LEXICAL AMBIGUITY ACROSS THE ADULT LIFESPAN

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ABSTRACT

Age differences in ambiguity detection were examined in the current study. Thirty (each) young (20-35), middle-aged (40-55), and older (60-73) adults were assessed on their ability to detect lexically ambiguous sentences that were presented in isolation (Experiment 1) or preceded by a contextual paragraph (Experiment 2).

In Experiment 1 the bias inherent in the ambiguous sentences was determined for each age group. Based on this information, sentences for Experiment 2 were selected and contextual paragraphs were designed. Paragraphs were congruent with either the dominant or subordinate meaning of the sentence. For one half of the context/sentence pairs, the relationship between the context and the ambiguous sentence was explicit, for the remaining context/sentence pairs, it was implicit.

Fewer ambiguities were detected when the context was congruent with the dominant than subordinate interpretation of the sentence. Similarly, fewer ambiguities were detected when the context/ambiguity relationship was implict than when it was explicit. A context by implicitness interaction indicated that the

effects of context were only manifest in the implicit condition. Detection latencies were longer in the dominant than the subordinate condition, and in the implicit versus the explicit condition.

Whereas there were no age differences in accuracy or latency of detecting isolated sentences, there were age differences in latencies for ambiguities preceded by context. Older subjects were slower to detect ambiguities than were young and middle-aged subjects, particularly in the implicit condition. The pattern of latencies varied by age. For young subjects, a dominant context led to the longest latencies and subordinate to the shortest latencies. Middle-aged subjects were relatively unaffected by context, and older subjects detected isolated ambiguities most rapidly.

Of the cognitive (verbal & perceptual) and demographic variables (age, sex, & education) assessed, crystallized ability best predicted both accuracy and latency of detection.

It was hypothesized that age differences did not occur when sentences were presented in isolation because access of multiple meanings is an automatic process unaffected by age. Age differences did occur when multiple meanings had to be held in working memory while inferences were drawn from contextual information.

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CHAPTER 1

Introduction

Language processing is one of the most complex mental activities carried out by humans. Although theorizing on language development has grown at a fast pace, until recently research has concentrated on language acquisition and there has been relatively little discussion of performance changes that may occur in adulthood. However this is beginning to change however with the rapidly emerging "contextual" approach in aging research (Hultsch, 1980). This approach is largely concerned with tasks that are ecologically valid in the day-to-day lives of older adults. Because the processing of spoken and written language is such a vital and constant part of our experience, potential age-related changes are of particular concern.

The current study focussed on one particular aspect of language processing, the ability to detect and resolve ambiguous information. Ambiguous information is defined here as words or sentences having two or more meanings. The question to be addressed was whether the ability to detect and resolve ambiguity varies across the adult lifespan, i.e., from young adulthood through

old age, with particular emphasis on the latter.

The impetus for this research comes from an overview by Kess and Hoppe (1981) of psycholinguistic research in ambiguity as well as from later empirical work by these authors (Hoppe & Kess, 1981; Hoppe & Kess, 1983). The current study was designed to synthesize this research with recent work in the area of lifespan cognitive development. Of primary concern is the possibility that the ability to disambiguate (i.e., to detect and resolve linguistically ambiguous information) might decline in late adulthood. The established view in adult cognitive development has been that verbal abilities and stored information show little if any decline with age. Recently, however, this view of no change is being challenged. Claims of no change are often based on the results of such tests as the Wechsler Vocabulary Subtest in which a subject must define words. As several authors have pointed out, the fact that this or similar functions are well-maintained throughout most of the lifespan does not necessarily mean that the vastly more complex processes involved in ordinary language functions are maintained (cf. Botwinick, 1967; Cohen, 1979).

The ability to disambiguate is a substantial aspect of a person's linguistic competence. Kess and Hoppe

(1981) suggest that the ability to disambiguate, rather than being a distinct verbal skill, may be one part of a larger, more extensive or complex cognitive process. They hypothesize parallels as have other authors (Schvaneveldt, Meyer & Becker, 1976; and Keil, 1980) between linguistic ambiguity and other types of ambiguity (e.g., reversible figures) suggesting that both types of ambiguities might be manifestations of a superordinate set of perceptual strategies. Keil (1980), however, found no correlation between children's ability to perceive linguistic and pictorial ambiguities. Although he conceded that some non-specific mechanisms might be shared by both modes, he concluded that at least some nontrivial component of linguistic ambiguity is task-specific to language. Developmental data on the processing of visually ambiguous figures and many illusion patterns indicates decrements in old age (Botwinick, Robbin & Brinley, 1959; Comalli, 1970; Coren & Porac, 1978, Porac & Coren, 1981). For instance, when Botwinick et al. (1959) presented young and old men with Boring's figure "my wife" and "my mother-in-law" (an ambiguous figure that can be perceived either as a beautiful young woman or alternately as an old woman) the older group had greater difficulty than did the younger group in reorganizing or

alternating their initial percept. This was true even after having been shown the alternative features on an unambiguous version of the figure.

Additional evidence that ambiguity detection may be tied to some higher order perceptual ability comes from a study by Lefever and Ehri (1976) who reported a relationship between the ability to disambiguate sentences and field independence. These authors pointed out that both abilities (disambiguation and field independence) require the perceiver to restructure the initial stimulus pattern, overcome contextual imbeddedness, and shift mental set. Developmental research indicated that young children, largely field dependent, become increasingly field independent as they mature perceptually. After a period of no change in adulthood, there is a steady increase in field dependence with advancing age (see Comalli 1970, for a review of age change studies on various field dependent tests).

In summary, there is contradictory evidence regarding the relationship between the ability to disambiguate and perceptual abilities involving the reorganization of an original percept. However, research indicates that the latter abilities tend to decline across the adult lifespan.

In the review of the literature to follow, (Chapter 2), the various levels at which ambiguity can occur are described. This is followed by a brief synthesis of developmental research in ambiguity which, as mentioned earlier, has concentrated on the acquisition of the ability. Finally, the issue of how ambiguity is resolved, a fundamental issue to psycholinguists, is introduced. Is only one meaning of a word or sentence processed at a time or are all possible meanings automatically accessed?

Kess and Hoppe (1981) point out that many of the experimental studies on ambiguity resolution have been questioned because of the lack of prior context or use of sentences in isolation. They argue that the lack of contextual information could induce strategies that are different than those used in normal language conditions. (The term context here refers to linguistic context, i.e., those words or sentences before or after a word or passage that influence its meaning.) Because ambiguity usually goes unnoticed by a listener/reader, it has been assumed that the context in which it occurs, allows the person to select among the possible interpretations, admitting only one to consciousness (Simpson, 1984).

Whereas psycholinguists are recognizing the need to include context in their studies of ambiguity detection,

recent studies in the aging literature suggest that the ability to utilize contextual information may decline in old age. It has been suggested, for instance, that the elderly may not encode and thereby store contextual information as well as younger individuals (Simon, 1979; Hess & Higgins, 1983). It has also been suggested that information that is encoded by the elderly may not be integrated with other new information or information already in memory (Cohen,1979, 1983; Spilich, 1983). This research also indicates that older people have difficulty drawing inferences from contextual information particularly when information is implicit rather than explicitly stated.

As mentioned earlier, psycholinguistic research is now concerned with the role that context may play in the processing of ambiguous information. As Simpson pointed out in his 1984 review of this literature, the principal issue concerns whether context influences lexical access directly or indirectly, at some post-access decision stage. One may ask, "... does context lead the language user directly to the appropriate meaning in memory without any consideration of other meanings, or is it used to decide among several meanings after they have been retrieved" (Simpson, 1984, p.316)? In chapter 2, the current models of ambiguity processing will be

outlined and research summarized that supports the latter position. This literature suggests that access of multiple meanings of an ambiguous word is automatic and that the effects of context take place following access. If this is the case, age differences would not be expected in the first or access stage of ambiguity detection. Research indicates that automatic cognitive processes are not as susceptible to age changes as "more effortful" processes (Hasher & Zacks, 1979, Hoyer & Plude, 1980). If they occur, age differences would be expected in the post lexical access stage where the individual must draw inferences from the context to resolve the ambiguity.

Hoppe and Kess (1981) developed a research paradigm to study the effects of biasing context on ambiguity detection. A modification of this paradigm was adopted in the current study. It involved asking subjects to detect two meanings of an ambiguous sentence that had either been preceded by a contextual paragraph or presented alone. By using this research design and testing people who varied in age from young adult through old age, it was hoped to determine not only if there are age differences in the abilty to detect and resolve linguistic ambiguity, but also the relative importance of context in ambiguity processing.

Taken together, the studies reviewed in chapter 2 indicate possible age decrements in the ability to process and utilize contextual information. Because disambiguating information in natural language often requires drawing inferences from contextual information, age differences in this ability are implicated.

Several of the studies surveyed in the literature review also indicate that at least some of the age differences in context processing may be intricately tied to individual differences in education or cognitive ablility. This issue is discussed and it is suggested that the high inter-subject variability reported in the ambiguity literature may be related to these factors.

CHAPTER 2

Review of the literature

Ambiguity

Ambiguity has been a central concept in the formation of modern linguistic theory. As such, it has been the focus of much psycholinguistic study for the past 20 years.

Ambiguity exists whenever there are two or more interpretations for a given word, phrase or sentence. It can occur at three linguistic levels. Lexical ambiguity occurs when a word has more than one meaning. For instance, in the sentence "The sailors enjoyed the port", "port" could refer either to wine or harbor. Surface structure ambiguity occurs when at least one of the words in a sentence has more than one linguistic function. For example, in the sentence "They are cooking apples", "cooking" can function either as an adjective or a verb. Deep or underlying structure ambiguity exists when two distinct sets of logial relatonships are shown by the same sentence. For example, the sentence "Visiting relatives can be a nuisance" could mean that going to visit relatives is a bother or having relatives visit you is a bother.

Whereas lexical and surface ambiguity can be resolved by knowledge of the rules or phrase structure of the language, deep structure ambiguity cannot. It was this third type of ambiguity that led psycholinguists to include a deep level of analysis, one directly related to the meaning of the sentence, in their transformational grammar. However, lexical ambiguity has generated the most research in recent years, with the preponderance of research at the lexical level of language processing.

Disambiguation involves first detecting ambiguity (i.e., discovering that there is more than one meaning for the given word or sentence), and second, resolving the ambiguity (i.e., determining the correct interpretation).

To date, developmental psycholinguistic research has concentrated on the acquisition of the ability to disambiguate. In a review of the literature, Hoppe and Kess (1983) reported that, as with other metalinguistic abilities, the ability to detect and resolve ambiguity appears "relatively late" in the language acquisition process (i.e., later than most of the structural aspects of language are acquired). In their 1983 study, these authors found that six-year-old children were not able to detect much ambiguity. Thirteen-year-olds, who could

perceive two meanings for almost all of the lexically ambiguous sentences, could only detect about one half of those that were structurally ambiguous. According to Hoppe (1986) structural ambiguities (surface and underlying) are more difficult to detect and, seemingly, are acquired later. Although some authors (e.g., Jurgens, 1971) suggest that the ability to recognize ambiguity may mature by age sixteen, Hoppe and Kess (1983) have found more than four percent of structural ambiguities were undetected by adults and 13 year olds. According to Hoppe and Kess (1983), "Metalinguistic abilities develop progressively over the middle and late childhood years and continue into adulthood." The primary concern of this paper is whether metalinguistic development, either increments or decrements, continues across the adult lifespan. To date, this issue has not been addressed.

The fundamental question to the psycholinguist studying ambiguity has focused on understanding how ambiguity is resolved. Is it the case that one meaning of a word or sentence is processed at a time (i.e., serial processing or single reading) or are all possible meanings automatically accessed (parallel processing or multiple reading)? A third alternative, the ordered access (or canonical approach) suggests that all

meanings are presented to working memory in a hierarchically ordered sequence. The many existing studies of ambiguity resolution have failed to yield a generally accepted theory. There is fairly consistent evidence that multiple readings may be accessed when these words are presented in isolation. However, the results of these experimental studies have been questioned on the basis that their lack of contextual information could provoke strategies that are different than those used in normal language conditions (Kess & Hoppe, 1981; Hoppe & Kess, 1986). For instance, context could restrict access to a single reading, or it could facilitate a selection between multiple alternatives.

Aging and Context Processing

While psycholinguists are recognizing the need to include context in their studies of ambiguity detection, studies in the aging literature suggest that the ability to utilize contextual information may decline in old age. It has been suggested, for instance, that the elderly might not encode contextual information as well as younger individuals (Simon, 1979; Hess & Higgins, 1983), or that they are less able to integrate contextual information with other information or information already stored in memory, and finally that they have difficulty drawing inferences from contextual

information that is implicitly stated (Cohen, 1979, 1981). The question arises whether age decrements in these aspects of information processing might affect the ability of the older individual to detect and resolve ambiguity.

Simon's (1979) suggestion that there might be age differences in the processing of contextual information stems from Craik and Lockhart's (1972) depth of processing model. The main tenent of this model is that "trace (memory) persistence is a function of depth of analysis, with deep levels of analysis associated with more elaborate, longer lasting and stronger traces" (p 675). Depth in this context refers to degree of semantic analysis. Simon and Craik (cited in Craik & Simon, 1980) hypothesize that deeper processing consumes more central resources or capacity and suggest that the deficiency with age in encoding and retrieval at the deepest levels may be due to reduced processing capacity among the elderly.

Simon's (1979) study tested the hypothesis that older adults may be deficient in elaboration, especially in the integrative aspects of the process. Subjects were presented with three lists of words in sentence format. Recall of these words was later preceded by no cue, a phonemic cue, a semantic cue, or a contextual

cue. Whereas semantic and contextual cues were most effective for the younger age group, phonemic cues were most effective for the old group. Simon concluded that aging was associated with poor elaboration; in particular, with inefficient integration of words with the context of presentation. She suggested that older people who fail to integrate may, in effect, be overloaded with information since they have encoded several separate, albeit small, units instead of one large unit. She suggested it may also be the case that older subjects fail to process contextual information at all, or do so superficially.

It should be noted that in Simon's (1979) experiment, subjects were told to read and study the sentences for the meaning of each to-be-remembered word no matter what cues were used. Therefore, it is possible that the elderly simply were not attending to context. Mistler-Lachman (1972) reports that "meaningfulness" can be judged without context and requires little more than shallow comprehension.

In Simon and Craik's (1980) study, old and young adults were given sentences containing a word to be learned (e.g., The highlight of the circus was the clumsy BEAR, or The lock was opened with a bent PIN). Recall cues were context specific (e.g., "clumsy" or

"bent") or were general descriptions of the words with no references to the sentence context (e.g., "wild animal" or "a fastener"). In keeping with the rationale that older subjects encode events in a less context specific manner, the general cues were more effective for this age group whereas younger subjects benefitted most from the specific cues. On the basis of these results, the authors concluded that older people have a tendency to be less influenced by context and to encode events in a similar way from occasion to occasion. Therefore, they will also benefit less from semantic encoding contexts.

It is also possible that the response of the older subjects reflected differential preferences unrelated to context. In studying age differences in free associations, Riegel (1968) notes a preference among elderly subjects for more meaningful, functional relations, which he suggests are adaptive and correspond more closely to linguistic relationships.

Hess and Higgins (1983) also examined adult age differences in context utilization. In their study, old and young adults were presented with a series of homographs (targets) each of which was surrounded by two semantically related words (e.g., river, bank, shore). The instructions were to memorize as many words in the

series as possible. Recognition for target words only was tested. In the recognition test, the context (i.e., surrounding words) associated with the target was either identical to that occurring during study, changed to be unrelated to the target, or eliminated altogether. Recognition was found to decrease in both age groups as the retrieval context became more dissimilar to the study context, suggesting that both young and old adults were sensitive to contextual manipulation. A second experiment was then conducted using the same initial learning procedure but only two recognition conditions for target items: old context and new related context. There were two distractor conditions, namely a new word appearing in an old semantically related context, and three new related words. Hess and Higgins hypothesized that if the elderly do encode in a more general manner than young adults, they would falsely recognize more lures in old contexts. This hypothesis was supported and the authors concluded that the older subjects were encoding general semantic information relating to the association between target and context, whereas younger adults were encoding distinctive information about individual targets.

The studies reported thus far indicate that older adults may be less likely than younger adults to encode

specific contextual information. However, the encoding of information is just the first step necessary in utilizing context. Once encoded, information must also be abstracted, organized and then integrated either with other information or with what one already knows so that inferences can be made. Cohen (1979, 1981) has conducted a series of studies that indicate these latter processes may be affected by age.

In Cohen's first (1979) experiment old and young adults listened to simple or complex messages averaging 60 words in length. These people were then asked questions that required either reproduction of facts that had been presented or an inference to be drawn from the facts. The old and young groups did not differ in the number of errors on factual information. However, the old adults performed significantly more poorly than the young on those questions that required inferences, particularly when this information was presented at a fast rate. Complexity of stimuli was not a significant factor. The absence of age effects on factual questions together with the absence of an effect of message complexity and position of question indicated that the inference deficit was not due to memory loss.

Cohen (1979) also noted that the inferential questions that caused the most difficulty were different

for the two age groups. Although no mention was made of what caused the most difficulty for younger subjects, negative premises and exclusion clauses (not when, only if, unless) seemed to cause more problems for the older adults and messages concerning relative speed and time seemed especially difficult. Cohen hypothesized that drawing inferences from negative premises caused a processing overload.

The stimuli in Cohen's (1979) experiment were spoken. It is well-established that there is a general slowing in the rate of information processing with age (Birren, 1970). Therefore, it may have been that in listening to speech the older adults simply did not have enough time to organize facts. In a subsequent study, Cohen (1981) tested young and old adults with logical reasoning problems in both spoken and written format. The older group, unlike the young, found it difficult to make inferences when the input was spoken rather than written. However, even in the self-paced, written condition, with unlimited processing time, the older adults made more errors than did the young, indicating that inferential reasoning per se may be affected by the aging process.

Spilich (1984) was concerned with finding the source of this processing deficit. Was the inference

construction stage of comprehension being either omitted, or carried out slowly and inaccurately? In his research, adults matched on WAIS Vocabulary scores read and answered questions on two stories. Their recall/recognition protocols were then analyzed in terms of the Kintsch and van Dijk (1978) model of text comprehension and production. Part of the process of speech comprehension involves parsing a sentence into its constituents and arranging them into an order of importance. More important in the process is the comprehension of an overall theme or establishing "global coherence". The Kintsch and van Dijk model assumes that this "carry-over" of important information is made possible through a working memory or short-term memory-like system that allows one to carry forward important idea units from sentence to sentence.

The model of information processing found to best fit the recall protocols of the elderly adults indicated a decrease in working memory capacity but no change in the strategy for selecting information. Spilich hypothesized that it is this decrement in working memory that causes the elderly to experience difficulty in generating inferences and conclusions necessary in the comprehension of complex verbal materials. He then offered a number of strategies for manipulating material

that may ameliorate or eliminate this problem.

Another of Cohen's experiments (1979) tested aspects of comprehension that required newly presented information be related to prior knowledge (i.e., knowledge already stored in memory). Subjects again listened to short spoken messages and were asked to judge whether each of these contained a mistake or a statement that could not be true. For instance, the statement that the Jones family was very close to an airport was followed by the statement that it was very quiet and peaceful. To detect these anomalies the listener had to access simple everyday facts stored in memory (e.g., airports are noisy) and note the discrepancy between this prior knowledge and the new information presented in the message. Again, older adults made significantly more errors than their younger counterparts in the integration of old and new information.

Taken together, the results of these experiments led Cohen to conclude:

> "...old age comprehension is handicapped by diminished ability to perform simultaneously the task of registering the surface meaning and also carrying out further processing involving integration, construction, or reorganization of different elements of the meaning. In general, surface comprehension is maintained at the expense of the integrative process" p.426.

In summary, research indicates that older adults may fail to encode contextual information, or if information is encoded, they often fail to integrate it with other information that is presented, or with information already stored in memory. The result is an inability to draw inferences from contextual information, particularly when this information is implied rather than explicitly stated. The ability to disambiguate information in natural language often requires drawing inferences from the linguistic context in which it occurs. The literature reviewed indicates this may be a problem for many older adults.

Individual Differences

In their review of the literature, Hoppe and Kess (1982) noted a high degree of individual differences in metalinguistic abilities,

> "...detection and ambiguity resolution are not linguistic abilities which are exhibited in the same fashion or in the same degree by all adult subjects in psycholinguistic tasks, rather one finds considerable individual differences in this area".

The question arises regarding what factors account for this variability.

In the aging literature certain indices of cognitive ability and lifestyle (e.g., education, occupation, activity level) have been found to interact

with age-related differences in various cognitive tasks. For instance, in the experiments reported by Cohen (1979) age comparisons were made between highly educated old and young adults and old and young adults who had dropped out of high school at ages 12 and 16 respectively. Education was found to be an important factor. Although the older educated group performed more poorly than the younger educated, their performance was comparable to the less educated young group. Performance was the lowest among the poorly educated elderly.

In a study involving perceptually ambiguous figures, Botwinick et al. (1959) also reported an increased ability to recognize perceptual stimuli that was related to increased education of the elderly subjects.

It has become common practice in aging research to match subjects on the basis of verbal performance because it tends to be highly correlated with education. Typically, the WAIS vocabulary subtest or some other vocabulary test is used for this purpose. Vocabulary tests are considered to be measures primarily of "crystallized" intelligence, a term used to describe skills that reflect learning and acculturation. "Fluid" intelligence, on the other hand, is thought to represent

a biologically-based capacity measured by tasks that involve abstract reasoning and perceiving relationships among complex figures such as Raven's Progressive Matrices (Horn & Cattell, 1967). Kausler (1982) reviewed several studies that implied that when age groups were adjusted for differences in education level and level of fluid (i.e., non verbal) intelligence, age differences typically found in problem-solving disappeared. Given its hypothesized relationship with perceptual abilities, the possibility arises that the ability to detect and resolve ambiguity may be closely related to "fluid" reasoning. Subjects in the current study were tested on tasks representative of both types of intelligence as well as several perceptual tasks in an attempt to determine the best predictor of ambiguity detection.

Ambiguity and Context

As mentioned earlier, studies of ambiguity have failed to yield a generally accepted theory of how ambiguity is resolved. There is fairly consistent evidence that multiple readings (i.e., interpretations) of some classes of ambiguous words are accessed when these words are presented in isolation. However, research concerning the effects of biasing context is less clear. Context could restrict access to a single

reading, or it could permit a selection between multiple alternatives. In the first instance, context would influence lexical access directly, whereas in the second it would influence a post-access decision process.

The following is a review of the three principal models of ambiguity processing that have emerged from the lexical ambiguity literature. According to the Context-Dependent Model, initial activation of a meaning of an ambiguous word is sensitive to the context in which it occurs. Context is thought to prime only the meaning that is consistent with it, therefore eliminating the necessity of resolving the ambiguity. The second, or Ordered-Access Model, contends that when an ambiguous word is presented its meanings are retrieved in a serial, self-terminating search. The most frequent meaning is activated first, and according to its fit with the context, this meaning is either accepted or rejected. If it is rejected, the second most frequent meaning is accessed and so forth until the correct meaning is found. In the third, or Exhaustive Access Model, presentation of an ambiguous word is thought to simultaneously activate all meanings of the word. Context is then used to select the appropriate meaning after which all other meanings are suppressed.

Although the Context-Dependent Model has received

minimal support, the Ordered-Access Model has fared better, particularly in experiments in which the task was to detect more than one meaning for an ambiguous word. Recent, albeit limited support has also been found using sentence comprehension and lexical decision tasks. To date, the Exhaustive Access Model has received the widest support. This support has come from research involving such experimental tasks as sentence completion, recall, phoneme monitoring, lexical decision, word naming, and Stroop interference. Simpson (1984) provides a complete review and discussion of the literature. Based on this review, he concludes that it is not possible to make a simple distinction between selective and exhaustive access. He proposes that more than one meaning will be activated, but the degree (or rate) of activation is sensitive to the dominance of the meaning and the context in which it is presented.

Of particular interest for the purposes of this research is a study by Seidenberg, Tanenhaus, Leiman, and Bienkowski (1982). These authors suggest that all meanings of an ambiguous word are accessed momentarily regardless of the relative frequency of the use of those meanings or the bias provided by semantic context. According to Seidenberg et al. (1982), context affects post-lexical processing and interacts with word

recognition in different ways; for instance, multiple access will occur when the interpretations are equally possible (regardless of the context). Selective access occurs if the contextually appropriate interpretation is the most probable and is of a much higher frequency than any alternative. Access of the inappropriate reading occurs if a word is used in a low frequency sense.

What are the implications of the psycholinguistic studies for the older individual who may or may not be able to utilize contextual information? If lexical access is automatic, it is possible that there would be no age differences in this stage of detection. Research has shown that automatic cognitive processes do not seem as susceptible to age changes as do effortful processes (Hasher & Zacks, 1979; Hoyer & Plude, 1980). Linguistically, this has been found for frequency judgements (Attig & Hasher, 1980, Kausler & Puckett, 1980), and perhaps more importantly for semantic activation during memory encoding (Howard, Lasaga & McAndrews, 1980). These results did not vary with educational level of the subject. Howard et al. concluded that "although the aged may be less likely or less able to engage in some forms of semantic elaboration, our results indicate that they are not deficient in the automatic semantic encoding that occurs

when words are held in working memory (p.70)". Burke and Yee (1984) also report no evidence for age related changes in semantic processing of sentences, including access to implicit information. Age changes then, if they occur, would be expected in the post-lexical processing stage where the individual must draw inferences from context in resolving the ambiguity.

Recently, Hoppe and Kess (1981) developed a research paradigm to study the effects of context on ambiguity detection. In their experiment, university students were asked to detect two meanings of ambiguous sentences that had been preceeded by a contextual paragraph or presented alone. The contextual paragraphs averaged 72 words in length and were designed to provide a thematic structure that was aimed toward one meaning of the sentence. It was hypothesized that this "thematic" context would influence the detection, i.e., limit the reading of the sentence to only one meaning. For example, the ambiguous sentence "He wears a light suit in the summer" could be preceded by a paragraph suggesting that the suit is "light in weight" or that it is of a "light color".

Although Hoppe and Kess (1981) had chosen ambiguous sentences that were not strongly biased, data analysis suggested that each sentence had some inherent bias when

presented in isolation. For example, in the sentence above it may have been the case that 75% of the subjects thought of light weight before they thought of light color (or vice versa). Because of this initial bias, Hoppe and Kess were able to examine the influence of context relative to the inherent bias of the sentence. In some instances the contextual paragraph was congruent with the inherent or dominant bias of the sentence, in other instances it was against or subordinate to the inherent bias. In keeping with Seidenberg et al.'s hypothesis, detection (of two meanings) was fastest when the context was against the bias of the sentence, suggesting that both meanings of the sentence had been automatically accessed. When the context was in line with the more common meaning of the sentence it took longer to elicit the second reading, suggesting that selective access had occurred (i.e., selection had been limited to the dominant reading).

The dependent variable in Hoppe and Kess's study was the time it took the subject to read the ambiguous sentence and indicate that they had seen two meanings of the sentence. Using the same dependent variable, what results might be expected when different age groups are included in this study? If older subjects do not process or integrate contextual information at all,

their detection latencies should be fairly equivalent in all three conditions (dominant bias, subordinate bias, and no context). On the other hand, an absence of age differences in the ability to encode and draw inferences from context would result in a similar latency pattern for all ages. Processing itself may take longer due to general slowing down of the rate of information processing with age, but the same pattern of latencies would be expected for all age groups. A third alternative is that latencies would be longest for the elderly subjects in the dominant bias condition. Here access is limited by context to only a single reading and the subject must switch to the second, less common reading. Memory research indicates that when information has to be transformed or reorganized, age deficits are especially noticeable. This problem should not occur in the subordinate bias condition where both meanings seem to be accessed simultaneously.

In summary, the current study was designed to synthesize recent work in psycholinguistics with research in the area of lifespan cognitive development. This research addressed a number of questions. First, are there age differences in the ability to disambiguate? Second, do age differences occur when resolution of ambiguity is dependent on the processing

of contextual information? Third, what is the effect of contextual bias on ambiguity detection? Does this factor interact with age? Fourth, is the explicitness of the context/ambiguity relationship a factor in disambiguation and if so, does this factor interact with age? Last, what cognitive and non-cognitive factors best predict ambiguity detection?

The current study attempted to answer these questions using a modified version of Hoppe and Kess's (1983) research paradigm. The ability to detect ambiguity among subjects who varied in age from young adulthood through old age was assessed in a no bias, a dominant bias, and a subordinate bias context condition. Subjects were presented with context/ambiguous sentence pairs that were either explicitly or implicitly related. Finally, a number of cognitive tasks (verbal, nonverbal, & perceptual) and demographic variables (age, sex, education) were examined to determine the best predictor(s) of ambiguity detection.

CHAPTER 3

Experiment 1

Experiment 1 was a scaling study. Its main purpose was to determine the inherent bias values for a number of ambigous sentences. On the basis of this information, stimuli for Experiment 2 were then selected. As Hoppe and Kess (1983) found, when lexically ambiguous words are presented in the context of a sentence, there is often a dominant or preferred reading to that sentence. However, it cannot be assumed that the preferred reading of a sentence will be the same for each age group. Therefore, a preliminary scaling study was conducted to ascertain age appropriate norms for selection of stimuli.

Method

Subjects. The 32 participants in the current study were all students, faculty, or staff members from Camosun College or the University of Victoria. Three age groups were tested. Students, faculty, and staff comprised the young and middle age groups, while students and faculty comprised the oldest group. Many

of the participants in the latter group were attending summer courses at the University, others were faculty members either still teaching or retired from Camosun College.

Ages for the three groups sampled ranged as follows: young participants, 20-35 years ($\bar{x}$=30.6), middle aged, 39-55 ($\bar{x}$=44.8), and the oldest, 65-73 ($\bar{x}$=66.1). The range in years of education was very similar for each age group. For the youngest group education ranged from 12-19 years ($\bar{x}$=14.4), the range for the middle group was 12-20 years ($\bar{x}$=17.1), and for the oldest group, 9- 20 years ($\bar{x}$=16.8). Initially, each group consisted of 10 subjects, 5 females and 5 males. Two additional subjects were added to the middle group; this addition will be explained in the results section of the scaling study.

When asked to assess their overall health, vision and hearing in general (i.e., compared to the general public) and relative to others their own age, all subjects reported their overall health to be either good or very good. The majority of subjects of all ages also reported their hearing and vision to be either good or very good. Approximately the same proportion from each age group reported that their hearing or eyesight was "fair" or "poor" relative to others their age.

Stimuli:

Stimuli for the scaling study consisted of 40 ambiguous sentences, each 8 to 10 words in length. These sentences can be found in Appendix A. Earlier research by Mistler-Lachman (1972) with young college students as subjects, indicated that all of these sentences were highly biased (80% or greater). The bias for each meaning of each ambiguous sentence is defined as the proportion of the sample that initially perceived the same meaning for the sentence. Each sentence was typed in bold face on a 12.6 x 20.3 cm index card.

The participants' crystallized intelligence was assessed with the revised version of the Peabody Picture Vocabulary Test (PPVT). This test of receptive vocabulary was developed and revised by Dunn and Dunn to estimate verbal ability and scholastic aptitude. It will be referred to as the Peabody. The Advanced Progressive Matrices Test (APM-1962) developed by J. C. Ravens was used to assess fluid intelligence. This abstract reasoning task was designed to assess the mental ability of people with above average intellectual ability. This test, widely used for school and vocational counselling and placement and research, will be referred to as Progressive Matrices.

Perceptual tests included the Hooper Visual

Organization Test (HVOT) and the Ambiguous Pictures Test. The Hooper, as it will be referred to, was developed by H. E. Hooper, and is a 30 item pictorial test designed to assess brain pathology of the right hemisphere. It consists of drawings of simple objects which subjects are asked to name. These objects have been cut into several parts and rearranged. The Ambiguous Pictures Test was designed for the current study, and will be referred to as Ambiguous Pictures. This test consists of seven pictures of reversible figures such as Boring's Wife/Mother-in-Law, Peter/Paul Goblet, duck/rabbit etc. which were glued onto 12.6 x 20.3 cm index cards. These figures can be found in Appendix B.

Procedure:

All subjects were tested individually. After a brief explanation of the purpose and general procedures of the experiment, subjects were asked to fill out anonymous personal data sheets. Testing commenced with presentation of the Hooper, followed by the Peabody. Presentation of these tests followed standardized procedures.

Upon completion of the Peabody, the participants were told that the next task involved sentences that were ambiguous. The deck of 40 sentence cards was

placed in front of the subject face down. The subject was instructed to turn over the cards one at a time, read the sentence, and say "yes" as soon as more than one meaning for the sentence was detected. The experimenter timed how long after turning the sentence card over it took the subject to say "yes". Thus, detection time for sentences included reading time. Immediately after saying "yes", subjects reported the first meaning of the sentence that had come to mind followed by the second or alternative interpretation. Subjects who failed to detect two meanings were timed until they indicated that they could only see one meaning, which they then gave. To guard against warm-up effects, four practice sentences were given first, and subjects were allowed to ask questions. To guard against order effects, the subsequent 40 test sentences were presented in a different random order to each subject.

Following the verbal ambiguity task, subjects were presented with the seven ambiguous pictures. The procedure for this task was the same as for the preceding task, i.e., picture cards were placed face down in front of the subject who was instructed to turn them over one at a time and indicate when they could see more than one object in the picture.

The last task presented was the Advanced Progressive Matrices Test. Subjects were given unlimited time on this task.

The current scaling study had three purposes. The first was to determine if there were age differences in ambiguity detection, the second was to examine the relationship between ambiguity detection and other cognitive tasks, and third, to determine the degree of bias inherent in the ambiguous stimulus sentences. Results of the scaling study will address these three issues.

Results and Discussion:

Mean correct responses and latencies for ambiguity and predictor tests can be found in Table 1. For ambiguity detection, a response was considered accurate if a subject paraphrased two interpretations of the sentence, each of which focussed on the lexically ambiguous key word.

First, an analysis of variance was conducted for each ambiguity measure to determine whether there was an age effect for ambiguity detection (number correct) and the time taken to resolve the ambiguity (latency). No significant age effect was found for either of these measures ($p > .10$ in each case).

Second, data on the seven predictor variables (age,

Table 1

Mean Correct Responses and Latencies for Ambiguity and Predictor Tests

	Ambiguous Sentences		Ambiguous Pictures	Progressive Matrices	Peabody	Hooper
Age Group	40*	Time(s)	7*	60*	175*	30*
Young	33.7	6.7	6.2	52.1	163.2	28.3
	(4.8)	(1.7)	(.7)	(3.6)	(8.9)	(.9)
Middle-Aged	35.3	6.6	6.0	51.9	169.4	26.2
	(2.1)	(1.6)	(1.1)	(4.0)	(3.1)	(1.5)
Old	35.4	6.4	5.3	42.3	167.1	25.4
	(3.6)	(1.9)	(.8)	(8.0)	(6.8)	(2.7)

* = Total Possible Score

Note. Standard deviations are in parentheses.

sex, education, Peabody, Hooper, Progressive Matrices and Ambiguous Pictures) were submitted to a canonical correlation analysis to see if there was a significant relationship between these variables and the criterion variables (number correct and latency). The relationship between the predictor and both criterion variables combined was significant $R^2 = .74$, Wilks Lambda $F(14,40) = 2.81$, $p < .006$.

Given the significance of the canonical correlation, separate regression analyses were performed on each of the criterion variables. A hierarchical set regression analysis was used in which demographic variables (age, sex and education) were combined as one set, the Peabody as a measure of crystallized intelligence formed the second set, and a third set representing fluid intelligence, was comprised of scores on the three perceptual tasks (the Hooper, Progressive Matrices and Ambiguous Pictures tests). The effects of each of these three predictor variables on the criterion variables were examined separately and in combination with each other (e.g., demographics, demographics + crystallized, demographics + fluid and demographics + crystallized + fluid).

Of the three factors and combinations thereof, only crystallized intelligence predicted the number of

ambiguities detected, $R = .36$, $F(1,26) = 10.68$, $p < .003$. When the criterion was latency of detection, crystallized intelligence, though not statistically significant ($p < .07$), was again the best predictor variable.

These results suggest that when ambiguous sentences are presented in isolation, the best predictor of both speed and accuracy of detection is crystallized intelligence. Demographic and fluid intelligence measures contributed marginally, if at all.

Correlations between the measures of ambiguity detection and the predictor variables can be found in Table 2. It can be seen that the relationship between accuracy and latency of detection was both low and negative ($r = -.13$). As well, the Peabody was negatively related to detection latency ($r = -.36$). This inverse relationship suggests that subjects highest in verbal skills were quickest to detect ambiguity. The number of ambiguities detected was positively related to vocabulary ($r = .54$). In sum, high verbal skills were associated with both speed and accuracy of ambiguity detection.

The third and most important purpose of the scaling study was to determine the bias value for each of the 40 ambiguous sentences for each age group. As mentioned

Table 2

Correlations Between Measures of Ambiguity Detection and Predictor Variables: N = 28

	Ambiguity Accuracy	Age	Sex	Education	Ambiguous Pictures	Progressive Matrices	Peabody	Hooper
Ambiguity Latency	-.129	-.269	.283	-.183	-.177	-.080	-.357	.156
Ambiguity Accuracy		-.021	-.137	.161	.213	.215	.540	.085
Age			.057	.459	-.443	-.545	.275	-.563
Sex				-.239	-.206	.099	.081	.097
Education					-.178	-.057	.245	-.397
Ambiguous Pictures	.					.343	.164	.362
Progressive Matrices							.308	.483
Peabody								.123
Hooper								

earlier, stimulus sentences for the scaling study were taken from previous research in ambiguity detection involving young college students (Mistler-Lachman, 1972). These sentences were all considered highly biased for that population, with bias values for the dominant meaning ranging from 81-100 % agreement (x= 91.5). The primary purpose of the scaling study was to ascertain whether the same high degree of bias would hold for middle-aged and older subjects.

In general, a great deal of variability in bias values was found for a number of sentences, both within age groups and between age groups. The intragroup variability was the highest in the middle-group, i.e., this group was least likely to show a strong bias for either interpretation of a sentence. For some sentences, the first reported or dominant meaning seemed to be age dependent. The most preferred or dominant meaning for one age group was the least preferred or subordinate choice for another age group.

Ultimately, 18 lexically ambiguous sentences were selected from the 40 in Experiment 1 to serve as stimulus sentences in Experiment 2. Three of the sentences could be considered highly biased for all three age groups with bias values for the more probable meaning ranging from 71-100% ($\bar{x}$=85%). An additional 10

sentences were highly biased for two of three age groups (range 75-100%, $\bar{x}$=83%) with the third group also favoring the dominant interpretation ($\bar{x}$=63%). The final five sentences met a minimum criterion of 60% bias or greater for all 3 age groups (range 61-90%, $\bar{x}$=71%). In order to meet a minimum criterion of 60% or greater two subjects were added to the middle aged group.

The 18 stimulus sentences and bias values can be found in Table 3. Again, all 18 sentences met a minimum criteria of 60% bias value for all three age groups. Although the degree of bias ranged from 60-100% the mean varied from 71% for the middle group to 78% and 80% for the oldest and the youngest groups respectively. The mean degree of bias for all 18 sentences was 76%.

In summary, results from Experiment 1 indicated that there were no age differences in either the speed or accuracy of detection of ambiguous sentences that occurred in isolation. These results can be explained by additional findings which indicated that both measures of ambiguity detection were best predicted by crystallized intelligence, an ability that remains stable across the adult lifespan.

Table 3

Ambiguous Stimulus Sentences and Bias Values by Age Selected for Experiment 2

Ambiguous Sentences	Bias Values for Most Prevalent Meaning			
	Young n = 10	Middle-Aged n = 12	Old n = 10	Mean Bias N = 32
I have never bought X'mas presents on time.	80%	75%	90%	82%
The candidate had secretly changed his address.	100%	82%	71%	84%
Numerous accused persons had already appeared before Mr. Williams.	100%	83%	88%	90%
The housewife was angry because she couldn't find her glasses.	70%	75%	90%	78%
He would not make the stakes any higher.	90%	64%	80%	78%
Mrs. Hendricks was finally satisfied with the large checks.	60%	82%	89%	77%
We gave the bat we had found to a boy in the park.	75%	67%	80%	74%
He confidently entered the office of the president.	78%	60%	86%	75%

(table continues)

Table 3 continued

Ambiguous Sentences	Bias Values for Most Prevalent Meaning			
	Young n = 10	Middle-Aged n = 12	Old n = 10	Mean Bias N = 32
James did not sufficiently emphasize the importance of their deed.	100%	60%	75%	78%
He did not actually expect the paper to cover everything.	90%	75%	60%	75%
Major Jones decided to execute the command.	88%	64%	89%	80%
We never expected the company to be on time.	63%	75%	80%	73%
Betty and Judy had not really enjoyed the slides.	80%	75%	60%	72%
We all knew their business was making money.	78%	73%	66%	72%
The spring was not as successful as we had hoped.	80%	64%	60%	68%
After several painful strokes the victim died.	67%	64%	90%	74%
The sickly young man was trying to avoid the draft.	70%	82%	60%	71%
The children lost the game.	67%	60%	88%	72%

CHAPTER 4

Experiment 2

The next step in the current study involved developing contextual paragraphs for the 18 stimulus sentences selected from Experiment 1. Two paragraphs were written for each sentence, one favoring the dominant interpretation, the other favoring the subordinate interpretation. Each contextual paragraph was 44-58 words in length ($\bar{x}$=52.5). Alternative paragraphs for any given sentence did not differ by more than eight words in length. The 36 contextual paragraphs can be found in Appendix C.

Again, the plan was to present subjects first with a thematic contextual paragraph that was biased either in favor of the dominant or subordinate interpretation of the sentence. The hypothesis was that the former would limit the reading of the subsequent ambiguous sentence to its preferred interpretation, while the latter would lead to both interpretations being produced almost simultaneously.

As mentioned earlier, research has indicated that older subjects have more difficulty than the young in

drawing inferences from complex verbal material, particularly when the information is implied rather than explicitly stated (Cohen, 1979, 1981). On the basis of Cohen's findings, the question arose whether the integration of the contextual paragraphs with the subsequent ambiguous sentences would be affected by the relationship between the context and the sentence. Would it be easier to integrate the ambiguous sentence with the contextual paragraph if the relationship between the two was explicit rather than implicit? To assess this question, context paragraphs for one-half of the sentences included the lexically ambiguous word from the sentence in the body of the paragraph. For instance, the word "draft" either in the military conscription sense (dominant interpretation) or as a stream of air (subordinate) sense was used in the paragraph preceding the sentence "The sickly young man was trying to avoid the DRAFT". In the remaining contextual paragraphs, the lexically ambiguous word was never stated explicitly, but rather was implied. For example, the sentence "The children LOST the game", was preceded by a paragraph which told of a game which the children didn't win (dominant interpretation) or of a game they had misplaced (subordinate interpretation).

In summary, based on the scaling study, 18

ambiguous sentences, with an average bias of 76%, were selected as test stimuli. Two contextual paragraphs (one favoring the preferred interpretation of the sentence, one favoring the alternative meaning) were developed for each sentence. One half of these dominant/subordinate context pairs included the lexically ambiguous key word from the sentence (explicit condition); for the other half, the key ambiguous word was implied but not stated (implicit condition). With this design it was hoped to discover not only whether there are age differences in the ability to detect ambiguity but whether ambiguity detection is dependent upon the nature of the context in which the ambiguity occurs.

Method

Subjects and Design: The 60 participants in this experiment were new subjects drawn from the same subject pool as the scaling study. Again three age groups were tested. Twenty Subjects (10 males & 10 females) comprised each age group. Within each age group, ten individuals were assigned to one of the two (dominant vs. subordinate context) experimental conditions. Assignment was random with the restriction that there be an equal number of males and females in each group. Thus, 5 young males and 5 young females were presented

with the dominant context, another 5 young males and 5 young females were presented with the subordinate context, etc. Each subject was presented with 18 paragraph sentence pairs, 9 of which were explicitly related; for the remaining 9 the relationship was implicit. The 30 participants from the scaling study served as controls for this experiment i.e. their responses to the 18 stimulus selected for Experiment 2 served as a neutral or no context control condition. In summary, the current study was a three (age group) by three (context) design with one repeated measure (explicitness).

The mean age and education for each of these age groups by condition can be found in Table 4. A 3 (age group) x 3 (experimental condition) Analysis of Variance with education as the dependent variable indicated that the experimental and control groups were similar in terms of education, i.e., there was no age by condition interaction. The three age groups did differ, however, in terms of education, $F(2,82) = 3.27$, $p<.05$. As Table 4 indicates, the youngest subjects had fewer years of education than did middle-aged and older subjects. This finding is not surprising given the number of young subjects who were still undergraduate students. The effect of interest however, was the homogeneity of the

Table 4

Mean Age and Education by Context Condition

Group	Context	Age*	Education*
	Dominant	30.2	15.8
Young (N = 30)	Control	30.6	14.4
	Subordinate	26.7	14.4
		29.2	14.9
	Dominant	47.4	16.2
Middle-Aged (N = 30)	Control	44.8	17.1
	Subordinate	46.4	16.8
		46.2	16.7
	Dominant	71.5	15.0
Old (N = 30)	Control	66.0	16.8
	Subordinate	71.9	17.1
		69.8	16.3

* = Years

three experimental groups within each age grouping.

Stimuli:

Stimuli for Experiment 2 consisted of the 18 ambiguous sentences derived from the scaling study and the 36 (18 dominant & 18 subordinate) contextual paragraphs. These paragraphs were typed on 12.6 x 20.3 cm index cards using the same bold face type that had been used for the ambiguous sentence cards. Again the Peabody, Progressive Matrices, Hooper and Ambiguous Pictures tests were administered to all subjects following standardized procedures.

Procedure:

The procedure for the current experiment was similar to the procedure followed in the scaling study. The only difference involved the presentation of the Verbal Ambiguity task that followed the Hooper and Peabody tests. Subjects were told that the task involved sentences that were ambiguous. They were instructed to first turn over and read a paragraph card which had been placed face down in front of them. Following this they were to pick up the next card, turn it over, read the sentence typed on the card, and to say "yes" when they could see more than one meaning for the sentence. Finally, they were asked to report those meanings to the experimenter in the order in which they appeared. Four

practice sentences each preceded by a contextual paragraph (two explicit, two implicit) were presented. Subjects were given a chance to ask questions about the task. This was followed by presentation of the 18 experimental paragraph/sentence pairs which were presented in a different random order to each subject. As in Experiment 1, the last test presented was the Progressive Matrices Test.

The results of Experiment 2 will be presented as follows. First, the effects of context on ambiguity detection will be presented; second, findings pertaining to the relationship between age and context will be given; and third, the results of analyses of predictor variables will be presented.

Results:

Ambiguity and Context. The effects of both the bias (dominant vs. subordinate) and the relationship (implicit vs. explicit) of context on ambiguity detection were assessed for each of three age groups. The results of these manipulations can be found in Tables 5 & 6. Two types of latency scores, raw and log transformed, were included in the analyses of this data. This decision was based on the skewed distribution of the latencies. Stem-and-leaf displays of raw and log

Table 5

Mean Explicit and Implicit Detections Scores

by Contextual Bias and Age

Contextual Bias	Age	Explicit	Implicit
Dominant	Young	8.00* (1.75)	6.50 (1.78)
	Middle-Aged	8.60 (.52)	5.60 (1.71)
	Old	7.80 (1.81)	5.70 (2.21)
		8.13 (1.36)	5.93 (1.90)
Control	Young	8.20 (1.14)	7.20 (1.81)
	Middle-Aged	8.55 (.69)	7.27 (1.68)
	Old	8.30 (1.08)	7.30 (1.25)
		8.35 (.97)	7.26 (1.58)
Subordinate	Young	8.60 (.97)	7.20 (2.10)
	Middle-Aged	8.80 (.42)	7.90 (.74)
	Old	8.20 (1.23)	8.10 (1.37)
		8.53 (.87)	7.73 (1.40)

* = mean score/9 possible.

Note: Standard deviations are in parentheses.

Table 6

Mean Explicit and Implicit Latency Scores

by Contextual Condition and Age

Contextual Bias	Age	Explicit	Implicit
Dominant	Young	7.03 (2.55)	8.93 (4.72)
	Middle-aged	5.65 (3.53)	7.48 (3.50)
	Old	7.69 (4.29)	10.36 (4.68)
		6.97 (3.46)	8.92 (4.30)
Control	Young	6.27 (1.97)	8.93 (4.72)
	Middle-Aged	6.33 (1.51)	7.29 (2.50)
	Old	4.76 (1.24)	6.97 (3.01)
		5.45 (1.57)	7.23 (2.52)
Subordinate	Young	4.12 (1.04)	4.41 (1.12)
	Middle-Aged	5.41 (2.35)	6.21 (2.96)
	Old	5.80 (2.15)	8.98 (3.75)
		5.11 (1.85)	6.53 (2.61)

Note: Standard deviations are in parentheses.

(10) transformed scores can be found in Appendix D. Log transformed latencies by context condition and age are given in Appendix E.

The raw data from Experiment 2 were subjected to a 3 factor between (2 sex x 3 age x 3 context) 1 factor within (implicit vs. explicit) Doubly Multivariate Repeated Measures Analysis of Variance on the two dependent measures (number correct & latency). This analysis produced the following results. First, a context by explicit/implicit interaction effect was found, Wilks Lambda multivariate $F(4,144) = 3.41$, $p < .05$. This interaction, which was significant only for the number correct variable, $F(2,73) = 6.15$, $p < .01$, is shown in Figure 1. Here it can be seen that context had little effect on the number of ambiguities detected when the ambiguous sentences were explicitly related to the contextual paragraphs. However, context did effect the detection of implicitly related ambiguities. Although significantly fewer implicitly than explicitly related ambiguities were detected in all conditions this difference increased from the subordinate to control to dominant conditions. Implicitly related ambiguities in the dominant context condition were least likely to be detected.

Second, a significant (between) main effect was

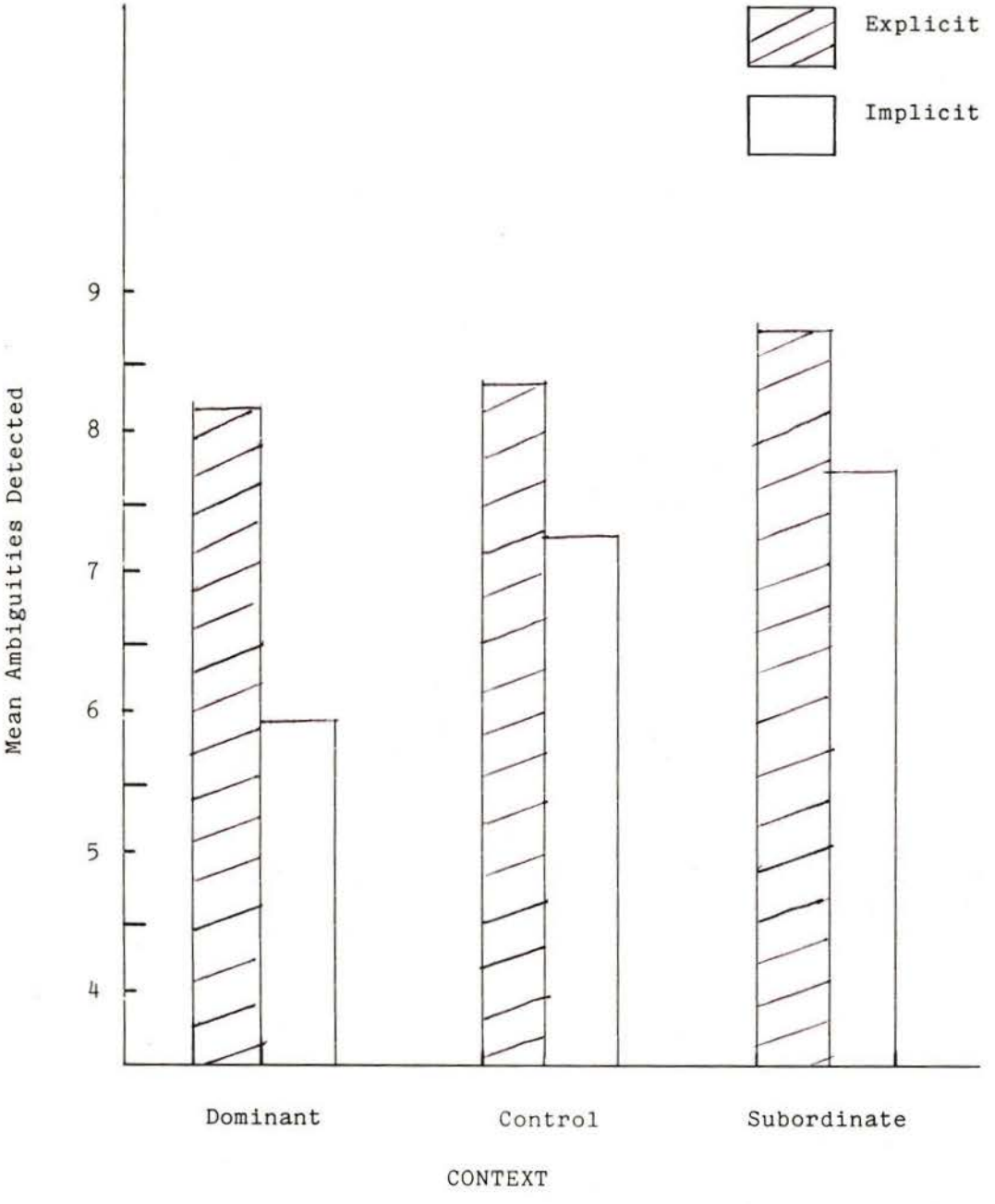


Figure 1. Mean ambiguities detected as a function of context and explicitness.

found for context, Wilks Lambda multivariate $F(4,144) = 4.83$, $p < .01$. This context effect was significant for both latency, $F(2,73) = 5.31$, $p < .01$, and for number correct, $F(2,73) = 6.91$, $p < .01$.

Examination of the means indicated that when the context was congruent with the dominant bias of the sentence, the detection times were slower than when the context was against the bias of the sentence. While latencies decreased from the dominant ($\bar{x}$ (6.97+8.92) = 7.96 s) to control ($\bar{x}$ (5.45 + 7.23) = 6.34 s) to subordinate ($\bar{x}$ (5.11 + 6.53) = 5.82 s) conditions, accuracy increased. The mean number correct (18 possible) increased from 14.06 (8.35 + 5.93) to 15.61 (8.35 + 7.26) to 16.26 (8.53 + 7.73) in the dominant, control, and subordinate conditions respectively. In summary, fewer ambiguities were detected and it took longer to elicit a second meaning when the context was congruent with the dominant bias of the sentence.

Special contrasts were included in the present analysis to determine whether this pattern of decreasing latencies and increasing accuracy scores was significant. When the main effect for context was partitioned in this manner, latencies in the dominant condition were found to be significantly slower than subordinate latencies $F(1,73) = 10.11$, $p < .01$. The

increase in the number of ambiguities detected from dominant to subordinate was also significant, $F(1,73) = 12.93$, $p < .01$.

The (within) main effect of implicit versus explicit was significant, Wilks Lambda multivariate $F(2,72) = 54.53$, $p < .001$. This effect was significant for both latency, $F(1,73) = 34.11$, $p < .001$ and number correct $F(1,73) = 69.33$, $p < .001$. Here the data indicate that when the relationship between the paragraph and the ambiguous sentence was implicit, latencies were longer (7.56 s vs. 5.84 s) and fewer ambiguities were detected (6.97/9 vs. 8.34/9) than when the relationship was explicit.

Subsequent analysis using log transformed data produced the same significant results. In addition, the multivariate log analyses indicated a significant sex by implicit/explicit interaction, Wilks Lambda $F(2,72) = 5.04$, $p < .008$. This interaction was significant for latencies only, $F(1,73) = 9.92$, $p < .003$. As mentioned earlier, detection latencies were longer in the implicit than in the explicit condition. This was true for both sexes. However, as Figure 2 shows, females were faster ($\bar{x} = .66$) than males ($\bar{x} = .70$) at detecting explicitly related ambiguities, and were slower ($\bar{x} = .78$) than males ($\bar{x} = .74$) when the relationship was implicit.

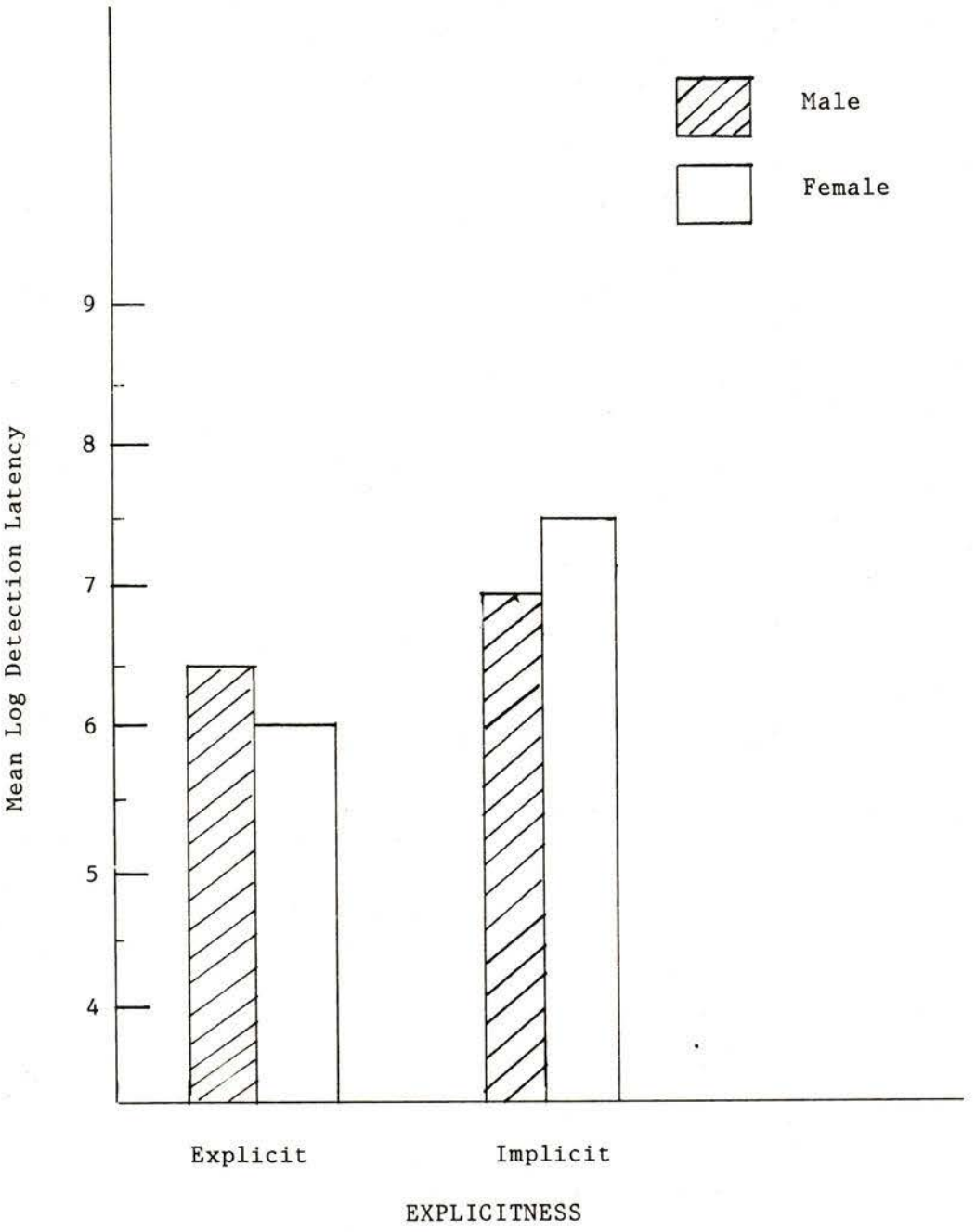


Figure 2. Detection latency as a function of explicitness and sex.

Examination of simple main effects indicated that although females showed a greater increase in latencies between explicit and implicit than did males, the increase was significant for each sex, $F(1,47) = 50.61$, $p < .001$, and $F(1,42), = 4.86$, $p < .05$, for females and males respectively.

Age and Context

Results of Experiment 1 indicated that there were no age differences on either measure of ambiguity detection (i.e., number correct or latency of detection) when ambiguous sentences were presented in isolation. Experiment 2 was designed to assess whether age differences would occur when ambiguous sentences were preceded by potentially disambiguating context. The effects of both the bias (dominant vs. subordinate) and the relationship (implicit vs. explicit) of context on ambiguity detection were assessed for each age group. The results of these manipulations can be found in Tables 7 and 8. Log transformed latencies by age and condition are given in Table 9.

Results of the 3 factor between (age, sex, & context), 1 factor within (implicitness) Doubly Multivariate Repeated Measures Analysis of Variance indicated that age of subject was not significant ($p > .05$) nor were any interactions involving this factor.

Table 7

Mean Explicit and Implicit Ambiguity Detection Scores by Age and Context Condition

Age	Contextual Bias	Explicit	Implicit
Young	Dominant	8.00*(1.75)	6.50 (1.78)
	Control	8.20 (1.14)	7.20 (1.81)
	Subordinate	8.60 (.97)	7.20 (2.10)
		8.27 (1.29)	6.97 (1.90)
Middle-Aged	Dominant	8.60 (.52)	5.60 (1.71)
	Control	8.55 (.69)	7.27 (1.68)
	Subordinate	8.80 (.42)	7.90 (.74)
		8.65 (.54)	6.92 (1.38)
Old	Dominant	7.80 (1.81)	5.70 (2.21)
	Control	8.30 (1.08)	7.30 (1.25)
	Subordinate	8.20 (1.23)	8.10 (1.37)
		8.10 (1.37)	7.03 (1.61)

* = mean score/9 possible

Note: Standard deviations are in parentheses.

Table 8

Mean Explicit and Implicit Latency Scores

by Age and Context Condition

Age	Contextual Bias	Explicit	Implicit
Young	Dominant	7.03* (2.55)	8.93 (4.72)
	Control	6.27 (1.97)	7.44 (2.06)
	Subordinate	4.12 (1.04)	4.41 (1.12)
		5.81 (1.85)	6.94 (2.63)
Middle-Aged	Dominant	5.65 (3.53)	7.48 (3.50)
	Control	5.33 (1.51)	7.29 (2.50)
	Subordinate	5.41 (2.35)	6.21 (2.96)
		5.46 (2.46)	6.99 (2.99)
Old	Dominant	7.69 (4.29)	10.36 (4.68)
	Control	4.76 (1.24)	6.97 (3.01)
	Subordinate	5.80 (2.15)	8.98 (3.75)
		6.08 (2.56)	8.77 (3.81)

Note: Standard deviations are in parentheses.

Table 9

Mean Explicit and Implicit Log Latency Scores by Age and Context Condition

Age	Contextual Bias	Explicit	Implicit
Young	Dominant	.75	.82
	Control	.72	.77
	Subordinate	.57	.59
		.68	.73
Middle-Aged	Dominant	.63	.76
	Control	.67	.76
	Subordinate	.64	.68
		.65	.73
Old	Dominant	.77	.88
	Control	.64	.77
	Subordinate	.72	.82
		.71	.82

When the analysis was repeated using log transformed data, age (which was not significant on the multivariate test) reached significance for latency on the univariate test, $F(2,73) = 3.23$, $p < .05$. Looking at the mean transformed latencies, it can be seen that overall, older subjects ($\bar{x} = .77$) tended to be slower at detecting ambiguities than did young ($\bar{x} = .70$) and middle aged ($\bar{x} = .69$) subjects. The difference in latencies was most pronounced in the implicit condition. There were no significant age differences in the number of ambiguities detected.

The purpose of including a middle-aged sample in the current study was to ascertain not only if there are age differences in ambiguity detection, but also when such differences emerge. For this reason it was decided to partition age using the following contrasts: young versus middle-aged, and young and middle-aged combined versus old.

When the data were partitioned in this manner, the second contrast (young and middle vs. old) was found to be "borderline significant" on the multivariate analysis ($p < .06$), and significant for latency on the univariate test, $F(1,73) = 6.15$, $p < .02$. Again, there were no significant age differences in the number of ambiguities detected.

Analysis using log transformed data also yielded an age (young vs. middle) by context interaction, Wilks Lambda multivariate $F(2,73) = 3.16$, $p < .05$ for latency alone. Partitioning the context effect into simple main effects indicated that the decrease in latency from dominant to subordinate context was significant for young subjects, $F(1,27) = 14.93$, $p < .002$, but not for middle aged. This interaction is shown in Figure 3. Here it can be seen that for the young, context had a much stronger effect on latency, both facilitative (subordinate context) and debilitative (dominant context) than it did for middle aged subjects.

Predictor Variables:

The final question to be addressed, concerned the prediction of ambiguity detection. Again, the effects of demographic variables (sex, age and education), crystallized intelligence (as measured by the Peabody) and fluid intelligence (as measured by Progressive Matrices, Hooper and Ambiguous Pictures tests) were taken into account.

Analyses of data in Experiment 1 (40 sentences) indicated that in the absence of context, crystallized intelligence was the best predictor of both speed and accuracy of ambiguity detection. Data on the 18 stimulus sentences from Experiment 2 were pooled with

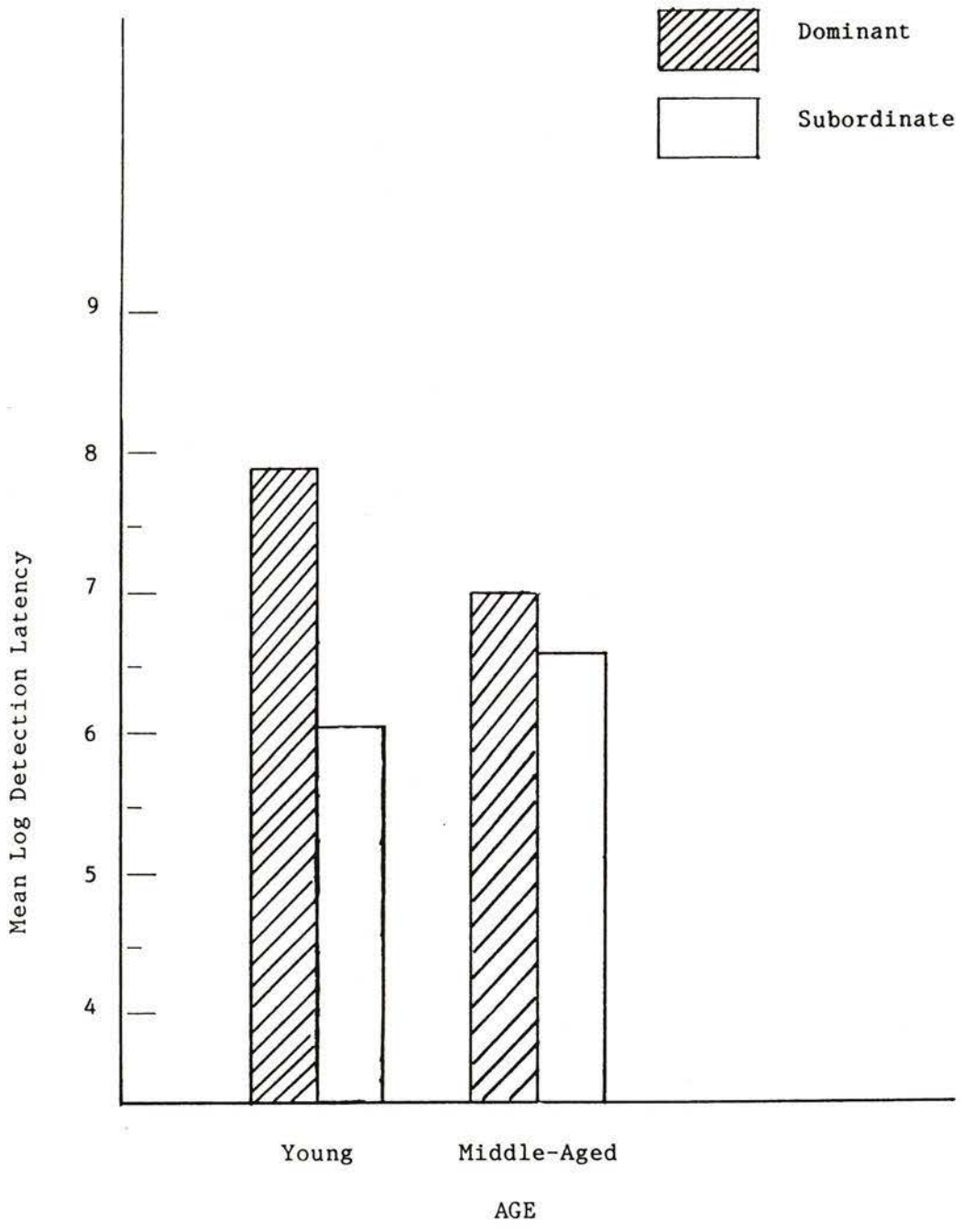


Figure 3. Detection latencies as a function of age and context.

the corresponding data from Experiment 1 to see if the same results would be obtained. The combined data was first submitted to a canonical correlation analysis to test the relationship between the two sets of variables (i.e., latency and accuracy of detection).

Based on the significant results of this test, Wilks Lambda $F(14,160) = 1.96$, $p < .03$, multiple regression analyses were conducted comparing the predictor variables with each criterion variable. As in Experiment 1, predictor variables were presented individually, in pairs, and hierarchically (demographics first, fluid intelligence second, and crystalized intelligence 3rd).

The best predictor of accuracy of detection was crystalized intelligence, $R^2 = .23$, $F(1,85) = 4.72$, $p < .04$. This was the best single predictor and the only predictor whose removal from the three factor model resulted in a significant change in the multiple regression.

The picture was less clear for the prediction of latency of detection. Taken individually, fluid intelligence was the only significant predictor, $R^2 = .31$, $F(3,83) = 3.01$, $p < .04$. However, when predictors were paired in the regression analysis, crystalized intelligence and demographic variables jointly provided

the best prediction of detection latency, $\hat{R}^2$ = .31, $F(4,82) = 3.43$, $p < .02$. This result, coupled with the finding that dropping fluid intelligence from the whole 3 factor model resulted in a non-significant change in the R, suggests that the best predictor of detection latency is a combination of crystalized intelligence and demographic variables.

Correlations between criterion and predictor variables can be found in Table 10. As in Experiment 1, a low negative relationship was found between the two measures of ambiguity detection, $r = -.21$. These results suggest that those subjects with the highest detection scores also tended to be the quickest at detecting ambiguity. Of the predictor variables, the Peabody had the highest correlation with accuracy of detection ($r = .23$). The relationship between age and latency of detection was positive, $r = .24$. This suggests, as did the regression analyses, that as age increases, so does latency of detection. Consistent with previous research, vocabulary increased with age ($r = .38$), while perceptual abilities declined ($r > -.38$ for Ambiguous Pictures, Progressive Matrices, and Hooper.

Table 10

Correlations Between Measures of Ambiguity Detection and Predictor Variables: N = 87

	Ambiguity Accuracy	Sex	Age	Education	Ambiguous Pictures	Progressive Matrices	Peabody	Hooper
Ambiguity Latency	-.213	-.040	.240	-.074	-.229	-.200	-.168	.038
Ambiguity Accuracy		.088	-.077	.012	.139	.183	.229	.090
Sex			.045	-.317	-.066	-.218	-.048	-.140
Age				.111	-.419	-.400	.382	-.378
Education					-.034	.165	.315	-.093
Ambiguous Pictures						.256	.039	.255
Progressive Matrices							.262	.374
Peabody								.126
Hooper								

CHAPTER 5

Discussion:

The primary question of interest in this study was whether age differences occur in the ability to detect and resolve ambiguity. It was hypothesized that if ambiguity detection is primarily a verbal ability reflecting crystallized intelligence, there would be no age decrements. Crystallized abilities tend to remain stable or, in some instances, increase across the adult life span. On the other hand, the possibility was raised that ambiguity detection is closely tied to perceptual ability and that both might be exemplars of some higher order cognitive ability such as fluid intelligence. If this were the case, age decrements in ambiguity detection would be expected, because fluid abilities decline systematically with age.

Data from the current study strongly support the hypothesis that ambiguity detection is a crystallized ability. Of the various verbal, perceptual, and demographic variables assessed, vocabulary was consistently the best predictor of ambiguity detection. Thus, crystallized ability best predicted both accuracy and latency of detection of isolated ambiguous sentences and accuracy of sentences preceded by context.

Since crystallized abilities tend to remain stable throughout most of adulthood, the lack of age differences in ambiguity detection was not surprising. Age differences occurred only in latency of detection when sentences were preceded by context. Here, demographic variables and vocabulary jointly predicted performance. It is hypothesized that the inclusion of demographics as a predictor variable is due primarily to the differential speed of processing of ambiguities by the three age groups. Older subjects took longer to detect ambiguities that had been preceded by contextual information than did young and middle-aged subjects.

In summary, the answer to the question, do age differences occur in ambiguity detection, depends upon the criterion. If the criterion of interest is accuracy of detection, age differences are negligible. If latency of detection is the criterion, there are age differences and context is a factor.

In general, context was found to have a significant effect on both the number of ambiguities detected and latency of detection. As latencies increased from the subordinate to neutral to dominant conditions, accuracy decreased. In other words, fewer ambiguities were detected and it took longer to elicit the second meaning when the context was congruent with the dominant or

preferred meaning of the sentence. This latency pattern, which is in keeping with results reported by Hoppe and Kess (1983) and Hogaboam and Perfetti (1975), has been attributed to selective access. Selective access or the restriction of access to a single meaning, is thought to occur when the contextually appropriate interpretation is also the most probable or dominant interpretation. However, when the context was biased toward the subordinate interpretation of the sentence, the selective access effect was weaker.

Examination of responses indicated that subjects were not only faster and more accurate at detecting ambiguities in the subordinate condition but tended to emit the dominant interpretation first on occasion, even though the context had been slanted toward the subordinate interpretation. For instance, 128/540 first responses emitted, or 24%, referred to the dominant interpretation whereas the remaining 76% referred to the subordinate meaning. On the other hand, when context was biased toward the dominant interpretation, only 39/540, or 7.2% of the first responses emitted referred to the subordinate meaning. These results suggest that while access was generally restricted to a single meaning, this effect was strongest when the context was congruent with the dominant interpretation of the

sentence.

In summary, context affected not only speed and accuracy of ambiguity detection, but also influenced the meaning first detected.

In terms of the relationship between context and age, the data indicate that the inclusion of contextual information had a different effect on ambiguity processing for each of the three age groups. This effect was manifest in speed of processing and meaning first detected, but was not manifest in accuracy of detection.

At the outset of this study, three different patterns of responses were hypothesized. The first was based on the premise that older individuals do not integrate contextual information. If this were the case, their detection latencies would be similar in each of the three experimental conditions. This hypothesis was not supported. Alternatively, it was hypothesized that if no age differences in the ability to encode and draw inferences from context were found, the pattern of latencies would be similar for each age group. This hypothesis was also not supported. Thirdly, it was hypothesized that if there were age differences in contextual utilization, these differences would be

manifest when context was biased toward the dominant interpretation of the sentence. In this condition, initial access is limited to the most frequent meaning and the subject must switch to the second, less common meaning, a task considered to be especially difficult for the older subject. This hypothesis was supported.

Relative to younger subjects, older subjects took longer to disambiguate in the dominant bias condition. Surprisingly, however, the older subjects also took longer to disambiguate in the subordinate bias condition. Age differences had not been anticipated in this condition where the literature suggests access of multiple meanings is simultaneous. Analyses of the data indicated that this may have been the case for younger and middle-aged subjects, particularly the former. The oldest subjects, however, detected ambiguity most rapidly when sentences occurred in isolation. The presentation of both dominant and subordinate context tended to restrict access to the meaning implied by that context, i.e., access was selective. Therefore, when presented with a subordinate context, the older subject experienced the same difficulty in "switching" to an alternative meaning as in the dominant bias condition. In summary, the equivalence of accuracy scores for the three age groups suggests that the elderly were able to

encode and utilitze contextual information. Their latency scores, however, suggest they may have been less efficient than younger subjects in doing so.

The meaning first detected in disambiguating also differed with age. The first meaning reported was generally congruent with the bias of the sentence. It was also found that a higher proportion of dominant responses were given following a subordinate context than vice versa. This pattern held for all age groups. However, in the subordinate condition, 10/10 or 100% of the youngest subjects reported a dominant meaning first at least once ($\bar{x}$ = 4.6), compared with 9/10 middle-aged subjects ($\bar{x}$ = 5.7), and only 6/10 of the oldest subjects ($\bar{x}$ = 3.7).

Examination of both the meaning first detected and latency of detection indicate that among the youngest subjects there was a strong selective access effect in the dominant bias condition. This effect was less pronounced in the subordinate condition. Whereas detection was restricted (therefore slowest) in the dominant condition, it was enhanced by the presentation of a subordinate context where both meanings seemed to appear almost simultaneously. Although the pattern of responses of the middle-aged group was similar to that of the younger subjects, the effects of context were

much weaker. Of the three groups, middle-aged subjects were relatively unaffected by context. They exhibited the least variability in latencies across the experimental conditions. Unlike the younger groups, the detection latencies of the older group were prolonged by the introduction of context regardless of bias. Since utilizing context to disambiguate demands concurrent processing of the meanings of both the context and the ambiguity, the resources or capacity of the older subject may have been overloaded.

Perhaps the strongest effect on ambiguity detection stemmed from the explicitness of the context/ambiguity relationship. When the relationship between the contextual paragraph and the subsequent ambiguous sentence was implicit, latencies were longer and fewer ambiguities were detected than when the relationship was explicit. Although the pattern of increasing latencies from the explicit to implicit condition held for all subjects, this trend was stronger in females than males.

The effects of context reported earlier, were also found to vary depending on the explicitness of the context/ambiguity relationship. Specifically, the increase in the number of ambiguities detected from the dominant to subordinate condition was manifest primarily in the implicit condition. When the context/ambiguity

relationship was explicit, the manipulation of the context had little or no effect on accuracy of detection.

In terms of the effects of explicitness on the different age groups, all ages were affected by this manipulation, i.e., latencies were longer and detections fewer in the implicit condition for all age groups. However, the implicit condition was disproportionately more difficult for the oldest subjects. Although their accuracy was not affected by this manipulation, it took these subjects longer than the other two age groups to detect implicitly related ambiguities. Again, the age differences in the pattern of detection was most noticeable in the subordinate condition. Whereas the increase in latencies from explicit to implicit tended to be minimum for young ($\bar{x}$ = .29 s) and middle-aged subjects ($\bar{x}$ = .80 s) in the subordinate condition, this was not the case for the older subject ($\bar{x}$ = 3.18 s).

Implicitness of context served to exacerbate the older subject's difficulty in drawing inferences from context, regardless of bias. These findings are in keeping with those reported by Cohen (1978 & 1981), who also found older subjects less able to draw inferences from contextual information, particularly information that was implicitly rather than explicitly stated. If

one assumes that drawing inferences from implicitly related information is more complex and requires more effort than from explicitly related information, the age differences reported above may again be attributed to overloading the resource capacity or working memory of the elderly.

An important distinction between Cohen's results and the results of the current study is that in the current study there were no age differences in accuracy. The older subjects' disadvantage in terms of the time cost for processing context seemed to be offset or compensated for by their knowledge of and experience with the English language. This is demonstrated by their facility at detecting ambiguity in the absence of context.

Summary: The current research indicates that age differences in ambiguity detection per se are minimal. The context in which an ambiguity occurs was found to affect subjects of all ages, specifically context which was biased in favor of the dominant interpretation of the sentence. It was more difficult to elicit alternative interpretations in this condition. Conversely, presentation of a subordinate context seemed to facilitate ambiguity detection particularly for the youngest subjects. This facilitative effect seemed

however, to attenuate with age. The earliest manifestations of this attenuation were evident by middle age. Context had little effect on subjects in this age group. By old age, regardless of bias, context consistently added to latency of ambiguity detection. Subjects in this age group detected and resolved ambiguity most rapidly in the absence of context.

The explicitness of the relationship between ambiguity and the context in which it occurs was also found to be an important factor in detection. Subjects of all ages benefitted from an explicit context/ambiguity relationship. Again, speed of detection among the elderly was particularly affected when the ambiguity was implicitly related to the preceding context. Implicitness tended to exacerbate the difficulty older subjects encountered when utilizing contextual information.

In general, crystallized intelligence, as measured by one's vocabulary, was found to be the best predictor of ambiguity detection. Vocabulary scores best predicted accuracy of detection. Demographic variables became an additional predictor when latency of detection was the criterion.

The current study was exploratory in nature. The question of potential age changes in the ability to

detect ambiguity had never been addressed. Subjects in the current study were all active, well-educated and relatively healthy. It was thought that if age differences in ambiguity detection occurred among these individuals, such differences would be more pronounced in a more "normative" sample. Further research might test this hypothesis.

Ultimately, the question arises whether age changes occur in the ability to disambiguate. Due to time constraints and the exploratory nature of the current research, age differences were examined. Would longitudinal research show that the ability to disambiguate among those with high verbal ability shows minimal changes with age relative to their less verbally proficient peers. Earlier research of verbal ability indicates this may be the case (c.f. Botwinick, 1967).

Age differences in the ability to detect lexical ambiguity was assessed in the current study. The question arises whether the same age pattern would occur in the detection of structural ambiguity. It may well be that the ability of older subjects to detect lexical ambiguity is a result of their acquisition of a generally large vocabulary over the years. It is not known whether ones' vocabulary would also facilitate structural disambiguation. Whereas crystallized

intelligence was found to best predict lexical disambiguation, the possibility exists that structural disambiguation is more closely related to fluid intelligence.

In summary, the current study although exploratory in nature, does indicate that any discussion of age differences in ambiguity detection must take into account the context in which the ambiguity occurs and the nature (explicitness) of the context/ambiguity relationship. In addition, both speed and accuracy of ambiguity detection must be examined.

References

Attig, M. & Hasher, L. (1980). The processing of frequency of occurrence information by adults. Journal of Gerontology, 35, 66-69.

Birren, J. (1970). Toward an experimental psychology in aging, American Psychologist, 23, 124-135.

Botwinick, J., Robbin, J. & Brinley, J. (1959). Reorganizations of perceptions with age. Journal of Gerontology, 14, 85-88.

Botwinick, J. (1967). Cognitive Processes in Maturity and Old Age. New York: Springer.

Burke, D. & Yee, P. (1984). Semantic priming during sentence processing by young and older adults. Developmental Psychology, 5, 903-910.

Cohen, G. (1979). Language Comprehension in Old Age, Cognitive Psychology, 11, 412-429.

Cohen, G.,(1981). Inferential reasoning in old age, Cognition, 9, 59-72.

Comalli, P. (1970). Life-Span changes in visual perception. In R. Goulet & P. Baltes (Eds.) Life-Span Developmental Psychology. New York: Academic Press.

Coren, S. & Porac, C. (1978). A new analysis of life-span age trends in visual illusions.

Developmental Psychology, 14,193-194.

Craik, F. & Lockhart, R. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning & Verbal Behavior, 11, 671-684.

Craik, F. & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. Journal of Experimmental Psychology: General, 104, 268-294.

Hasher, L. & Zacks, R. (1979). Automatic and effortfull processing in memory. Journal of Experimental Psychology: General, 108, 356-388.

Hess, T. & Higgins, J. (1983). Context utilization in young and old adults. Journal of Gerontology, 38, 65-71.

Hogaboam, T. & Perfetti, C. (1975). Lexical ambiguity & sentence comprehension. Journal of Verbal Learning & Verbal Behavior, 14, 265-274.

Hoppe, R. (1986). Private correspondence.

Hoppe, R. & Kess, J. (1986). Biasing thematic contexts for ambiguous sentences in a dichotic listening experiment. Journal of Psycholinguistic Research, 15, 3, 225-241.

Hoppe, R. & Kess, J. (1981). The effect of bias on ambiguity detection in the presence of context. International Journal of Psycholinguistics, 8-3, 23:137-151.

Hoppe, R. & Kess, J. (1983). The acquisition of Metalinguistic abilities. Rassegna Italiana de Linguistica Applicata/Italian Review of Applied Linguistics, 15, (2-3) 105-120.

Horn, J. & Cattell, R. (1967). Age differences in fluid and crystallized intelligence. Acta Psychologica, (Amsterdam) 26, 107-129.

Howard, D. Lasaga, M. & Mc Andrews, M. (1980). Semantic activation during memory encoding across the adult life-span. Journal of Gerontology, 35, 884-890.

Hoyer,W. & Plude, D. (1980). Attentional and perceptual processes in the study of cognitive aging. In L. W. Poon, (Ed.) Aging in the 1980's. Washington, D.C.: American Psychological Association Inc.

Hultsch, D. (1980). Encoding, storage and retrieval in adult memory: the role of model assumptions. In L.W. Poon, J. Fozard, L. Cermak, D. Arenberg, & L. Thompson (Eds.) New Directions in Memory and Aging: Proceedings of the George A. Talland Memorial Conference. Hillsdale, N.J.: Erlbaum Associates.

Kausler, D. (1982). Experimental Psychology and Human Aging. New York: John Wiley.

Kausler, D. & Puckett, J. (1980). Frequency judgements and correlated cognitive abilities in young and elderly adults, Journal of Gerontology, 35, 376-382.

Kess, J. & Hoppe, R. (1981). Ambiguity in psycholinguistics, Pragmatics and Beyond. 2, (4) Amsterdam: John Benjamin B. V..

Keil, F. (1980). Development of the ability to perceive ambiguities: Evidence for the task specificity of a linguistic skill, Journal of Psycholinguistic Research, 9, 3, 219-229.

Kintsch, W. & van Dijk, T. (1978). Toward a model of text comprehension and production, Psychological Review, 85:5, 363-394.

Lefever, M. & Ehri, L. (1976). The relationship between field independence and sentence disambiguation ability, Journal of Psycholinguistic Research, 5:2, 99-106.

Mistler-Lachman, J. (1972). Levels of comprehension in processing of normal and ambiguous sentences, Journal of Verbal Learning & Verbal Behavior, 11, 614-623.

Onifer, W. & Swinney, D. (1981). Accessing lexical ambiguities during sentence comprehension: Effects of frequency of meaning and contextual bias, Memory & Cognition, 9,(3) 225-236.

Porac, C. & Coren, S. (1981). Life-span trends in the perception of the Mueller-Lyer: Additional evidence for the existence of two illusions, Canadian Journal of Psychology, 35, 58-62.

Riegel, K. (1968). Changes in psycholinguistic performance with age. In G.A. Talland (Ed.). Human Aging and Behavior. New York: Academic Press, 239--279.

Schvaneveldt, R., Meyer, D., & Becker, C. (1976). Lexical ambiguity, semantic context, and visual word recognition. Journal of Experimental Psychology: Human Perception, and Performance, 2, 243-256.

Seidenberg, M., Tanenhaus, M., Leiman, J. & Bienkowski, M. (1982). Automatic access of the meanings of ambiguous words in context: Some limitations on knowledge-based processing. Cognitive Psychology, 14, 489-537.

Simon, E. (1979). Depth and elaboration of processing in relation to age, Journal of Expeimental Psychology:Human Learning & Memory, 5, 115-124.

Simon, E. & Craik, F. (1979). Resource constraints on depth and elaboration of processing. Reported in Craik & Simon, 1980, Age differences in memory: The roles of attention and depth of processing. In L. Poon, J. Fozard, L. Cermak, D. Arenberg, & L. Thompson (Eds.)New Directions in Memory and Aging. Hillsdale, N.J., Erlbaum Associates.

Simpson, G. (1984). Lexical ambiguity and its role in models of word recognition, Psychological Bulletin,

96, (2), 316-340.

Spilich, G. (1983-84). Implications of cognitive change for gerontological pedagogical practice, International Journal of Aging & Human Development, 18, 31-37.

APPENDIX A

Practice and Test Sentences, Experiment 1

Practice Sentences:

Albert knew his record was not the best.

Willard did not seem sure of the right fork.

Dick and Jane shared a valuable bond.

Mary and Joan steadily improved their figures as the course progressed.

Test Sentences:

Wilson could not find many poor students in history.

Many New Yorkers would never miss the ballet.

Jacob did not take the right turn at the intersection.

He had difficulty reading the notes even when wearing his glasses

I know their help was quite troublesome last year.

Tom's aunt couldn't bear children.

Interest must increase if the plan is to succeed.

Gerald and Marvin agreed it was a great play.

The major universities can help the economy by degrees.

They will be free all day today.

The account was not clearly presented at all.

Joe thought a new pitcher would be a good idea.

Marcia reached for the note with a thrill of excitement.

No one knew anything about the refugees' flight.

They had not filled the tanks with gasoline.

The judges thought the proposal was fair.

Hospitals do not treat rich and poor alike.

the solution had not seemed clear in Chemistry class either.

The poor frightened horse had run into the barn.

We did not know the nickel was valuable.

You did not have the power needed for the task.

I have never bought X'Mass presents on time.

The candidate had secretly changed his address.

Numerous accused persons had already appeared before Mr. Williams.

The housewife was angry because she couldn't find her glasses.

He would not make the stakes any higher.

Mrs. Hendricks was finally satisfied with the large checks.

We gave the bat we had found to a boy in the park.

He confidently entered the office of the president.

James did not sufficiently emphasize the importance of their deed.

He did not actually expect the paper to cover everything

Major Jones dicided to execute the command.

We never expected the company to be on time.

Betty and Judy had not really enjoyed the slides.

We all knew their business was making money.

The spring was not as successful as we had hoped.

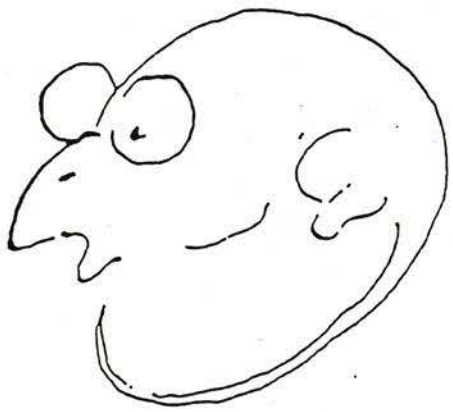
After several painful strokes the victim died.

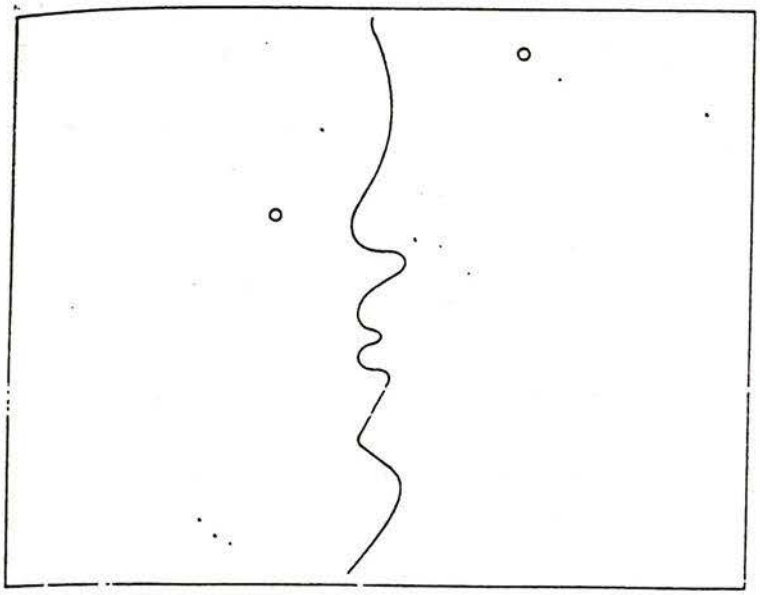
The sickly young man was trying to avoid the draft.

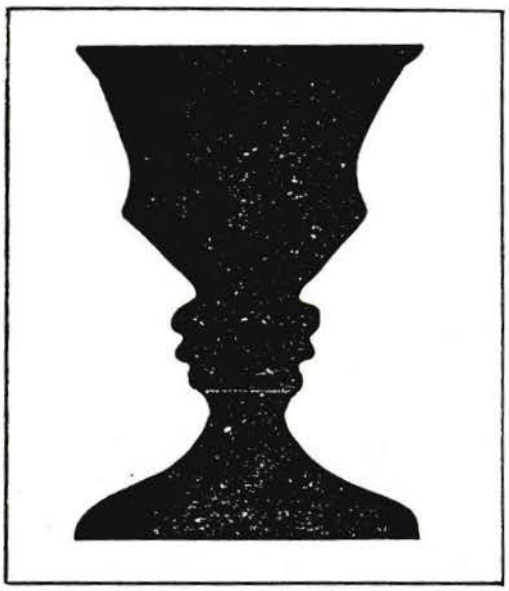
The children lost the game.

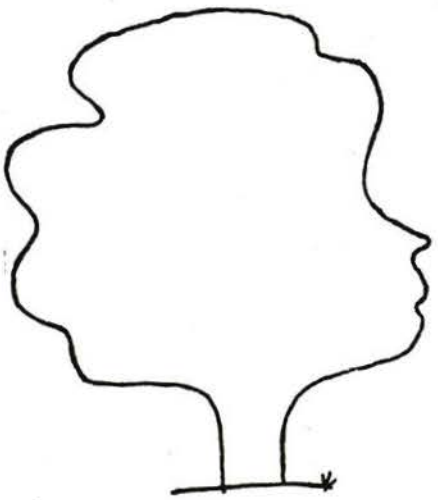
APPENDIX B

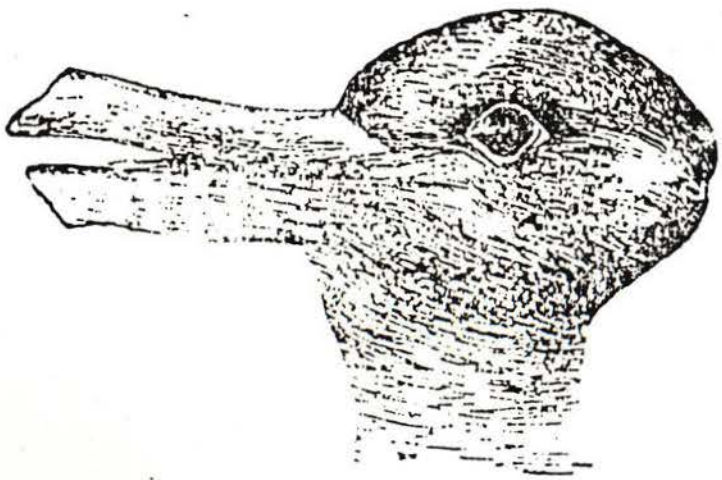
Ambiguous Pictures Test











APPENDIX C

Test Sentences and Contextual Paragraphs: Experiment 2

The housewife was angry because she couldn't find her glasses.

Muriel had noticed a marked deterioration in her vision over the past year. After much procrastination she finally visited an opthamologist who prescribed reading glasses for close work. What a difference these glasses made! However, because she was not used to wearing glasses and only needed them for reading and sewing, Muriel found she was constantly misplacing her glasses. (Dominant)

Many people find moving a frustrating experience. First everything has to be packed. This is a chore, especially for things like china and glassware. This chore is no sooner completed and one has to begin unpacking. Experienced movers label all boxes carefully. Although Muriel had labeled everything she could not find the box that had her 'everyday' glasses. (Subordinate)

We gave the bat we had found to a boy in the park.

On the spur of the moment, we decided to take a picnic lunch to the park. We arrived just in time to see the last inning of a baseball game. After the children had left, we found a bat leaning against the bleachers. Twenty minutes later one of the players returned to retrieve it. (Dominant)

What mysterious creatures bats are. Some people are afraid of them, others are fascinated. I still remember the first time I saw one. We were exploring some caves at the far end of the park. I heard this odd sound, and finally spotted the poor creature flapping about. Its wing had been torn. **(Subordinate)**

The children lost the game.

What a lacross game! The children were playing their top rivals for the gold medal. Both teams were evenly matched. At the end of the last period the score was tied. It was decided that the first team to score in overtime would be the winner. Unfortunately, the other team scored first. **(Dominant)**

Joette had worked very diligently at training her children to pick up after themselves. When they were through playing with games and toys for instance, all pieces, however small, had to be found before being put away. It was puzzling therefore, when they couldn't find their monopoly game. **(Subordinate)**

The sickly young man was trying to avoid the draft.

The 60s were a troubled time in the United States. While many young men enlisted voluntarily in the armed forces

and many others cooperated once drafted, there were some who did not want to be involved in the war. There were a number of ways of avoiding conscription, some of which were quite drastic. **(Dominant)**

Gerald had been sick all winter. Somehow he had not been able to shake his persistent cough. Of course his living quarters didn't help matters much. The heat in his apartment only worked some of the time and there was little, if any, insulation, so when the wind blew there was a cold draft. **(Subordinate)**

Mrs. Hendricks was finally satisfied with the large checks.

In an effort to capitalize on the planned rebate program, the company's publicity director, Mrs. Hendricks, decided to use large, colorful rebate checks. She hoped these large, unusual checks would be remembered by the consumers who would then identify positively with the company. **(Dominant)**

For those who follow fashions, vivid plaids and checks were in vogue last fall. This was a radical departure from the muted tones of the previous fall. Mrs. Hendricks had a great deal of difficulty deciding which of the various combinations of checks and plaids to buy. **(Subordinate)**

A group of children went to the park to try out the new equipment. While the adventure bridge and the rope swings were novel and exciting, the water slides provided most of the entertainment. These slides are definitely not for everyone. However, most of the children seemed to enjoy them, especially the boys. **(Subordinate)**

We never expected the company to be on time.

When I was a child I remember that Sunday dinner was always at six o'clock. The only exception was when the Bibbets came to dinner. On those occasions Mother would give us children a light snack at 4:00 with a promise of "more to come...sooner or later." **(Dominant)**

The major industry in our town provided both employment and support for local retailers through a "buy locally" policy. The drawback was the somewhat whimsical payment schedule of the company. We dealt with this lack of consistency by adjusting the dates on our "expected" versus "real" due date on the accounts receivable. **(Subordinate)**

Major Jones decided to execute the command.

In war many decisions are based on the overall objective of defeating the enemy in the long run. This sometimes means

sacrificing entire infantry units in local battles in order that the greater objective will be realized. Seasoned officers are aware of this and are also aware of the sometimes homicidal nature of the orders they must execute. **(Dominant)**

In order to indoctrinate new recruits into the military way of thinking and acting, many stories are told about the rewards of duty and heroism. In the same vein, there are a few legendary stories told of infantry units who had abandoned their positions and upon reaching their own lines had been executed for cowardice. **(Subordinate)**

He did not actually expect the paper to cover everything.

It was always difficult when writing term papers to know how much information to include. Should one try to cover everything or did the instructor prefer brevity? Unfortunately, not all instructors gave specific guidelines regarding content coverage. However, Dr. Jacob's instructions were always quite clear, a brief overview was all that was necessary. **(Dominant)**

John was afraid there might not be enough wall paper to cover the entire room. However, with company coming in two days he didn't have time to order more. He started to paper the room anyway since even a partial job would

be an improvement. He was surprised to find he had just enough to finish the job. **(Subordinate)**

James did not sufficiently emphasize the importance of their deed.

The children did not realize the implications of what they had done. They had seen smoke coming out of Mr. James' window and had rushed in. It never occurred to them that they were placing their own lives in jeopardy. James himself, did not seem surprised or grateful that they had saved his life. **(Dominant)**

When the twins were younger they worked every summer for Mr. James. These boys were really hard workers and Mr. James thought so highly of them that when the twins graduated he gave them the title to 10 acres of his ranch. Not realizing that this was a legal document, the boys lost the paper. **(Subordinate)**

We all knew their business was making money.

The many long hours the Russells had put into their business seemed to be paying off. The first sign came when they replaced their original store with a larger one. In addition, they leased the commerical spaces they had built on the premises. Rumor has it, they are in the process of buying another store. **(Dominant)**

Years ago, my uncle Milt worked at the Federal Reserve. His division was in charge of destroying "mutilated" money (bills that had become tattered). Once the mutilated bills were destroyed, new ones were printed. Uncle Milt always delighted in shocking strangers by telling them how much money he had burned that day. **(Subordinate)**

Numerous accused persons had already appeared before Mr. Williams.

Although he was innocent, the young man was worried. He had never been in court before. He wondered who would be presiding that day. Mr. Williams was an experienced judge with a reputation for fairness. However, there was also a new judge who had little experience dealing with cases of this sort. **(Dominant)**

Everyone at the demonstration had been arrested. Mr. Williams was shocked to be treated like a common criminal, after all, he had only been trying to make a statement. He wanted to be the first to appear in court, however, the accused were being called in alphabetical order. Mr. Williams would be last. **(Subordinate)**

The candidate had secretly changed his address.

During the campaign for election, investigative reporters revealed that the candidate had possibly been involved in

organized crime. After the story broke, swarms of reporters and media representatives descended upon the candidate's home for interviews hoping to continue the expose. This did little but disrupt the neighborhood as the candidate no longer lived there. **(Dominant)**

In order to win the widest possible support from his party members, the candidate agreed to many policy platforms which he could not really fulfill. These negotiations won him enough votes for the nomination. In his acceptance speech, the candidate shocked his newly won supporters by not sticking to his prenomination "deals." **(Subordinate)**

The spring was not as successful as we had hoped.

Every winter a few businesses fail. Others of us hang on until spring hoping the losses we incurred during the winter will be recouped during the tourist season. Unfortunately, Easter, which marks the beginning of the tourist season, was quite early this year. As a result, tourist trade was slow until mid-June. **(Dominant)**

Our gymnasts had been training for this event for months. Now the moment of truth had arrived. Overall, our performance was excellent. The only flaw was a poor spring from the parallel bars. In spite of practice on each part of the event, the leap fell short of its mark. **(Subordinate)**

He would not make the stakes any higher.

The casino manager has the discretion of raising the betting limits in the high stakes poker games. It is a general rule however, that the stakes are predetermined and rarely altered. There is still the odd customer who persists in trying to persuade the dealer to "bend the rules, just this once." **(Dominant)**

For many years the height that tomatoes would grow remained fairly constant between varieties. With the modern hybrids this growth now varies considerably between varieties and in many cases growth is much higher than before. Unless gardners are prepared to alter their stakes, many plants will break at the top. **(Subordinate)**

Betty and Judy had not really enjoyed the slides.

The Bossey's were avid photographers. After returning from a memorable holiday in Moose Jaw they presented a very well thought out and lengthy slide program for their friends. Oddly enough many people were too busy to visit the Bossey's. Two less fortunate souls, Betty and Judy (the Bossey's tenants) simply "suffered in silence" for three hours! **(Dominant)**

After several painful strokes the victim died.

Mr. Jones had been in poor health for some time. The doctors had diagnosed his problem as atherosclerosis or the formation of fatty nodules on hardening artery walls. Although he agreed to change his diet and exercise more, I'm afraid these changes in lifestyle came too late to help Mr. Jones. **(Dominant)**

The refugee was trying to escape from the bandits who had attacked his family's boat during the night. Although badly wounded, he managed to slip overboard. He thought if he could just swim to shore he might be able to bring back help for his family. However, this was not to be. **(Subordinate)**

He confidently entered the office of the president.

As a new employee, Jones had been somewhat hesitant to offer suggestions. However, the recommendation he finally made was heralded as brilliant, one that would save the company thousands of dollars. Today he was to meet with the president who wanted to congratulate Jones personally. **(Dominant)**

As a young man, Jones had one dream and that was to someday become President of his country. Only then would

he be able to make the changes he so firmly believed in. After years of hard work, his dream had become a reality. **(Subordinate)**

I have never bought X'mas gifts on time.

It's too easy today to live beyond one's means. In the past, if you didn't have money for something you just did without until you could afford it. Take Christmas for instance. I still remember my Mother's story of stockings filled with fruit and nuts and maybe one gift. Today, people think nothing of "charging" Christimas. **(Dominant)**

Some people are organized. They begin their Christmas shopping in the fall when there is still a selection. By the first of December their cards are all written and out of town parcels are mailed. Others of us, however, don't even start thinking about shopping until December, by which time both selection and patience are limited. **(Subordinate)**

APPENDIX D

Stem-and-Leaf Display for Raw Data

```
 2 . 9015666779999
 4 . 011233345688990011223445778889
 6 . 00111233355677888999023577777
 8 . 24462368999
10 . 44638
12 . 25
14 . 29
16 . 1
```

Stem-and-Leaf Display for Log (10) Transformed Data

```
 4 . 779
 5 . 4566779999
 6 . 01223335568899
 7 . 00111133345666788999
 8 . 000012223333445677899 9
 9 . 1224678999
10 . 0222578
11 . 057
12 . 3
```

APPENDIX E

Mean Explicit and Implicit Log Latency Scores

by Context Condition and Age

Contextual Bias	Age	Explicit	Implicit
	Young	.75	.82
Dominant	Middle-Aged	.63	.76
	Old	.77	.88
		.72	.82
	Young	.72	.77
Control	Middle-Aged	.67	.76
	Old	.64	.77
		.68	.77
	Young	.57	.59
Subordinate	Middle-Aged	.64	.68
	Old	.72	.82
		.64	.70

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May, R.B., Cuddy, L.J., and Norton, J.M. (1979). Temporal contrast and the word frequency effect. Canadian Journal of Psychology, 33(3), 141-147.

May, R.B., & Norton, J. (1981). Training task orders and transfer in conservation. Child Development, 52, 904-913.

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Lexical Ambiguity Across The Adult Lifespan

Autho[redacted]

JANICE M. NORTON

Feb. 2, 1987