studies which demonstrated that accessing prior knowledge may affect speed of recall and other cognitive tasks (Britton & Tesser, 1982; Lewis & Anderson, 1976). It was argued that since processing capacity is thought to diminish with age, any further reduction in working memory capacity may cause older subjects to recall less information under the Information First condition than in the Information Last condition. The absence of such an effect in this

study may indicate that perhaps the measures used were not sensitive enough to tap the subtle changes in working memory capacity under these conditions. Further research which includes a measure of changes in reading speed and retrieval time may offer a more precise method of testing this hypothesis.

Aside from a quantitative assessment of age related differences in recall, as measured by the number of idea units remembered by subjects by both age groups, this study also investigated qualitative differences due to age by examining the importations present in recall protocols. In both initial and final stages of recall, old and young subjects did not differ significantly in the number of overgeneralizations, pseudodiscriminations, and inferences that they brought to recall. Age differences in elaborations appeared in the Final Recall phase, but failed to emerge in the Initial Recall phase.

No particular predictions were made regarding pseudodiscriminations and it would seem from this study and other research (Arbuckle & Harsany, 1984) that this measure does not reflect age differences in recall. On the other hand, older subjects failed to offer more overgeneralizations than younger subjects as they had done in the Arbuckle Harsany (1984) study. It is not clear why age differences in overgeneralizations appeared in the earlier study and did not here, but perhaps the nature of the experimental materials may have some influence on the generation of overgeneralizations. The passage in the former study consisted of a moral story while this study examined recall of descriptions of famous individuals.

If older subjects offer as many overgeneralizations and pseudodiscriminations, but give less verbatim responses in their recall than younger subjects, this would suggest that studies that include overgeneralizations and pseudodiscriminations in a category of correct recall responses in their scoring systems may offer some advantage to the elderly as compared to the young. In comparing loose and stringent scoring criteria in assessing prose recall, Smith et al (1983) demonstrated that age differences tend to fade under loose scoring conditions. The acceptance of pseudodiscriminations and overgeneralizations as correct recall responses constitutes a loose scoring criterion. It would seem important, then, to consider differences in scoring methods and their effect on results obtained in studies of recall when assessing age differences across different studies.

Results from this study showed that older subjects offered more inferences in their recall than younger subjects, although this difference was not significant. This finding suggests that the elderly are not devoid of inferential processing and, in fact, can and do spontaneously produce as many inferences in their recall as young adults. Other studies that have assessed inferential reasoning in this manner (Arbuckle & Harsany, 1984; Smith et al, 1981) have demonstrated similar findings. However, when inferential processing has been examined by the use of syllogistic reasoning problems, which sometimes include nonsense syllables and employ multiple choice questions, age difference do emerge. (Cohen, 1981; Fullerton, 1983). One must

consider the ecological validity of these studies in assessing true age differences. Multiple choice questions may be unfamiliar to older adults and nonsense syllables are by their nature, meaningless. For the older adult who has not attended school for years, perhaps such tasks are not well practiced nor perhaps meaningful enough to motivate them to mobilize their best efforts. Nevertheless, there exists a substantial difference in difficulty level between the making of simple inferences and solving logical reasoning problems. It is possible that inferential reasoning ability does decline over the lifespan, but perhaps it does so in stages or is restricted to certain kinds of inferences. Some researchers (Blanchard-Fields, 1981; Light and Anderson, 1983) have demonstrated that inferential processing involving world knowledge remains intact throughout the lifespan. From this study, it would seem that the ability to make simple inferences that integrate facts together while processing information from a passage also may remain intact in old age.

Elaborations may be considered a reflection of global processing since their production entails the accessing of prior knowledge stores. Since older adults are purported to engage in global processing on a regular basis, it was expected that older subjects would offer more elaborations than younger subjects in both recall phases. Older subjects were found to offer significantly more elaborations in the Final Recall phase only.

It is not clear why significant age differences in elaborations appeared in Final Recall but not in Initial Recall; however, two

possibilities may be considered. At the time of Final Recall, all subjects in both the Information First and Information Last conditions have been informed of the identity of the famous person described in the passage. Under the Initial Recall phase, subjects are informed of the identity of the famous individual in all sections presented under the Information First condition, but only one section under the Information Last condition. Since the opportunity to be informed occurs less often in Initial Recall than Final Recall, subjects in this recall phase have less of an opportunity to access prior knowledge and make elaborations. Subjects in fact, did offer less elaborations in the Initial Recall phase ($M = .21$) than in the Final Recall phase ($M = .33$). Means from both these data sets, however, are low which suggests that elaborations represent a phenomenon that occurs rather infrequently. Perhaps elaborations figures for Initial Recall phases are so low, in fact, that they fail to reveal age differences because of floor effects.

A second possibility for the discrepant findings regarding elaborations in the two recall phases may involve the passage of time. Under Initial Recall, subjects remember each passage section immediately after presentation, while under Final Recall, subjects recall passage sections after a certain amount of time has passed. Studies (Bartlett, 1983; Frederiksen, 1975; Hultsch & Dixon, 1983) have demonstrated that the passage of time increases the number of additions or elaborations brought to recall. Perhaps the absence of an age effect in Initial Recall and the presence of it in Final Recall reflects a greater sensitivity to the passage of time in the production of elaborations for

older adults than younger adults. This differential effect of age in the amount of elaborations produced in recall tests over time points to the possibility of age-related differences that may occur during the retention period.

Contrary to Smith et al's (1983) study where additions brought to recall and verbatim responses were found to be positively correlated for older adults, no such positive relationship between elaborations and verbatim responses emerged in the recall protocols of either young or old adults in the present study. This would suggest that in the present study, the making of elaborations does not represent an efficient encoding mechanism to assist recall; or, if elaborations are made in an effort to facilitate recall, they do not do so efficiently.

A further understanding of the production of elaborations may be gained by examining the condition by section interactions that emerged from the data. These interactions revealed that the verbatim recall performance of both age groups tended to decline when subjects were remembering the critical sections of the passage. Critical sections refer to those passage sections that contain the well known information regarding the famous person described. As well, both age groups tended to offer more inferences and more elaborations while recalling critical sections. These findings resemble those that have emerged from research investigating performance of younger subjects to passages describing famous people (Dooling & Christiaansen, 1977; Sulin & Dooling, 1974). In these studies, subjects tended to make more confusion errors on recognition tests of memory when they were aware of the identity of the

famous person than when they were not, indicating that other well known facts about the famous individual had intruded into their memory of the passage. In this study, elaborations tended to increase, and verbatim responses decrease, in number when subjects recalled previously acquired information. This pattern of results would suggest that elaborations may represent intrusions of previously known facts into recall, because of a confusion of these facts with information present in the passage. This hypothesis is consistent with the one proposed by Hultsch and Dixon (1983) in their study investigating the performance of young and old age groups in the recall of passages describing entertainment figures.

The results of the present study indicate that, although providing a context enhances overall recall performance, as evidenced by greater recall performance under the Information First condition than the Information Last condition, it also interferes with the recall of the section that describes that context. It would seem, then, that the accessing of prior knowledge may have contradictory effects on recall. It is possible that, in learning new information, the availability of a context frees the individual from having to provide his or her own context or organizational structures with which to cluster incoming information, and allows him or her to gather newly learned facts under a specifically assigned and previously acquired domain of knowledge (e.g., facts about Lincoln). This process may enhance later recall by freeing processing capacity and attentional resource to engage in other encoding strategies that may facilitate later retrieval of information. However, it is possible that these newly acquired facts are not attached to a

domain in the same manner as facts acquired pre-experimentally.

A hypothesis proposed by Anderson (1981) may offer an explanation for the findings of the present study. Anderson (1981) proposed that when individuals acquire new information regarding a topic about which they have prior knowledge, they store these new facts in sub-locations that are linked to, yet remain separate from, older knowledge stores. Anderson (1981) found different effects on the retention of new facts that were learned during his experiment, and the retention of old facts that were known pre-experimentally. Providing context may enhance the recall of newly acquired information by pointing to an already established domain to which subjects may attach sub-locations where new facts may be stored and later retrieved. However, when the subjects access older pools of information, the other facts stored there that were not presented may interfere with memory and become confused with the facts that were presented experimentally. Consequently, the activation of prior knowledge may enhance recall of new information, but the recall of previously known facts may not be enhanced because this recall presents some difficulty in distinguishing presented facts from old knowledge.

The important finding in this study is that both age groups followed the same recall pattern in response to the activation of prior knowledge. Both age groups were equally facilitated by the context provided by the Information First condition and both groups were equally vulnerable to the interference of prior knowledge when recalling critical sections. This similarity in recall pattern suggests that

older and younger adults do not engage in radically different styles of processing information.

A further analysis that was performed on the importations brought to recall involved correlations of all categories of recall responses with each other as well as with the education and vocabulary scores attained by the subjects. Although no hypotheses were made regarding these correlations, previous research has found positive correlations between verbatim responses and elaborations (Smith et al, 1981), as well as vocabulary scores and verbatim responses (Gordon & Clark, 1974; Taub, 1979) in the recall of older subjects. The absence of a positive correlation between verbatim responses and elaborations was discussed earlier. The relationship between verbatim responses and vocabulary scores for older subjects in this study was found to be positively correlated and approaching significance, while a negative, although nonsignificant, correlation between these two variables was evident for young subjects. These results at least resemble earlier findings that indicate a predictive relationship between the verbal ability, as measured by vocabulary scores, of the elderly and their recall of verbal stimuli (Taub, 1979).

The only strong finding that emerged from the correlational analysis was a positive relationship between pseudodiscriminations and inferences in the recall of younger subjects. Perhaps the rather small size of the sample used in this study did not allow for a powerful enough test for the correlational analyses to elicit more interesting relationships that may exist among the variables. No significant

conclusion can be derived from the correlational pattern that did emerge, since it may be expected that by chance alone one significant relationship would emerge from the data. The significant association that did appear in the data may simply represent this chance finding.

Aside from analyzing the quantitative and qualitative differences due to age in discourse recall, a further purpose of this study was to examine age-related differences in retention of items over successive recall trials. Both the forgetting of items that were once recalled, as well as the recovery of items that were not initially recalled were assessed for age differences. The analyses indicated that over two recall tests without intervening presentation, older subjects forgot more of the items that they recalled on the first test than did younger subjects. Similar findings were also evident in Taub's (1979) study where over trials older subjects were found to change their responses to comprehensive questions more often than younger subjects. These findings suggest that older adults, as compared to younger adults, may not only show decrements in the ability to remember material presented to them, as evidenced by their poorer verbatim recall performance in the Initial Recall phase, but they also may be less likely to remember facts that they have previously recalled.

No main effect of age appeared for the Recover measure, indicating that older subjects made as many hypermnesic responses as younger subjects despite their hypothetical deficiency in imaginal encoding. An age by condition interaction, however, was found for the Recover measure. This interaction indicated that young subjects tended to

recover more items over trials in the Information Last condition than in the Information First condition. Older subjects showed no significant difference in the Recover measure under the two different conditions, although they tended to recover more items in the Information First condition than in the Information Last condition. Younger subjects seemed to perform better on this measure when they did not know the identity of the famous individual described in the passage. This finding suggests that younger subjects may prefer and may benefit in their recall performance over trials from a focussed mode of processing, that is, when their prior knowledge is not activated. Since older adults tended to do better in the Information First condition, it is possible that they may prefer and perhaps benefit in their recall over trials when their prior knowledge stores are stimulated. Such an interpretation is consistent with the idea that young and old adults process information differently, or at least that their recall performance may be optimized by somewhat different modes of processing.

The correlations between subjects' verbatim responses and their prior knowledge grid scores were examined in order to evaluate the relationship between an individual's recall performance and his or her subjective assessment of prior knowledge of the individual described in the passage. The results showed that for the old these associations were not statistically significant and were generally negative in direction particularly under the Information First condition. Thus, there was no evidence in these data that activation of prior knowledge facilitated the verbatim recall of older subjects. For the young,

these associations were generally positive in direction, the exception being a significant negative correlation for the Lincoln passage under the Information Last condition. This negative correlation is somewhat puzzling, particularly since the only significant positive correlation was for the Lincoln passage under the Information First condition. It may be simply that the grid was not an appropriate measure of prior knowledge, particularly since it was administered after the experiment and hence, the rating was confounded by the information that the subject had encountered during the experiment. If the grid ratings are indeed valid and not simply reflective of errors of measurement, then it would appear that greater prior knowledge may slightly enhance the recall of the young and slightly interfere with the recall of the old.

To summarize, the findings of this study indicate that the effects of aging on memory are more quantitative than qualitative. Older subjects recalled less information verbatim than younger subjects on both immediate and final recall tests, and older subjects forgot more items over trials than younger subjects. However, young and old subjects displayed similar modes of information processing. This similarity was especially apparent in their recall of information that was known to them pre-experimentally. When recalling critical sections of the passage, both age groups offered less verbatim responses and more inferences and elaborations than when recalling non-critical sections. This pattern of results suggests that both age groups were equally vulnerable to the potential confusion of previously acquired facts with information presented in these sections. The age groups did not differ

in the number of inferences they made in Initial and Final Recall tests, nor in the number of elaborations in Initial Recall. Finally, both age groups benefited from the context provided by the Information First condition, indicating that young and old adults responded in the same manner to the activation of prior knowledge stores.

Some minor indications did emerge, however, that may point to differences in processing styles between young and old adults. Older subjects offered more elaborations than younger subjects in the Final Recall phase. As well, young subjects recovered more items over trials when they were not informed of the identity of the famous person described in the passage, while older adults tended to recover more items over trials when they were informed of the famous person's identity. Both these findings would be consistent with a preference of older adults to use a more global processing style and of younger adults to prefer a more focussed processing style. However, these indications seem trivial compared to the evidence against processing style differences that emerged from the remainder of the study. As well, it is important to note that most of the age differences in processing style found in this study involved the passage of time. Older subjects produced more elaborations on a later test of recall than on immediate recall, while younger subjects did not. Age differences also were found in the Recover measure, which assessed recall after various retention intervals had passed. These findings point to the need for more research on the possibility of age differences during the retention period and how these differences may be related to encoding

and retrieval strategies.

The absence of any substantial age-related differences in processing style in this study suggests that the hypothesis that proposes a difference in the style of processing with age cannot offer an explanation for the age-related differences found in recall performance. One possible explanation for the deficiency in recall found in older adults may be gained by examining a recent study (Spilich, 1983) on age differences in text recall. Spilich (1983) found that young and old adults employed the same encoding strategies to aid recall. Young and old subjects did not differ in selecting which propositions were important enough to be in a working memory buffer; however, they differed in the number of propositions they were capable of storing in working memory at any one time. Older subjects had a working memory buffer capacity of two propositions while younger subjects had a capacity of four.

Spilich's (1983) findings are useful in understanding the results of this study. As in Spilich's (1983) study, young and old subjects in this study tended to engage in similar styles of encoding, however, differences in verbatim recall were found. These differences may reflect changes in working memory capacity over the lifespan. It would seem that older adults are capable of mobilizing efficient encoding strategies but, because of a diminished working memory capacity, they are limited in the amount of information to which they can apply these strategies. The reason for a diminished working memory capacity, however, is not apparent at this time.

The findings of this study may have some practical implications. They suggest that the elderly may benefit most by instructional materials that are highly organized, provided a context, and contain many repetitions. By providing a context and building an organizational component into a text, this frees working memory capacity somewhat from the task of organizing incoming information. By providing many repetitions within a text, information may have several opportunities to re-enter working memory so that it may be sufficiently encoded for efficient storage and retrieval. These are suggestions that may be considered in planning educational and instructional materials for older adults.

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Appendix 1

Recognition Lists

Recognition List for Passage 1

Genghis Khan

Benito Mussolini

Machiavelli

Joseph Stalin

Alexander the Great

Napoleon Bonaparte

Adolf Hitler

Vladimir Lenin

Juan Gomez

Julius Caesar

General Franco

Attila the Hun

Fidel Castro

Nikita Krushchev

Papa Doc Duvalier

Salvatore Allende

Nero

Louis XIV

Otto von Bismarck

Charles I

Recognition List for Passage 2

George Washington

Andrew Jackson

Ulysses S. Grant

John Adams

James Buchanan

William McKinley

James Munroe

Thomas Jefferson

William H. Taft

Zachary Taylor

James Madison

Abraham Lincoln

Harry S. Truman

Theodore Roosevelt

Martin van Buren

Woodrow Wilson

Calvin Coolidge

James K. Polk

John Tyler

Warren G. Harding

Recognition List for Passage 3

Oscar Wilde

Samuel Coleridge

William Wordsworth

Nathaniel Hawthorne

Thomas Hardy

Somerset Maugham

Edgar Allan Poe

James Joyce

W.H. Auden

Ernest Hemingway

Joseph Conrad

Jonathan Swift

John Donne

Alexander Pope

Alfred Tennyson

Robert Browning

Charles Dickens

Henry James

Daniel Defoe

John Dryden

Recognition List for Passage 4

Marilyn Monroe

Kim Novak

Betty Grable

Veronica Lake

Janet Leigh

Elizabeth Taylor

Lee Remick

Olivia de Havilland

Faye Wray

Brooke Shields

Jane Russell

Mae West

Jayne Mansfield

Bo Derek

Ursula Andress

Raquel Welch

Jessica Lange

Dolly Parton

Dorothy Lamour

Suzanne Sommers

Appendix 2

Speech Perception Test

Speech Perception Test

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Appendix 3

Reasons for Subjects Being Disqualified From the Study

Reasons for Subjects Being Disqualified from the Study

	Young	Old
Rated health "fair"	1	
Speech perception score below 20		1
Guessed Hitler too early	1	6
Did not guess Lincoln	2	
Did not guess Dickens	1	1
Guessed Hitler too early & did not guess Dickens	2	
Guessed Hitler & Taylor too early		1
Guessed Hitler & Taylor too early & did not guess Lincoln		1
Did not guess Hitler nor Lincoln	1	
Did not guess Lincoln nor Dickens	1	1
Did not guess Hitler, Lincoln nor Dickens	1	
Guessed Taylor too early and did did not guess Dickens		1

Appendix 4

Passages in the Information First Condition Divided into Idea Units

Passage 1

Thousands of people/ were attracted/ to his speeches./ In order to expand/ the boundaries/ of his country/ and because of his belief/ in the superiority/ of his race,/ he caused the deaths/ of millions/ of innocent/ Jewish people./

His father/ was employed/ in the customs service./ He was close/ to his mother/ who doted on him./ As a child/ he was dreamy/ and lazy/ and he had a difficult time/ making friends./ He never graduated/ from high school./

He served/ in the army/ as a corporal/ and was awarded/ the Iron Cross/ for his bravery./ He was insanely jealous/ and drove a family member/ to suicide/ because of this./ He thought marriage/ would hamper/ his career./

Passage 2

He established/ a successful/ law practice/ and later was elected/
president/ of the United States./ He had his share/ of enemies/ in the
South/ and eventually was assassinated/ while watching/ a play/ in a
theatre./

His father/ descended/ from an English weaver/ and his mother/ was of
illegitimate birth./ His mother/ died/ when he was still young/ but his
father/ later happily/ remarried/ a widow/ with children of her own./

He had received/ little formal education/ but tried/ his hand/ at
several different/ occupations/ including flatboating/ down the
Mississippi River./ His wife/ was often jealous/ and depressed/ and was
declared insane/ after his death./

Passage 3

He worked/ as a reporter/ for Parliament./ Later he began to write/
fictional stories./ He always championed/ the poor/ and pointed out/ the
injustices/ of Victorian society,/ but he is best loved/ for everyone's
favorite/ "Oliver Twist"./

Although his father/ earned his living/ as a clerk,/ his family/ often
shifted/ from place to place./ His mother/ tried to open up/ a school/
but no one/ ever came to it./ Meanwhile, he studied/ under a Baptist
minister./

He married/ the daughter/ of an editor,/ and she bore him/ ten children/
in fifteen years./ Eventually, they were separated,/ since he took/ a
young actress/ as his mistress./ He visited/ America/ but disliked it./

Passage 4

She began working/ as a child/ first enjoying/ small acting roles in the movies./ By the time she was twelve/ she was a star/ renowned/ for her beauty./ Her private life/ often makes the headlines/ especially concerning her six husbands/ one of whom was Richard Burton/ whom she married twice./

She was born/ an ugly baby/ with a crinkled face,/ but blossomed/ into a beautiful child./ She had a brother/ two years older than her./ Her mother/ was dominant/ and ruled/ her early life./ Her father/ was distant./

She was sloppy/ and allowed/ her pets/ to roam/ throughout the house./ She had many sicknesses/ and accidents/ suffering through/ over thirty operations./ Although born a Christian Scientist/ she converted to Judaism/ in midlife.

Appendix 5

• Passages in the Information Last Condition Divided into Idea Units

Passage 1

His father/ was employed/ in the customs service./ He was close/ to his mother/ who doted on him./ As a child/ he was dreamy/ and lazy/ and he had a difficult time/ making friends./ He never graduated/ from high school./

He served/ in the army/ as a corporal/ and was awarded/ the Iron Cross/ for his bravery./ He was insanely jealous/ and drove a family member/ to suicide/ because of this./ He thought marriage/ would hamper/ his career./

Thousands of people/ were attracted/ to his speeches./ In order to expand/ the boundaries/ of his country/ and because of his belief/ in the superiority/ of his race,/ he caused the deaths/ of millions/ of innocent/ Jewish people./

Passage 2

His father/ descended/ from an English weaver/ and his mother/ was of illegitimate birth./ His mother/ died/ when he was still young/ but his father/ later happily/ remarried/ a widow/ with children of her own./

He had received/ littel formal education/ but tried/ his hand/ at several different/ occupations/ including flatboating/ down the Mississippi River./ His wife/ was often jealous/ and depressed/ and was declared insane/ after his death./

He established/ a successful/ law practice/ and later was elected/ president/ of the United States./ He had his share/ of enemies/ in the South/ and eventually was assassinated/ while watching/ a play/ in a theatre./

Passage 3

Although his father/ earned his living/ as a clerk,/ his family/ often shifted/ from place to place./ His mother/ tried to open up/ a school/ but no one/ ever came to it./ Meanwhile, he studied/ under a Baptist minister./

He married/ the daughter/ of an editor,/ and she bore him/ ten children/ in fifteen years./ Eventually, they were separated,/ since he took/ a young actress/ as his mistress./ He visited/ America/ but disliked it./

He worked/ as a reporter/ for Parliament./ Later he began to write/ fictional stories./ He always championed/ the poor/ and pointed out/ the injustices/ of Victorian society,/ but he is best loved/ for everyone's favourite/ "Oliver Twist"./

Passage 4

She was born/ an ugly baby/ with a crinkled face,/ but blossomed/ into a beautiful child./ She had a brother/ two years older than her./ Her mother/ was dominant/ and ruled/ her early life./ Her father/ was distant./

She was sloppy/ and allowed/ her pets/ to roam/ throughout the house./ She had many sicknesses/ and accidents/ suffering through/ over thirty operations./ Although born a Christian Scientist/ she was converted/ to Judaism/ in midlife./

She began working/ as a child/ first enjoying small acting roles/ in the movies./ By the time she was twelve/ she was a star/ renowned/ for her beauty./ Her private life/ often makes the headlines/ especially concerning her six husbands/ one of whom was Richard Burton/ whom she married twice./

Appendix 6

Partial Counterbalancing Schedule

Partial Counterbalancing Schedule

Passage Number

Subject Number	Session 1		Session 2	
	Info. First Condition	Info. Last Condition	Info. Last Condition	Info. First Condition
1	1	2	3	4
3	3	4	1	2
5	2	4	1	3
7	1	3	2	4
9	3	1	4	2
11	4	2	3	1
13	4	3	2	1
15	2	1	4	3
	Info. Last Condition	Info. First Condition	Info. First Condition	Info. Last Condition
2	1	2	3	4
4	3	4	1	2
6	2	4	1	3
8	1	3	2	4
10	3	1	4	2
12	4	2	3	1
14	4	3	2	1
16	2	1	4	3

Appendix 7

Verbatim Instructions Given to the Subjects

Instructions

This task consists of listening to a short passage describing a famous person's life. I would like you to read along with the passage as you hear it on the tape recorder.

Each passage is divided into three sections. After each section, the tape recorder will be stopped and that passage section will be taken from you. At this point, you will be asked to guess the famous person described the passage. After you guessed the person, you will be asked to recall the section of the passage you have just heard.

This procedure will continue for each of the three sections of the passage. However, after the second and third sections of the passage, you will be asked first to recall the section you have just heard, and then to go back and recall everything you have heard from the very beginning of the passage.

We are doing this because we are interested in how people recall something they have already recalled before. It is important then, that when I ask you to repeat your recall, that you say everything you heard from the beginning, even though you may have recalled certain parts of the passage before. Therefore, you are expected to repeat yourself. In other words, pretend that an entirely different person who has not heard your recall before is listening to your recall, and you must recall everything from the passage again for this person.

Since your recall is oral, I will be taping your response, but please try not to take any notice of the recording and be as relaxed as

possible.

At the end of each passage, you will be asked to rate your knowledge of the famous person described on a line marked from 0 to 10, where 0 will indicate no knowledge of that person, and 10 will indicate an excellent knowledge of that person.

This entire procedure will be repeated three more times, once again in this session with another passage, and then two more times in the next session.

Appendix 8

**Tables of Means and Standard Deviations for Recall Responses
on Initial and Final Recall in Relation to Age, Condition,
and Order of Presentation of Passage Sections.**

Table A

Means and Standard Deviations (in parentheses) for Verbatim Responses on Initial Recall in Relation to Age, Condition, and Order of Presentation of Passage Sections.

Condition	Section Order	Age		Mean
		Young	Old	
Information 1st First	1st (Critical)	16.63 (4.30)	12.75 (3.74)	14.69
	2nd (Noncritical A)	19.63 (2.89)	16.41 (9.21)	18.02
	3rd (Noncritical B)	20.34 (2.39)	18.03 (3.83)	19.19
	Mean	18.87	15.73	17.30
Information 1st Last	1st (Noncritical A)	18.03 (2.80)	14.38 (3.04)	16.21
	2nd (Noncritical B)	16.41 (3.48)	12.34 (4.17)	14.38
	3rd (Critical)	15.16 (3.46)	12.94 (4.52)	13.55
	Mean	16.53	12.90	14.71

Table B

Means and Standard Deviations (in parentheses) for
Overgeneralizations on Initial Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		
		Young	Old	Age
Information 1st First	1st (Critical)	1.75 (1.11)	1.19 (0.93)	1.47
	2nd (Noncritical A)	1.94 (1.18)	2.16 (1.04)	2.05
	3rd (Noncritical B)	1.60 (1.10)	1.50 (1.45)	1.55
	Mean	1.76	1.62	1.69
Information 1st Last	1st (Noncritical A)	1.91 (0.99)	1.69 (0.87)	1.80
	2nd (Noncritical B)	2.19 (1.20)	1.63 (1.43)	1.91
	3rd (Critical)	1.25 (0.77)	1.48 (1.25)	1.37
	Mean	1.78	1.60	1.68

Table C.
 Means and Standard Deviations (in parentheses) for
 Pseudodiscriminations on Initial Recall in Relation to Age,
 Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information 1st (Critical) First		0.31 (0.44)	0.09 (0.27)	0.20
	2nd (Noncritical A)	0.13 (0.29)	0.09 (0.27)	0.11
	3rd (Noncritical B)	0.22 (0.37)	0.35 (0.32)	0.29
	Mean	0.22	0.18	0.20
Information 1st (Noncritical A) Last		0.09 (0.27)	0.13 (0.50)	0.11
	2nd (Noncritical B)	0.19 (0.36)	0.13 (0.29)	0.16
	3rd (Critical)	0.47 (0.81)	0.34 (0.63)	0.41
	Mean	0.25	0.20	0.22

Table D

Means and Standard Deviations (in parentheses) for
Inferences on Initial Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information First	1st (Critical)	2.59 (1.19)	2.66 (0.93)	2.63
	2nd (Noncritical A)	0.41 (0.69)	0.78 (0.91)	0.60
	3rd (Noncritical B)	0.94 (1.21)	1.22 (1.06)	1.08
	Mean	1.31	1.55	1.43
Information Last	1st (Noncritical A)	0.56 (0.57)	0.75 (0.86)	0.66
	2nd (Noncritical B)	0.78 (0.88)	1.13 (0.74)	0.96
	3rd (Critical)	1.94 (1.25)	2.22 (0.98)	2.08
	Mean	1.09	1.37	1.23

Table E

Means and Standard Deviations (in parentheses) for
Elaborations on Initial Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information 1st First	(Critical)	0.47 (0.74)	0.25 (0.37)	0.36
	2nd (Noncritical A)	0.03 (0.13)	0.44 (1.14)	0.24
	3rd (Noncritical B)	0.00 (0.00)	0.13 (0.39)	0.07
	Mean	0.17	0.27	0.22
Information 1st Last	(Noncritical A)	0.00 (0.00)	0.03 (0.13)	0.02
	2nd (Noncritical B)	0.00 (0.00)	0.16 (0.44)	0.08
	3rd (Critical)	0.34 (0.44)	0.63 (0.72)	0.49
	Mean	0.11	0.27	0.19

Table F

Means and Standard Deviations (in parentheses) for Verbatim
Responses on Final Recall in Relation to Age, Condition,
and Order of Presentation of Passage Sections

Condition	Section Order	Age		Means
		Young	Old	
Information 1st First	(Critical)	15.13 (3.98)	11.47 (4.43)	13.30
	2nd (Noncritical A)	18.72 (2.49)	14.25 (4.83)	16.49
	3rd (Noncritical B)	19.22 (3.28)	16.06 (4.46)	17.64
	Mean	17.69	13.93	15.81
Information 1st Last	(Noncritical A)	16.78 (2.39)	12.38 (3.88)	14.58
	2nd (Noncritical B)	16.19 (3.88)	11.72 (4.63)	13.96
	3rd (Critical)	15.16 (3.70)	11.53 (4.10)	13.35
	Mean	16.04	11.88	13.96

Table G

Means and Standard Deviations (in parentheses) for
Overgeneralizations on Final Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information First	1st (Critical)	2.44 (1.11)	1.94 (1.20)	2.19
	2nd (Noncritical A)	2.91 (1.05)	3.44 (2.37)	3.18
	3rd (Noncritical B)	2.06 (1.03)	1.97 (1.22)	2.02
	Mean	2.47	2.45	2.46
Information Last	1st (Noncritical A)	2.59 (1.67)	2.34 (1.42)	2.47
	2nd (Noncritical B)	2.06 (1.35)	2.16 (1.42)	2.11
	3rd (Critical)	1.69 (0.85)	1.91 (1.52)	1.80
	Mean	2.11	2.14	2.13

Table H

Means and Standard Deviations (in parentheses) for
Pseudodiscriminations on Final Recall in Relation to Age,
Condition, and Order of Presentation of Passage Conditions

Condition	Section Order	Age		Mean
		Young	Old	
Information 1st (Critical) First		0.44 (0.51)	0.16 (0.35)	0.30
	2nd (Noncritical A)	0.22 (0.45)	0.31 (0.48)	0.27
	3rd (Noncritical B)	0.28 (0.48)	0.38 (0.50)	0.33
	Mean	0.31	0.28	0.30
Information 1st (Noncritical A) Last		0.19 (0.31)	0.06 (0.25)	0.13
	2nd (Noncritical B)	0.19 (0.36)	0.25 (0.55)	0.22
	3rd (Critical)	0.16 (0.44)	0.31 (0.48)	0.24
	Mean	0.18	0.21	0.19

Table I

Means and Standard Deviations (in parentheses) for
Inferences on Final Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information First	1st (Critical)	2.69 (1.35)	3.19 (1.22)	2.94
	2nd (Noncritical A)	0.69 (0.54)	0.88 (0.59)	0.79
	3rd (Noncritical B)	1.13 (1.18)	1.06 (1.14)	1.10
	Mean	1.50	1.71	1.60
Information Last	1st (Noncritical A)	0.53 (0.56)	1.03 (1.09)	0.78
	2nd (Noncritical B)	1.19 (0.96)	1.66 (1.19)	1.43
	3rd (Critical)	2.13 (1.12)	2.47 (1.48)	2.30
	Mean	1.28	1.72	1.50

Table J

Means and Standard Deviations (in parentheses) for
Elaborations on Final Recall in Relation to Age,
Condition, and Order of Presentation of Passage Sections

Condition	Section Order	Age		Mean
		Young	Old	
Information 1st First	(Critical)	0.50 (0.71)	0.66 (0.93)	0.58
	2nd (Noncritical A)	0.06 (0.17)	0.31 (0.48)	0.19
	3rd (Noncritical B)	0.06 (0.25)	0.41 (0.55)	0.24
	Mean	0.21	0.46	0.33
Information 1st Last	(Noncritical A)	0.00 (0.00)	0.13 (0.29)	0.07
	2nd (Noncritical B)	0.19 (0.36)	0.38 (0.62)	0.29
	3rd (Critical)	0.56 (0.54)	0.63 (0.67)	0.60
	Mean	0.25	0.38	0.31

Appendix 9

**Source Tables for Multivariate and Univariate Analyses
of Variance for all Recall Responses in Initial Recall**

Table A

Summary Table of Multivariate Analysis of Variance of
All Recall Measures in Initial Recall

Source	TSq	<u>WCP</u> <u>L Ratio</u>	<u>F</u>
Age	18.98		3.29*
Condition	321.63		47.08**
Condition x Age	0.55		0.10
Section	107.67		7.54**
		0.43	5.93**
Section x Age	13.41		0.94
		0.84	0.98
Condition x Section	176.11		12.33**
		0.23	12.09**
Condition x Section x Age	6.87		0.48
		0.87	0.80

* $p < .05$

** $p < .01$

Table B

Source Table for Univariate Analyses of Variance of Verbatim
Responses in Initial Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	551.82	14.11**
Error	30	39.10	
Within			
Condition	1	321.63	47.08**
Condition x Age	1	3.13	0.46
Error	30	6.83	
Section	2	15.38	2.40
Section x Age	2	4.75	0.74
Error	60	6.42	
Condition x Section	2	218.13	27.47**
Condition x Section x Age	2	1.60	0.20
Error	60	7.94	

** p < .01

Table C

Source Table of Univariate Analysis of Variance of Overgeneralizations
in Initial Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	1.42	1.06
Error	30	1.34	
Within			
Condition	1	0.13	0.00
Condition x Age	1	0.03	0.02
Error	30	1.48	
Section	2	4.65	4.81*
Section x Age	2	0.77	0.79
Error	60	0.97	
Condition x Section	2	1.35	0.93
Condition x Section x Age	2	1.60	1.11
Error	60	1.44	

* $p < .05$

Table D

Source Table for Univariate Analysis of Variance of
Pseudodiscriminations in Initial Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	0.11	0.46
Error	30	0.23	
Within			
Condition	1	0.03	0.17
Condition x Age	1	0.01	0.01
Error	30	0.19	
Section	2	0.86	4.61*
Section x Age	2	0.04	0.19
Error	60	0.19	
Condition x Section	2	0.20	0.88
Condition x Section x Age	2	0.25	1.13
Error	60	0.22	

* $p < .05$

Table E

Source Table for Univariate Analysis of Variance
of Inferences in Initial Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	3.13	1.92
Error	30	1.63	
Within			
Condition	1	1.98	2.20
Condition x Age	1	0.01	0.01
Error	30	0.90	
Section	2	14.97	19.20**
Section x Age	2	0.23	0.29
Error	60	0.78	
Condition x Section	2	39.05	53.85**
Condition x Section x Age	2	0.27	0.04
Error	60	0.73	

** p < .01

Table F

Source Table for Univariate Analysis of Variance of
Elaborations in Initial Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	0.81	2.25
Error	30	0.36	
Within			
Condition	1	0.03	0.14
Condition x Age	1	0.03	0.14
Error	30	0.24	
Section	2	0.24	1.19
Section x Age	2	0.63	3.17*
Error	60	0.20	
Condition x Section	2	2.55	9.50**
Condition x Section x Age	2	0.28	1.05
Error	60	0.27	

* $p < .05$ ** $p < .01$

Appendix 10

Source Tables for Multivariate and Univariate Analyses
of Variance for all Recall Responses in Final Recall

Table A

Summary Table of Multivariate Analysis of Variance of
All Recall Measures in Final Recall

Source	<u>TSq</u>	<u>WCP</u> <u>L Ratio</u>	<u>F</u>
Age	26.93		4.67**
Condition	23.61		4.09**
Condition x Age	1.98		0.34
Section	122.73		8.59**
		0.51	4.49**
Section x Age	16.63		1.16
		0.85	0.94
Condition x Section	245.20		17.16**
		0.20	13.68**
Condition x Section x Age	2.28		0.16
		-0.98	0.17

** p < .01

Table B

Source Table for Univariate Analysis of Variance of
Verbatim Responses in Final Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	754.06	15.85**
Error	30	47.58	
Within			
Condition	1	164.10	14.82**
Condition x Age	1	1.98	0.18
Error	30	11.07	
Section	2	44.09	5.06**
Section x Age	2	4.70	0.54
Error	60	8.71	
Condition x Section	2	130.05	16.65**
Condition x Section x Age	2	0.57	0.07
Error	60	7.81	

** p < .01

Table C

Source Table for Univariate Analysis of Variance of
Overgeneralizations in Final Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	0.01	0.01
Error	30	1.89	
Within			
Condition	1	5.33	3.20
Condition x Age	1	0.02	0.01
Error	30	1.67	
Section	2	8.69	5.28*
Section x Age	2	1.94	1.18
Error	60	1.65	
Condition x Section	2	7.38	2.98
Condition x Section x Age	2	0.69	0.28
Error	60	2.48	

* $p < .05$

Table D

Source Table for Univariate Analysis of Variance of
Pseudodiscriminations in Final Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	0.01	0.01
Error	30	0.21	
Within			
Condition	1	0.52	2.03
Condition x Age	1	0.05	0.18
Error	30	0.26	
Section	2	0.08	0.41
Section x Age	2	0.50	2.61
Error	60	0.19	
Condition x Section	2	0.06	0.42
Condition x Section x Age	2	0.04	0.23
Error	60	0.15	

Table E

Source Table for Univariate Analysis of Variance of
Inferences in Final Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	5.00	2.38
Error	30	2.10	
Within			
Condition	1	0.52	0.58
Condition x Age	1	0.63	0.70
Error	30	0.90	
Section	2	10.17	9.05**
Section x Age	2	0.52	0.46
Error	60	1.12	
Condition x Section	2	51.80	60.48**
Condition x Section x Age	2	0.17	0.20
Error	60	0.86	

** p < .01

Table F

Source Table for Univariate Analysis of Variance of
Elaborations in Final Recall

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	1.69	5.40*
Error	30	0.31	
Within			
Condition	1	0.02	0.07
Condition x Age	1	0.19	0.65
Error	30	0.29	
Section	2	0.52	2.20
Section x Age	2	0.03	0.12
Error	60	0.23	
Condition x Section	2	3.22	10.89**
Condition x Section x Age	2	0.07	0.25
Error	60	0.30	

* $p < .05$ ** $p < .01$

Appendix 11**Source Tables for Multivariate and Univariate Analyses
of Variance for Repeat Recall Measures**

Table A

Summary Table of Multivariate Analysis of Variance
of all Repeat Recall Measures

<u>Source</u>	<u>TSq</u>	<u>F</u>
Age	29.28	14.15**
Condition	1.12	0.54
Condition x Age	7.10	3.43*

** p < .01

* p < .05

Table B

Source Table for Univariate Analysis of Variance of the
Forget Repeat Recall Measure

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Between			
Age	1	1906.41	29.08**
Error	30	78.85	
Within			
Condition	1	0.01	0.01
Condition x Age	1	88.13	0.91
Error	30	96.67	

** p < .01

Table C

Source Table for Univariate Analysis of Variance of the
Recover Repeat Recall Measure

Source	df	MS	F
Between			
Age	1	50.06	0.63
Error	30	78.85	
Within			
Condition	1	45.23	1.12
Condition x Age	1	241.80	5.99*
Error	30	40.34	

* $p < .05$