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THE UNIVERSITY OF ALBERTA

A COMPARISON OF COMPREHENSION MONITORING ABILITIES IN YOUNG AND HEALTHY ELDERLY ADULTS

by 

KATHY ANNE LOGAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

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A COMPARISON OF COMPREHENSION MONITORING ABILITIES IN YOUNG AND HEALTHY ELDERLY ADULTS

SUBMITTED BY KATHY ANNE LOGAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN SPEECH PATHOLOGY

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DATE: APRIL 3, 1990

To my heroes --

Mom, Dad and Nanny

Did you ever know that you're my heros?

You're everything I would like to be.

I can fly higher than an eagle,

You are the wind beneath my wings.

ABSTRACT

This investigation compared the spoken-language comprehension monitoring skills of healthy elderly and young adults during their responses to following directions using a board game and a game marker. The tape recorded instructions were simple, obscured, ambiguous, complex or impossible. Forty subjects were tested: 10 females and 10 males in each of two age groups, young (18 - 25 years) and elderly (70 - 80 years). Signs of comprehension monitoring were analyzed in terms of frequency, latency and form between subject groups and across instruction categories. Findings suggested that both age groups signalled comprehension monitoring with similar frequency, with the exception of ambiguous items on which the elderly subjects did not indicate recognition as frequently as the young subjects. Elderly subjects used significantly more verbal than non-verbal indicators of comprehension monitoring, while the young subjects used both types of indicators with similar frequency. Finally, the elderly group was generally slower at indicating comprehension monitoring than the younger groups for all stimulus conditions, with responses to the "impossible" category generating the longest and only statistically significant difference. In summary, comprehension monitoring skills were maintained in the elderly group under study, although differences were evident between the two age groups in terms of latency and form of indication. This may have important social, medical and linguistic implications for the elderly.

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CHAPTER I

INTRODUCTION

For many years, developmental theorists held the belief that the most dramatic and most important changes in an individual occurred from conception through adolescence. The bulk of material in texts of human development or developmental psychology was devoted to pre-adolescence, with sections on adolescence more rare, and references to adulthood rarer still. The underlying assumption was that adult behavior was quite stable and could be predicted from early behavior. Recent research, however, indicates that during adulthood, significant changes and new behaviors occur that warrant study. This has led to the field of "life-span development," an approach which studies the normal aging process (Huyck & Hoyer, 1982).

Within the fields of speech-language pathology and psycholinguistics, the study of adult language has previously been restricted to patients who exhibited significant language change as a result of an acquired neurological impairment due to traumatic brain injury, stroke or dementia. The issue of development was confined to the study of child language. It was largely assumed that once an individual attained adulthood, his language skills would remain static, despite informal observations of rambling speech and reduced comprehension skills among old persons. Recently, researchers have realized that documentation of normal language changes in elderly adults is crucial in determining what may or may not be attributed to disease processes (Ulatowska, Hayashi, Cannito & Fleming, 1985).

Because aging has been identified as the greatest single risk factor in stroke (Sahs, Hartman & Aronson, 1976), it is clinically relevant to know "which language changes are attributable merely to aging and which are attributable to stroke related pathological alterations" (Ulatowska et al., 1985, p. 126). For example, it has been documented that Broca's aphasia occurs predominantly in younger stroke patients while Wernicke's and global aphasias are more common in older victims of stroke (Holland & Bartlett, 1985). Also, North, Ulatowska, Macaluso-Haynes and Bell (1986) report that normal elderly individuals make some types of errors

commonly reported in aphasic language. Aging has also been identified as "the most common factor associated with language changes in diffuse or multi-infarct brain diseases in dementia" (Ulatowska et al., 1985, p. 127).

A commonly reported disturbance in senior citizens is reduced ability to understand spoken language (Cohen, 1979; Cohen, 1981; Davis, 1984; Emery, 1985; Obler, Nicholas, Albert & Woodward, 1985; Spilich, 1983; Taub, 1979; Ulatowska et al., 1985). This implies that elderly adults may be less able than younger adults to manage the day to day events that necessitate language comprehension, such as exercising rights and privileges and accessing services. Tymchuk, Ouslander and Rader (1986), for example, reported significant impairments in the comprehension of a nursing home "Bill of Rights," in a group of cognitively intact, elderly residents. This study, while raising an interesting point, did not address the question of whether or not these individuals expressed the realization that they did not understand the contents of the document provided to them. The issue of "knowing about knowing" is referred to as metacognition. One particular aspect of metacognition is comprehension monitoring, an individual's ability to recognize communication failure and to take the steps necessary to compensate for it.

This investigation compared the comprehension monitoring skills of healthy elderly and young adults. The intent was to discover whether any differences exist in such skills between these two groups with the premise that if elderly adults were noticeably less able to monitor their comprehension, services offered to this population such as health care, legal advice or therapy following a medical crisis may need to be modified to account for this comprehension monitoring deficit. The rationale for this study evolved from a review of the literature on age-related cognitive, language and metacognitive skill changes that pertain to comprehension monitoring. As well, non-verbal behaviors that might be used to indicate non-comprehension were explored.

CHAPTER II

LITERATURE REVIEW

Adult Cognitive Development

Several aspects of mental performance, indirectly related to speech and language comprehension, show well-documented age-related decline. Cognitive geropsychologists have proposed two theories to account for the diminished proficiency of many specific cognitive processes, namely the principles of diminished resources and speed of processing (Kausler, 1988). The diminished resources theory argues that elderly individuals have fewer resources available to them for performing cognitive tasks than do young adults. Researchers speculate that those resources are part of a working memory system, a cognitive structure thought to have a limited capacity for temporarily storing information or for processing that information while held in storage. Age differences in cognitive task performances are contingent upon the involvement of working memory. As Kausler (1988) summarizes, ". . . task performances that make demands on working memory are age sensitive; those that do not are age insensitive." (p. 85).

The second principle, espoused by Birren (1970) and Salthouse (1982), suggests that with age, the rate of processing information in the central nervous system slows down. The slowing is thought to be generalized throughout the system, not solely in any one process critically involved in task performance. Age differences in performance would increase as the cognitive demand increased, because each additional process required for task completion would decrease the overall rate of processing. Operationalization and independent measurement of individual differences are needed to illustrate experimentally both the diminished resources and speed of processing principles. Both adequately account for many aging deficits in cognitive tasks, depending on the performance requirements for the old and young subjects (Kausler, 1988).

Although the exact relationship of communication to cognition is not clear, it can be predicted that certain communicative functions will be more dependent

than others on intellectual processes. Thus, it is unrealistic to expect that while cognitive functions deteriorate, communicative functions are spared (Bayles, Tomoeda & Boone, 1985). Several researchers have addressed the issue of age-related language changes indirectly through the exploration of questions regarding verbal learning, memory or problem solving skills. Davis (1984) suggests that "because language processing is a cognitive function, constrained by short-term memory and involving long-term memory, the study of cognitive changes has some relevance for the study of language changes" (pp. 79-80). Regardless of the possible cause, speech and language comprehension in the elderly population may be sensitive to changes in the cognitive functions of perception, attention, memory, problem-solving and intelligence.

Perception

Perception refers to the recognition and identification of sensory information. The analysis and processing of such information is known as pattern recognition (Kausler, 1988). As Kausler (1982) explains, "pattern recognition enters into virtually all aspects of our interactions with our environment, such as our understanding of sound patterns as spoken words and our reading of printed letter patterns as words" (p. 307). Declines in sensory sensitivity with age imply that elderly adults have access to less sensory input with which to process information than young adults have (Kausler, 1988). In addition, aging is known to affect pattern recognition in terms of the diminished speed of conducting basic operations (Kausler, 1982).

In keeping with the diminished speed theory, Birren (1970) reported that the rate of information processing slows down with age, resulting in the inefficient processing of information presented at fast rates. Kausler (1982) cited a study by Poon, Fozard, Vierck, Dailey, Cerella and Zeller (1976) in which slowing in both peripheral and central processing with advancing age became increasingly apparent as the required processes became more complex. In even a simple test of reaction time that required participants to press a button in response to a visual signal, the average response time increased progressively across subjects from those in their twenties to those age 60 and over (Wilkinson & Allison, 1989). Baron

and Journey (1989) investigated age differences in manual versus vocal reaction times. Elderly and young adults indicated the spatial location of a visual stimulus by moving a lever or by speaking. The authors reported that for both age groups, reaction times increased when the response was vocal rather than manual, although the older adults were slower than the young adults for both response modes. Further, as the number of response alternatives increased, so too did reaction times. Of interest was the slope of the vocal data; the similarity of the slopes between the two age groups led Baron and Journey to suggest that their elderly subjects were as efficient as the younger subjects in processing information, albeit slower.

Pattern recognition studies have been conducted primarily using visual, rather than auditory, stimuli to assess changes in information processing with age. Visual pattern recognition studies have attempted to specify the locus of age sensitivity at either peripheral or central stages of information processing. Peripheral processing, influenced by physical attributes of stimuli, accounts for rapid decisions of sameness based on physical identity. For example, the set "AA" is more rapidly identified as the same than the set "Aa". The latter set, "Aa," requires a match based on name identity rather than physical identity. The need for informational attributes when making comparisons implies a deeper or more central level of processing (Kausler, 1982).

Attention

Elderly people also have difficulty allocating and maintaining attention (Broadbent & Heron, 1962; Rabbitt & Birren, 1967). The three attentional phenomena of vigilance, selective attention and divided attention may be affected by age. Vigilance, simply defined as a person's readiness for detecting a stimulus change, demands minimal cognitive activity but a high degree of arousal and resistance to fatigue (Kausler, 1982). Wilkinson and Allison (1989), in their study of age and simple reaction time, postulated that the ability to sustain attention during the longer preparatory intervals may have contributed to the age-related differences they encountered. Differences in vigilance, in subjects above 65 years, were attributed to an age-related factor of fatigue (Talland, 1966). When memory as

well as vigilance are required, greater deficits in performance are observed (Kirchner, 1958).

The second phenomenon, selective attention, refers to a person's ability to focus on relevant stimuli in the presence of potentially distracting, irrelevant stimuli. Elderly adults are more susceptible to distraction effects from irrelevant stimuli than are young adults (Layton, 1975), suggesting that the older adults have reduced selective attention. Ford, Hink, Hopkins, Roth, Pfefferbaum and Kopell (1979), however, contend that electrophysiological data obtained from groups of young and elderly adults in a behaviorally-based decision-making task supported the notion that both groups attended selectively to the relevant stimuli equally well, but that the older people were more latent in their decision-making. Thus, what manifested as a deficit in selective attention was the result of slower decision-making.

The possibility that selective attention is reduced in the elderly population has implications for an older person's ability to scan visual information (a skill not necessarily related to or dependent upon visual acuity), and for spatial cognition. Although information pertaining to visual scanning is scant, age-related decrements have been noted (DiLollo, Arnett & Kruk, 1982; Plude & Hoyer, 1981; Plude, Kaye, Hoyer, Post, Saynisch & Hahn, 1983). Plude et al. (1983) found that when the processing load is sufficiently large, younger and older adults alike appeared to benefit from a fixed rather than varied set of targets when performing a controlled search, but older adults were consistently slower. DiLollo et al. (1982) speculated that the ability to scan a memorial representation of a visual array declines with age, as their elderly subjects were unable to complete such a task while their young and middle-aged adult subjects did so. Plude & Hoyer (1981) attribute decrements in visual search to the need for elderly adults to engage in effortful, rather than automatic, information processing.

Diminished spatial cognition in the elderly, a process thought to be affected by selective attention, has been reported by Weber, Brown and Weldon (1978). Elderly residents were shown slides of various areas of the nursing home in which they lived and were asked to identify on a map the location of the depicted scene. Mean percentage of identification ranged from 3.9% to 60.5% for seven different

areas. A group of university students, taken on a tour of the same facility for less than 40 minutes, identified 19.8% to 85.22% of the same areas. It was proposed that the identification rates varied across areas because some areas were more visually distinctive than others. Student identification performance was significantly better than the elderly resident performance in all areas of the nursing home except the building exterior. A further finding was that residency duration, suggestive of the degree of familiarity, was not related to the subjects' ability to identify the areas photographed. Since the elderly group had been selected on the basis of high level perceptual and cognitive functioning, their poorer performance was viewed as a likely consequence of aging (Weber et al., 1978). A more recent study (Zelinski & Light, 1988) hypothesized that elderly adults use contextual information less effectively than younger adults and consequently remember spatial information less well. The results of their study did not substantiate this, however, as age was not found to interact with the contextual variables presented in their task. Thus, age differences reported on tasks of spatial cognition do not result from degree of familiarity with given stimuli (Weber et al., 1978) or from differences in the ability to derive information from context (Zelinski & Light, 1988).

The third component of attending behavior, divided attention, involves "the shared processing of multiple sensory stimuli, all of which are relevant to the ongoing activity of the organism" (Kausler, 1982, p. 331). The phenomenon of divided attention has been studied largely through dichotic listening tasks in which two different tasks are presented simultaneously and must then be performed, or through dichotic memory tasks in which simultaneous sets of auditory stimuli are presented in successive pairs for later recall. Observed age-related deficits have been attributed to three possible factors. The first implies age changes in short-term memory storage. The second explanation suggests that unlike young adults, elderly adults use up an inordinate amount of their processing resources to organize their division of attention for multiple inputs. The third hypothesis is based on the theory of cerebral hemisphere laterality. Because language is processed in the dominant (usually left) hemisphere, information presented to the right ear is processed more proficiently than

information presented to the left ear. Further, it has been argued that "neural degeneration with aging may be more pronounced for the non-dominant right hemisphere than for the dominant left hemisphere" (Kausler, 1982, p.337). Research findings support the laterality principle in that an age deficit was evident when information was delivered to the left ear (non-dominant hemisphere) (Kausler, 1982).

Memory

At the core of cognition is memory. It is intimately related to the understanding of the cognitive processing involved in language comprehension and production. Language use involves encoding information into memory, storing or retaining that information over time, and retrieving or decoding that information when needed for communication. If deficiencies are evident in these stages of memory, correlated changes might be predicted in the ability to use language (Smith & Fullerton, 1981).

The current model of memory divides the system into separate stores or components. Incoming information is retained briefly in short-term memory, and may then be processed or encoded into a long-term memory system for retrieval and utilization much later. Information held in the long-term store may be either semantic or episodic in nature. Semantic, or generic memory refers to the internal lexicon, with memory traces organized by concept and semantic meaning. The permanent knowledge held in semantic memory is stored having no reference to or context about when and where it was acquired. Episodic memory, on the other hand, holds personally-experienced information for which the context for acquisition is known, and can thus be thought of as an internal diary (Kausler, 1988; Smith & Fullerton, 1981). A third component, working memory, is thought to be responsible for the encoding, transmission and retrieval processes involved in episodic memory (Kausler, 1988).

From their review of the literature on memory and aging, Burke & Light (1981) concluded that elderly adults consistently perform more poorly on memory tasks than young adults. Age-related deficits have been attributed to changes in the processes of information encoding, storage and retrieval (Belmore, 1981; Bowles &

Poon, 1985; Burke & Light, 1981; Gordon & Clark, 1974; Hartley, 1986; Spilich, 1983; Talland, 1968). Early studies demonstrated that short-term memory is more vulnerable to interference in older than younger subjects, and that when the input must be transformed or reorganized, memory deficits become especially noticeable, perhaps because of the reduced amount of information elders are able to store (Talland, 1968). Strong and reliable age differences in the recall of text among groups of young, elderly-normal and elderly-impaired individuals were found by Spilich (1983), who suggested that age-related changes in cognitive operations are more quantitative than qualitative in nature. This was particularly evident in the elderly-impaired group of subjects in his study, a phenomenon that Spilich felt was related to their inability to differentiate material stored in episodic memory from that in semantic memory. Alternatively, Spilich hypothesized that the elderly-impaired subjects could not inhibit the intrusion of information from long term memory into working memory. Limitations in working memory resources also may account for age differences found in discourse processing (Hartley, 1986). Burke and Light (1981) hypothesized that differences in the capacity and/or efficiency of working memory may explain cognitive aging and suggest that retrieval processes rather than production deficiencies were the integral factor in memory changes. Bowles and Poon (1985) agree that older adults exhibit a retrieval deficit in semantic memory resulting from changes in the fundamental processes involved in the retrieval of information.

Gordon and Clark (1974) contended that their findings of a greater age-related decrement in long term recall of prose supported the theory of a storage deficit in the elderly. A later study (Belmore, 1981), involving verification of meaning of prose passages, found that the elderly subjects were deficient in their retention of meaningful information. Belmore attributed the deficiency to memory limitations rather than to an inability to comprehend linguistic meaning. In summary, the interaction between storage, encoding and retrieval, and the effect of this interaction on learning and memory in elderly persons, is not well understood.

Problem Solving

Age-related decline in problem solving abilities has been reported by Arenberg (1974), Denney (1985) and Denney, Pearce and Palmer (1982). In a longitudinal study of logical problem solving in a large sample of well-educated, middle class men 24 to 87 years old, Arenberg (1974) found significant age differences for the group aged 70 years and over. Denney et al. (1982) investigated two types of problem-solving with subjects 20 to 80 years of age. In a traditional laboratory problem-solving activity (the Twenty Questions Task), performance decreased with increasing age. The elderly subjects asked significantly fewer constraining questions (those which would serve to eliminate a number of possible answers) than did their younger counterparts. The second component of the study involved solving practical problems relevant to young, middle-aged and elderly individuals. The performance of the younger subjects was superior to that of the elderly subjects on all of the problem-soving tasks. The most dramatic decreases in performance occurred in the 60 and 70 year old groups (Denney et al., 1982). In a later study, Denney (1985) found that performance was not facilitated by attempts to increase elderly adults' motivation, additional practice or by attempts to improve their confidence in their ability to perform cognitive tasks. Their performance improved, however, when the task was simplified to the point of making an efficient problem solving strategy obvious, and when the task was made so difficult that an efficient problem solving strategy was absolutely necessary. Denney (1982) and Denney et al. (1985) attributed reduced problem solving capacity in elderly adults to diminished cognitive resources.

Intelligence

A frequently-addressed issue in the literature on aging is intellectual development. Researchers traditionally have characterized adulthood as a cognitively stable period of life, with qualitative changes in an individual's cognitive structures viewed as "processes occurring either progressively during youth or adolescence or regressively in old age" (Allman, 1980, p. 1). The traditional maturational model of development, which held that intellectual

development and physiological development occurred concurrently, reaching a peak toward the end of adolescence, has been modified by the now widely accepted theory of crystallized and fluid intelligence (Cattell, 1963; Horn & Cattell, 1966).

Fluid intelligence, which reflects non-verbal cognitive abilities, is thought to be physiologically based and to progress along a developmental course predicted by a maturational model. A sharp age-related decline would be expected in this intellectual component. Verbal and numerical abilities, on the other hand, are sustained in crystallized intelligence, thus they are thought to be more directly linked to acculturation and education and therefore maintained or improved with advancing age. A decline would be evidenced only when deterioration of physiological structures prohibited further growth (Cattell, 1963; Horn & Cattell, 1966).

Allman (1980) points out that "physiological development was quite justifiably the predominant supportive base for the early phase of the life-span and also served to explain the decline in intellect characteristic in institutionalized geriatric patients" (p. 2). Birren (1970) hypothesized that 'normal aging' differed significantly from 'pathological aging', however, and found that the correlations between physiological malfunction and intellectual deficit in unhealthy elderly subjects were not true for elderly subjects in good health. Longitudinal data reported by Hertzog and Schaie (1986) supported the notion that individual differences in general intelligence were highly stable over time. Additional analysis (Hertzog & Schaie, 1988) revealed levels of general intelligence increased in a group of young subjects, remained stable in a middle-aged group, and declined almost linearly in an old group. This pattern of decline, beginning at around age 60, was thought to reflect a normative developmental transition. Baltes, Dittman-Kohli and Kleigl (1986) investigated the range of fluid intellectual reserve available to a group of healthy elderly persons (60 - 86 years) through a short-term longitudinal training study. Although performance on the trained items improved, the overall level of intelligence did not increase. The authors cautioned that the generality of their findings was unknown; results were biased in favor of those in good health. It would thus appear that general intelligence may be affected by aging although data to support this are scant.

In summary, age-related deficits in cognitive processes have been attributed to diminished resources available to elderly adults, to decreased speed of processing or to a combination of both. Differences in the performance of elderly as opposed to middle-aged and young adults have been documented in the cognitive functions of perception, attention, memory, problem - solving and intelligence. Predictably, language, as a cognitive function that interfaces with those mentioned above, would not be immune to age-related changes which conceivably affect the entire system. Cohen (1979) points out,

> understanding speech requires rapid processing of a continuous input, and memory for the earlier portions of the message must resist interference caused by intake of the later parts of the message. Attention must be sustained and divided between continuous monitoring of the input and simultaneous analysis and integration of the successive elements, and full comprehension depends on depth of processing. Thus it is reasonable to hypothesize that deficits in memory, attention, and speed of processing will be reflected in defective comprehension of spoken language (p. 413).

Effects of Aging on Language

Geriatric psycholinguistics is a relatively new field of study. The past decade has seen a sharp increase in the number of studies devoted to normal, age-related changes in adult language. In the field of speech-language pathology, it is important to understand which variations in language can be attributed to pathological versus normal changes for accurate diagnosis of patients with aphasia or dementia. Thus, patients with dementia or aphasia may be seen as having a deficit of function, while those without pathology may be considered to have a decline of function (Davis, 1984).

Early research in the area of geriatric psycholinguistics refuted the broad assumption of unimpaired language skills in the normal elderly population put forward by Cattell (1963) and Horn and Cattell (1966). Examples of such refutations included decreased quality of response on vocabulary tests, as judged by the aptness, economy and generality of the word definitions; a weakened or unstable lexical organization, demonstrated by age-related changes in word association; and increased difficulty in generating abstract rather than concrete explanations of proverbs (as cited by Cohen, 1979). Emery (1985, 1986), in an extensive study that

compared groups of pre-middle-aged and elderly individuals on a variety of language functions, used the context of the semiotic theory of signs for analysis of results. This theory is hierarchical in nature, encompassing simple to complex units of speech in the categories of phonology (the production, transmission, and reception of speech sounds), morphology (the patterns of word formation), syntax (the structure of grammatical sentences) and semantics (the relationship between signs and what they mean). The latter three (morphology, syntax and semantics), as well as inferential reasoning and discourse perception and production will be discussed.

Morphology

Information on the use and comprehension of morphological markers by elderly speakers is scant. As reported by Benjamin (1989), Kynette and Kemper (1986) studied morpheme usage by older adults through the analysis of 50 consecutive spontaneous utterances elicited during interviews. Age-related differences included the presence of fewer different verb tenses, fewer different grammatical forms, and fewer forms used correctly. Further investigation of morphology was conducted by Emery (1985, 1986). As part of her extensive test battery comparing normal pre-middle-aged adults, healthy elderly adults and elderly adults with senile dementia of the Alzheimer's type, Emery administered the *Test for Syntactic Complexity* (Emery, 1982) on which a verb tense discrimination task was used to test word-internal morphology. Word-internal morphology refers to the presence of a linguistic marker which signals meaning (for example, the regular past verb tense marker "-ed", as in kicked), as opposed to lexical morphology, which implies the entire meaning rests in a single unit (for example, the noun horse). A highly significant difference in performance was documented between the pre-middle-aged and normal elderly subjects. This difference was not evident on tests at the lexical sub-category of morphology, leading Emery to conclude that increased processing was required for the more complex word-internal morphological tasks. Thus, performance on tasks related to morphology may decline with age.

Syntax

The syntactic parameter has been more frequently investigated than other linguistic parameters. Bayles et al. (1985), who evaluated subjects' performance on a task of syntactic judgment and correction, found no differences in ability among groups of adults ranging in age from 20 to 79. Contrary to these findings, at the syntactic level, Emery (1985, 1986) found statistically significant differences between the pre-middle-aged and elderly groups of subjects on every measure administered, including the *Token Test* (DeRenzi & Vignolo, 1962; Spreen & Benton, 1969), the *Test for Syntactic Complexity* (Emery, 1982) and *The Chomsky Test of Syntax* (Chomsky, 1969, 1979). The normal elderly group consistently demonstrated decrement in syntactic function as a correlate of age. When the elderly group was sub-divided into younger and older halves, the older-elderly sub-group was found to have performed more poorly overall. Emery concluded that this demonstrated a direct relationship between age and deficit in syntactic processing because of the stringency of control of demographic variables. Of the syntactic variables evaluated, several were noted to occur late in the sequence of language development and concomitantly, were the most complex. These included passive voice subject-object discrimination, prepositions of time sequence, prepositions of location, possessive constructions of a reversible form, and communication of complex relations in contrast to the communication of events. Emery (1985, 1986) observed that language deterioration may be sequential in that the syntactic forms mastered latest in development were those in which the greatest processing deficits were evident.

Age effects in sentence comprehension were reported by Feier and Gerstman (1980) and Davis and Ball (1989). In the study by Feier and Gerstman (1980), four groups of subjects (18 - 25, 52 - 58, 63 - 69 and 74 - 80 years) were asked to act out the meaning of four different types of complex sentences by manipulating small animal or human figures. The two oldest groups made significantly more enactment errors than the two younger groups, with the oldest group demonstrating the greatest variability in performance. As well, this group made errors of a more serious nature, including omission of clause enactments and more multiple errors within a single sentence enactment. Feier and Gerstman

discussed their results in terms of the role of immediate memory in sentence processing, lack of linguistic understanding, attentional lapses and fear of failure by elderly individuals.

Using a procedure similar to that of Feier and Gerstman (1980), Davis and Ball (1989) investigated comprehension of complex sentences in five groups of adults, ranging in age from young to old, to determine whether age-related changes occurred in the appreciation of semantic or syntactic components of language. Results indicated that normal aging affects comprehension of complex sentences, with declines apparent after the age of 60. The semantic component was unaffected; the syntactic component was weakened when sentences conveyed implausible information. Finally, subjects in their 70s demonstrated subtle effects of the distance between sentence constituents that were not related to embedding of subordinate clauses. Davis and Ball submit that normal aging may effect interactions between components of the language system rather than only a single component.

In summary, it is apparent that age-related changes occur in the syntactic parameter of language. The extent to which these changes affect the accuracy and effectiveness of daily communication, however, has not been well demonstrated. Benjamin (1989) goes so far as to suggest that "qualitative changes in the syntactic behaviors of older adults do not appear sufficiently detrimental to adversely affect communication in daily life" (p. 171).

Semantic Function

Within the semiotic hierarchy, semantics pertains more to content than to actual structure, albeit with different levels of complexity. Changes in the semantic parameter of language may reflect differences in education, attention, memory and cognitive associations (Benjamin, 1989). In a synopsis of recent research on semantic function in older persons, Benjamin (1989) reported that word meaning is generally maintained, although the types of word associations differ between the old and the young. Word-finding difficulties are more common in older adults. As well, they perform more slowly than younger persons on

divergent and convergent naming tasks which demand quick word retrieval. If reaction time is not measured, however, elderly and young adults demonstrate similar semantic competence (Benjamin, 1989).

Several studies pertinent to semantic funtion in the elderly population merit mention. Emery (1985, 1986) tested the most elementary level of semantics, meaning in single words, simultaneously with the lexical subcategory of morphology using the *Boston Diagnostic Aphasia Examination* (Goodglass & Kaplan, 1972), and as previously discussed, found no significant differences between the normal elderly and the normal pre-middle-aged groups of subjects. Further, no significant differences were found between the two groups in responses to demographic, personal or medical history questions, suggesting that both groups dealt with meaning and with context equally well. Significant differences between the pre-middle-aged and elderly groups were present, however, on measures of semantic function that were more complex, more abstract and non-redundant. On the *Token Test* (DeRenzi & Vignolo, 1962; Spreen & Benton, 1969), a measure of ascending semantic complexity which, through its non-redundancy, necessitates processing the semantic value of each word, the elderly group in Emery's research showed significant decrement in semantic processing at a sentence level when compared to the pre-middle-aged group (Emery, 1985; 1986). The heavy memory load on this test may have contributed to performance differences; however, this element was not factored out in statistical analysis. The greatest decrement in semantic processing and integration was found when semantic abstractness and syntactic complexity were combined, such as in the *Test for Syntactic Complexity* (Emery, 1982).

Obler et al. (1985) evaluated the role lexical/semantic predictability played in the comprehension of sentences in noise. Both younger and older subjects were affected by the absence of semantic predictability, but overall performance decreased with advancing age. Bayles et al. (1985) observed no age-related deficits for a sentence disambiguation task on which subjects were asked to explain the two possible meanings of the ambiguous sentences provided. The authors pointed out, however, that distribution of performance scores suggested a possible ceiling effect. An investigation into the ability to comprehend lexical ambiguity in

sentences by Byrd (1988) found that the processing efforts of young adults were disrupted minimally by the presence of lexical ambiguity. Older adults, however, demonstrated a significantly greater amount of ambiguity-related disruption as evidenced by slower reading time and interference in reading the second fragment of a two-fragment sentence. Ulatkowska, Hayashi, Cannito and Fleming (1986), who found the use of reference deficient in elderly subjects, related the deficits to changes in both lexical and semantic structure. In spoken texts, the elderly subjects used a reduced variety of noun types as well as "fewer proper names occurring in association with a pervasive increase in frequency of pronominal usage" (p. 36). Thus, in research using both receptive and expressive measures of semantic function, age-related deficits have been reported.

Inferential Reasoning

Inferential reasoning has been identified as vulnerable to the effects of aging (Cohen, 1979; 1981). As Cohen (1981) pointed out, both spoken and written forms of communication contain implied as well as explicitly stated information. If elderly people fail to draw inferences correctly, significant communication breakdowns may occur. Inferences are typically constructed during comprehension, with both explicit and implicit information represented in the memory of a text. Failing to process implications results in impoverished comprehension.

Cohen's initial treatise (1979) delving into the area of adult language compared young and elderly subjects of high and low educational levels on three different tasks. In the first task, each subject listened to 16 short messages recounting everyday events. The messages were of two different levels of complexity and were presented at two different rates. Following each message, two questions were asked, one requiring a reproduction of the facts as presented, the other requiring an inference to be drawn from the presented facts. The elderly subjects made significantly fewer inferences than the younger subjects although no difference was evident for verbatim questions that required comprehension of only the surface meaning.

The second task used 16 new messages, of which half made good sense and half contained an anomaly. Each subject was asked to judge each message as

"right" or "wrong". The elderly groups made significantly more errors on this task than the younger groups. The third task involved having each subject listen to and then retell as accurately as possible, a story. The transcription of this oral reproduction was scored for (1) the total number of constituent facts or propositions correctly recalled; (2) the presence of six facts, labeled summary propositions, that conveyed the gist of the story; and (3) the use of a specific class of elements called modifiers. Again, the elderly groups were significantly poorer than the young groups on all three scores.

Three specific observations were made with regard to the performance of the elderly groups. First, deficits were apparent in their abilities to construct inferences that would typically occur spontaneously during conversation, suggesting that this process was either omitted or inefficiently performed. Second, elderly subjects were more likely to access irrelevant prior knowledge when required to integrate new material with prior knowledge. Cohen (1979) explained that "the nature of the errors suggested that the difficulty lay in retrieving the relevant prior knowledge for matching against the current input" (p. 427). Third, the elderly subjects demonstrated reduced retention of gist information in a story recall task, either because of inability, or because they chose not to prioritize it for recall. Based on her results, Cohen concluded that the elderly had "diminished ability to perform simultaneously the task of registering the surface meaning and also carrying out further processes involving integration, construction, or reorganization of different elements of the meaning" (p. 426).

From two later comparative experiments with old and young subjects, Cohen (1981) concluded that an age-related deterioration exists in making inferences based on logical relationships as well as on factual knowledge. The elderly subjects had more difficulty than the young subjects in solving logical problems, presented either in spoken or in written form. Spoken, as opposed to written input exacerbated elderly persons' difficulty in drawing correct inferences, likely because the rate of input exceeded their processing capacities. During a reading task, however, the old subjects also were found to be inefficient at extracting implicit information, despite being given an unconstrained amount of time. Cohen

(1981) argued that this supported the contention that aging adversely affects verbal reasoning ability.

Discourse Perception and Production

Some studies have focused specifically on the recall of discourse, as "memory for discourse . . . reveals the kind of omissions and distortions that may be imposed on information when memory is impaired by aging" (Cohen & Faulkner, 1981, p. 253). These authors presented a spoken text to young and elderly subjects, who then had to detect changes in a written version of the text. Cohen and Faulkner found a substantial age-related impairment in memory for discourse, possibly from deficits in acquisition or retention of the spoken information, rather than from retrieval failure. A second component of their study investigated the effects of delay between the spoken and written stimuli, and amount of intervening material (as judged by the number or words in the text). The results supported the hypothesis of a retention deficit, which led Cohen and Faulkner (1981) to conclude that "in old age, the deeper levels of encoding appear insufficiently robust to survive delay and interference from interpolated material" (p. 263).

Processing connected discourse into meaning demands rapid decoding. When the rate of speech was increased beyond normal limits, older adults recalled sentences more poorly than young adults although the elders were not at a disadvantage in processing informationally dense passages (Stine, Wingfield & Poon, 1986). The removal of processing time through an increase in speech rates lends support to the notion that some cognitive operations, particularly working memory, are performed more slowly by the older adult. Stine et al. (1986) propose that despite this apparent slowing, it may be that elderly adults compensate for this by engaging in some operations in a qualitatively different way. A later study (Stine & Wingfield, 1987) considered not only the rate of speech, but the degree of linguistic and prosodic cuing. As the speech rate increased, the elderly subjects demonstrated a differential decrease in recall performance. This was disrupted further by the removal of prosodic cues, which Stine and Wingfield (1987) attributed to the older adults' dependency "on the redundancy provided by intonational contour during the online processing of speech" (p. 278). The attention paid to prosodic contour was hypothesized to be an important strategy

used by elderly adults in daily communication if indeed age-related slowing in working memory processing affects their short-term retention of spoken information.

Production deficits of elders' connected discourse also have been addressed. North et al. (1986) found linguistic differences between elderly and middle-aged subjects on several production tasks that varied in degree of difficulty and cognitive demand. Identified differences included the recall of fewer explicit propositions, the production of fewer propositions, fewer correctly answered probe questions and the use of significantly more pronouns in retelling a complex narrative Kemper (1986, 1987) concurred with these findings, inferring from production tasks involving sentence imitation and prose recall that syntactic processing ability is impaired in elderly adults. In spontaneous discourse, they were observed to use reduced numbers of different grammatical forms, syntactic structures and verb tenses. Elderly adults were less able than young adults to imitate and paraphrase complex syntactic structures. Kemper suggested these results may be attributable to memory limitations. Further evidence of age effects for discourse production was provided by Bayles et al. (1985). On a verbal description task presented to six groups of adults from 20 to 80 years of age, the middle-aged subjects gave the best performance; whatever age effect occurred on this task did not occur as a gradual across-the-decades decline in performance. Rather, a gradual increase in ability was observed, peaking at middle-age, with a subsequent decline thereafter.

A study by Ulatowska et al. (1986) supported the notion of impairment of reference in elderly adults, as measured by noun/pronoun proportion in narratives, procedural discourse and responses to probe questions. The performance of three groups, middle-aged (27-55 years), young-elderly (64-75 years) and old-elderly (77-92 years), was compared on several tasks involving narrative or procedural discourse. The young-elderly group exhibited significantly more ambiguity of reference than the middle-aged group. The old-elderly group exhibited even more pronounced deficits. This led the authors "to suggest a life span continuum of referential decline within the normal population (young to elderly)" (p.34). Ulatkowska et al. (1986) speculated that within the normal elderly

population, cognitive etiology may underlie referential decline, based on their subjects' cognitive test results. Four standardized cognitive measures were used, including Raven's Matrices, Block Design, Symbol Digit and Verbal Fluency. Significant differences existed between the old-elderly and middle-aged groups on all measures, between the old-elderly and young-elderly groups in Block Design and Symbol Digit, and between the young-elderly and middle-aged groups in Raven's Matrices, Block Design and Symbol Digit.

Ulatowska et al. (1985), based on the results of two of their studies, made the following generalizations about discourse abilities in elderly adults: "(1) discourse impairments are more pronounced in older elderly subjects; (2) these impairments are evident even in well-educated people; (3) age-related difficulties are more evident on complex tasks; however (4) they occur across a variety of discourse types (i.e., narrative, procedural and conversational); and (5) they are modestly correlated with performance on cognitive and comprehension tasks" (pp. 134-135). Emery (1985) concluded that "linguistic deficits in the normal elderly are not a random occurrence, but rather follow an orderly and predictable pattern" (p. 40). Bayles et al. (1985), however, advise caution in assuming a decline in linguistic competency even for individuals over 70 years of age. They suggest that a gradual decline may follow a gradual performance increase, peaking at middle-age. They further warn that the senior population is by no means a homogeneous one, thus uniform linguistic performance, or uniform changes therein, cannot be expected.

The cognitive bases of language behavior, however, involve several seemingly dichotomous factors (Davis & Ball, 1989). For example, linguistic or grammatical knowledge may remain intact, while information processing, comprised of memory and attentional demands, declines. Language function may appear to be reduced on some language tasks when in reality, it is the result of general cognitive declines rather than inadequate language-specific processes. Further information about the language skills in the healthy elderly population is essential to clarify and isolate specific areas areas of decline.

Comprehension Monitoring

Metacognition

Prutting (1982) observed that the field of speech-language pathology has recently been directed toward how people with communication disorders regulate their relationships with others that are mediated by speech and language. She explains that "their appropriateness, effectiveness, and success depend on the ability to monitor context" (p. 132). This monitoring ability is part of the larger process of metacognition, explained as a person's knowledge about cognitive processes (Flavell, 1978). The best studied cognitive domain to date is memory (Yussen & Bird, 1979); little is known about the development of other metacognitive areas such as communication, problem-solving and perception, although these areas cannot be completely separated (Flavell, 1978). It has been suggested by some theorists that although each of these areas may be under the direction of different cognitive processes, there may also be a centralized, developing core of metacognitive insights (Flavell, 1978). This is supported by Yussen and Bird (1979) who studied children's understanding of the impact of length, noise, age and time across the cognitive domains of memory, communication and attention. Results revealed that four and six year old children apply common insights across cognitive domains, suggesting that metacognitive development may evolve in a systematic, or synchronous fashion.

Baker and Brown (1984) describe the major components of metacognition as awareness, monitoring and implementation of compensatory strategies. These components can be clearly demonstrated through the cognitive domains of communication and memory.

Awareness

An individual's "metalinguistic awareness" allows him to be his own audience; he generates ideas, then thinks about the ideas generated, in a manner similar to his assuming the role of the listener in a prototypical communication situation. If the intent is to encode these messages for an external audience, the person not only thinks about the message, but joins the audience in listening to it (Flavell, 1978).

Hakes (1980) states that "metalinguistic abilities are different from and emerge later than, the abilities involved in producing and understanding language" (p. 2). He claims that their greatest development occurs roughly between the ages of four and eight years, and is thought to be a linguistic corollary of the cognitive developmental stage that Piaget described as concrete operational thought. Messages sent engender cognitive representations and experiences for both adults and children, albeit somewhat differently. For example, it is during middle childhood that children develop the metalinguistic ability to recognize ambiguity, incorrectness or vagueness in a message. Unlike adults, young children do not scrutinize or evaluate the messages and representations, nor do they consciously monitor the continual generation and reception of these cognitive events (Flavell, 1978).

Monitoring

Listeners typically understand an utterance they hear without stopping to judge its acceptability; the need to make a judgment is not inherent in comprehension. The processes involved in language comprehension appear to be largely automatic; that is, they "are executed with extreme rapidity and seem also to be relatively invariant in their execution from one occasion to the next" (Hakes, 1980, p. 22). Making a judgment of acceptablity is an optional process that occurs in addition to comprehension processing (Hakes, 1980).

Research in the area of cognitive monitoring has been predominantly child-oriented, focusing on the development of these skills. Some studies report that young children are less competent than older children at monitoring their memories, and that young children's knowledge about memory contributes at least in part to observed developmental differences in memory performance (Flavell, 1977; Flavell & Wellman, 1977). Yussen and Bird (1979), in studying metacognitive tasks pertaining to memory, communication and attention, found that six year old children were more accurate in overall performance than four year old children, supporting a developmental theory of metacognitive ability. In a paired-associate learning task, Bisanz, Vesonder and Voss (1978) found that unlike older children and adults, younger children may not successfully use a "discrimination-utilization

strategy," in which "individuals discriminate their own correct and incorrect responses on a given trial and use this information for distributing processing effort on the subsequent trial" (p. 116).

Studies pertaining to comprehension monitoring in children have been completed by Markman (1979) and Flavell, Speer, Green and August (1981). In Markman's (1979) study of six, seven and eight year olds, the younger children were extremely insensitive to blatant omissions in directions given with regard to learning a particular task, despite having been instructed to check the material for its comprehensibility. Only when they attempted to complete the direction as given did they discover that anything was wrong. Markman proposed that they did not construct the instructions on a mental level as they listened, nor did they analyze the relationship between the behavioral goal and the direction as given.

Flavell et al. (1981) investigated comprehension monitoring skills in kindergarten and second-grade children, who, having been given tape-recorded instructions, were to construct block buildings. They were then asked to judge whether their buildings were the same or different than those of the child-confederate who gave the instructions. The older children were more proficient than the younger children at detecting the inadequate instructions, as evidenced by pauses, perplexed facial expressions, requests to replay the tape and verbal comments. A second study demonstrated that inability to remember the instructions was not a factor in the kindergartners' performance. Thus, the studies by Markman (1979) and Flavell et al. (1981) support the hypothesis that children develop comprehension monitoring abilities over time. The assumption is that these abilities are developed by adulthood.

Use of Compensatory Strategies

The reciprocal nature of communication implies that the maintenance of a communicative interchange is of paramount importance. It is only when communication breaks down that awareness of comprehension processes is triggered, provoking the conscious application of a compensatory strategy (Baker & Brown, 1984). These monitoring strategies were reliably identified in children by Flavell et al. (1981), who initially developed a coding scheme that contained 146

categories of behavior. The similarity of many items prompted a consolidation to 75 categories for final analysis, with interjudge reliability ranging from 72% to 100%. Behaviors categorized for analysis included motor or non-verbal methods of problem detection (e.g., facial expressions, manual or other body movements, glances directed to the examiner or tape recorder, obvious hesitation, manual vacillation) and verbal comments (e.g., interjections, unspecified statements, specified statements). Although the children in this study were subjected to tape-recorded rather than live-voice presentation of directions, it could be argued that their use of monitoring behaviors in an artificial situation would predict their use at a spontaneous conversational level.

In conversation, communicative interchange is maintained by having the listener provide feedback to the speaker. As Chapey (1986) explains, "this involves the listener's ability to monitor and evaluate the speaker's message and ability/willingness to indicate whether or not he believes it is effective and acceptable" (p. 227). Such monitoring occurs as a method of regulating the discourse. Further maintenance of communication occurs when such feedback is acted upon by the speaker in the form of repairs and/or revisions which modify or clarify the message (Chapey, 1986). Davis (1986) explains that in the presence of a communication breakdown, the listener may respond with a 'contingent query'. Such an utterance is intended to correct the communication breakdown by seeking clarification or requesting a repetition or a revision. Davis (1986) cites Apel, Newhoff and Browning-Hall (1982) who found that aphasic patients successfully used contingent queries when the speaker's utterances were intentionally ambiguous.

Newhoff, Tonkovich, Schwartz & Burgess (1982) and Rezania, Hambrecht and Quist (1989) compared the strategies used by groups of aphasic and non-aphasic individuals when a listener failed to comprehend their message. Newhoff et al. (1982) reported that although the frequency of occurrence of revision categories were similar for the aphasic and non-aphasic groups, the strategies used were significantly different. Persons with aphasia used more exact repetitions and phonological revisions, while the non-aphasic subjects used more syntactic revisions, information additions and information deletions. This led to the

conclusion that aphasic individuals retain their understanding of revision behavior despite having lost specific language skills (Newhoff et al., 1982). Rezania et al. (1989) concurred, reporting that when a communication breakdown occurred, aphasic patients in their research understood the necessity of recoding the original message, but suffered a breakdown in the recoding process. Although they used the same recoding strategies as the non-aphasic subjects, the aphasic participants used the strategies (particularly expansion and deletion) less frequently. The observed recoding deficits in the aphasic patients were thought to be related to conceptual thinking abilities.

Metalinguistic Skills in Adults

Analysis of meta-abilities in adults has been restricted largely to the cognitive area of memory. Perlmutter (1978) compared young (20-25 years) and elderly subjects (60-65 years), whose maximum educational achievement levels ranged from the completion of high-school to attainment of a doctoral degree, on a variety of tasks related to memory. Results indicated significant age decrements in word recall and recognition that were independent of education. Further analysis revealed that both the young and elderly groups were comparable in terms of memory knowledge, memory prediction and memory confidence, suggesting that "age differences in monitoring skills do not contribute to age differences in adult memory" (p. 342).

Metacommunication skills in the adult population have been studied minimally. Longhurst and Siegel (1973) studied the effects of communication failure induced by distorting the speech signal transmitted over a microphone-earphone link between visually separated speakers and listeners. The listener was to select a line drawing from an array as described by the speaker. Because the listener could not communicate directly with the speaker, the examiner told both subjects whether the listener's choice was correct. When the listeners received distorted speech signals, their performance on the task improved. The authors suggested that this may be accounted for by improved listener competence in the interpretation of interrupted speech, but of more significance may be the contribution of the strategies employed by the speakers when communication

failed. Speakers were observed to lengthen their descriptions, reduce their rates of talking and use redundant speech. Longhurst and Siegel (1973) postulated that since no explicit consequences were attached to success, it was reinforcing for the speakers to be understood. Further, they claimed it was quite obvious that "speaker performance was sensitive to listener behavior within the confines of the task" (p. 138). In this study, listeners were not given the opportunity to communicate directly with the speakers; their possible verbal expressions pertaining to their non-comprehension and the strategies they might have employed to rectify the situation were not evaluated.

Metacommunication skills were investigated in a fairly unstructured manner by Siegel and Gregora (1985), who studied the communication performance of young and elderly subjects, grouped in dyads that were either homogeneous (young-young, old-old) or heterogeneous (old-young) for age. Each partner in the dyad was given an identical set of objects and a 16-square matrix. With a barrier between them to prevent visual access to their partner's tabletop, members of the dyad were to place the objects in the same position on the matrix. The members of each dyad were responsible for deciding, between themselves, how this was to be organized and completed. Performance was scored for both accuracy and time. The researchers also recorded those utterances used to direct attention to or manage the task, which they labelled "meta-communication" units. Siegel and Gregora did not find an age-related decline in the accuracy of, or time needed for, task completion. There was a significant difference between the mixed and homogeneous dyads in the number of meta-communication units used. The old-young group made more comments about the task and possible stategies for its completion. The two homogeneous groups did not differ significantly in the number of comments given. Siegel and Gregora (1985) suggested that these results did not support the contention that elderly adults communicate with less efficiency and effectiveness than younger adults.

Verbal vs. Non-verbal Communication

Human communication has been defined by Richmond, McCroskey and Payne (1987) as "the process of one person stimulating meaning in the mind of another person (or persons) by means of verbal and/or non-verbal messages" (p. 1). Aspects of verbal communication, comprehension and expression through a formal linguistic code, have been discussed in other sections of this paper. Robbins (1986) estimates that only 7% of what is communicated is transmitted purely through words; the bulk of information exchange is non-verbal. This includes not only tone of voice (38%), but body language (55%) such as facial expressions, gestures and other movements. Richmond et al. (1987) explain that non-verbal behaviors function as non-verbal communication only when a behavior is interpreted as a message and the message is given meaning. Thus, non-verbal communication occurs only in the presence of another person. It is possible for a non-verbal message to be sent intentionally or accidentally, depending on the interpretation of the behavior by the receiver. Also, the receiver may not interpret the behavior as it was intended by the message sender, but some form of communication has occurred nonetheless.

Non-verbal communication usually occurs jointly with verbal communication. It is possible to interpret both types of messages independently, but meaning is typically derived from the combined impact of both verbal and non-verbal modes. Non-verbal messages function in relation to verbal messages in the following forms: complements (clarify the verbal meaning), contradictors (conflict with the verbal message; for example, sarcasm), repetitions (affirm the verbal message, and could stand alone if the verbal was not present), regulators (coordinate verbal interactions; for example, a finger raised to indicate the message is not finished), substitutes (replace verbal messages) and accents (emphasize distinct points in the verbal message). Categories of non-verbal messages include physical appearance, gesture and movement, face and eye behavior, vocal behavior, space, touch, environment, scent and smell, and time. Messages from within these categories exist in the presence of messages from other categories, verbal messages and contexts (Richmond et al., 1987).

Blanck, Buck and Rosenthal (1986) explain that non-verbal communication is a spontaneous process that involves motivational and emotional states, while verbal communication is intentional, with rules that control non-verbal expression. It is thought that non-verbal messages have a far greater impact than verbal messages on the affective, or relational state (Richmond et al., 1987). Thus, verbal communication serves primarily a content function, while non-verbal communication serves primarily a relational function.

There is little in the literature that explores age-related changes in non-verbal behavior. Physiological changes known to occur with age could predictably result in motoric differences, but these are not discussed as they pertain to communicative function. Two studies by Malatesta and her colleagues (Malatesta, Fiore & Messina, 1987a; Malatesta, Izard, Culver & Nicolich, 1987b) have investigated emotion-based expressive patterns through the facial characteristics of older persons. In a study of emotion communication skills in young, middle-aged and older women, Malatesta et al. (1987b) reported trends suggesting that decoding the affective expressions of older subjects may be more difficult because of structural changes in the face. The clarity of the signal may be blurred by wrinkling and/or sagging of the striate musculature (Malatesta et al. 1987b), and compounded by traces of emotional content such as disgust, interest or sadness in the face, even during the resting state (Malatesta et al., 1987a).

Rationale

Studies of the cognitive and psycholinguistic behaviors of elderly adults have revealed valuable information that is pertinent to an understanding of language competence in elders. Differences in perception in elderly adults have been attributed to diminished sensory sensitivity (Kausler, 1988) and to reduced speed of processing in the central nervous system (Kausler, 1982; Salthouse, 1982). Deficiencies in the attentional phenomena of vigilance, selective attention and divided attention may be a result of fatigue (Talland, 1966), degree of automaticity of information processing (Plude & Hoyer, 1981) or changes in memory storage (Kausler, 1982). Besides storage, the encoding and retrieval of information has been implicated as prone to interference in the aged, resulting in age-related

deficits observed on memory tasks (Burke & Light, 1981; Spilich, 1983). Elderly subjects' performance on problem solving tasks has been noted to be inferior to that of younger and middle-aged subjects (Denney et al., 1982; Denney, 1985). Intelligence is thought by some to be highly stable throughout adulthood (Hertzog & Schaie, 1986), although other studies have shown significant age-related differences in measures of general intelligence (Hertzog & Schaie 1988) and fluid intelligence (Baltes, Dittman-Kohli & Kleigl, 1986).

The effects of aging on language are not as conclusive as they are on cognition. Age-related differences have been documented on tasks of morpheme usage (Emery, 1985; Emery, 1986; Kynette & Kemper, 1986). Emery (1985, 1986), Feier and Gerstman (1980) and Davis and Ball (1989) have reported age-related decrements in both the comprehension and production of several syntactic variables, although Bayles et al. (1985) found similar ability in young and elderly subjects in their judgments and corrections of syntactic forms. With regard to the semantic function of language, elderly individuals exhibit varied skill. Although appreciation of the meaning of single words appears to be maintained, age-related deficits become evident as an increased level of processing is required, such as when dealing with a combination of semantic abstractness and syntactic complexity (Emery, 1985; 1986). As well, elders have more difficulty than their younger counterparts in comprehending lexical ambiguity in sentences (Byrd, 1988). In spontaneous expression, elderly subjects were noted to have deficient use of anaphoric reference (Ulatowska, et al., 1986).

Cohen (1979; 1981) identified inferential reasoning as vulnerable to the effects of aging. Age-related deterioration was evident in elders' ability to solve problems based on logical relationships as well as on factual knowledge, with information presented either in spoken or written form. Deficits in discourse perception, involving recall of text (Cohen & Faulkner, 1981) and decoding sentence meaning (Stine et al., 1986), also have been found in research on elders. Production deficits of connected discourse include reduced numbers of different grammatical forms, syntactic structures and verb tenses (Kemper, 1986; 1987) as well as the production of fewer propositions, fewer correctly answered probe questions and the use of significantly more pronouns than nouns in retelling complex narratives (North et al., 1986; Ulatowska et al., 1986).

Metacognitive awareness has been implicated in the effectiveness of communication with others (Prutting, 1982). The major components of metacognition, awareness, monitoring and the use of compensatory strategies, have been researched more extensively in children than in adults, and more frequently in communicatively impaired adults than in healthy adults. There is some evidence to suggest that some aphasic individuals, for example, maintain some understanding of the need to recode an original message, but suffer a breakdown in the recoding process (Newhoff et al, 1982; Rezania et al., 1989).

With the exception of the information provided by Longhurst and Siegel (1973) and Siegel and Gregora (1985), very little is known about the metacognitive skill of comprehension monitoring in the geriatric population. In view of the reported decline in language comprehension skills with advancing age, an accompanying decrease in comprehension monitoring skills might be predicted. Are older individuals able to detect, as frequently or as rapidly, that they have failed to understand something said to them? Do they assume they have understood, only to discover later that the information was ambiguous or incomplete? Are they immediately aware that a direction or instruction cannot possibly be completed because of inaccuracies or complexity? Information such as this has yet to be documented but is important, nonetheless.

Declining ability to monitor their comprehension, as evidenced by detecting communication failure, could have serious implications for senior citizens in terms of their health care, needs for travel, legal and financial advice, appreciation of sociopolitical issues, and thorough enjoyment of leisure activities. If comprehension monitoring does decline with age, access to and acquisition of such services or opportunities may be jeopardized. Furthermore, information about normal changes in comprehension monitoring abilities with age is of value to professionals in disciplines that deal with elders whose competence may be compromised by neurological injury or disease, or generally poor health. Thus, the nature of comprehension monitoring skills in the healthy elderly population would provide valuable information pertinent to assumptions about the premorbid abilities of patients who are victims of stroke or dementia, a practical necessity given the use of pragmatic therapy approaches in treatment of aphasia, and communication facilitation strategies in the management of dementia.

Statement of the Problem

Whereas comprehension monitoring abilities in elderly adults warrant further investigation, several hypotheses were formulated comparing their comprehension monitoring skills to those of younger adults.

Given spoken information of different forms, the elderly subjects of this study will differ from a younger group in the detection of communication breakdown, in their speed of acknowledging such a breakdown, and in the nature of their acknowledgement, as proposed in the following hypotheses:

Hypothesis 1: There will be a difference in the frequency of communication breakdown detection between age groups and among stimulus types, and there will be an interaction between age and stimulus types. Specifically, the elderly group will detect instances of communication breakdown less frequently than the younger group.

Hypothesis 2: There will be a difference in the mean response time to communication breakdown between age groups and among stimulus types, and there will be an interaction between age and stimulus types. Specifically, the elderly group will have a longer mean response time to communication breakdown than the younger group.

Hypothesis 3: There will be a difference in the nature of the response (verbal, non-verbal or no response) used to signal communication breakdown between age groups and among stimulus types. (There are no data available in the literature to allow the prediction of a directional hypothesis about response type.)

CHAPTER III

METHOD

Subjects

Forty subjects were tested, ten females and ten males in each of two age groups, young (range 18 - 25 years; mean 21.62 years) and elderly (range70-80 years; mean 74.44 years). A cross-sectional, rather than a longitudinal, method was used. Although this approach does not provide information about age changes over time or address variations due to cohort influences, it does yield information about age group differences (Huyck & Hoyer, 1982).

All subjects were native speakers of English and were drawn from middle-class districts in an urban area of western Canada (Edmonton, Alberta). All elderly subjects lived independently in the community; the young subjects typically resided with family. Subjects were recruited by means of personal contacts and advertisements in a local community newspaper. In an effort to reduce the influence of factors other than age on the performance of the two groups, the factors of health, hearing, vision, cognition and education were considered in subject selection. A summary of subject information is presented in Table 1.

Health

Only healthy individuals were selected for inclusion in the experimental procedure, for several reasons. Physical health was identified by Milligan, Powell, Harley and Furchtgott (1984) as a predictor of behavioral performance in elderly men. Three groups, consisting of hospitalized veterans, veteran out-patients and non-hospitalized veteran volunteers, differed significantly from one another in objective and self-assessments of physical health. Those in poorer health did significantly less well on reaction time and serial learning tasks. Field, Schaie and Leino (1988) reported that health was commonly implicated when documented change in cognitive functioning was extreme. Furthermore, because illness is more prevalent in the elderly population, a comparison of old and young subjects in reality may be a comparison of poor and good health (Layton, 1975). Therefore,

major health differences among participants were controlled by having potential subjects rate their states of health on a four-point scale (4 = excellent, 1 = poor) based on the findings of Maddox and Douglass (1973) and LaRue et al. (1979) that individuals' self-ratings of health correspond strongly with physicians' ratings of health in those individuals. No subjects in the present study rated their health as "poor". The mean rating for the young subjects was 3.45, and for the elderly was 3.43. All potential subjects also were questioned about their use of medications; those being medicated for, or having a history of, high blood pressure or heart disease were excluded from the study because of the high correlation between chronic hypertension and stroke (Sahs et al., 1976), and because cardiovascular disease and the drugs used to combat it may be a contributing factor to disordered intellectual function (Eisenberg, 1985; Hertzog, Schaie & Gribbin, 1978).

Table 1. Subject Information

Factor		Young (Mean)	Elderly (Mean)
Age		21.62 years	74.44 years
	Male:	21.62 years	74.23 years
	Female:	21.62 years	74.65 years
Self-Ratings of Health		3.45	3.43
	Male:	3.35	3.40
	Female:	3.55	3.45
Education		13.3 years	12.25 years
	Male:	13.3 years	11.9 years
	Female:	13.3 years	12.6 years
WAIS-R Block Design		10.8	11.3
	Male:	10.8	11.3
	Female:	10.8	11.3
WAIS-R Vocabulary		10.3	11.05
	Male:	10.1	11.2
	Female:	10.5	10.9
Hearing Handicap Inventory		n/a	3.9
	Male	n/a	4.6
	Female	n/a	3.2

Hearing

Two indicators of hearing adequacy were used in subject selection. All potential subjects were screened for their ability to hear the experimental stimuli adequately by presenting ten simple verbal instructions in a format similar to Subtest II of the *Revised Token Test* (McNeil & Prescott, 1978). These directions were presented on an audio tape recorder under sound level and orientation conditions comparable to those of the experimental session; namely, between 70 and 80 dB SPL and azimuth presentation at 1m. The screening test directions were recorded by the same male announcer who recorded the experimental stimuli. On this measure of hearing adequacy, criterion for eligibility to serve as a subject in the experimental task was 100% correct performance. Hearing test items are contained in Appendix A.

The "Hearing Handicap Inventory for the Elderly" (Appendix B) (Ventry & Weinstein, 1982) was administered to the elderly subjects to obtain a subjective report of hearing ability. A second hearing criterion for eligibility to serve as a subject in this research project was a score of ≤20 on this measure. Anyone attaining a score greater than 20 was excluded form the experimental study because of the likely presence of a hearing loss that would interfere with daily activity. A score of 0 was the mode (10 out of 20 subjects), with the remaining scores ranging from 2 to 16. Subjects who wore hearing aids were included in the study so long as they met these two hearing screening criteria.

Vision

All potential subjects were screened for the ability to see the experimental materials adequately by having them read aloud ten words (Appendix C), selected from among the printed stimuli used in the experimental tasks. The stimulus words were printed in type face identical to that used on the gameboards in the experimental task, and were presented one at a time. The vision criterion for inclusion in the experimental task was 100% correct performance on this screening task. Subjects who wore eyeglasses were included so long as they met this criterion. No subject reported having color blindness.

Cognition

Attempts to achieve cognitive similarities among subjects were made through the administration of the Vocabulary and Block Design Subtests of the *Weschler Adult Intelligence Scale: Revised (WAIS-R)* (Weschler, 1981). Raw scores were converted to scaled scores for each of the age groups according to the *WAIS-R* norms, with norms for those aged 70 - 74 used for subjects up to the age of 80. Only those individuals whose scaled scores fell within the range of eight to twelve were included in the study. Means for the elderly subjects' performances were slightly higher (11.05 for Vocabulary, 11.3 for Block Design) than those for the young participants (10.3 for Vocabulary, 10.8 for Block Design).

Education

Given the age of the elderly subjects and the history of the area from which they were drawn (Edmonton, Alberta) as a rural community in the early 1900's, it was virtually impossible to match the young and elderly subjects for educational level. Education is considered an important factor in gerontological research; because the average amount of formal education obtained by North Americans in urban areas has increased over the past century, observed differences between young and elderly subjects in performance on cognitive tasks may be attributable to fewer years of formal education among elders rather than to diminished cognitive skills associated with age (Perlmutter, 1979; Parks, Mitchell & Perlmutter, 1986). Mean educational level for the young group in this study was 13.3 years (range 12 - 16.5 years) and for the elderly group was 12.25 years (range 8 - 18 years). An unpaired t -test revealed no significant difference between the two groups for years of education ($p<.05$).

Possible effects of educational level on experimental task performance were explored by comparing the vocabulary words included in the test stimuli to the spoken word frequencies compiled by Howes (1966). Only 38 of the 231 (16.5%) different word roots used were not on this list, suggesting a very high proportion of familiar words. Further, a Grade 5 teacher reviewed the test stimuli and cited the vocabulary he felt his students might not understand. The thirteen words identified by this primary school teacher were then given to two children, both

nine years of age, who were able to define eight of the words satisfactorily. The remaining five words in question were included as stimuli for the vision screening test.

Materials

Stimulus items were presented to each subject using a Sony TCM-5000EV cassette tape recorder (azimuth presentation at 1m. from the subject). Instructions were recorded by a professional male radio announcer on an Otari 5050B reel-to-reel tape recorder, then dubbed onto cassette tapes. For the purposes of this study, audio-taped stimulus presentation was deemed preferable to live-voice presentation. Although Obler et al. (1985) reported that the comprehension of both older and younger subjects was negatively affected by the absence of the visual input provided by a live speaker, it was postulated that tape-recorded directions would resemble receiving directions over the telephone, a situation in which a person must rely heavily on his/her comprehension monitoring skill to acquire sufficient information. Moreover, this allowed for control of stimulus presentations within subjects (for replays) and across subjects in terms of loudness level, voice quality and uniformity of prosody (rate, intonation, pause and linguistic stress). All experimental sessions were audio-video taped.

Four game boards of varying sizes were designed for the experimental task, and are shown in Appendix D. They depicted the following scenarios: a hospital (16cm x 21cm), the downtown area of a city (20cm x 21cm), a city shopping area (20cm x 27 cm) and a shopping mall (20cm x 27cm). Although slightly different in size, they contained a similar number of written elements (19, 20, 19 and 25 elements respectively). The use of four game boards was based on a preliminary version using only one larger design (60cm x 60cm). Pilot investigations revealed that with a board that large, a considerable amount of time was spent visually scanning to find the specified locations for marker placement. It was thought that the difficulty with target location may confound a subject's actual comprehension monitoring, thus the format was modified to reduce the number of elements to be considered for any given stimulus item. Additional materials for the experimental task included a game marker and play money from copyrighted board games.

Procedure

Each potential subject was screened over the telephone with regard to age, health status and medications. Those who met the inclusion qualifications established for these factors in the study were invited to the university for a testing session and were reminded to bring their eyeglasses and/or hearing aids with them if needed. It is uncertain what effect testing in an unfamiliar environment has on elderly subjects. Perlmutter (1979) has suggested that a laboratory as opposed to a home setting may create artifactual differences because of the elderly person's increased susceptibility to anxiety produced by unfamiliar situations. Molfese, Hoffman and Yuen (1981), on the other hand, concluded that task setting had minimal influence on performance, based on their comparison of elderly persons' performances when completing a task at home versus in the laboratory. The ability to achieve more procedural control and consistency by testing subjects in the same setting was the deciding factor in having all subjects complete the screening and experimental tasks at the university location.

Each subject was tested individually by the same experimenter in a small, quiet, well-lit and well-ventilated room. The session began by having each subject sign a consent form (Appendix E) to indicate his/her informed agreement to participate in the study, and an authorization for photography to verify permission to videotape the session (Appendix F). Those subjects who expressed discomfort about being videotaped were offered the opportunity to view themselves prior to testing. The testing session included the vision, cognitive and hearing screening procedures. A total of 63 subjects were screened. Individuals who did not pass these screening tests according to the inclusion criteria were given a choice as to whether or not they wished to participate in the actual research task. All chose to do so. Data from these individuals were not included in the analysis of results for this study.

The research task was implemented with the subject and experimenter seated at a table, at right angles to each other, and with a game board on the table oriented toward the subject. The tape recorder on which the directions were played was placed on the table near the examiner and 1m. from the subject. The examiner read the game instructions aloud from a specified script (Appendix G).

The object of the game was for the subject to collect as much play money as possible by running a series of "errands" using a marker and four game boards, presented one at a time. The play money was intended to serve as a game incentive. Provision of incentive has been found to improve the overall level of performance in elderly adults (Leech & Witte, 1971), although this may take the form of increased involvement in the task rather than actual increased accuracy of performance (Hartley & Walsh, 1980). Initially, $30 of play money was given to a subject. An additional $10 was awarded for the accurate completion of each errand; $10 was forfeited for inaccurate completion of the errand. Each subject was informed that in order to win a prize at the end of the game, he/she must retain a minimum of $50. The prize was a restaurant gift certificate.

The examiner familiarized the subject with the tape recorded presentation format, the game boards and the marker by playing four easily-understood practice stimuli, one for each of the gameboards. Each subject was instructed to place the hand to be used in manipulating the marker against the edge of the board, or near the marker, in preparation for each item. Subjects were asked to refrain from picking up the marker until each direction was presented in its entirety, and then to complete the task as quickly as possible once the direction was given. The examiner mentioned that each direction could be replayed once on the tape recorder at the subject's request. This replay option was reiterated following presentation of the first complex stimulus item, because pilot subject performance had revealed that subjects, regardless of age, consistently forgot they could request a replay. The subject was allowed to ask questions to clarify the rules of the game prior to the commencement of the first stimulus item.

Each subject listened to 30 stimulus items pertaining to the movement of a marker on the game boards. The directions were relevant to events of daily living, in that they represented situations, arranged into hypothetical "scenarios", that might occur from time to time in one's everyday life. The scenarios and task stimuli were developed by the principal investigator. Ten of these instructions were clear and presumably easily understood. These simple directions were intended to provide positive reinforcement for the subject's participation and attention, and allowed for the collection of sufficient play money to win the game.

They were randomly interspersed with the the remaining twenty directions, which were designed to provoke a breakdown in comprehension. These twenty stimuli were divided into four categories containing five stimulus items each, as described in Table 2 (after Dollaghan & Kaston, 1986). Test stimuli are included in Appendix H.

Table 2. Categories for "Inadequate" Stimuli

a) Obscured — a key noun in a simple direction was masked by a superimposed noise, in this case, that of a loud telephone ringing that obscured the complete message, rendered the message ambiguous and made completion of the direction more difficult.

Example: "Get a paper from the (telephone ring)."

b) Ambiguous — two equivalent choices were given, without specification for the intended placement of the marker, so that no certain response to the direction as given was possible.

Example: "Go to the florist across the street from the Post Office." (There are two florist shops in that location.)

c) Complex — the stimulus was lengthy and thus contained a considerable memory load. Completion of these items was possible but difficult.

Example: "If you haven't already delivered the cheque to the travel agent, go there before heading to the telephone company to pay your bill. Then proceed to the bank only if you can't get to the Instabank more easliy."

d) Impossible — the physical layout of the board precluded the direction's being completed as stated.

Example: "Go to the restaurant beside the insurance agent for a cup of tea." (There is no restaurant in that location.)

After each response attempt by the subject, the examiner resumed playing the tape recording which provided feedback as to the correct placement of the marker. This allowed the subject to correct the marker placement, if necessary, and eliminated the need for the examiner to provide verbal reinforcement that might have biased the subject's subsequent response patterns. If the subject had the marker in the correct place, he/she collected $10. If the marker was in the wrong place, the subject forfeited $10.

It was anticipated that all subjects would complete the clearly-recorded, simple stimuli accurately, and that some would complete the obscured-simple, and complex items accurately. For each ambiguous direction there were two possible correct choices. One choice was selected by the examiner as being "correct"; there was thus a 50 per cent chance of a subject's completing the instruction. This strategy was adopted to avoid having a subject anticipate an inevitably correct response when faced with an ambiguous instruction. Responses to the impossible items were followed by clarifying comments from the speaker on the tape recorder, giving a credible placement for the marker. Money was awarded for this alternative placement to reduce the possible frustration of being unable to complete the item. Comments from the subject pertaining to the stimulus items were answered non-judgmentally by acknowledging the complex, ambiguous, impossible or obscured nature of the items. All subjects concluded the task with considerably more than the $50 necessary to win the prize.

Data Analysis

Response Coding

Subjects indicated awareness of comprehension breakdown in two general ways, verbal comments and nonverbal behaviors. From the videotapes, the principal investigator documented verbal and nonverbal indicators of comprehension monitoring produced by each subject in response to each of the five task message types. Only the first obvious indicator of comprehension monitoring for each stimulus was tallied and categorized according to the verbal measures outlined in Table 3, or the nonverbal measures outlined in Table 4. These were derived from the categories used by Flavell et al. (1981), and from pilot and actual data collection for the present study. Inaccurate performance on the ten easy stimuli, and no indication of comprehension monitoring in response to the twenty inadequate stimuli were recorded. All responses were scored from the videotape instead of on-line to avoid confounding intra- and inter-judge reliability.

Table 3. Verbal Expressions of Problem Detection

a)	Interjection — one-word utterance suggesting problem detection, such as "what?" or "huh?".
b)	Unspecified — general statement of non-comprehension, with no explicit delineation of the nature of the problem, such as "I didn't understand that".
c)	Specified — explicit statement of non-comprehension regarding the nature of an experimentally-contrived problem, such as "Which florist shop?".
d)	Request— question directed to the examiner seeking clarification or repetition of a stimulus item, such as "What did he say?"
e)	Replay request — request to replay the tape for the apparent purpose of clarifying a detected problem, or to verify a direction.
f)	Verbal Rehearsal — reiteration of part or entire stimulus item without the specific intent to obtain more information or clarification.
g)	Other — statement which did not solicit additional information or make reference to non-comprehension, such as "I wonder where the bus stop is?"

Table 4. Non-verbal Expressions of Problem Detection

a)	Facial expressions of puzzlement or amazement.
b)	Manual or bodily expressions of puzzlement, such as head scratching or shoulder shrugging.
c)	Visual gaze — shifting gaze from tape recorder to game board or experimenter, or from game board to tape recorder or experimenter.
d)	Manual vacillation — hand movements that seemed to indicate awareness of more than one placement option.
e)	Other — actions that depicted puzzlement, such as turning the game board over; laughter.
f)	Hesitation — excessive visual scanning with no accompanying verbal comments or defineable non-verbal behaviors.
g)	No observable response, apparently because the subject believed he understood the direction as stated and completed it accordingly.

In the event of a replay request, the subject's response on the second attempt at the stimulus was not included in the data analysis; only the first response for each stimulus was scored. Use of a replay suggested that the subject either perceived his/her first response might be incorrect, or that he/she needed additional information or processing time to complete the item. This was considered to be a demonstration of comprehension monitoring.

Because the "simple" condition contained twice as many items as each of the other four conditions, a random sample of five of these stimuli was selected for analysis. This allowed for identical cell sizes for each of the response types.

Response Time

Elapsed response time (seconds) was calculated using the video-taped records, from the termination of the stimulus presentation to the onset of a verbal or clear non-verbal indication of comprehension failure. These measurements were used for statistical analysis. Items completed by a subject to his/her satisfaction, with no indication of comprehension monitoring, were timed for the purposes of reliability but were not included in the data analysis.

Reliability Assessment

To establish interjudge reliability, a second observer judged response type and measured response time from four videotapes, randomly selected from each of the two age categories (10% of the subjects). Because the age of the principal examiner approximated that of the young group, the age of the second observer approached that of the elderly group to reduce potential age bias in scoring the results. The observer recorded and subsequently scored verbal and non-verbal task responses according to the categories outlined in Tables 3 and 4. Judgments of response coding for specific categories agreed 93.3% of the time (112/120 items). Differences in the eight remaining items appeared to occur randomly among the verbal, non-verbal and no response classifications. Of the 120 total responses, 64 were judged as "no response", leaving 56 for which to calculate the time to the first indication of non-comprehension. Response times were judged accurate if the difference between the two calculations was plus or minus 0.3 seconds. Interjudge

reliability for response time was 86.96% (50/56 items). The difference in the response times for the remaining six items ranged from .51 to 1.81 seconds, with an average of .82 seconds.

Intrajudge reliability for the principal examiner was established by the same tape selection and review procedure, two weeks following the completion of the initial analysis. Judgments of response coding for specific categories agreed 90% of the time (108/120 items); if anayzed by general verbal versus non-verbal response type, agreement increased to 95% (114/120 items). Differences in judgments for the six remaining items appeared to occur randomly among the verbal, non-verbal and no response options. Again, response times were judged accurate if the difference between the two calculations was plus or minus 0.3 seconds. Intrajudge reliability for response time was 92.5% (111/120 items). The difference in the response times for the remaining nine items ranged from .33 to .83 seconds, with an average of 0.5 seconds.

Statistical Analysis

The study included two independent variables: age and stimulus type. Age was a classificatory variable with two levels, young and old; stimulus type had five levels, simple, simple-obscured, ambiguous, impossible and complex. There were three dependent variables: frequency of criterion response, latency of response and nature of response.

Data for the first two experimental hypotheses were analyzed using a 2 X 5 analysis of variance with repeated measures on one factor (stimulus type) to compare 1) mean frequency of communication failure acknowledgement between groups for all stimulus types; and 2) mean latency (seconds) of response to all items between groups for all stimulus types. For the third hypothesis, the breakdown of the nature of responses into three categories (verbal, non-verbal or no response) resulted in the use of one-factor repeated measures analysis of variance to determine differences within each age group, and the *Z* -test for differences between proportions to determine differences between age groups.

The majority of data were analyzed on a Macintosh Plus personal computer using the statistical program STATVIEW 512+ (Feldman, Gagnon, Hofmann & Simpson, 1986), with relevant post hoc testing completed using CLR ANOVA (1986).

Tests of homogeneity of variance were applied prior to computing the analysis of variance based on the hypothesis that the elderly subjects would demonstrate greater variability in performance than the young subjects (Weismer, 1984). The assumption of homogeneity of variance was not met, thus results must be interpreted with caution. When using analysis of variance, it is assumed that the variances from group to group are statistically the same. If variances differ widely within-groups variance may be inflated, resulting in an *F*-test that may not accurately reflect significant differences between the group means (Kerlinger, 1973). Kerlinger (1973), however, suggests that the *F*- test is sufficiently robust to reflect significant differences between the means even when homogeneity of variance is violated.

CHAPTER IV

RESULTS

Detection of Communication Breakdown

Hypothesis 1 stated that there would be a difference in the frequency of communication breakdown detection by age and by stimulus type, and that there would be an interaction between age and stimulus type. A two-factor (2 X 5) analysis of variance with repeated measures on one factor (Age [young/elderly] X Stimulus Type [simple, ambiguous, obscured, impossible, complex]) yielded a main effect for stimulus type ($F = 165.39$; df 1, 4; $p<0.0001$), but not for age ($F = .187$; df 1, 4; $p<.6678$). An interaction of Age X Stimulus Type was evident ($F = 4.282$; df 1, 4; $p<.0026$). Post hoc comparisons by the Tukey Honestly Significant Difference test (Tukey hsd) showed that response differences between groups on the "ambiguous" stimuli alone were responsible for this significant interaction.

Figure 1 illustrates the mean number of indicators of comprehension monitoring given by the two age groups for the five types of stimuli. Both groups followed a similar pattern. The small proportion of indicators to the "simple" stimuli suggested that, according to *a priori* expectations, these items were easy to understand and served as adequate controls against which to compare responses observed for the other four stimulus types. The few indicators documented for the "simple" items were interpreted as reflections of subjects' difficulty in locating the target placement on the game board rather than an acknowledgment of an inadequate message. At the other end of the spectrum, only one of the forty subjects failed to indicate the impossibity of completing an "impossible" direction across all five presentations of this stimulus genre.

Response Time

Hypothesis 2 stated that there would be a difference in the mean response time to acknowledgement of communication breakdown by age and stimulus type, and that there would be an interaction between age and stimulus type. A two-factor (2 X 4) analysis of variance with repeated measures on one factor (Age

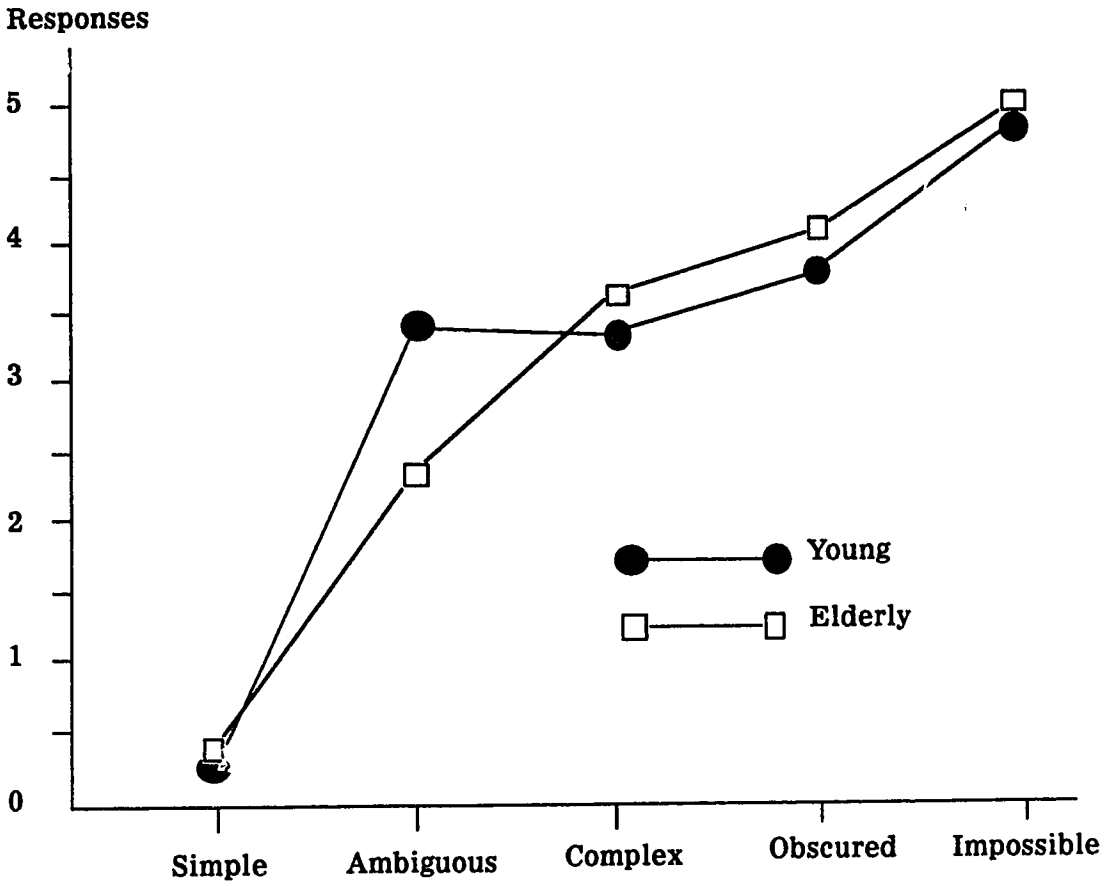


Figure 1. Mean number of indicators of communication breakdown.

[young/elderly] X Stimulus Type [ambiguous, obscured, impossible, complex]) demonstrated main effects for age (F = 6.198; df 1, 3; p<.0173) and stimulus type (F = 42.61; df 1, 3; p<.0001). No interaction of Age X Stimulus Type occurred (F = 1.297; df 1, 3; p<.279). "Simple" stimulus items were excluded from this analysis because subjects completed these easily, thus communication breakdown was not elicited. Post hoc examination of the simple main effect for age indicated a significant difference between the old and young groups' response times only for the "impossible" stimuli; the elderly subjects were significantly slower than the young subjects (Xdiff = 1.85; F = 7.433; df 1; p<.007) in acknowledging communication breakdown on the "impossible" items. Post hoc comparisons among stimulus types using the Tukey hsd test showed that all subjects' reaction times to the stimuli in the "impossible" condition were significantly different from (longer than) those for the "ambiguous", "obscured" and "complex" conditions.

Figure 2 illustrates the mean response time (seconds) to the indication of awareness of communication breakdown. The elderly group was slower at indicating comprehension monitoring than the younger group for all stimulus conditions, although the trends for both groups were similar. The "impossible" items generated the longest response time in both groups. The elderly subjects

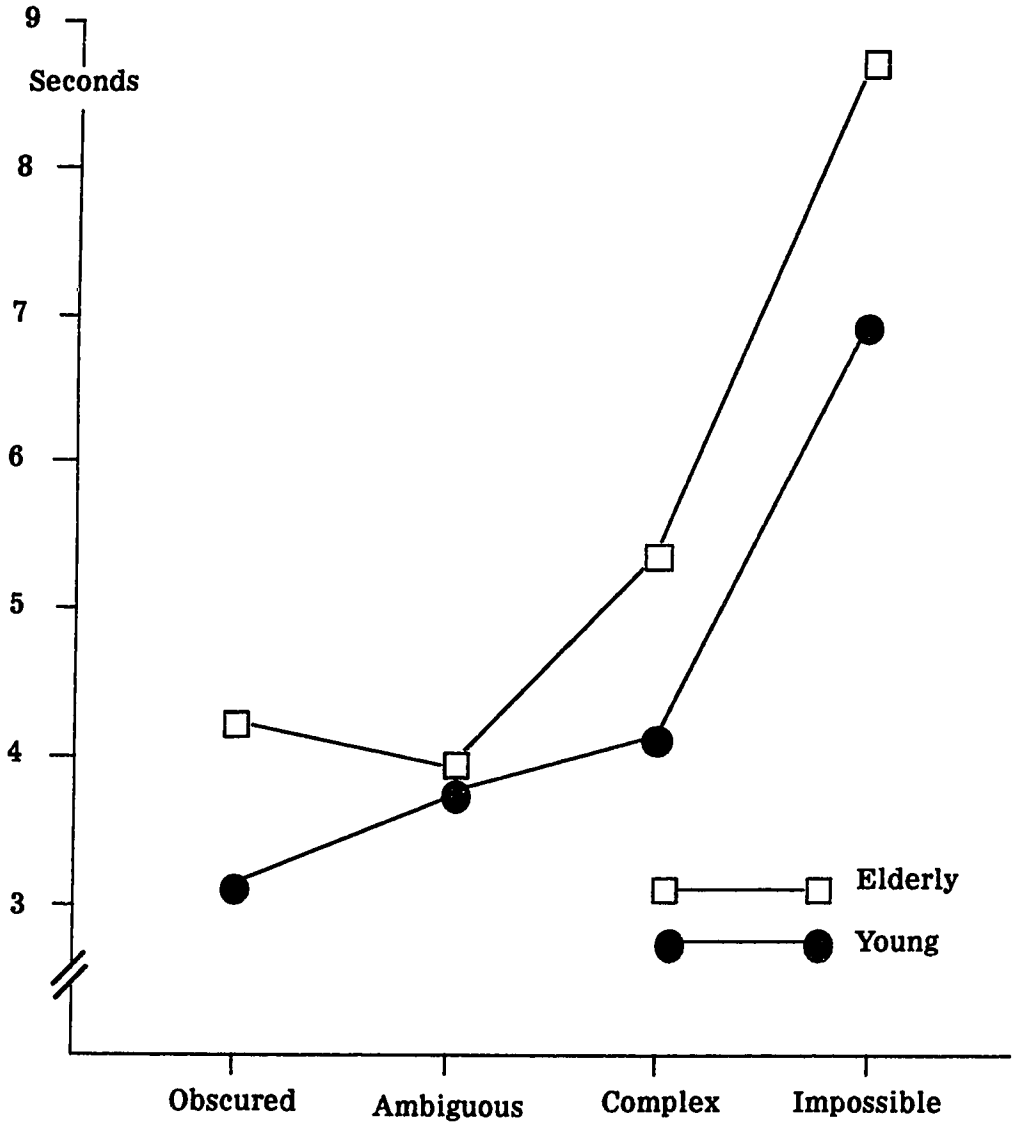
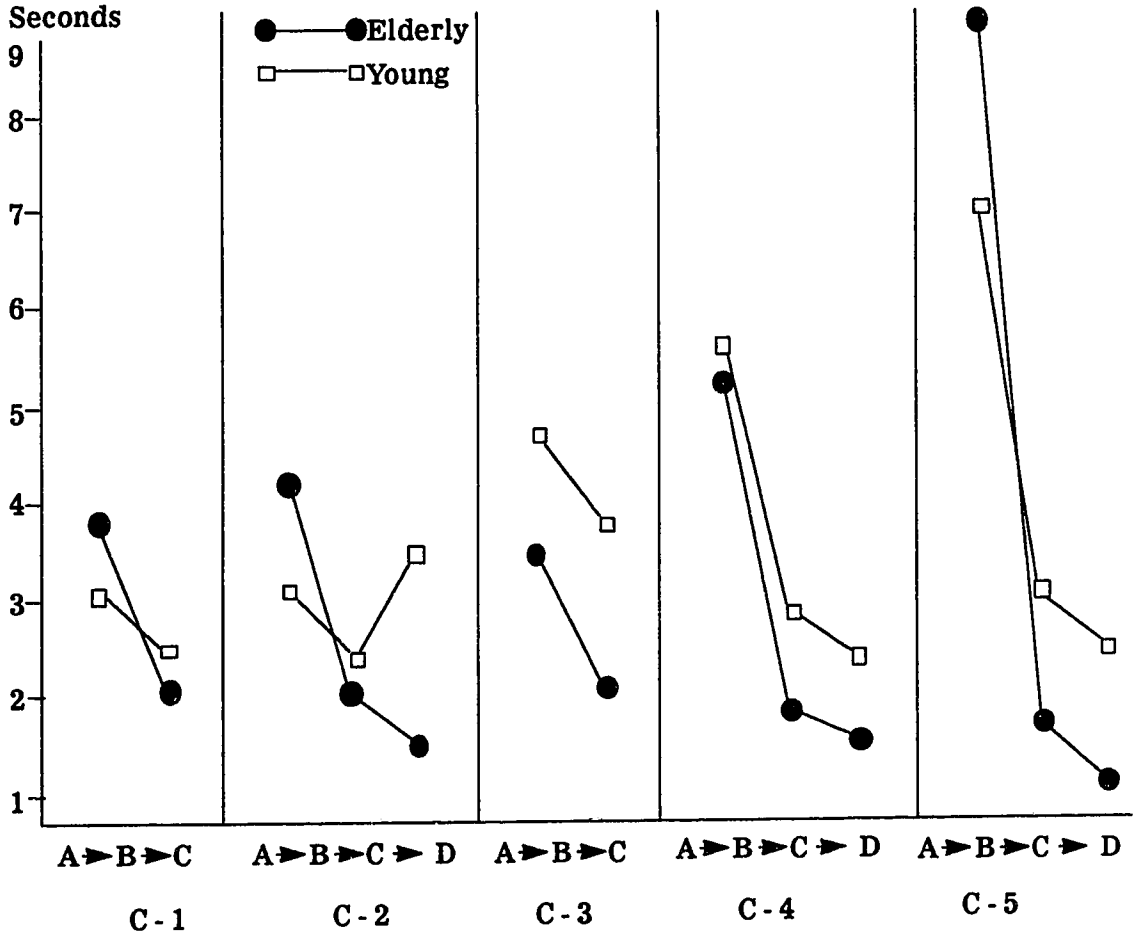


Figure 2. Mean response time to indication of communication breakdown.

were slightly quicker responding to "ambiguous" items than to the "obscured" items, while the reverse was true for the younger subjects.

Response time for the "complex" items was further analyzed by documenting the mechanical time for each component. The results of this analysis are displayed in Figure 3. Response time was recorded from the end of the stimulus presentation (A) to a subject's placement of the marker on the first target (B; recorded on Figure 3 as A→B), from that point to the placement of the marker on the second target (C; B→C), and if applicable, from that point to the placement on the final target (D; C →D). As shown in Figure 3, there is a trend in the performance on four of the five "complex" stimuli for subjects' response times to decrease from first-to-last target within any one response sequence. The texts of these complex items can be found in Appendix H.

Post hoc analysis of differences in verbal and non-verbal response times between the young and elderly groups was attempted using a two-factor repeated



measures analysis of variance. Because some subjects did not indicate comprehension monitoring using both verbal and non-verbal indicators, however, too few data were available for a valid analysis.

Nature of Response

In Hypothesis 3, it was stated that there would be a difference in the nature of the response (verbal, non-verbal or no response) used to signal communication breakdown by age and stimulus type. Table 5 illustrates the percentage of responses by each age group for the three categories. Two types of analysis were used. To determine possible differences within each age group, two one-factor analyses of variance with repeated measures for response type were calculated. No significant difference was found among the proportions of response type used by the young group ($F = .663$; df 2; $p<.521$). There was, however, a main effect for the elderly ($F = 11.277$; df 2; $p<.0001$). Post hoc comparisons among the older subjects' response modes by the Scheffe F-test revealed that the elders' performances were characterized by significantly more use of verbal indicators or instances of no indication of communication breakdown than use of non-verbal indicators.

Table 5. Response Type Percentages for Young and Elderly Subjects.

Age	Verbal	Non-Verbal	No Response
Young	31.4%	32.4%	36.2%
Elderly	44%	18.4%	37.6%

For a comparison between age groups for each response type, the Z- test for differences between proportions was used. Significant differences ($p<.01$) occurred in the verbal and non-verbal conditions, with the old group giving more verbal and fewer non-verbal responses that the young group. Both groups had similar proportions in the no response category; no significant difference was found.

Figure 4 breaks down the frequency of verbal vs. non-verbal responses by stimulus type. As illustrated, the elderly group consistently gave more verbal than non-verbal responses across all conditions. The younger subjects were more

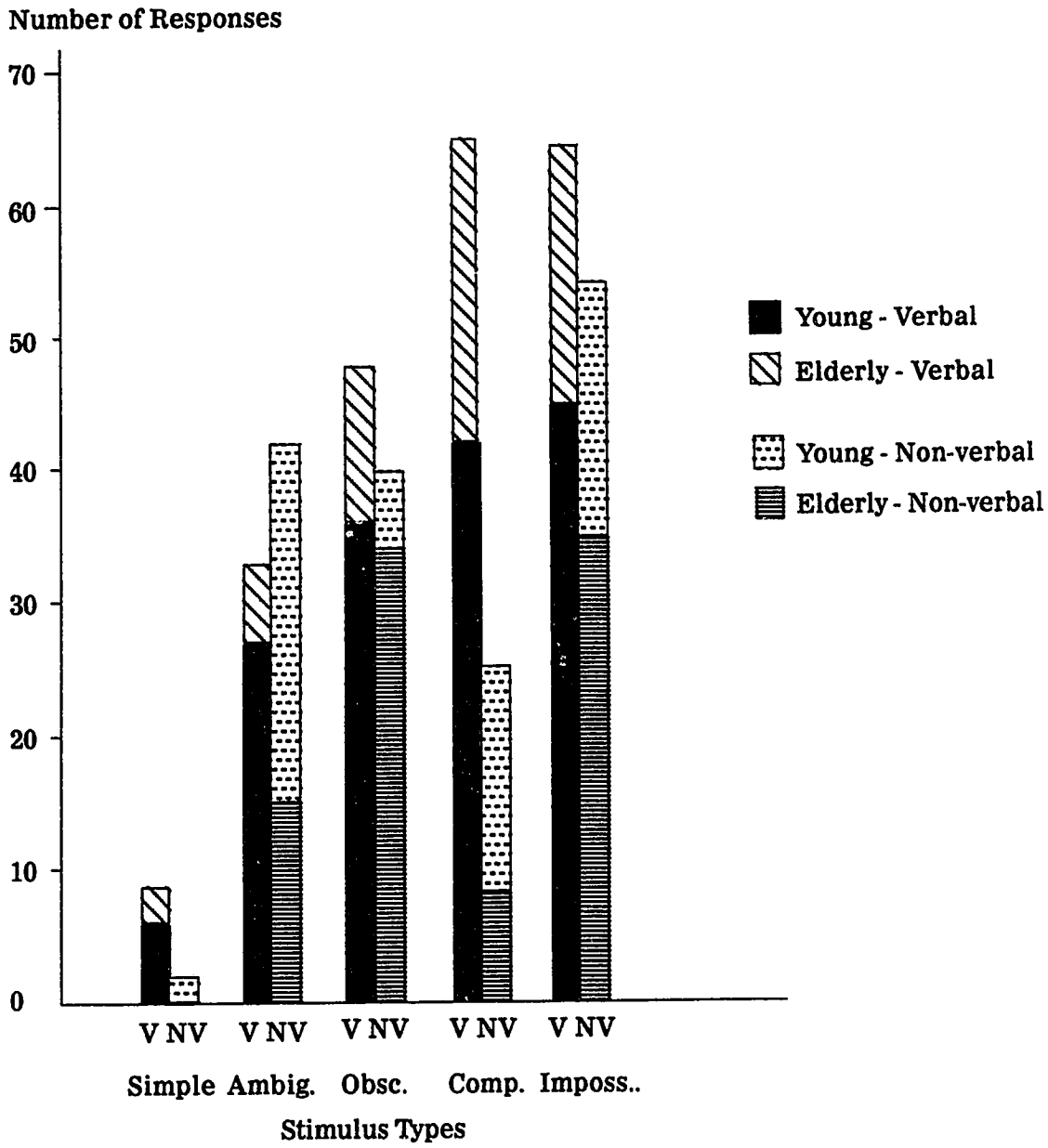


Figure 4. Comparative frequencies of general response type across stimulus conditions.

variable in their response types, with more verbal than non-verbal indicators occurring for "simple" and "complex" items, and more non-verbal than verbal occurring for "ambiguous", "obscured" and "impossible" items.

Types of verbal and non-verbal expressions of problem detection, as outlined previously in Tables 3 and 4, are illustrated in Figure 5. Among the verbal response categories, the older individuals exceeded the younger individuals in all

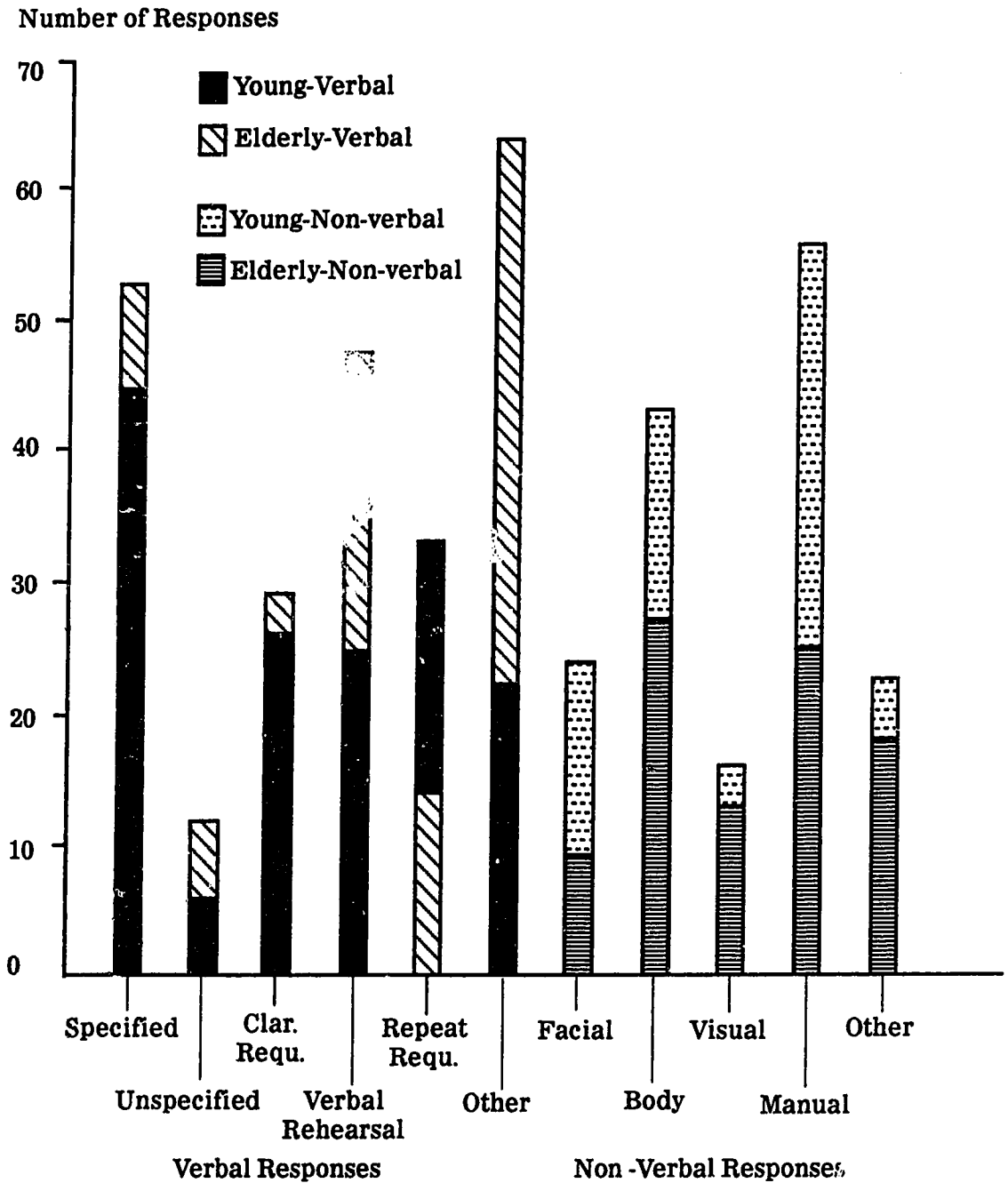


Figure 5. Comparative frequencies of response by specific category.

except the number of replay requests. Both groups used a high proportion of "specific" comments that directly indicated the nature of the problem they had with each item. "Other" comments, such as "We have a little problem here", or "I

know I saw the bus stop somewhere", were the most frequently used verbal indicator by members of the elderly group, and occurred twice as often in this group as in the young. The elderly subjects also used "verbal rehearsal" twice as often as the young subjects.

Five behaviors were classified as non-verbal responses: facial expression, body movement, observable shift in visual gaze, manual vacillation and other actions (for example, turning a game board over). The young group exceeded the elderly group in the use of non-verbal indicators of non-comprehension, although the frequencies for both groups within the "visual gaze" and "other" categories did not appear markedly different. The young group used predominantly "manual" indicators, followed in frequency by "body" and "facial" indicators.

The total number of replay requests was tallied. This included a replay request as the first indicator of comprehension monitoring, as well as replay requests made following the use of another verbal or non-verbal indicator. The young group made 34 replay requests, and the elderly group made 50. These are broken down by stimulus type in Figure 6. In both groups, most requests occurred for the "obscured" and "complex" conditions, and the elderly group exceeded the young group in replay requests for these stimulus types. Few requests for replays were given by either group for "impossible" items; among those noted, requests by the younger group accounted for slightly more than those made by the older group for these items. Neither group requested replays for "ambiguous" items.

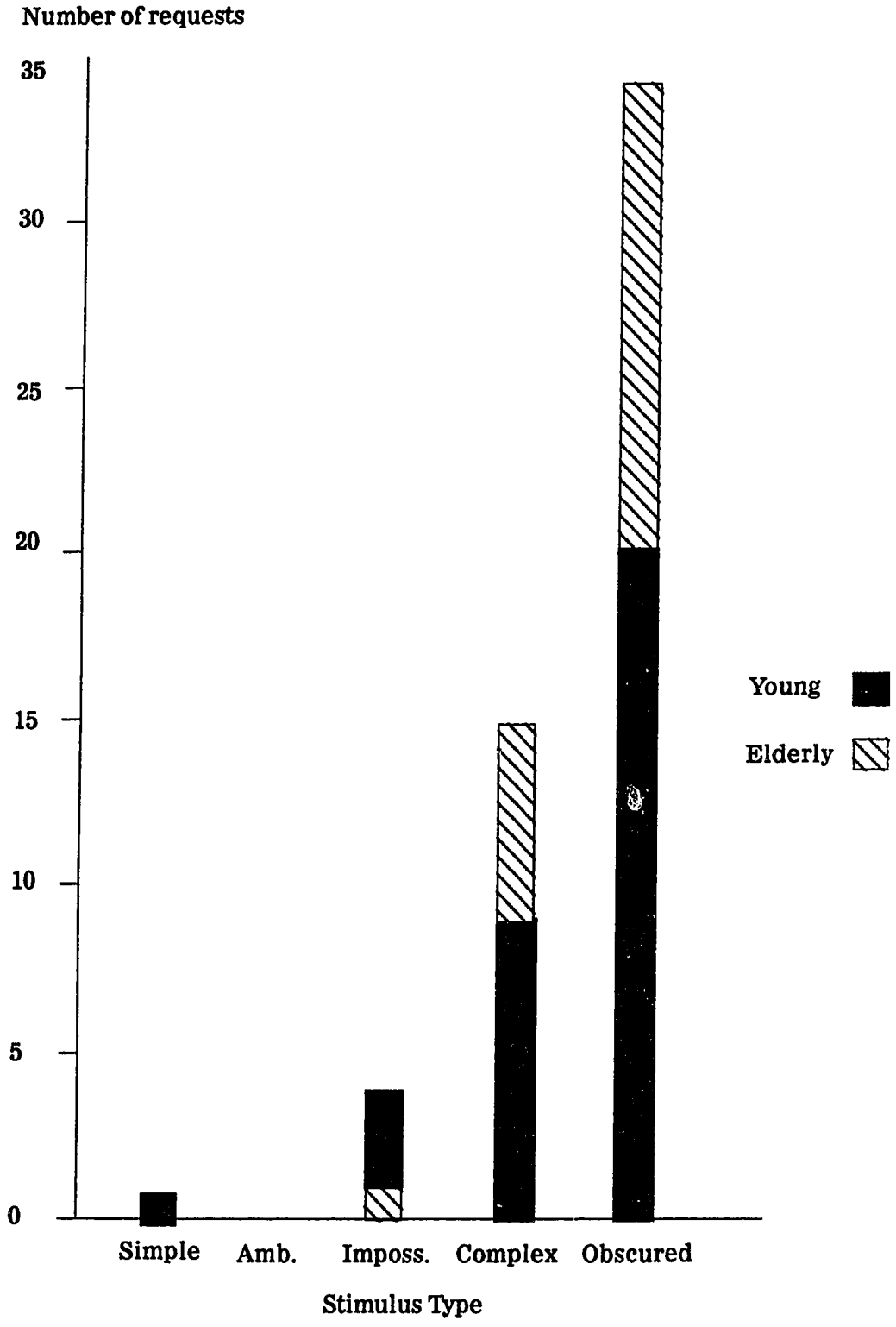


Figure 6. Comparative frequencies of replay requests.

CHAPTER V

DISCUSSION

Several interesting results arose from this investigation of comprehension monitoring skills in elderly adults. These included similar frequencies of response for both the young and elderly groups, with a significant difference only for "ambiguous" items, similar response times except for "impossible" items, and differences in verbal/non-verbal response style.

Frequency of Response

Contrary to predictions, the young and elderly groups detected the contrived "problem" verbal directions with similar frequency. These detections manifested as a variety of verbal and non-verbal behaviors which were interpreted as instances of comprehension monitoring. The participants could have judged all stimuli "acceptable" in terms of grammar or appropriateness of vocabulary, but they made a variety of judgments that suggested they were engaging in information processing in a more complex manner than simply verbal comprehension. This supports the notion that metalinguistic abilities are different from, and used in addition to, those involved in understanding language (Flavell, 1978; Hakes, 1980) and further, that comprehension monitoring, a skill aquired in childhood, is preserved in healthy elderly adults and functions in addition to spoken language comprehension. In general, "unacceptable" stimuli were identified as such, making it apparent that messages were under some form of scrutiny or evaluation by the individuals listening to them. Given that the subjects in the study had not expected unacceptable directions, their evaluations occurred as an optional process that accompanied comprehension processing. As discussed by Baker and Brown (1984), Chapey (1986), Davis (1986) and Siegel and Gregora (1985), and as demonstrated in this study, healthy older adults attempt to maintain communication through the application of conscious compensatory strategies such as contingent queries or revisions which might clarify the message. The extent to which competency in monitoring comprehension is maintained in less healthy, less

active senior citizens who have not sustained brain trauma would be an interesting avenue of future research.

The young and elderly groups monitored with similar frequency the communication breakdowns contrived for the "complex," "obscured" and "impossible" stimulus types, but the elderly subjects acknowledged "ambiguous" items considerably less frequently than did the younger subjects. This cannot be attributed solely to lack of awareness of the two choices provided, based on informal questioning of subjects; several indicated that they had seen the two choices but made a guess as to which one was correct without seeking any form of clarification from the examiner. The two groups did, however, approach the ambiguous items in different manners, and this may lend additional credence to the findings of Byrd (1988) which indicated diminished ability in the resolution of lexical ambiguity in older adults. Byrd proposed that adults of all ages use well-learned automatic lexical access procedures when dealing with unambiguous material, and that when faced with ambiguous information, they use effortful word recognition strategies to comprehend sentences. However, elderly adults may be less proficient at engaging their information processing strategies when contextual conditions require the use of these skills. A possible relationship among older subjects' diminished recognition of ambiguity in this study, elders' reduced comprehension of ambiguity in sentences as reported by Byrd (1988), and their use of significantly more ambiguity of anaphoric reference in discourse as reported by Ulatowska et al. (1986), is an intriguing one which warrants further investigation. The relationship between deficits in input (i.e., recognition or comprehension of ambiguity) and deficits in output (i.e., increased ambiguity of reference in spoken language) has yet to be firmly established.

One of the most obvious indicators of comprehension monitoring was a request for a replay of a stimulus. "Obscured" and "complex" stimulus items elicited the majority of replay requests. Because the telephone ring used to mask the noun for the "obscured" items was so obvious and difficult to hear through, and because it is not uncommon for people to request repetition when noise obstructs communication, it was thought that replay requests would naturally occur on these stimuli. Certainly, the obscured items favored the hearing abilities of the younger

group; presbycusic hearing loss may have hindered the possibility of elders' hearing the recorded message through the masking noise of the ringing telephone. "Complex" items elicited a large number of indicators of comprehension monitoring from both age groups. These items were thought to tax the capacity and/or efficiency of working memory; difficulty completing the complex directions on the first trial may have reflected changes in encoding, storage or retrieval processes, known to be susceptible to the effects of aging (Kausler, 1988).

Response Time

The response time data suggest that elderly and young subjects alike demonstrated some degree of efficiency in processing information. Arguments asserting that the speed of behavior slows with age as a result of centralized slowing in the nervous system (Woodruff, 1983), that slowing is an artifact of inability to maintain sufficient attention (Layton, 1975; Wilkinson & Allison, 1989), or that discrepancies might be based on differences in decision making (Ford, et al., 1979), were supported only minimally by the results of this study. The nature of this task provided greater potential for reflecting the principle of speed of processing than that of diminished resources, but it was not possible to attribute differences confidently to speed of processing because of the small differences between groups. Significant group differences resulted for the "impossible" items only; the elderly group demonstrated a longer mean response time than the younger group, and performance for both groups was slower on these items than for stimuli in other categories. The trends of the data showed an overall slower response time across stimulus categories for the older subjects, but this was not supported by significant statistical differences. Differences and similarities between the two age groups can be discussed in terms of internal and external influences.

Internal Influences

All subjects adequately read aloud the single words presented on the visual screening test. Nevertheless, the combination of many printed stimuli, the graphic representation of the scene, and the general lack of familiarity with the

game boards may have resulted in the need for increased time for actual visual scanning by members of the elderly group. For the "impossible" items in particular, many elderly subjects were observed to scan the board visually, then to scan with the aid of a finger for guidance, sometimes several times around the board. The younger subjects tended to scan visually only once and then indicate their awareness that the item could not be completed as directed. Although visual search was not the specific behavior under scrutiny in this study, its availability in the data allows comparison with the work of others (Plude & Hoyer, 1981; Plude et al., 1983; DiLollo et al., 1982) who have reported slower response times for elderly subjects in tasks requiring visual search. As Plude and Hoyer (1981) propose, this observed age-related decrement might represent the need of older people to engage in more effortful, rather than automatic information processing. If viewed in terms of the increased attention used in effortful processing, it may follow that younger individuals do not consume as many attentional resources as their elderly counterparts in activities requiring visual search.

Reports of generalized slowing of motor responses in the elderly (Woodruff, 1983) support the prediction that the elderly subjects would demonstrate increased response time when giving non-verbal indicators. The mechanical time, that is, the amount of time taken to pick up the marker and place it on a designated position, was generally excluded from the data because the behavior under study was the indication of comprehension monitoring, not direction completion. Mechanical time may have been a factor, however, when subjects gave non-verbal responses such as manual vacillation. It is unfortunate that analysis of verbal versus non-verbal response time differences within and between groups was not possible in light of Baron and Journey's (1989) study, which measured vocal and manual responses to the spatial location of a stimulus. They found that for both young and old adults, vocal responses were slower than manual responses. It is interesting that the elderly individuals in the present investigation relied predominantly on a vocal response pattern; this type of response might actually be slower than a non-verbal response.

External Influences

It has been suggested already in the previous section on internal influences that the older subjects' use of their fingers to assist in scanning, particularly for "impossible" items, could be interpreted as additional self-cueing for remembering the components of the stimuli, and may have represented an attempt at monitoring their comprehension, all of which contributed to a slower response time. The response latency of the elders, however, also may be interpreted as a sociological artifact of this particular cohort. In their desire to be correct, or their fear of being seen as less able by the younger examiner, compulsion or caution may have contributed to a slower response time. Thus, the difference in age between the elderly subjects and the examiner may have had a negative impact on the confidence of the senior group for the performance of the experimental task.

It has been hypothesized that elderly adults are uncomfortable in new situations, perhaps because of diminished self-confidence. The resulting expectation and fear of failure, loss and rejection manifests as cautious behavior. This is evidenced in clinical studies as preference of accuracy over speed, or avoidance of responding (omission errors) versus making errors in responding (commission errors). In this manner, cautiousness has been interpreted as a defence of one's ego, and contributes to the desire of older individuals to be very certain before committing themselves to a response. The uncertainty in situations that are difficult or ambiguous does not provide a high level of confidence in being correct, thus task performance is not optimal (Botwinick, 1978). It is possible that the elderly subjects in this study were cautious in their responding, as evidenced by their use of finger-assisted scanning and verbal rehearsal on the "impossible" items. In this particular task, omission errors were not as likely to occur, perhaps because of the need to complete the item before moving on to the next stimulus, or possibly because of the monetary reward for correct marker placement.

Nature of Response

Elderly and young adults were found to differ in their manner of first response; the younger individuals used similar numbers of verbal, non-verbal and no responses, and the elderly individuals used significantly more verbal than non-

verbal or no responses. Literature relevant to age-related verbal/non-verbal differences is scant, although there is some evidence to suggest that both internal and external factors might play a role.

Internal Influences

From a physiological standpoint, age-related changes are well-documented; skeletal, muscular and neurological considerations may be significant factors in the response type chosen by different age groups, but thorough examination of these is beyond the scope of this paper. Researchers such as Malatesta and her colleagues (1987a, 1987b) have identified structural changes in the face over time as a compounding factor in the ability to decode affective expressions of older subjects. It is possible that in the analysis of responses in this investigation, facial affect was overlooked in deference to the more powerful, verbal responses given by the elderly subjects. Other possible explanations for the predominant use of verbal as opposed to non-verbal responses by the elderly subjects would be purely speculative.

Another internal factor to consider is the function of working memory, exemplified in the response patterns through the frequent use of verbal rehearsal by the elderly subjects. Items which elicited such a comprehension monitoring response supported the notion that active processing occurred in working memory rather than simple rote retrieval of information held in memory. Verbal rehearsal was interpreted as a strategy for retaining relevant information in short term memory.

External Influences

The communication process is affected by the accumulated perceptions and expectations of both the sender and receiver (Shadden, 1988). This is perhaps most true of communication with elderly individuals. Attitudes toward the elderly are derived from past interactions with this age group. These learning experiences frequently occur on an emotional unconscious level, but the ensuing behaviors may be very visible. If an individual's perception of an older person is distorted by these unconscious "lessons", the resulting judgment may be excessively, but

erroneously, positive or negative. Such attitudinal barriers may result in the delivery of less than optimal services to the elderly population (Chafetz & Wilson, 1988). Shadden (1988) contends that "ageism", or a discriminatory attitude, against older individuals is prevalent in society. In an investigation of the effect of aging on communicative interchange, three groups of participants, elderly (65 years and over), children of older parents (over 65 years) and professionals providing service to senior citizens, were compared in their responses to an interview protocol that examined the perceptions of several aspects of communication with and by older persons. Despite the indications of general adequacy of communication by older persons, the general perception was that the aged experienced more problems than younger people in their daily communications. Further, there was strong support for the notion that people communicate differently with the elderly than with other age groups. The professional group tended to judge the behavior of those communicating with the elderly more negatively. The relevance of these findings to the current study lies in the unspoken but evident differences between the younger examiner and the elderly subjects during the actual testing, and the possible perceptual bias in the analysis of responses. The bearing of previously discussed issues, such as the degree of confidence of the respondant, may also have affected the nature of response. It is hypothesized that the higher the level of comfort and ease, the more naturally a person will behave; an increased level of uncertainty may inhibit a person from responding in an outgoing, spontaneous way and may generate a more subdued, verbal response mode.

Concluding Comments

This study explored age-related differences in comprehension monitoring skills. The findings, although interesting, are of undetermined value if not supported by results of similar efforts. Because the task presented was a reasonably straightforward direction-following task, there were minimal expectations of the subjects to integrate, construct or reorganize elements of the meaning of the directions. If these constraints to the comprehension of surface meaning were imposed, as in the judgment of anomalous sentences conducted by Cohen (1979), perhaps more differences between the two age groups would have

been apparent. Several points are worth emphasizing as a guide for future research.

Methodological Considerations

Subjects' responses to the varying types of stimuli (simple, ambiguous, complex, impossible, obscured) were unique enough to warrant individual analysis. This might allow for manipulation of each type of stimulus in a variety of ways, as demonstrated by Davis and Ball (1989) in their study of right-branching and centre-embedded complex utterances. Although the comparisons between the stimulus types are interesting, more information may be obtained from including a greater number of related stimuli. For example, several types of masking signals could be used instead of the one type used in this study.

Secondly, it should be noted that no social validation experiments were done to demonstrate homogeneity within or across stimulus types, or to verify that the stimuli within each category were consistent with the subject groups' concepts of the categories ambiguous, complex, etc. Such validation should be considered if further investigation in this area is undertaken.

A third methodological concern is the use of a manual stopwatch to time responses. Both inter- and intrajudge reliability measures were acceptable, but some margin of human error was evident. Designing the task such that an electronic timing device could be incorporated would improve not only reliability, but also the overall precision of the findings.

A fourth consideration pertains to obtaining information about how or why a decision was made when comprehension monitoring occurred, and perhaps more importantly, when it did not occur. Some form of debriefing following a response regarding the acknowledgement of the difficulty of the item is recommended. Intermittent questioning of subjects by the examiner following completion of ambiguous items in this study revealed some subjects' lack of awareness of the ambiguity (e.g., "Oh, I didn't notice that one.") as well as a variety of reasons for subjects' response choices (e.g., "That one was closer.").

It is possible that a ceiling effect may have resulted from the levels of motivation experienced by the subjects who participated in this study. It would be

very difficult to control the level of internal motivation, that is, those factors that lead each subject to volunteer and to participate with the spirit of competitiveness. External motivation could be under the examiner's control, however, leading to the fifth methodological consideration. The use of a monetary incentive could have induced subjects to try a given item without acknowledging communication breakdown, just because there was a chance of success.

A final methodological consideration pertains to the nature of the paradigm used in the study. The use of tape-recorded instructions allowed for controlled stimulus presentation, but did not necessarily reflect a natural communication context in which one speaker interacted with another. This could be achieved by using a live-voice presentation, although control of loudness, prosodic and rate variations would be lost. The direction-following paradigm was restrictive in that the listener had no way to modify the speaker's behavior. The use of a dyadic context in an experimental task may be more analagous to an interactive communication style and thus tend to reflect real communication differences. If a direction-following activity is implemented again in research of this kind, more differences might be apparent if the linguistic complexity is increased, generating greater demands on the cognitive and memory systems.

Sampling Considerations

Caution must be exercised when interpreting data derived from a comparison between two groups vastly different in age. As Chafetz and Wilson (1988) point out, any group of elders does not reflect a representative sample of the total elderly population. The heterogeneity of this population cannot be dismissed, thus the validity of conclusions generalized from studies of groups of elders is in question. Further, differences between age groups may not be related only to the effects of physiological age, but also to cohort effects (Bayles et al., 1985; Chafetz & Wilson, 1988). The results of this study would suggest that declines in linguistic competency for the tasks performed cannot be assumed for or generalized to the entire senior population.

Theoretical Considerations

The disparities among the geriatric research findings suggest that age differences may occur in only some kinds of tasks or stages of processing. Further investigation is needed to determine whether age-related differences are the result of a failing neurological system, a lack of urgency to maintain these skills, or both (Stine & Wingfield, 1987). The cognitive functions of language, thought, memory, perception and attention cannot be assessed independently; rather, these processes are synergistic (Emery, 1986). Ongoing attempts to parse out these factors will provide a greater understanding of linguistic function in the elderly population. Stine and Wingfield (1987) reported that older adults depended heavily on prosodic contour for short term retention of speech, and suggested that this may be an important strategy used in everyday listening. The use of an exaggerated intonational contour by those speaking to an elderly individual "may be a behavior that has evolved as an adaptive stragegy on the part of the speaker to facilitate communication" (p. 278). Procedures in the present study controlled these variables across subjects and stimuli. Future research may investigate the effects of variations in speech rate and the removal of prosodic cues on comprehension monitoring among elders.

Summary

In summary, the results of this study provide the basis for ongoing research in the area of comprehension monitoring in the geriatric population. There is some evidence to suggest that in healthy elderly adults, comprehension monitoring skills are maintained with some degree of efficiency. Despite several reports of linguistic decline in the elderly population, there is no strong evidence to suggest that metalinguistic skills deteriorate in tandem. Indeed, the presence of comprehension monitoring skills among the elderly subjects of this study gives evidence that not all skills decline with age. Deficiencies may be apparent in some circumstances, however, which requires some consideration. The findings of this research cannot be readily generalized to elders in poor health, or to those with communication deficits arising from neurological conditions such as stroke or

dementia, but might contribute to data-based expectations for premorbid language abilities in elders similar to the ones studied. Further research into the area of comprehension monitoring among all facets of the geriatric population is needed.

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APPENDIX A

Hearing Screening Test Items

1. Touch the big green circle.
2. Touch the small blue square.
3. Touch the big yellow square.
4. Touch the small black circle.
5. Touch the big red square.
6. Touch the big blue circle.
7. Touch the small yellow square.
8. Touch the small blue circle.
9. Touch the big black square.
10. Touch the small red square.

APPENDIX B

Hearing Handicap Inventory

(Ventry & Weinstein, 1982)

	Yes	Sometimes-	No
1. Does a hearing problem cause you to use the phone less often than you would like?	—	—	—
2. Does a hearing problem cause you to feel embarrassed when meeting new people?	—	—	—
3. Does a hearing problem cause you to avoid groups of people?	—	—	—
4. Does a hearing problem make you irritable?	—	—	—
5. Does a hearing problem cause you to feel frustrated when talking to members of your family?	—	—	—
6. Does a hearing problem cause you difficulty when attending a party?	—	—	—
7. Does a hearing problem cause you to feel "stupid" or "dumb"?	—	—	—
8. Do you have difficulty hearing when someone speaks in a whisper?	—	—	—
9. Do you feel handicapped by a hearing problem?	—	—	—
10. Does a hearing problem cause you difficulty when visiting friends, relatives or neighbours?	—	—	—
11. Does a hearing problem cause you to attend religious services less often than you would like?	—	—	—
12. Does a hearing problem cause you to be nervous?	—	—	—
13. Does a hearing problem cause you to visit friends, relatives or neighbours less often than you would like?	—	—	—
14. Does a hearing problem cause you to have arguments with family members?	—	—	—

	Yes	Sometimes	No
15. Does a hearing problem cause you difficulty when listening to radio or TV?	—	—	—
16. Does a hearing problem cause you to go shopping less often than you would like?	—	—	—
17. Does any problem or difficulty with your hearing upset you at all?	—	—	—
18. Does a hearing problem cause you to want to be by yourself?	—	—	—
19. Does a hearing problem cause you to talk to family members less often than you would like?	—	—	—
20. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	—	—	—
21. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	—	—	—
22. Does a hearing problem cause you to feel depressed?	—	—	—
23. Does a hearing problem cause you to listen to TV or radio less often than you would like?	—	—	—
24. Does a hearing problem cause you to feel uncomfortable when talking to friends?	—	—	—
25. Does a hearing problem cause you to feel left out when you are with a group of people?	—	—	—

APPENDIX C

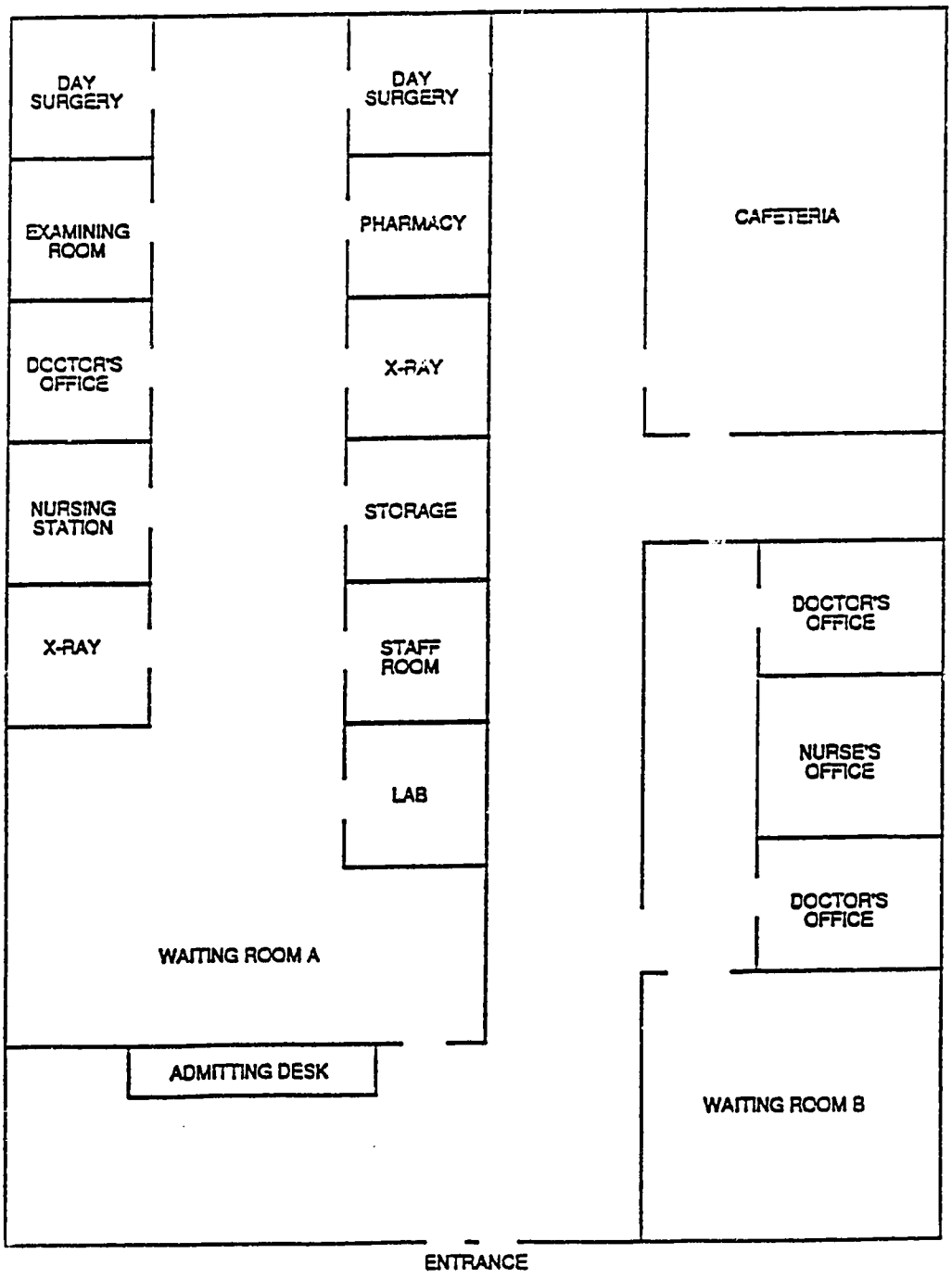
Vision Screening Items

MATINEE	INSURANCE
CONSENT	CONSTRUCTION
PENSION	DEPARTMENT
DRUGSTORE	TEXACO
EXAMINING	STORAGE

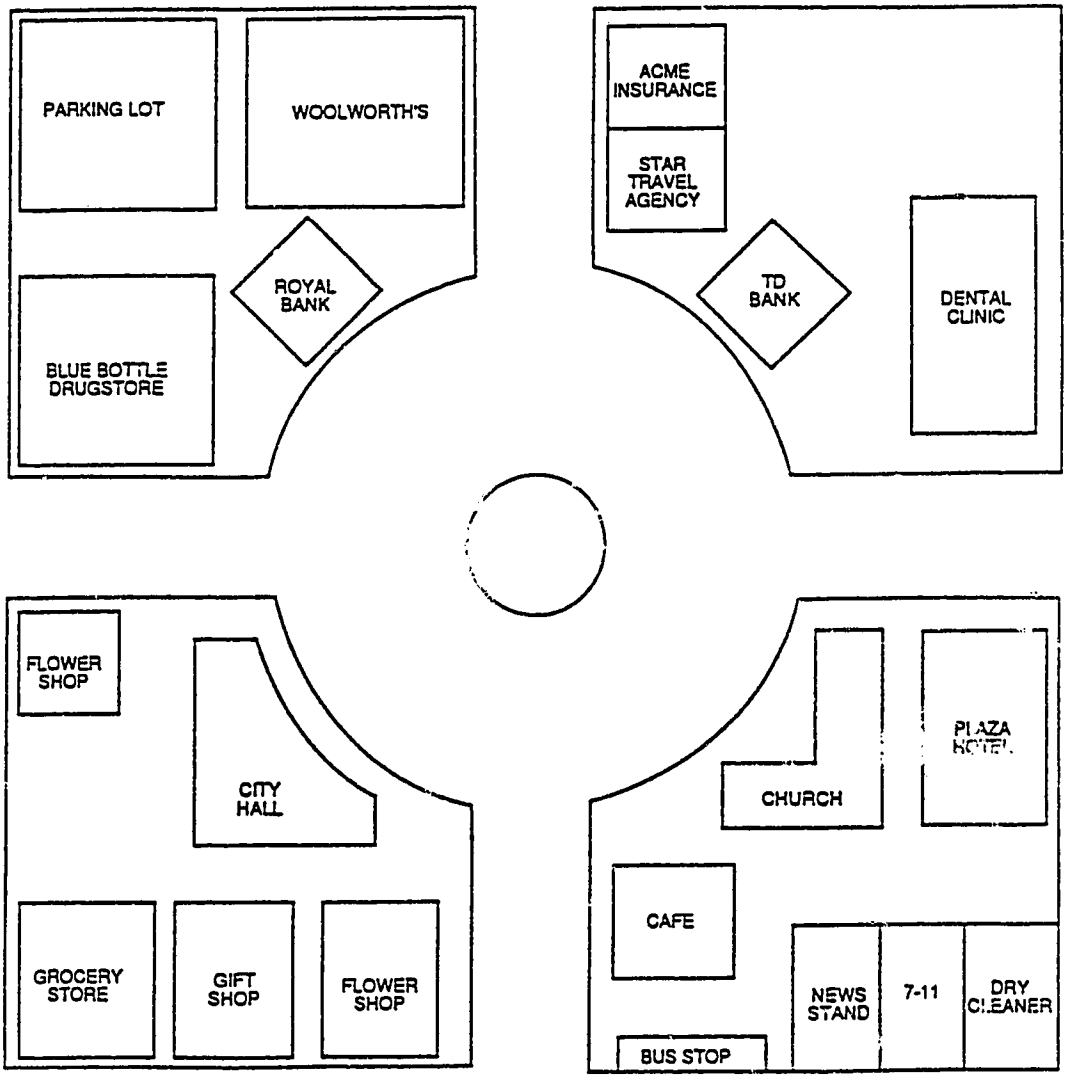
APPENDIX D

Gameboards

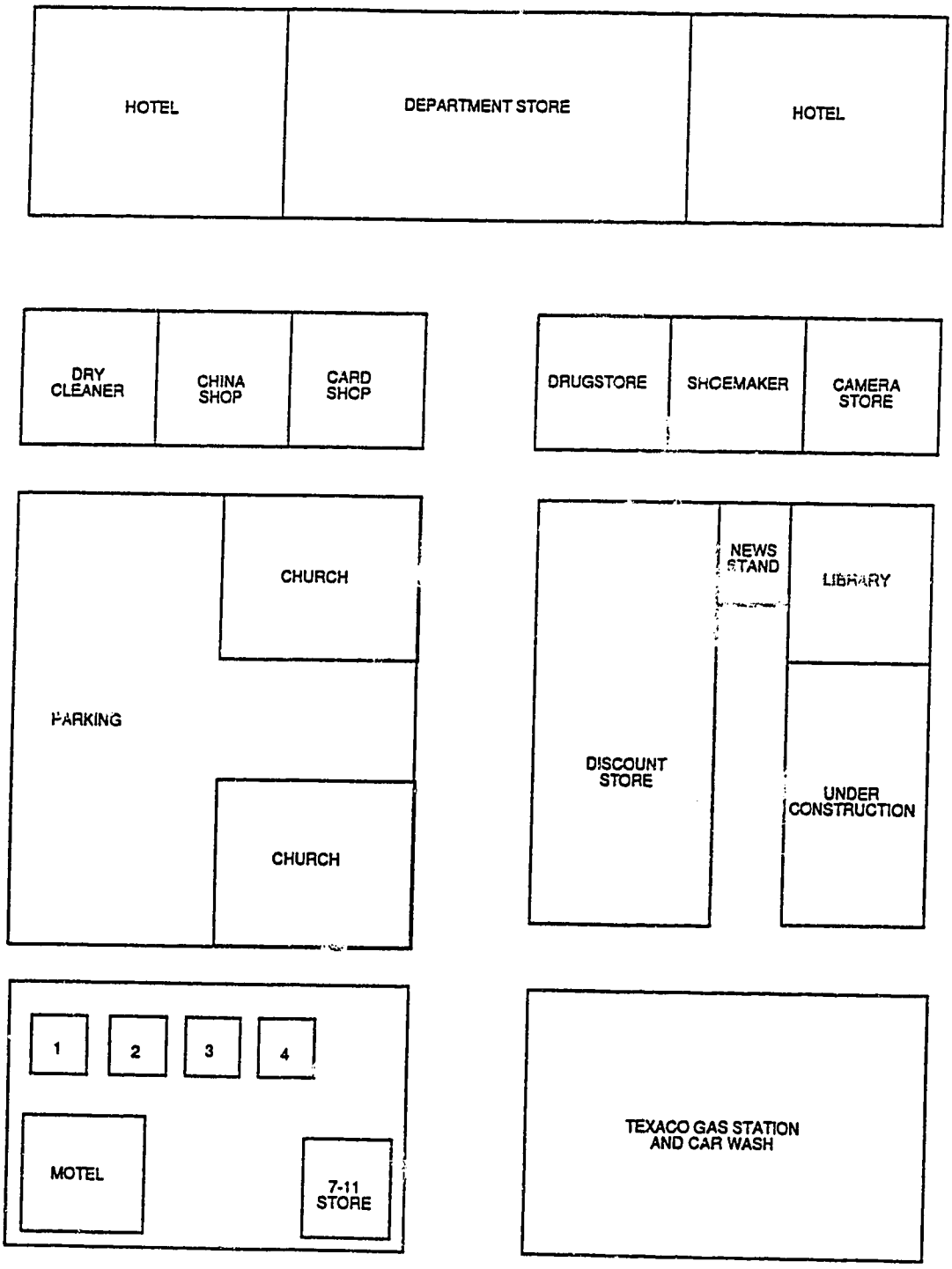
Gameboard 1



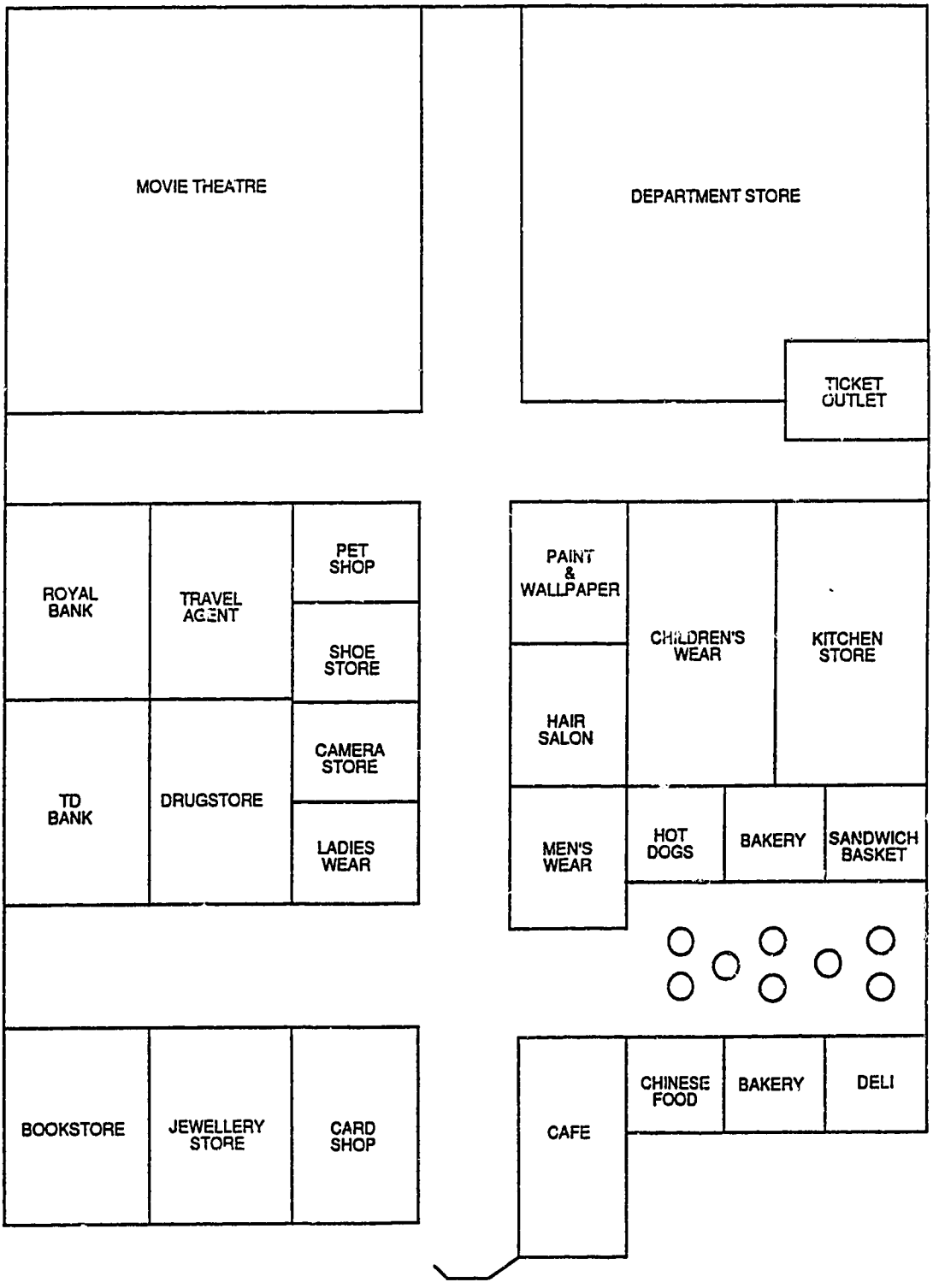
Gameboard 2


PARKING LOT
WOOLWORTH'S
ROYAL BANK
BLUE BOTTLE DRUGSTORE
ACME INSURANCE
STAR TRAVEL AGENCY
TD BANK
DENTAL CLINIC
FLOWER SHOP
CITY HALL
GROCERY STORE
GIFT SHOP
FLOWER SHOP
CHURCH
PLAZA HOTEL
CAFE
NEWS STAND
7-11
DRY CLEANER
BUS STOP

Gameboard 3


HOTEL
DEPARTMENT STORE
HOTEL
DRY CLEANER
CHINA SHOP
CARD SHOP
DRUGSTORE
SHOEMAKER
CAMERA STORE
CHURCH
PARKING
CHURCH
NEWS STAND
LIBRARY
DISCOUNT STORE
UNDER CONSTRUCTION
1
2
3
4
MOTEL
7-11 STORE
TEXACO GAS STATION AND CAR WASH

Gameboard 4


MOVIE THEATRE
DEPARTMENT STORE
TICKET OUTLET
ROYAL BANK
TRAVEL AGENT
PET SHOP
SHOE STORE
TD BANK
DRUGSTORE
CAMERA STORE
LADIES WEAR
PAINT & WALLPAPER
HAIR SALON
CHILDREN'S WEAR
KITCHEN STORE
MEN'S WEAR
HOT DOGS
BAKERY
SANDWICH BASKET
BOOKSTORE
JEWELLERY STORE
CARD SHOP
CAFE
CHINESE FOOD
BAKERY
DELI

APPENDIX E

Subject Information Form

Thank you for agreeing to participate in this study, which will look at differences between young and elderly adults on several dimensions. A maximum of two hours of your time will be needed.

There will be several components to the session. In the first part, you will be given short tests for hearing and vision. If you have difficulty seeing or hearing the test materials, you do not have to continue with the other tasks if you do not want to. The other tasks involve following directions. All subjects will receive a small token of appreciation for their willingness to participate.

All personal information about you, including your name, address, telephone number and test results will be kept confidential. In other words, I will use them for my records and nothing else. The session will be videotaped to enable me to score the results accurately. You will be asked to sign a special authorization for photography.

You are free to withdraw from this study at any time without any consequences.

Should you need to reach me, please call me at home at 466-2929, or leave a message for me at work, at 471-2262, ext. 2463. I will be happy to answer any questions you might have about the procedures to be used.

Kathy Logan, B. Sc.
Speech-Language Pathologist

Consent Form

I, _____, fully understand the procedures and requirements of this study, having received a Subject Information Form, and agree to act as a participant in this study.

_____ _____

Date Signature

_____

Investigator

APPENDIX F

Authorization for Photography

In the interests of education, the University of Alberta, Department of Speech Pathology & Audiology is hereby authorized to make television and sound recordings of _____ and to use these recordings for scientific purposes, including the presentation of scientific and professional reports. I hereby expressly waive any and all claims against the Department of Speech Pathology & Audiology and the University of Alberta in any manner whatsoever relating to the said recordings.

_____ _____

Date Signature

_____

Investigator

APPENDIX G

Instructions to Subjects

This is a game called "Living in the Eighties". I have four game boards representing places in a city you might visit as a resident of this city. For the next fifteen minutes, you will be asked to run errands that city residents typically run. For example, you might be asked to pick up some cold cuts from a delicatessen, or go to the dentist for a check-up. Each game board represents a different scenario. There are about 8 errands for each game board.

You will start out with $30 of play money. For each errand you complete as directed, you will receive $10. For each errand you do not complete as directed, you will receive a "traffic ticket" and will have to pay back $10 The object of the game is to end up with at least $50. If you do, you will win a prize.

The directions for the errands will be given by a man on a tape (the same man that you heard before). You may listen to each direction two times. At your request, I will replay the tape. At the completion of each errand, the man will confirm where you should be, and you should correct the placement of your marker if you need to. I will be the "banker" and will give or take away the play money according to the success of your errands.

As with every game, there are some rules! First, you must follow the directions exactly as given. If he tells you to go to more than one place, go to all of them in the order he says. Second, you must wait for the man to finish each direction before you begin. Then, try to complete each errand as quickly as you can. Have your hand resting on the edge of the board before each item so that you can complete it as quickly as possible. Let's try some practice items. Any questions?

APPENDIX H

Task Stimuli

Code: S = Simple

O = Obscured

A = Ambiguous

I = Impossible

C = Complex

Sample Items: (One for each game board; confirmation follows in parentheses.)

(S) •• Go to the hair salon for a haircut.
(You should be at the hair salon.)

(S) •• Park your car in the parking lot by the two churches.
(You should be in the parking lot by the two churches.)

(S) •• Go for lunch at the Plaza Hotel.
(You should be at the Plaza Hotel.)

(S) •• Visit the Day Surgery in the corner of the hospital.
(You should be in the Day Surgery in the corner of the hospital.)

Test Items:

Tape 1: You must accompany your aunt to the hospital where she has to have some tests.

(S-1) •• Check in at the admitting desk.
(You should be at the admitting desk.)

(A-1) •• The admitting clerk directs you to have a seat in the waiting room.
(You should be in Waiting Room B.)

(I-1) •• Buy a magazine from the gift shop.
(I'm sorry, the gift shop is under construction. Please return to Waiting Room B.)

(C-1) •• Before your aunt can be seen by the doctor in the examining room, you must take her to the lab for a blood test but only after she has had an interview with the nurse in the nurse's office.
(You should have gone to the nurse's office, the lab, and then the examining room.)

(O-1) •• To have X-rays taken, your aunt must sign consent forms at (the nursing station).
(You should be at the nursing station.)

(S-2) •• Take your aunt to the cafeteria for a cup of coffee.
(You should be in the cafeteria.)

Tape 2: Your aunt found out that she has to stay in hospital for a couple of days. You must run some errands for her.

(I-2) •• Buy a toothbrush from the drugstore beside the church.
(I'm sorry, the drugstore moved to a larger location beside the Royal Bank.)

(C-2) •• If you haven't stopped by her house to pick up slippers and a robe, you'll have to buy them from Woolworth's after getting some fruit from the grocery store and a magazine from the newstand beside the bus stop.
(You should have gone to the grocery store, the newstand, and then Woolworth's.)

(S-3) •• Stop at the cafe for a bite of lunch.
(You should be at the cafe.)

(A-2) •• After lunch, go to the flower shop by city hall to pick up a bouquet.
(You should be at the flower shop across the street from the drugstore. They have a much better selection.)

(S-4) •• Go to the Dental Clinic to cancel her appointment.
(You should be at the dental clinic.)

(O-2) •• Pick up her statement from (the insurance agent).
(You should be at the insurance agent across from Woolworth's.)

(O-3) •• Pay her bills at (city hall).
(You should be at city hall.)

(S-5) •• Deposit her pension cheque at the Royal Bank.
(You should be at the Royal Bank.)

(S-6) •• Return to your car in the parking lot.
(You should be in the parking lot behind the Royal Bank.)

Tape 3: Your nephew is getting married today and there are several things you must do to prepare for the wedding.

(C-3) •• If you haven't stopped at the camera store to buy film, you should go over to the discount store to get the best deal. But before that, pick up your clothes from the drycleaners.
(You should have gone to the drycleaners and then the discount store.)

(A-3) •• Confirm the reservation for the newlyweds at the hotel beside the department store.
(You should be at the hotel across from the camera shop.)

(C-4) •• Run over to the Texaco station to fill up and wash your car, but only after you have dropped off your books at the library and before you have purchased confetti at the drugstore.
(You should have gone to the library, the Texaco station and then the drugstore.)

(S-7) •• Go to the china shop to purchase a gift.
(You should be at the china shop.)

(O-4) •• Buy a card and some gift wrap from (the department store).
(You should be at the department store.)

(S-8) •• Collect your shoes from the shoemaker.
(You should be at the shoemaker's.)

(I-3) •• Pick up your sister from Room 6 at the local motel.
(I'm sorry, they tore down Room 6. She is now in Room 4.)

(A-4) •• Go to ceremony at the church across the street from the discount store.
(You should have gone to the church closest to the card shop.)

Tape 4: Your friend, also in town for the wedding, wants to go shopping at the mall the next day.

(I-4) •• Get some money from the Bank of Commerce.
(I'm sorry, they moved across the street. Go to the Royal Bank instead.)

(C-5) •• Before you go to the pet store to price a dog collar for your friend, but after you check out the sale on TV sets in the department store, pick up some paint chips to look at from the paint and wallpaper store.
(You should have gone to the department store, the paint and wallpaper store, and then the pet store.)

(S-8) •• Take your watch to the jewellery store to be fixed.
(You should be at the jewellery store.)

(O-5) •• Pick up your tickets from (the travel agent).
(You should be at the travel agent.)

(A-5) •• Stop at the bakery for a cinnamon bun.
(You should be at the bakery beside the Sandwich Basket.)

(I-5) •• Check out the Number One Bestseller at the bookstore across from the department store.
(I'm sorry, they closed out. Go to the book department in the department store.)

(S-10) •• Enjoy yourself at the afternoon matinee at the movie theatre.
(You should be at the movie theatre.)