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# Modality effects on adult learning

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# MODALITY EFFECTS ON ADULT LEARNING

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ABSTRACT

**Modality Effects on Adult Learning**

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This paper focuses on improving older adults' recall of important health information. The study's objective is to test which of three presentation modalities (text, audio or text plus audio) leads to improved performance of older adults' learning health information. The total number of participants consisted of 16 males and 18 females, or a total of 34 participants. The mean age of the group was 72.5. The participants were divided into three groups and each group was presented with one of three modalities (i.e. text, text plus audio, and audio), selected randomly, on an "auto start" CD, using PowerPoint as a guide. The outcome measures were a 10 question, Likert scale Ease of Comprehension Questionnaire, and a 10 Question Multiple-Choice Test. There was no main effect for the Ease of Comprehension variables or the Multiple-Choice Test recall variables due to treatment effects. The effect size for the Ease of Comprehension variable equaled .530 as measured by Eta squared. Given more power, the outcome would likely demonstrate significant results.

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# CHAPTER 1

## INTRODUCTION

In view of the U. S. Census Bureau's (2000) projected growth of older adults over 65 years old, one key challenge or problem that faces the nation currently is improving older adults' understanding of health information disseminated via the World Wide Web. In other words, providing older adults deeper insight and understanding of health information concerning such areas as preventing falls, stroke prevention, getting a good night's sleep, arthritis advice, dealing with diabetes, high blood pressure, depression, and menopause. This health information is provided by the National Institute on Aging (NIA), an agency of the Department of Human Health and Human Resources. This information is readily available to the public and older adults directly from NIA's World Wide Web site. (National Institute on Aging [NIA], 2004).

The above mentioned health matters are important because research has shown that older adults want to (a) maintain good health, (b) live longer, healthier lives, (c) reduce disability conditions, such as arthritis, heart disease or diabetes, (d) maintain an independent, active life style, (e) avoid nursing homes, and (f) maintain their cognitive skills, which are important for maintenance of older adults' independence and vitality (National Institute on Aging, 2001).

## Hypothesis and Experimental Design

The study investigated which modality was best to improve older adults' understanding of health information disseminated via the World Wide Web. The hypothesis is that older adults will better recall health information presented in an audio plus visual modality via the World Wide Web than health information presented in a single modality (audio or visual) via the World Wide Web. The independent variable is the presentation format for a series of computer based sentence reading and listening tasks concerning health issues. The tasks were presented in three formats (a single modality, audio or visual, and a dual modality, audio plus visual). The dependent variable is task comprehension as measured by the answers to questions posed in the reading tasks.

## The Theoretical Implications of the Study

This research is based on several established theories that provide structure formulating the research, for example, Paivio's (1986) Dual Coding Theory (DCT), which stresses the significance of non-verbal (pictures) imagery of memory. While DCT was not incorporated into this research, a corresponding approach to management of sensory images provides the means of presenting health information in a dual modality (visual plus audio) to provide better imagery of health information for older adults' than presentation of the same health information in a single modality (audio or visual).

Additionally, the conceptual frameworks of metacognition and metamemory have influenced this research, particularly as it impacts memory outcome performance of older adults. Hartley (2001) defines metacognition as "thinking about thinking." Hertzog and

Hultsch (2000) identify three major metacognition categories: Knowledge about cognitive functions; beliefs about cognition, including beliefs about one's own cognition, and beliefs about cognition and aging. Furthermore, Hertzog and Hultsch (2000) postulate that knowledge about strategies for encoding benefit learning and remembering. This knowledge is particularly applicable to older adults because such knowledge can benefit learning and overcome older adults' beliefs and perceptions about cognition, particularly if they are influenced by negative perceptions.

## How the Study Relates To Previous Work in This Area

An extensive search of the literature failed to reveal published studies or articles on methods that improve older adult's recall of health information via the World Wide Web. In most instances, prevailing studies center on older adults' capacity to remember information and these studies have been narrowly focused on discussion and recall of words. As the literature review will indicate, there are ample studies spotlighting difficulties of older adults' cognitive functions in such areas as memory, speed of processing, and language processing. Since this research area is their primary concern, researchers have paid relatively little attention to improvement of older adults' comprehension and maintenance of health information (K. Kemtes, personal communication, September 2, 2003)

## Significance of the Study

This study is important because it focuses on improving the recall of health information presented via the World Wide Web. Subsequent benefits accruing from this

research resulted in making older adults' aware of important, vital health information provided by the National Institute of Aging (NIA) and available on the World Wide Web. The education of older adults about important health information, such as high blood pressure, depression, diabetes and other important health topics, is critical in matters concerning successful aging, avoiding disability, avoiding disease, and sustaining high cognitive physical functioning. In addition, these topics are also important because relevant health information contributes to longer living, maintenance of a healthy life style by being self-sufficient and engaging in life (Rowe and Kahn, 1997).

The importance of older adults' understanding health information has also been underscored by the National Institute of Aging (NIA). The NIA has stated that health information is important to older adults because research has shown that older adults want to keep out of nursing homes, preserve good health, live healthier, longer lives, decrease arthritis, heart disease or diabetes conditions, maintain an independent, active life style, and maintain their cognitive skills, which are important for upholding older adults' independence and strength (National Institute on Aging, 2001).

Furthermore, this study is important because research literature has a paucity of studies examining issues that contribute to increasing older adults' recall of health information presented through the World Wide Web. Given that the Web increasingly utilizes multiple modalities for content presentation, it is important to better understand how older adults learn from different presentation formats.

## Purpose of This Study

The purpose of this study is to improve our understanding of older adults' recall of important health information presented in a Web-based format. More specifically, the aim of this study is to test which of three presentation modalities (visual, auditory, or visual plus auditory) leads to improved performance of older adults' learning health information disseminated via the World Wide Web.

## Research Question

Are older adults more likely to recall health information presented in an audio only, text only or audio plus text format?

# CHAPTER 2

## LITERATURE REVIEW

As previously indicated, there is a noticeable absence of research concerning studies examining older adults' recall of health information received via the World Wide Web. Additionally, there are no articles or published studies on methods that could enhance older adults' capacity to comprehend and recall health information delivered via the Web. This chapter addresses the relevant literature that provides the background necessary to support the need, purpose and design of this study. The relevant literature review is organized in four main sections. The first section begins with a survey of literature regarding (a) the generalized effects on cognitive functioning in older adults. These generalized effects play a key role in identifying factors that contribute to older adults' age-related slowing and reduction of working memory. The second section describes (b) information processing theory and memory content. The discussions suggest that research using information processing models, coupled with strategy instruction, benefit individuals through regulation of working memory. The third section discusses (c) modality effects and highlights a significant gap in literature with respect to older adults. The fourth section (d) focuses on the current study and includes the importance and need to improve older adults' recall of health information received via the Web; the purpose of this study, and the research question.

## Generalized Effects on Cognitive Functioning

### Cognitive aging

According to Raz (2000), cognitive aging is a fundamental biological process that can be defined, measured, described and manipulated. Furthermore, Raz adds that aging of cognitive skills mirror complex picture of brain aging by displaying a pattern of selective preservation and decline against the background of generalized changes. He further states that cumulative records of research on cognitive aging indicate that a large proportion of age-related variances in cognitive performance can be explained by two fundamental factors: (a) generalized age-related slowing; and (b) reduction in working memory (Raz, 2000, p. 1). Although older adults' attitudes play a key role in their recall of information, researchers like Raz, (2000) find aging, in and of itself, to be the greatest factor on cognitive functioning in older adults. In addition, other researchers find aging to be a biological process, that is, a development that involves every bodily cell, organ, and molecule (National Institute on Aging, 2004).

The National Institute of Aging reports that the researchers contend that the period of time each individual uses in the aging progression (i.e. as they grow older), is dependent on his or her life span--a variable that could be attributable largely to genes. Additionally, there may be other mitigating factors that influence the aging process, such as health, social or economic status, and environment. Nonetheless, in the course of time, the aging process remains irrevocable.

## The Greatest Impact of Sensory Changes on Cognitive Functioning In Older Adulthood

Other researchers investigated the path of aging by identifying sensory changes in vision and hearing (Baltes and Lindenberger, 1997). These researchers have recognized that sensory changes in vision and hearing have an impact on cognitive functioning in older adults. Their research has also established a strong link between sensory systems domain (visual and auditory) and the intelligence domain (cognitive ability). Their research represents a distinct departure from previous cognitive aging research that focused on working memory span measures and inhibitory control measures. Moreover, the Baltes and Lindenberger (1997) model more accurately predicts age-based changes in cognitive functioning through (a) its linkage of sensory systems domain and the intelligence domain, and (b) its correlation with variances in oratory and visual functioning through age-based changes in older adults' central nervous system. Consequently, the research appears to show promise of rendering added predictability of cognitive functioning in older adults. While working memory measurements and sensory changes in vision and hearing are important in assessing cognitive functioning in older adults, possibly even more important to older adults are models that postulate successful aging. For instance, successful aging is thought to be dependent upon three essential elements: (a) engaging in life, (b) sustaining high cognitive and physical functioning, and (c) avoiding disease and disability (Rowe and Kahn, 1997). Consequently, Rowe and Kahn, advocate that to achieve the first essential, older adults must be engaged in activities that are productive, such as creating services to meet a need of financial value. In addition, older adults can be involved in voluntary activities, paid or unpaid, that

provides goods or service. The researcher's contend that all three elements are essential and necessary for successful living.

Moreover, an additional review of the literature shows that natural aging, in and of itself, has the greatest impact on cognitive functioning in older adults. In the literature, aging is considered a maturational process that everyone experiences during his or her lifetime. As a result, the aging process is essentially biological, but at the same time, complex, involving every bodily organ, cell and molecule. These are regular changes that occur over everyone's lifetime (Raz, 2000; NIA, 2004). Sensory changes in vision and hearing also have an impact on the cognitive functioning of older adults. Variances in oratory and visual functioning in older adults are age-related and are correlated with age-based changes in older adults' central nervous system. Baltes and Lindenberger (1997), indicate there is a strong link between the sensory systems domain (visual and auditory) and the intelligence domain (intellectual ability).

## Limited Processing Resources

Wingfield and Stein-Morrow (2000) argue that there are common structural features in all languages that even though they vary among languages are nevertheless common to all earthly societies. The authors describe these common features as lexicon (a vocabulary keyed to specific concepts) and syntax (rules representative of relationships between modality elements); the components of lexicon are action verbs, object and concept nouns or words and noun modifiers. In syntax, the reader or listener must determine which are the main nouns and verbs, their modifiers, and their connectives. Wingfield and Stein-Morrow further argue that understanding and language production

cannot proceed without also considering language receiver and language producer processing resource limitations. They acknowledge that limited capacity categorization has evolved to meaning a cognitive system having limited processing resources or limited additional resources. According to Wingfield and Stein-Morrow, the construct of working memory is the most widely used construct on language processing. Working memory has been conceptualized as (a) a cognitive system with limited capacity holding recent information and provides space to store materials that can be manipulated and monitored (Baddely, 1986); and (b) the individual's limited quantity for storage, activation, and computation. Included in these mechanisms are upper limits on processing speed, effect of one's allocated limited resources among competing task, and efficiency of inhibiting relevant information.

Syntactic processing is also a significant concern in terms of limited processing resources. Syntax is the system defining acceptable word order. The English Language has syntax. For example, the sentence: "The dog bit the man." has a permissible word order in English, and is considered grammatically correct. In contrast, a sentence similar to "The bit man dog." is inaccurate because the words do not appear in an acceptable order. Syntax contributes to the meaning of a sentence, given that a different ordering of the same words will evoke rather different meanings. Case in point: the following sentence, "The dog bit the man.", depicts a very different situation from "The man bit the dog." Consequently, to understand the meaning of a sentence, readers must be able to organize a sentence to understand its meaning. The process of organizing the structure of sentences is called parsing or syntactic processing.

In a study involving younger and older adults' online processing of syntactically ambiguous sentences, Kemtes and Kemper (1997) made use of McDonald, Just and Carpenter's (1992) Working Memory Capacity-Constrained Sentence Processing model. Overall, the general problem addressed by the research was to determine if working memory affects the immediate syntactic analysis of a sentence, off-line processes, or both. However, more specifically the McDonald, et al. model was adopted by Kemtes and Kemper (1997) to assess essentially three questions: (a) determine if a working memory model can give an explanation for older and younger adults' performance on language processing tasks, and (b) determine if older adults' less efficient language processing stems from abridged working memory capacity, or (c) if the abridged working memory capacity is subjective to other factors impacting language processing, such as inhibition or speed. The authors developed several hypotheses that were foundational to the research. The first hypothesis pointed to an expectation that older adults would read text slower than younger adults and were expected to allot additional processing time at the ambiguous sentence areas containing the main verb and relative clause. The second hypothesis was the expectation that within age groups, high-span persons would show slower sentence reading times at the ambiguous sentence areas of each sentence. Conversely, reading times for medium and low-span individuals would be impervious to the ambiguity. In general, low-span persons and older adults would show more difficulty in answering the off-line comprehension questions compared to high-span younger adults. Kemtes and Kemper (1997) defined reading span score as "... the highest level at which a participant correctly recalled all the words from two of the three sets [low,

medium and high]. Participants received an additional half point if they correctly recalled one of the three sets from the next highest level" (p.364).

Respecting questions concerning ambiguous sentences, the fourth hypothesis postulated that younger and older adult high-span persons would exhibit greater accuracy in answering comprehension questions compared to lower-span person in their peer groups. Finally, in the fifth hypothesis, the author's articulated that since they considered question decision times and question accuracy as indexes of off-line processing; both could be predicted to show the largest effects of age.

From the Kemtes and Kemper (1997) study, there emerged a number of important findings, such as the following: (a) that there must be an individual-difference approach regarding the syntactic processing of older adults, primarily because syntactic processing declines are not specific to all older adults. Consequently, the authors propose that future research of on-line syntactic processing determine how specific variances in older adults are accounted for by cognitive processing factors; (b) compared to young adults, older adults' sentence reading times were appreciably slower. However, when compared to low-span older adult readers, high-speed older adult readers were the fastest readers within their age group. The Kemtes and Kemper study attributes working memory and processing speed as causal of these conditions. Also, their research indicated the variances may be due to differences between how off-task thoughts hamper attention with information in working memory during processing of syntactic sentences; (c) the consequences of working memory limitations was readily apparent concerning questions involving main verb ambiguities. The authors acknowledge that this finding is supported by other off-line memory assessments that have found poor performance of older adults

when sentences to be remembered are syntactically complex or semantically complex, or both. In conclusion, Kemtes and Kemper (1997) posit that for future research a more complete examination should be made of the array of difficulties that produce age and span effects.

From the 1997 Kemtes and Kemper research, it is clear that on-line syntactically ambiguous sentences in stimulus materials (text) should be avoided at all costs, particularly where the goal is for participants in a study to fully understand the stimulus materials presented. Concurrently, with respect to older adults, the authors make it apparent that avoidance of on-line syntactically ambiguous sentences in stimulus material is essential because such materials negatively impact older adults' working memory and processing speeds. These findings are well suited to this research since the goal of this research is to improve older adults' recall of important health information presented in a Web-based format. Therefore, syntactically ambiguous sentences were not included in this study.

## Information Processing Theory and Memory Content

### Model modal and associative memory structures

How human information processing occurs is one of the most important aspects to understanding working memory. Fortunately, several theoretical models have been developed over time that address concerns about working memory and also provide a framework for understanding both human cognition and cognitive aging. For example, human information processing models, such as the modal model of working memory (Baddely, 1986) and associative memory structures (Collins and Loftus, 1975) have

proven instrumental in establishing a theoretical framework that illustrates how human memory works. Additionally, Bruning, Schraw, and Ronning (1999) suggest that research using information-processing models show that strategy instructions may benefit individuals through regulation of working memory. To further explore this point of view, a logical approach would be to look at how strategy instruction concepts can be beneficially applied to improve older adults' recall of health information via the Web, which is the focus of this research.

The literature is clear that the above models are successful in providing deeper understanding of both younger and older adults' recall mechanisms. Additionally, the cited human information processing models have enabled extensive study on the effects of cognitive aging. Nonetheless, fundamental questions remain, such as "How much is working memory capacity reduced in older adults?" (Meyer, Glass, Mueller, Seymour, and Kieras, 2001).

## Executive-Process Interactive Control (EPIC)

Answers to this question and predictions about memory effects on cognitive aging, have been provided by a unified computational architecture know as Executive-Process Interactive Control (EPIC). The performance of both younger and older adults is modeled by this architecture. The EPIC architecture correctly accounts for (a) aging effects on reaction times, (b) yields accuracy in basic dual-task and working memory paradigms, and (c) accurately reports the components of age-related declines in verbal working memory (Mueller, Seymour, Glass, Kieras, and Meyer, 2000; Meyer, Glass, Mueller, Seymour, and Kieras, 2001). Examining the empirical evidence, methods and results

published in the cited references clearly validates their applicability to the study of cognition and aging.

In the final analysis, one of the most important keys to adult recall of information is for older adults' to retain a positive attitude and high-confidence about their overall capabilities. Retaining a positive attitude is vital, because in this context attitude is the perception of memory changes, and the perception of control over one's memory. Typically, older adults with low-confidence view memory pessimistically. On the other hand, older adults with high-confidence view memory decrements as a challenge and quickly engage in activities designed to improve their memory performance, such as attending memory training sessions (Dellefield and McDougall, 1996). According to Zacks, Hasher and Li (2000), if older adults characteristically hold such negative views about themselves as compared to younger adults, it is not astonishing that older adults could be less enthusiastic to improve their performance by (a) changing their attitudes and (b) by using feedback to generate appropriate task strategies to improve their memory performance. As a result it is no surprise that older adults may consider themselves as having less self-efficacy than younger adults. In comparison, Zacks, Hasher and Li (2000) conclude that literature on self-efficacy does not robustly support that alterations in and individual's self-efficacy will cause associated alterations in memory performance. However, not all researchers agree with the Zacks, et al. position. For example, as previously indicated, Dellefield and McDougall, (1996) contend that older adults' memory performance is improved by their attending memory training sessions. There is also sufficient literature demonstrating that self-efficacy improves memory performance in both older and younger adults. Additionally, the self-efficacy

literature shows considerable improvement in performance outcomes for younger adults, for the most part students and teachers with high self-efficacy (Bandura, 1986; Pajares, 1996; Bruning et al., 1999).

## Modality Effects

### Unimodal and bimodal presentations

*Cognitive load Theory (CLT)*

While previous sections addressed abridged working memory capacity in older adults, the following section speaks to cognitive load theory (CLT). The theory, developed by Sweller (1988, 1994) is directed at developing training materials that make effective use of an individual's available cognitive processing capacity and motivates a learner's capability to use attained knowledge and skills in new circumstances (Van Gerven, Paas, Van Merrienboer and Schmidt 2002). In other words, cognitive load theory is concerned with the cognitive load that performing a particular task imposes on an individual's cognitive system. The idea is to use less cognitive capacity in learning a task by reducing task demands through elimination of extraneous materials and by providing only germane materials that establish more efficient links to encoding and retrieving information.

In their research, Van Gerven, et al. (2002) view Sweller's cognitive load theory (CLT) as a construct that stimulates younger and older adults to use acquired knowledge and skills in new situations. The researchers further state that CLT-based training formats meet older adults' cognitive abilities especially well. More specifically, cognitive aging brings declines in older adults' working memory and hampers acquiring complex

cognitive skills. Nevertheless, the researchers argue that learning can be enhanced by optimizing use of the remaining cognitive resources skills by the application of Sweller's (1988, 1994) cognitive load theory.

Cognitive Load Theory (CLT) is based on automaticity of procedural knowledge, information processing concepts and schema, which as defined by Sweller (1988, 1994), is a structure that enables an individual to catalog and solve problems in a specific domain. Sweller's (1988, 1994) cognitive load theory posits that (a) human working memory is limited. The mind can only retain a few things at a time; (b) schema acquisition and automation of procedural knowledge are the two tools that can be that can be applied to get around the confines of working memory. Van Gerven, et al. (2002) assert that Sweller's (1988, 1984) CLT offers significant tools that accomplish this purpose, because the limits of working memory are a direct concern of CLT. Moreover, CLT maintains that the most desirable use of working memory requires the maximum number of mental operations that add directly to the learning process while at the same time minimizing the number of operations that do not contribute the process of learning. To accomplish this process, the authors assert that training should be designed to enable learners to spend working memory on relevant (germane) cognitive load and not on non-relevant (extraneous) cognitive load.

With respect to older adults, Van Gerven, et al. (2000) indicate that CLT takes the older adults' limitations of working memory into account, and keeps extraneous cognitive load as low as possible, which increases germane cognitive load allowing older adults to construct schemata at an early stage. Because of the recurring process, this results in adding more schema and lowering of perceived task complexity. To test these claims, the

researchers used two training formats: conventional problems condition and worked examples condition. The conventional problems condition required older adults and young adult participants to solve four conventional problems requiring basic strategies. In the worked examples condition, older adults and younger adult participants studied the same basic problems presented that were previously worked-out. The worked-out format is in keeping with Sweller's (1988, 1994) position toward problem solving and learning by use of completed worked examples. Applying Sweller's CLT to conduct these tests, Van Gerven, et al. noted the following outcomes from testing the efficiency of worked examples compared to conventional problems for both young adults and older adults: (a) Older adults' subjective cognitive load was substantially lower in the worked examples condition than in the conventional problems condition; (b) the older adults' displayed a substantial efficiency gain in the worked examples condition compared to the conventional problems condition. Solving the conventional problems was highly inefficient for older adults; (c) older adults spent more time on training and experienced higher levels of cognitive load compared to younger adults. Van Gerven, et al. postulate that this finding supports the view that working memory rather that intellectual ability plays an essential role in learning new skills; (d) worked examples were found to be a more efficient means of training older adults than conventional problems. Additionally, older adults took more advantage of worked examples than younger adults; (e) based on the interactions between age groups, training time and cognitive load strongly suggested that older adults benefited more from worked examples than younger adults. Older adults achieved an equal performance level with younger adults by investing less mental effort

when studying worked examples. The findings imply that added germane cognitive load is offered by worked examples.

Van Gerven, et al. (2002) concludes that their findings indicate that worked examples aimed at older adults could be designed to address different modalities and their associated components of working memory. To accomplish this designation, the authors suggest the use of multimedia techniques in which animations or images are combined with narrations that offer vast learning opportunities. The authors further believe this approach would reduce the amount of extraneous cognitive load caused by visual search or split attention, thus increasing germane cognitive load. In addition, the authors contend that this approach would produce greater beneficial results favorably impacting the training illustrations efficiency ratio between an individual's invested mental efforts compared to the individual's test performance results (proportion of solved problems). An analogous concern respecting verbal and pictorial elaborations that enhance memory for older and younger adults was expressed by Cherry, Park, Frieske, and Smith, (1996). Cherry, et al. (1996) found little that directly addresses the issue of pictorial illustrations that could promote recall of sentential material specifically as it pertains to older adults. Also, Cherry et al. reported there were few studies that directly examined verbal elaborations on older adults' recall. Those few studies that were done in this area had mixed results. The researchers also reported that they found few studies that addressed the issue of pictorial elaborations on verbal recall in younger adults, and no prior studies that addressed this issue with older adults.

In summary, the Van Gerven, et al. (2002) findings were in keeping with Sweller's (1994) proposition to consider schema acquisition as being the primary mechanism of

learning when considering intellectual activities. The Van Gerven, et al. worked examples, which built larger schemas rather than cognitive load when compared with solving conventional problems, played a key role in reducing difficulties of the materiel that needed to be learned by older adults. This learning approach was also in keeping with Sweller's (1988, 1994) cognitive load theory. Without a doubt, CLT has significant benefits for learning, particularly as the concept applies to older adults' memory recall. The reduction of extraneous cognitive load through use of worked examples has considerable merit. The CLT based training formats obviously meets well with the cognition abilities of older adults. The training formats enhance the cognitive abilities of older adult learners and therefore serve to bridge the decline of working memory capabilities attributed to aging. The CLT theory was useful in this study throughout the application of multiple modality protocols designed to reduce each participant's cognitive load. These multiple modality protocols were tested in this study and the outcomes are indicated in the subsequent sections of the study.

*Dual-Coding Theory (DCT)*

In the late 1960s investigative studies began to appear concerning memory models that discussed in what way sensory information is coded. The investigative studies were the outgrowth of Cognitive Information Processing (CIP) theory, which explains the mind's structural components for processing information, in addition to the actions necessary for activating those components. The dual-code model developed by Paivio in 1971, described how visual information is processed and stored in memory, and was one of the models emerging from the (CIP) investigative studies.

Paivio (1986) points-out that from its beginning, Dual Coding Theory (DCT) was in response to the existing dominating view that memory performance and other cognitive tasks were mediated primary by linguistic or verbal processes. In contrast, the DCT view stresses the significance of nonverbal imagery as a mode of thought distinct from verbal processes. Additionally, the DCT studies manifested the first methodical purposeful measurement of the effects of imagery on memory. According to Paivio (1991), DCT evolved from his studies on the role of imagery in associative learning. These studies marked the first systematic objective measurement of the effects of imagery on memory. Before reviewing these effects, a brief description of the assumptions and components of this theory is needed.

The DCT postulates that for processing information, memory is composed of two independent, interrelated symbolic coding systems—one symbolic verbal sub-system and one symbolic visual sub-system. The verbal and visual symbolic sub-systems function independently, however interrelations between the two sub-systems allow dual coding of information. The two sub-systems interconnectedness permits cueing from one system to the other that facilitates understanding of our environment. There are different functions for each system, such as memory units, and storage processing characteristics (Rieber, 1994). The verbal system is specialized for processing linguistic information, for instance words and sentences. Paivio (1986) depicts an associative structure as storing verbal information in discrete, sequential units that are named *logogens*. In contrast to the verbal system, the visual (non-verbal) system stores perceptual information, such as images and pictorial information in an associative structure named *imagens*. ChanLin (1994) illustrates the power of images (depicted in Paivio,1986, symbolic system structure) by

an example of a visually processed face that is perceived at the same time as a whole consisting of mouth, eyes, nose, distinctive sub-elements, in great detail. On the other hand, a verbal depiction would require sequential description of each individual element. Consequently, the level of detail is relative to the length of the description in this situation.

Dual-Coding Theory (DCT) has major benefits for learning and memory recall. Paivio's (1986) symbolic, non-verbal (picture images) sub-system has clearly demonstrated that pictures are superior to words for memory tasks. Moreover, DCT has demonstrated that adding pictures, internally or externally, to verbal learning (words) facilities learning. In Paivio (1986), the author makes the following remarks:

The updated dual coding approach presented here [Paivio, 1986] retains much of the constructive empiricism and the basic theoretical assumptions of the earlier version. In defense of those views, I spell out the advantages of an empiricist approach to the study of cognitive phenomena and show that the fundamentals of dual coding theory have stood up well to the empirical challenges over the years. Indeed, the supportive evidence is apparently so compelling that some propositional theorists have been motivated to adopt structural and processing assumptions essentially like those of dual coding theory... (p. viii).

Although Sweller's CLT addressed student learning, presumably young adults, DCT has applicability to older adults, students and non-students. According to Paivio (1986), the usefulness of imagery in associative learning through the dual coding approach has been established and has stood up well to empirical challenges over the years. The interrelated role of processing information both verbally and visually (dual coding of

information) to enhance learning and recall is undoubtedly transferable and applicable to older adults. The more holistic approach of imagery (pictorial information) over verbally described information could prove highly beneficial to older adults' recall of health information received via the Web. For example, in their research, Cherry et al. (1996) confirmed that pictorial elaborations substantially enhanced recall for both younger and older adults. Additionally, their research found that the combination of verbal and pictorial elaborations resulted in substantial improvement in recall performance for older adults compared to verbal elaborations alone. Furthermore, in supporting the high benefits of imagery, Bruning, et al. (1999) assert ". . . there is little doubt that imagery is important to memory and cognition .... A large body of evidence shows that materials high in imagery are more memorable and that learners instructed to create images will enhance their learning" (p. 62). The DCT theory was useful in this study throughout the application of audio and visual protocols designed to reduce each participant's cognitive load. The concept framed this research by describing the way sensory information is coded and how the mind processes information through its structural components.

## Aids to Computer-Based Multimedia Learning

In undertaking this research, it was essential to recognize (a) how learners became actively engaged in the learning process and (b) understand the concepts of organizing information into coherent representations, and integrating the representations with prior knowledge. The Mayer and Moreno study provided this research with solid guidelines that addressed these issues. For example, the general problem researched by Mayer and Moreno (2002) was to understand how words and pictures could help individuals know

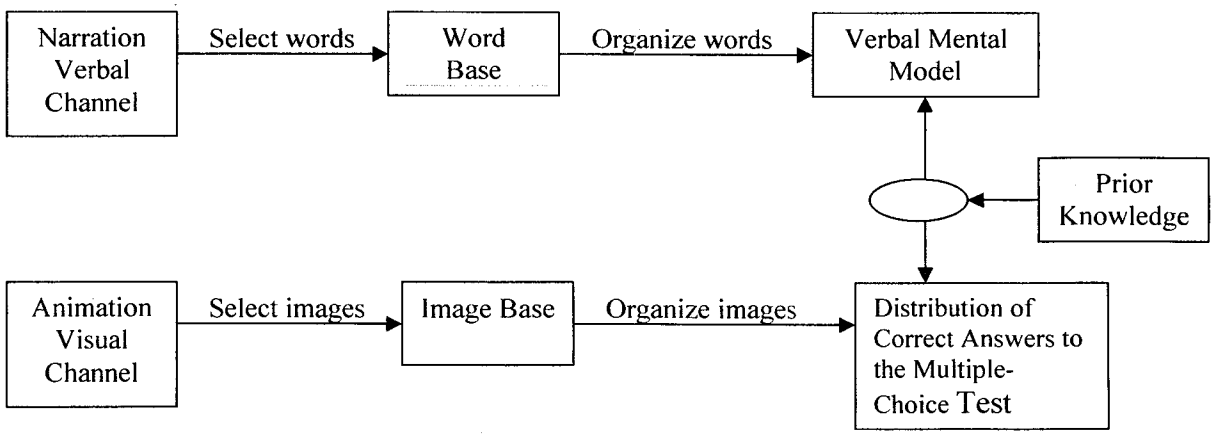
how scientific systems work, such as the human repository system, how a bicycle tire pump works and how lighting storms develop. To accomplish this, the researchers focused on several areas, beginning with (a) determining how to design multimedia messages that promote meaningful learning; (b) furnishing individuals with multimedia explanations consisting of words and pictures, (c) focusing on computer-based learning environments, and (d) focusing on problem-solving transfers that promote constructivist learning. Mayer and Moreno (2002) define constructivists learning as an activity in which a learner is actively engaged in the cognitive process for understanding.

Mayer and Moreno (2002) employ several theories supporting their goal to improve design of computer-based multimedia learning. To promote greater understanding in learners, their study is guided by the following theories: (a) the cognitive theory of multimedia learning, which draws on Paivio's (1986) Dual Coding Theory. The researchers make the point that what leads to an individual's cognitive overload and failure to process information is to many complex pictures and to many words; (c) constructivist learning theory, which Mayer and Moreno (2002) posit that learning occurs when learners actively select relevant information. Also, learning occurs when learners organize the information into coherent representations and integrate the information with prior knowledge. The researchers also posit that these cognitive processes are necessary in order for learners to hold visual and verbal representation in memory at the same time.

In an overview of the cognitive theory of multimedia learning, Mayer and Moreno (2002) further posit that the theory involves cognitive activities that must be engaged for meaningful learning to occur. The researchers stipulate that the process is iterative and that the learner must perform each of the following cognitive processes: (a) the learner

must select appropriate words and images, (b) the learner must arrange the words and images into logical, visual and verbal representations, and (c) the learner must connect the visual and verbal representations with prior knowledge. A schematic of the author's cognitive theory of multimedia learning is shown in Figure 1.

Figure 1
A Cognitive Theory of Multimedia Learning




In summary, the study shows that for the author's design principles, students have deeper learning when their visual and verbal working memories are not overloaded. Also, constructivist learning almost certainly occurs when, in working memory, learner's needs have matching verbal and visual representations simultaneously. Furthermore, the report also shows to what extent instructional design adds to cognitive theory and to what extent theory based research in multimedia learning contributes to a raising set of design principles.

This research concurs with Mayer and Moreno's (2000) assertion of constructive learning where learning occurs when (a) learners organize information into coherent

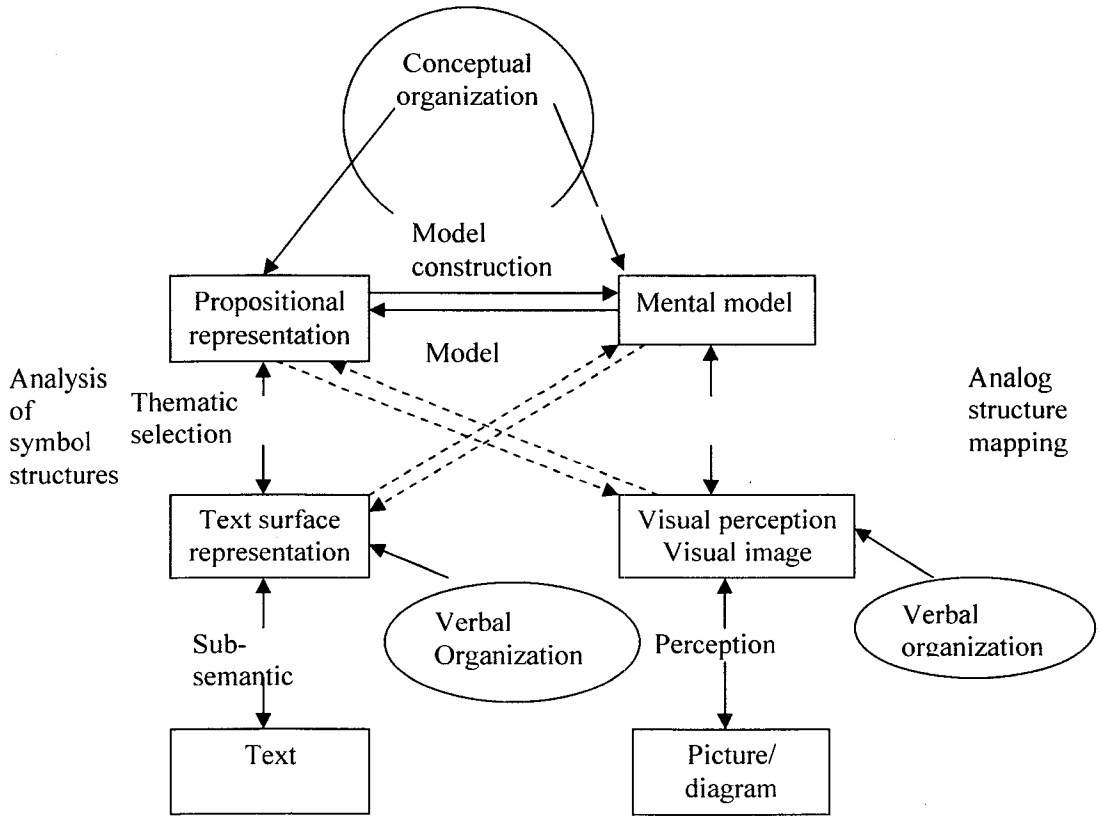
representations and integrate the information with prior knowledge; (b) learning occurs when learners actively select relevant information. Recognition of these conditions is very important in this research which focuses on older adult's recall of health information presented via the World Wide Web. To facilitate this process, every effort was made to get older adults actively involved in testing the learning and recall of health information delivered via the Web.

## Toward An Integrated View of Learning from Text and Visual Display

To further appreciate how learners become actively engaged in the learning process, and how external and internal mental representations contribute to comprehension, the researcher examined (Schnotz, 2002) paper Towards an Integrated View of Learning from Text and Visual Display is a survey of literature concerning text and visual displays. The article is part of a special edition of Educational Psychology Review (2002), which included excellent articles by distinguished researchers on spatial text adjuncts, for example, Schnotz (2002). The Schnotz article proposes an integrated model of learning from text and visual displays.

Schnotz (2002) introduces what the author terms an integrative model of text and picture comprehension. The author argues that the model gives more emphasis to representational principles that consider external and internal mental representations to comprehension. The integrative model of text and picture comprehension is shown in Figure 2.

Figure 2
Schematic Illustration of an Integrative Model of Text and Picture Comprehension




The model is configured with two sides. The left side is termed descriptive and the right side is termed depictive. The descriptive left side of the model consists of three components: (a) the internal mental representation of the text structure, (b) the propositional representation of the text structure, and (c) the external text. Symbolic processing forms the basis of interaction between the descriptive representations. The depictive right side of the model also consists of three components: (a) the image on internal, visual perception of the picture, (b) the external picture, and (c) the subject matter's internal, mental model presented in the picture. The basis for interaction between

the depictive representations is predicated on the process of structure mapping caused by structural correspondence between the representations.

As stated by the author, external representations are pictures and text; internal representations are mental representations built during picture and text comprehension. Also, readers construct multiple mental representations for both picture and text comprehension. In the comprehension of text, a reader's mental representations are assumed to (a) include a propositional text base, which symbolizes semantic construct of the text; (b) surface representations of the text, consisting of specific words or phases; (c) mental mode of what the text is all about, and (d) a genre level, which captures equivalent information about the text's function and class of the text. In the comprehension of pictures, the individual also builds multiple representations, which consist of (a) surface structure representation that matches the visual image of the picture placed in the individual's mind; (b) the mental modal which stands for the subject matter shown in the picture; (c) a communication level that represents the practical context of the pictorial communication, and finally (d) a genre level that represents knowledge about the class pictures and their equivalent functions.

In summary from a global perspective, the author concludes that spatial text adjuncts are depictive representations that support thinking, communication, and learning. However, this supportive function must ensure that visual-spatial displays interface properly with an individual's cognitive system and with human visual acuity. This is essential because an individual's cognitive system and human visual perception typify cognitive abilities, prior knowledge and learning skills. As a result, the author contends that with visio-spatial text adjuncts, effective learning can be promoted by sufficient

processing strategies and by suitable instructional design. Both sufficient processing strategies and appropriate instructional design depend on sufficient understanding of how the human cognitive system interacts with visio-spatial displays. The Schnotz (2002) integrative model of text and picture comprehension has considerable merit, and the model provided this research with deeper understanding of the relationship between propositional representation and the mental model that could apply to this research, particularly in regard to the recall of health information from the Web.

In the literature on modality effects, several other good examples of modality effects are illustrated on audio-visual language processing. In 1991 Ressler examined the need for natural research about every daily thing to be remembered, comparing hospital patients' information recall to unimodal presentations (talking only) and bimodal presentations (showing and talking). All participants were selected by hospital discharge planners and were hospital patients 60 years and older. The hypothesis of the Ressler (1991) research was that bimodal presentation (showing and talking) would increase recall over unimodal presentations (talking only). Ressler found that bimodal information (showing and talking) has a positive effect on older adult recall of recently presented information. However, the bimodal information has to be augmented with other aids, for example, writing the information down for the patient. Furthermore, one limitation in the Ressler study was the potential for researcher bias due to Ressler's direct involvement in both the presentation of information and in the recall evaluation. In Ressler's 1991 research, the question arises as to how would recall be more effectively impacted given availability of a presentation that exhibited more selectivity in its presentation and appearance to older adult patients? This researcher suspects that memory performance of

older adult patients would be measurably improved given greater selectivity of the presentation information.

## Verbal and Pictorial Elaborations

Cherry, Frieske, Park, and Smith (1996) examined the facilitative role of verbal pictorial elaborations in young adults and older adults in two experiments: first, explanatory verbal elaborations and second, pictorial elaborations. The Cherry et al., article postulates two separate hypotheses for two different experiments: experiment 1 postulates that verbal elaborations enhance verbal recall for both younger adults and older adults. Experiment 2 postulates that pictorial elaborations improve recall for both younger adults and older adults. The Cherry et al. research established that the occurrence of pictorial facilitation might depend on the number of stimuli presented for study, test and the quality of encoding. Further, Cherry et al. confirmed that pictorial elaborations substantially enhanced recall for both younger and older adults. Their research found that the combination of verbal and pictorial elaborations resulted in substantial improvement in recall performance for older adults compared to verbal elaborations alone. The conclusions reached were clearly justifiable and consistent with similar research conducted by prominent researchers that were repeatedly cited in each of the research papers.

Because of differences in research objectives and approach, research hypothesis about modality effects differed across literature review studies. To illustrate, Frieske and Park (1999) conducted research-measuring memory for news studies using actual news programs in print, audio and TV formats. Frieske et al. had two main findings: (1)

younger adults recall more news content than older adults; (2) information presented in a TV format showed better results than an audio format with both younger and older adults. Additionally, the authors postulate that their findings extended a common cause view of cognitive mediation of age decrements in news memory. This means that from their commonality analysis, the researchers found that 75% of the age-related variance was mediated jointly by acuity and speed. The hypothesis in Frieske and Park's research appears to be a sensory functioning and processing account for age-related variances in everyday tasks of remembering news. Frieske and Park had two main findings: (a) younger adults recall more news content than older adults; (b) information presented in a TV format showed better results than an audio format with both younger and older adults. Additionally, the authors postulated that their findings extended a common-cause view of cognitive mediation of age decrements in news memory.

## A Significant Gap in the Literature and Its Impact on Older Adults

Previous work in this area has addressed some of these issues, but they have not addressed them as they specifically apply to older adults. For example, Cherry, et al. (1996) found little that directly addresses the issue of pictorial illustrations that could promote recall of sentential material specifically as it pertains to older adults. Also, Cherry et al. reported there were few studies that directly examined verbal elaborations on older adults' recall. Those few studies that were done in this area had mixed results. The researchers also reported that they found few studies that addressed the issue of pictorial elaborations on verbal recall in younger adults, and no prior studies that addressed this issue with older adults.

There is also a scarcity of long-term or longitudinal studies that examine intelligence and cognitive aging in older adults as compared to younger adults. These studies are important because most studies of cognitive aging are cross-sectional and compare cognitive aging processes of older adults to younger adults. These comparisons can often be misleading and can give credence to the notion that all older adults are on an accelerated slope of decline, particularly after age 65. However, longitudinal studies often illustrate a different picture (Lamdin and Fugate, 1997). As Lamdin and Fugate express it:

> The old believe that the intelligent curve plateaus in the thirties and, after holding steady for 10 years, begins to go downhill. That notion has given way to the results of more sophisticated studies using more highly differentiated intelligence tests which show, among other things, that on measures of vocabulary and other skills reflecting educational experience, individuals seemed to maintain their adult level of functioning into the six, and even the seventh decade. Even skills that are likely to decline with age (memory, speed, visual-motor flexibility) can be compensated for by the accretion of experience and education that is termed "crystallized intelligence" Moreover, barring organic brain disease, older people can actually improve their cognitive skills through training and exercises. The more one is involved in learning activities, the more one's ability to learn expands. Continuing learners are better learners (p. 38).

An example of double standards used to assess perceived memory declines in older adults has been demonstrated by the research of Erber, Szuchman and Rothberg (1990).

Their research shows that memory failures considered common and daily occurrences have a tendency to be more harshly judged when older adults make such failures. These failures in older adults are often treated as an indication of cognitive decline, compared to younger adults making similar failures, which are usually dismissed as a nonevent or an inconsequential matter. Along a similar line of reflection, Crowell (1997) of Georgia Tech quotes Dr. Arthur D. Fisk, a distinguished, eminent and often cited Georgia Tech psychology professor, as follows:

> We have a lot of opportunities because of the aging of the American population. I am interested in solving important, fundamental problems of cognition and aging, and skill acquisition and aging. It is also important to determine, from a practical perspective, what aspects of system design, product design, training and the activities of daily living we really need to worry about from an age-related perspective older individuals do quite well in this world. Look at the age of chief executive officers in this country. Look at the age of our very good scientists. Age brings with it an awful lot of capabilities, not limitations (pp.1-2).

Marsiske and Willis (1995) postulate that in measured cognitive processes, age-related declines may not imply corresponding declines in the ability to perform cognitive tasks of living. Positive age trends, with older people outperforming younger people despite lower performance on some measures of cognitive processing have been actually shown in some research.

Finally, Cohen (1988) may have expressed the effects of learning capacity and aging best with the following observation:

> The capacity to learn knows no endpoint in the human life cycle. The findings . . . of continued growth of vocabulary among many individuals well into advanced old age support this statement. In my own study of mentally healthy older adults between the ages of 65 and 102, examples of new intellectual growth and inquiry are abundant. One of these subjects, an 82-year old woman with a high school education, had only since her late 70s developed an interest in reading books. This interest, however, so motivated her that in the six months prior to my first interview with her she had devoured 21 novels (pp.26-27).

## Current Study

The general problem addressed in this research is the importance and need to improve adults' recall of health information received via the Web. The need for improvement could apply equally to other areas of adult life such as general education or literacy improvements in reading, writing, and math. There are several educational mediums that could be used to accomplish such improvements, and these mediums include television, video, the Web, and radio. There are distinct advantages to each media. In the case of television, combining multiple image systems (written and spoken language, music and sounds, which are combined for presentation), offer a distinct advantage over dual modalities (visual, audio only) and single modalities (visual, audio alone). Research confirms enhanced learning of information presented visually with audio redundancy (Drew and Grimes, 1987).

Another important consideration in facilitating accessibility to educational programs that promote improvement of adult recall of information is availability of equipment and avenues through which such programs can be promoted and viewed. A U. S. Census Bureau report in 2000 indicated that of the 281 million people in the country, 248 million have at least one television, 54 million have one or more computers, and 44 million have Internet access (U.S. Census Bureau, 2000). The large number of people with at least one television would mean that educators could have available a larger audience to present literacy and general education programs through the medium of television compared to presenting educational programs through the Internet. An added advantage to educational television is a development of visual technologies (video recording and playback, CD-ROM and video disk technology). This multi-computer technology provides users with more control and interactivity to apply televised instruction to meet the needs of a variety of learning styles and learners (Moeller, 1996).With respect to radio and its impact on education, Larry Cuban (1986) indicated that radio lasted from its first documented educational use in 1923 until the arrival of television in the 1950s.

Additionally, cognitive skills can also be learned through observation and imitation. Adult learning can be presented with online technologies using what is often termed as gerontechnology. Gerontechnology is defined as "the study of technology in aging for the improvement of daily functioning of the elderly" (Bouma, 1992, p.6). Research has shown that older adults can learn computer skills and online technology that will provide a better quality of life (Jones, and Bayer, 1998). Moreover, research has shown that older adults' use of electronic communications (bulletin boards) provide (a) social interaction for adults, (b) mental stimulation by providing links to other uses of the system, and (c)

minimizes isolation and loneliness for older adults with restrictive mobility. Additionally, general interaction with computer technology decreases levels of depression among older residents in long-term care facilities, and increases older adults' cognitive functioning (Morrell and Echt, 1997). These findings are good news and indicate an important process that will serve the current older adult population and the on-coming "baby-boom" cohorts in the future.

It is acknowledged that television's capability to combine multiple image systems (written and spoken language, music and sounds, which are combined for presentation), plus advances in gerontechnology systems are formidable media for learning health information. These media offer distinct advantages over recall of health information through dual modality (visual plus audio) presentations via the Web. Nonetheless, this study has focused on dual modality presentations of health information received via the Web.

## Purpose of This Study

The purpose of this study is to further our understanding of older adults' recall of important health information presented in a Web-based format. More specifically, the aim of this study is to test which application of three modalities (visual, auditory, or audio plus visual) leads to improved performance of older adults' learning health information disseminated via the Web.

## Research Question

Are older adults more likely to recall health information presented in an audio only, text only or audio plus text format?

# CHAPTER 3

## METHODOLOGY

### Participants

Study participants were seniors 65+ years of age from a volunteer group of seniors recruited from the Las Vegas area. The participants were recruited by flyers handed-out at various locations and meetings and by word of mouth through various individuals who in turn, passed the word along to their colleagues and associates. The total number of participants consisted of 16 males and 18 females, or a total of 34 participants. Participants were paid a remuneration stipend of $10.00 as compensation for participating in the study. There was an equal opportunity for male and female participants to be selected among older adults. Participants with a known neurological disorder history, or self-reported hearing or uncorrected visual defects were excluded from this study. Such conditions are reported by the participants in the self-assessed Participant Profile Questionnaire.

### Design

This study is a single factor study with the factor having three levels. It is a between subjects design. Participants were randomly assigned to one of the three methods of presentation (Text Only, Audio Only, and Text plus Audio only). The independent variable was the method of presentation: Audio Only, Text Only, and Audio plus Text.

The dependent variables were coherence (ease of comprehension) and comprehension (test). The method of presentation was developed on three CDs, which were designed for presentation of each specific modality: Text Only, Audio Only, and Audio plus Text. The modality was randomly assigned to a session through being selected by another individual independent of the researcher.

## Materials

The self-assessed, thirty-four question Participant Profile assessed the participant's level of educational attainment and general health, such as their vision, their hearing, their ability to use both hands, and their memory (see Appendix C).

The health content was presented in one of three modalities (i.e. Text Only, Audio Only, or Audio plus Text). As mentioned previously, the three modalities were randomly assigned to each group. The test subject was obtained from the National Instituted of Health, (2006), National Eye Institute, (2006) and the National Institute of Aging Information Center, (2006). The text was informative and consisted of 700 words, which were organized in the following five sections: Eyes, Common Eye Problems, Common Eye Diseases and Disorders, and Five Steps to Protect Your Eyesight. (see Appendix F). Also, see Appendix G for the seventeen PowerPoint Windows Screens that were used for the Eyes presentation slides. The slides were intended to convey text only information. However, the slides for the text and text plus audio modalities did contain graphic images. The use of the images was merely to reflect common practice. The graphic images were inserted into the lower right corner of the PowerPoint slides and were intended to enhance and be reflective of the text's subject matter. For example, the text

on one slide asked the question: "Are you holding the newspaper further away from your eyes then you used to"? A graphic showing a newspaper, along with an accompanying magnifying glass, was inserted to emphasize the question. Similarly, in another slide, a graphic with sunglasses over a happy face, was inserted to emphasize that sunglasses could help reduce tearing if an individual's eyes were sensitive to light, wind, or temperature changes. No graphics or text was included in the PowerPoint presentation of the audio modality. In presentation of this modality, participants were introduced to an "audio only" (commentary) presentation with no text or graphic images. The commentary of the "Eyes" text was presented to the participants verbatim, or word for word. The design content was reviewed by an educator familiar with design principles.

The first dependent variable, coherence, was measured with the Ease of Comprehension Questionnaire. (see Appendix D). The Ease of Comprehension Questionnaire has a total of ten questions and asks the participant to rate each question for interest using a 5-point Likert type scale similar to that developed by Schraw, Lehman, and Hartley (2000), and Lehman and Schraw (2002). In completing the Ease of Comprehension Questionnaire, each participant was asked whether he/she agrees or disagrees with each statement, and he/she was also asked to select a response from a 5 point continuum ranging from "Strongly Disagree" to "Strongly Agree." Each participant's responses were scored using the following format: The Ease of Comprehension Questionnaire was scored by the summation of assigned point values to each item category, such as Strongly Disagree (1 point), Disagree (2 points), Not Applicable (3 points), Agree (4 points), and Strongly Agree (5 points). A participant's total score is the sum of the points associated with the response given in each of the ten

response questions. The higher scores on the continuum are given for responses showing a favorable attitude toward the construct.

In addition, the Ease of Comprehension Questionnaire was designed to contain inverse related questions as a check on the participant's understanding of the question. For example, question number one (I thought the health information presentation was easy to understand) is inversely related to question ten (The health information required a lot of effort for me to understand). There is a similar inverse relationship between question two (I thought the health information was presented in a well organized manner), and question seven (In certain places, the health information seemed confusing to me).

The second dependent variable, comprehension, was measured with a multiple choice test designed to gauge each participant's overall understanding of health information about "Eyes." (see Appendix E). The test was developed from the "Eyes" text obtained from the National Eye Institute (NEI). The test questions were reviewed by an educator familiar with test construction and psychometric methods. When completed, participants placed the finished test in their study packet. In the fourth and final part of the protocol, the participants gave their packet to the researcher and exited the room. Upon submission of their packet to the researcher, each participant received remuneration of $10.00 and was thanked for their participation. Participants were given an opportunity to sign up for a copy of the completed manuscript as they exited the study room.

## Procedures

Participants are all volunteers who signed-up to become involved in the research program. A volunteer scheduler subsequently called each participant and scheduled the time each participant selected to take part in the study. Participants were scheduled to participate in three groups ranging from nine in group one, to eleven in group two, and fourteen in group three. In the first part of the protocol, participants arrived at the time appointed and each participant was greeted with a "welcome" and "thanked" for their voluntary participation in the study. Each participant was provided with a study packet of printed materials organized in 9 x 12 in. manila envelopes containing a pen, the Consent (65+) Form, the Participant Profile, the Ease of Comprehension Questionnaire, the Multiple-Choice Test, and an ink pen to complete all the forms. The participants were then instructed to draw a random number from the "bucket", which they were later instructed to place all documents in their packet. No names of participants were asked for in any of the documents. The entire three sessions are contained on three CDs. which were initially blindly selected and numbered by an individual independent of the researcher. The CDs were again blindly selected by another individual, independent of the researcher, and were assigned to each scheduled session. The first randomly selected CD was then placed in the computer for the first session. The second randomly selected CD was placed in the computer for the second session. The third remaining CD was placed in the computer for the third session. This procedure resulted in a double blind random selection of the presentation CDs, which were all selected independent of the researcher.

Using the "auto start" CDs, the second part of the protocol started with opening instructions for each participant to complete the forms contained in the packet envelop previously described. Using the PowerPoint presentation as a guide, the following schedule was used to present the study topics: Step 1 – fill out consent form, Step 2 – fill out participant profile, Step 3 – to view the target content, health information, in the modality selected for the session, Step 4 – fill out Ease of Comprehension Questionnaire and Step 5 – take a ten-question, multiple-choice test. Each of the three scheduled groups completed the study in less than one hour.

# CHAPTER 4

## RESULTS

### Modality Effects on Adult Learning

This study investigated which modality was best to improve older adults' understanding of health information disseminated via the World Wide Web. The hypothesis is that older adults will better recall health information presented in an audio plus visual modality via the World Wide Web than health information presented in a single modality (audio or visual).The resulting group of participants consisted of 16 male and 18 female for a total of 34 participants (see Table 1). The participants formed a close homogeneous group. They all attend the same church and participate in monthly social gatherings in each other's homes.

Table 1

Participant Demographics

| Participant's Gender | Number |
|---|---|
| Male | 16 |
| Female | 18 |
| Total | 34 |

The mean age of the group was 72.5 or 73 years old, rounded. The age range was 65 minimum, and 86 maximum (see Table 2).

Table 2

Participant Age Demographics

| Age Range | | | | | |
|---|---|---|---|---|---|
| 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | Total |
| 11 | 10 | 8 | 3 | 2 | 34 |

From the self-assessed "Participant Profile", participants were asked the question: "How many years of education do you have?" Responses to this question showed that all participants were high school graduates, 12 years of education; one participant held an undergraduate degree, BA/BS, 16 years of education, and four participants held Master Degrees, 18 years of education (see Table 3).

Table 3

Years of Education

| Category | Number |
|---|---|
| High School Graduate | 34 |
| Participants with Undergraduate Degrees | 1 |
| Participants with Graduate Degrees | 4 |

From the self-assessed "Participant Profile", participants were asked the question: "How would you rate your memory at the present time?" Responses to this question showed that ninety-seven percent of all assessed their memory as being excellent to fair, with one participant assessing their memory as poor (see Table 4).

Table 4

Participant's Self Assessed Memory Evaluation

| Category | Number |
|---|---|
| Have Excellent Memory | 3 |
| Have Good Memory | 19 |
| Have Fair Memory | 11 |
| Have Poor Memory | 1 |

## Results Ease of Comprehension Questionnaire

The Ease of Comprehension Questionnaire, a 10-item Likert scale, asking participants to judge the coherence and ease of understanding of the text, was developed by Lehman and Schraw (2002) model. The questionnaire was scored as described in the methodology section.

The means and standard deviations for the Ease of Comprehension Questionnaire (coherence) are shown in Table 5 by modality.

Table 5

The Ease of Comprehension Means and Standard Deviations by Modality

| | Type of Modality | |
|---|---|---|
| Measure | | |
| Ease of Comprehension | M | SD |
| Text Only | 37.69 | 2.175 |
| Audio Plus Text | 39.60 | 2.675 |
| Audio Only | 39.91 | 2.386 |
| Total | 38.97 | 2.540 |

There was no main effect for coherence due to treatment, $F(2, 31) = 3.04$,.P.= .062.

The effect size for the ease of comprehension variable equaled .530 as measured by Eta squared. This is in the medium effect size range, using the guidelines cited by Hinkle, Wiersma and Jurors (1998) in which values of .25σ, .50σ, 1.00σ indicates qualitatively small, medium, and large effect sizes in standard units. This means that, given more power, the outcome would likely demonstrate statistically significant results.

## Results –Multiple-Choice Test

The Multiple-Choice Test, an uncued recall test, and a 10 question multiple choice test, was an adaptation after the Lehman and Schraw (2002) model. The means and standard deviations for the Multiple-Choice Test (recall and comprehension) are shown in Table 6 by modality.

Table 6

Recall Means and Standard Deviations by Modality

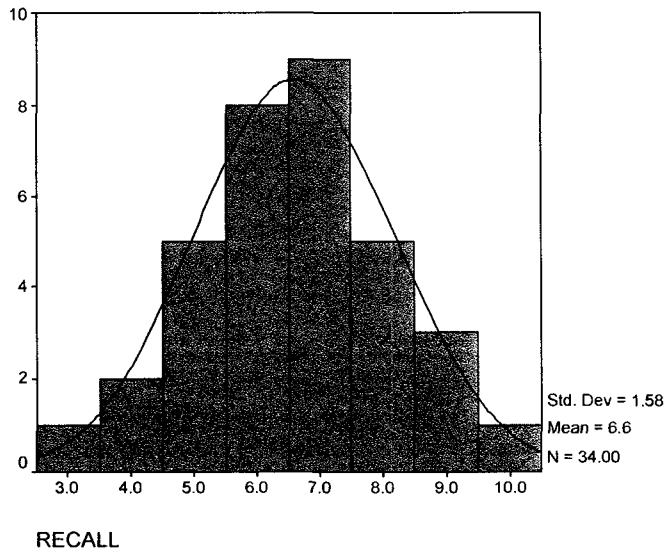
| | Type of Modality | |
|---|---|---|
| Measure | M | SD |
| Text Only | 6.6154 | 1.609 |
| Audio Only | 6.546 | 1.508 |
| Text plus Audio Only | 6.589 | 1.579 |

There was no main effect for comprehension due to treatment, $F(2, .31) = .01$, P.=.99. This research's lack of statistical power is believed to be one reason that contributed this outcome. The lack of statistical power is further addressed subsequent sections of this research.

With respect to a possible ceiling effect, (i.e. the upper limit of the Multiple-Choice Test), the distribution of the test scores is shown in Figure 3.

Figure 3

Distribution of Test Scores




The Histogram indicates a normal frequency distribution of participant test scores, with no concentration of upper limit test scores. The normal distribution of the test scores were anticipated because the test construction was designed to meet Crocker and Algina (1989) classical and modern test development theories, which require inspection of overall test content and assessment of individual test item content.

## Summary of Findings

There were no statistically significant differences between groups on measures of coherence and recall. However, there may be some practical differences when it comes to coherence, given the differences between the two groups.

Overall, the results do not support the proposed hypothesis. The hypothesis was based on the well-founded assumption that the modalities of Text plus Audio would help older adults to better recall health information over presentation of health information in a single modality, such as Text, or Audio. The Ressler (1991) research postulated that bimodal presentation (showing and talking) would increase recall over unimodal presentations (talking only). Ressler found that bimodal information (showing and talking) has a positive effect on older adult recall of recently presented information.

However, in this research the modality, Text plus Audio (i.e. unimodal presentation) indicated that no differences in learning occurred. Consequently, this outcome raises the question of why no learning difference occurred in learning. This matter is further addressed in the Explanation of Findings section of Chapter 5.

# CHAPTER 5

# DISCUSSION

## Summary and Discussion of Findings

### Hypothesis

This study investigated which modality was best to improve older adults' understanding of health information disseminated via the World Wide Web. The hypothesis is that older adults will better recall health information presented in a dual modality (text plus audio) via the World Wide Web than health information presented in a single modality (text or audio).

## Explanation for Findings

### Review of results

As previously cited, there were no statistically significant differences between groups on measures of coherence and recall. However, there may be some practical differences when it comes to ease of comprehension and coherence, given the differences between the two groups. The effect size for the ease of comprehension variable equaled .530 as measured by Eta squared. This is above the medium effect size, using the guidelines cited by Hinkle, Wiersma and Jurors (1998) in which values of .25σ, .50σ, 1.00σ indicates qualitatively small, medium, and large effect sizes in standard units. This means that, given more power, the outcome would likely demonstrate significant results. Although

the ease of comprehension findings did not reach statistical significance, the differences will be treated as real. This is justified by the substantial effect size combined with the low sensitivity of the design.

An Oneway- analysis was conducted on comprehension. In this analysis, there was no main effect for the type of modality variable, indicating that none of these three groups (i.e. Text, Audio or Text plus Audio) differed with respect to overall comprehension.

## Implications of Findings

### Theoretical implications

The theoretical implications of this study relate to the established theories of Paivio's (1986) Dual Coding Theory (DCT), Mayer's redundancy principle (2001) and Sweller et al. Cognitive Load Theory (1988, 1994). Paivio's dual coding theory stresses the significance of non-verbal (pictures) imagery of memory. The Paivio theory provided the justification for this research by supporting the presentation of health information in a dual modality (visual plus audio) to provide better imagery of health information for older adults' than presentation of the same health information in a single modality (audio or visual). The implicit assumption in Paivio's DCT theories was that the DCT had major benefits for learning and memory recall, and that materials high in imagery are more memorable and that learners instructed to create images will enhance their learning. The results of this research are not completely consistent with Paivio's DCT theory. This is because the dual modality (text plus audio) showed no different treatment effects than the single modality (text and audio). Since this study lacked statistical power and that is one possible reason why this research did not reach similar conclusions as in the studies cited in this research, which indicated that the dual modalities of text plus audio lead to better

understanding of information then the single modality of text and audio, in accordance with research conducted by Paivio (1971). This research has similar inconsistencies that will be described in more detail with the research conducted by Chandler and Sweller (1994); as well as Mayer and Moreno (2000).

## Modality Effect on Measures of Coherence

Mayer (2001) found that the notion of learning could be improved by using less cognitive capacity in learning a task, reducing task demands through elimination of extraneous material, and by providing only germane materials that establish more efficient links to encoding and retrieving information. Additionally, Mayer (2001) found that words or screen as text result in poorer learning when compared with words on screen as animation (pictures) and narration (spoken words). Mayer (2001) indicated that in 4 of 4 tests, learners who received narration and animation perform better on transfer then did learners who received animation on screen. The transfer performance was assessed by a transfer test, which involve students writing answers to the essay questions, such as: "What could be done to reduce the intensity of a lightning storm". Mayer (2001) reports that the results were strong and indicates a medium effect size of 1.17; animation students, on average, obtained 80% more creative solutions on transfer tests than students with animation and text. Based these studies, Mayer postulated a "redundancy effect" (2001). The redundancy effect imperative, as applied by Mayer (2001), maintains that learning from narration and illustrations (animation) is better than learning from the same materials coupled with narration that matches printed text. In this research, no

illustrations (animation) were used in presenting any of the three modalities (text only, text plus audio only, and audio only).

In addition, Sweller's Cognitive Load Theory (CLT) postulates that the notion that learning could be improved by using less cognitive capacity in learning a task; reducing task demands through elimination of extraneous materials, and by providing only germane materials that establish links to encoding and retrieving information. The research conducted by Van Gerven, Paas, Van Merrienboer and Schmidt (2002) tested Sweller's cognitive load theory and found with regard to older adults, that their subjective cognitive load was substantially lower in worked examples condition then in the conventional problems condition; the older adults' displayed a substantial efficiency gain in the worked example condition compared to the conventional problems condition. For example, with respect to older adults, cognitive load was substantially lower in the worked examples then in the conventional problem conditions. Van Gerven, et al. reported a significant decrease in cognitive load for elderly participants.

In contrast to the Mayer (2001) understanding of the redundancy effect previously discussed, the research of Sweller, van Merrienboer and Paas (1998) present a different view of the redundancy effect concerning coherence and recall. Sweller, et al. (1998) cite an example of redundancy through describing a diagram demonstrating the blood flowing in the body (e.g. lungs and heart) with statements indicating that blood flows into the left atrium from the lungs. Arrows were included in the diagram demonstrating that blood flowed into the left atrium from the lungs. Sweller, et al. contend that the blood flow diagram was intelligible because it could be understood on its own without the statements. The statements were considered redundant. In further discussing their

research, Sweller, et al. posit that redundancy effect takes place when students, who are not presented with redundant information, outperform students on tests who are presented with redundant information. Sweller, et al. further support their research concerning the negative effects of redundant information by citing the research of Chandler and Sweller (1994), which provided evidence that redundancy increased cognitive load by replicating results from their previous study Sweller and Chandler (1994).

In another example of the negative effects, when including redundant material, Sweller, et al. (1998) cited an experiment using biological and electrical engineering instructional materials. The experiment found that with respect to redundancy, the best instructional design removes redundancy or, at minimum, allows learners to ignore redundant material when it is separated from other relevant materials. In essence, the Sweller, et al. studies indicate that multimedia situations which eliminate redundant material result in better performance than when the extraneous (redundant) material is included. These findings are consistent with The Cognitive Load Theory (CLT) developed by Sweller (1988, 1984), which posits that (1) using less cognitive capacity in learning a task, reduces task demands through elimination of extraneous materials and (2) that task demands are also reduced by providing only germane materials that establish more efficient links to encoding and retrieving information.

This research is inconsistent with the Sweller, et al. (1998) findings in terms of coherence because the audio only modality mean (39.91) and the audio plus text (i.e., redundant) mean were essentially equal.

This raises a question regarding the redundancy effect and its applicability to seniors. For example, while this is speculation, there may be some compensatory effect taking

place because participants seemingly work harder to overcome the negative effects found in other research. Clearly, more research would be necessary to test both the compensatory effect and the application of the redundancy principle to this research's hypothesis and experimental design.

## Modality Effects on Measure of Comprehension

Mayer (2001) found that learners who received animation and narration performed better on retention then did learners who received animation and on screen text. Mayer (2001) indicated that in 4 of 4 tests, learners who received narration and animation performed better on recall than did learners who received animation with text. Mayer's research indicated that the results were strong and indicates a medium effect size of .84, and that animation with narration students remembered on average 30% more of the important material than the animation with text students. This study's results are not consistent with the Mayer (2001) research. The current study indicated no difference between modalities on measures of comprehension. For example, the mean for each modality was as follows: audio (6.546), text (6.6154), and text plus audio (6.589). Consequently, this outcome is inconsistent with the prior research. One possible reason why this research did not reach similar conclusions is because the study lacked statistical power, which was necessary to provide an adequate test of the research hypothesis Keppel (1991); Hinkle, Wiersma, and Jurs (1998).

In another independent study, Ressler (1991) research involved a study relative to 60 year old hospital patients using audiovisual language processing. Ressler examined every daily thing to be remembered by the patients. The hypothesis of the Ressler research was that bimodal presentation (showing and talking) would increase recall over unimodal

presentations (talking only). Ressler found that the bimodal information (showing and talking) had a positive effect on older adult recall of recently presented information. This research is inconsistent with the Ressler research in that the audio modality (narration) was not significant compared to text and text plus audio modalities. Consequently, this outcome is inconsistent with the prior research.

## Limitations of this Study

### Experiment sensitivity

This study lacked statistical power and that is one possible reason why this research did not reach similar conclusions as in the studies cited in this research, which indicated that the dual modalities of text plus audio lead to better understanding of information then the single modality of text and audio, in accordance with research conducted by Paivio (1971); Ressler (1991); Mayer and Marino (2000), and Schnotz (2002). Nevertheless, according to Keppel (1991), power is the sensitivity of the experiment in providing an adequate test of the research hypothesis. He contends that one way of increasing sensitivity in an experiment is to increase the number of subjects allocated to each condition. Hinkle, Wiersma, and Jurs (1998) reached the same conclusion and provide that the question of an appropriate sample size is crucial to an experiment because of the relationship between sample size and the statistical significance applied to the data. In summation, the researcher acknowledges that one possible prime factor contributing to results of this research is that not enough people were involved in the research. In other words, the size of the research population (N) was not adequate.

Limitations of cross-sectional studies

There is a concern that this cross-sectional study and subsequent outcomes may be entirely different in a longitudinal study conducted over a greater period of time. To further illustrate this situation, Salthouse (2000) points out that there appears to be some ambivalence about the value of cross-sectional studies on aging because a number of researchers dismiss 51 cross-sectional studies and find them less in value than longitudinal designs. However, Salthouse also acknowledges that cross-sectional designs are more efficient, considerably less expensive and quicker than longitudinal designs. Additionally, cross-sectional studies are useful in determining whether age-related differences exist in certain variables and in specifying, at time of observance, corrections of the differences or proximal determinants at the time of observance, as Salthouse categorizes these correlations.

Use of images

In addition, another limitation of the study was the introduction of graphic images into the "Eyes" text presented to the participants. Although, the graphic images were not manipulated in any way across treatments, they could have been detractors creating split attention, because learners were faced with multiple sources of information that required to be integrated before they can be understood Sweller, et al. (1998). This situation may have also contributed to the mean variances in the modalities, with the exception of the audio only modality, which included no graphics in the PowerPoint presentation. Nevertheless, in this case, a possible confound may have been presented to the participants, because graphics were included in the text modality and audio plus text, but were not included in the audio modality.

## Methodological Contributions to the Literature

This study contributed to the findings in the literature in a number of respects. First, with respect to methodology and materials, the method of presentation was developed on three CDs, which were designed for presentation of each specific modality: Text, Audio, and Text plus Audio. The entire three sessions are contained on three CDs, which were selected in a double blind procedure by individuals independent of the researcher. The first randomly selected CD was then placed in the computer for the first session. While this idea is not new, the notion to present three modalities (i.e. text, text plus audio, audio) and health information from the World Wide Web, using a PowerPoint presentation on CDs has not been clearly articulated in the previous research. A second contribution relates to the use of older adults as participants. The opportunity to perform this study was both challenging and exciting with respect to providing older adults with a method to improve their understanding of health information disseminated by the World Wide Web. The knowledge that such a process could provide older adults with deeper insight and understanding of health information in a key area, such as "Eyes", is both exciting and rewarding. It is rewarding because it directly contributes to the paucity of studies concerning older adults' recall of health information presented through the World Wide Web. Consequently, continued research in this area will contribute to current studies by adding cumulative knowledge to modality research that will increase older adults understanding of health information disseminated by the World Wide Web. Also, equally important, is that continued research may enhance older adults' ability to maintain good health and, in this case, minimize common eye problems through "Eyes" information presented in a PowerPoint presentation.

## Future Direction

Future studies should explore which modality is best to improve older adults' understanding of health information disseminated via the World Wide Web with a larger sample size.

Future research should also investigate the effect of expanding the areas and locations for selection of older adult research participants. This expanded direction permits a greater opportunity for selection of a more diverse profile of older adults, which in turn increases the validity of the research. As a result, this change may affect the outcome results more differently than in the present study.

Group dynamics emerged as an important consideration in this study. As mentioned previously, the participants in this study formed a close homogeneous group. This group's homogeneity was based on individuals knowing one another and frequently socializing with each other for many years.

The cumulative effect of these activities served to strengthen not only the homogeneity of the group as previously mentioned, but also, over time, "honed" each individual's reading and listening skills. For example, the activities engaged in by the participants (e.g. Sunday school services, Sunday morning and Sunday evening services, and Wednesday evening services) required each individual's close attention to discussions. Each participant's obligation for comprehension of textual material, with narration, is frequent and reappears each week. While this is speculative, it is hypothesized that increased levels of cognitive engagement were used by each individual to not only follow the discussions, but to also gain insight and understanding of the topics under discussion. This is important because it served, in due course, to provide the basis

(platform) for developing enhanced listening skills and reading skills. Ultimately, this seems to have become an imperative for each individual in church activities and social gatherings where repartee and relevant commentary were required to address the numerous issues raised in the discussions. The study's participants may differ from other senior groups because the study group is more engaged and actively participates in numerous regularly scheduled weekly and monthly activities. This compilation of activities required individual attention and relevant commentary contributing to the discussions. The observations of the research team suggest that this may be the most important factor in helping improve seniors' comprehension of health information.

## Conclusion

The impetus for this study was an apparent need to provide health information to seniors via the Web. Thus, in conclusion, some suggestions will be provided for the design of health information Web pages intended for seniors. Initially, the research team would have advocated narration of text as the best presentation modality for coherence and recall. As the results of this research indicate, the audio modalities (audio only and audio plus text) appear to be the superior to the text only modality. However, the results of this research have been tempered by the lack of statistical power, which is necessary to provide an adequate test of the research hypothesis. Additionally, the results of this study, contradict the Sweller, et al. (1998) redundancy study which clearly indicates that students who are not presented with redundant information perform better on tests then students who are presented with redundant information. Consequently, Sweller, et al.

suggests that improved comprehension will result when redundancies are removed. However, this assumes that special populations, such as seniors, will perform similarly.

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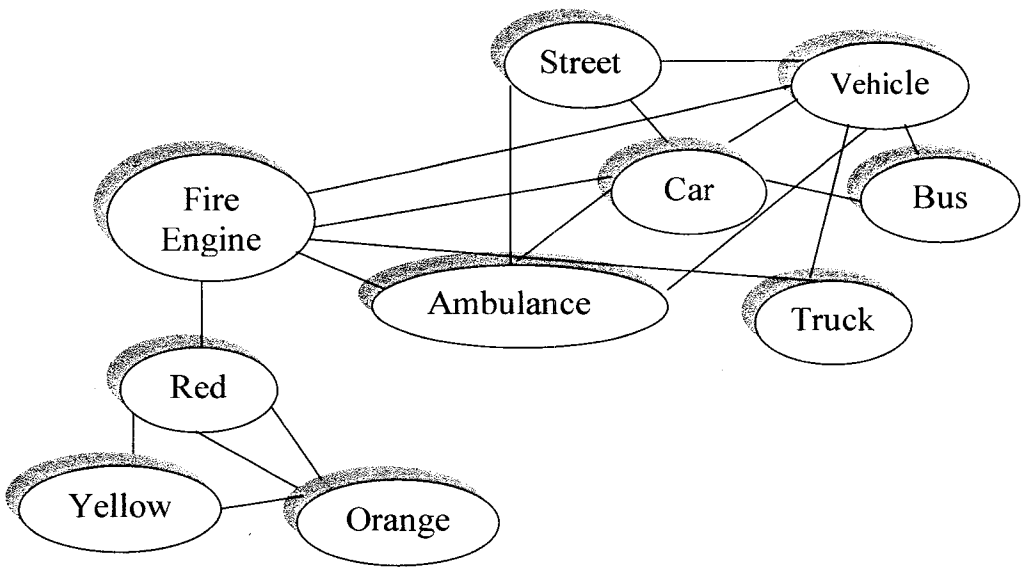
APPENDIX A

COLLINS AND LOFTUS THEORY OF SEMANTIC MEMORY

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APPENDIX B

CONSENT FORM (OLDER PARTICIPANTS)

INFORMED CONSENT (65+)

Department of Curriculum & Instruction

TITLE OF STUDY: Modality Effects on Adult Learning

INVESTIGATOR(S): Kendall Hartley, Ph.D., and Earl Douglas, MBA

CONTACT PHONE NUMBER: 702-895-4982

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to examine older adults' comprehension of sentences when listening to speech versus reading printed text.

Participants
You are being asked to participate in the study because your participation, including the resulting data, represents a valuable contribution toward our understanding of how language is comprehended when it is read or heard. Only adults 65+ were included in this research study. Adults with uncorrected hearing or uncorrected visual defects were excluded from this research.

Procedures
If you volunteer to participate in this study, you will be asked to do the following: fill out a participant profile, attend to a presentation about health care then answer some written questions about both the content of, and your preferences for, the presentation.

Benefits of Participation
There may not be direct benefits to you as a participant in this study. However, we hope to learn how language is comprehended when it is read or heard. Also, participants will have an opportunity to gain more knowledge of health issues that may relate to their individual needs. In addition, participants will be introduced to websites containing health information from the National Institute of Health, National Eye Institute, and National Institute of Aging Information Center.

Risks of Participation

There are risks involved in all research studies. This study may include only minimal risks. For example, you may experience temporary cognitive fatigue due to focused attention on the materials presented.

Cost /Compensation
There will not be financial cost to you to participate in this study. The study will take approximately 1 hour of your time. You will be compensated $10.00 for your time. You will be paid the $10.00 compensation even if you withdraw during the session. The University of Nevada, Las Vegas may not provide compensation or free medical care for an unanticipated injury sustained as a result of participating in this research study.
Contact Information

If you have any questions or concerns about the study, you may contact Kendall Hartley at 702-895-4982 or Earl Douglas at 702-647-3304. For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV Office for the Protection of Research Subjects at 702-895-2794.

Voluntary Participation
Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with the university. You are encouraged to ask questions about this study at the beginning or any time during the research study.

Confidentiality
All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for at least 3 years after completion of the study. After the storage time the information gathered will be destroyed.

Participant Consent:
I have read the above information and agree to participate in this study. I am at least 65 years of age. A copy of this form has been given to me.

Signature of Participant Date

Participant Name (Please Print)

Participant Note: Please do not sign this document if the Approval Stamp is missing or is expired.

Contact Information
If you have any questions or concerns about the study, you may contact Kendall Hartley at 702-895-4982 or Earl Douglas at 702-647-3304. For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV Office for the Protection of Research Subjects at 702-895-2794.

Voluntary Participation
Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with the university. You are encouraged to ask questions about this study at the beginning or any time during the research study.

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Participant Consent:
I have read the above information and agree to participate in this study. I am at least 65 years of age. A copy of this form has been given to me.

Signature of Participant Date

Participant Name (Please Print)

Participant Note: Please do not sign this document if the Approval Stamp is missing or is expired.

APPENDIX C

PARTICIPANT PROFILE

Name_____

Address_____

Telephone (Ext.) :_____( can also be reached at):_____

Best Times to Call: _____

Birthrate: _____ Handedness: R L Ambidextrous Gender: M F

Hobbies:

_____

_____

| Educational Level | | Major |
|---|---|---|
| 4th Grade (4) | _____ | |
| 8th Grade (8) | _____ | |
| Competed High School (12) | _____ | |
| Some College (give #) | _____ | _____ |
| Completed College (16) | _____ | _____ |
| Graduate Work (give #) | _____ | _____ |

1. Do you have arthritis? Y N
2. Do you have full use of both hands? Y N
3. Do you have high blood pressure? Y N
4. Do you have diabetes? Y N
5. Do you have any severe visual impairment such as cataracts of glaucoma? Y N
6. Is your vision corrected (glasses or contacts)? Y N
7. The next questions ask about difficulty with vision. Do you have difficulty...

A) Reading ordinary print in newspapers?

No difficulty - A little difficulty -

B) See print in dim light (such as at a restaurant)?

No difficulty - A little difficulty --'- Moderate difficulty_____Extreme difficulty____

C) Doing work or hobbies that require you to see well up close such as cooking, sewing, fixing things around the house, or using hand tools?

No difficulty - A little difficulty_____Moderate difficulty _____ Extreme difficulty_____

8. Do you any difficulty hearing loss? Y N

9. Trouble with telephone conversations? Y N
10. Do you have any difficulty hearing speech? NY, Sometimes Y, Often
IF YES: Please describe the types of difficulties you are having
Speech sounds muffled or indistinct at times Y N
Have difficulty hearing speech in noisy surroundings Y N
Have some problems using telephone

Other problem(s) hearing speech:_____
_____

Participant Profile Page 1 of 2

11. Have you had any surgery on your ears? Y N
When?_____

12. Do you use a hearing aid? Y N Which ears? L R Both
13. Have you had surgery in the last 3 months? Y N
14. Have you had a stroke in the last 5 years? Y N
15. Do you have a learning disability? Y N
16. Has this disability been formally diagnosed? Y N Diagnosis:

17. Do you have an attention deficit? Y N
18. Has this deficit been formally diagnosed? Y N
19. Are you taking any medications for either of the above? Y N If so, what? _____
20. Are you presently taking any other medications on a regular basis? Y N If yes, what are they?
_____
_____
_____

21. How would you rate...

| | Your overall health? | Your vision? | Your hearing? |
|---|---|---|---|
| Good | _____ | _____ | _____ |
| Excellent | _____ | _____ | _____ |
| Average | _____ | _____ | _____ |
| Fair | _____ | _____ | _____ |
| Poor | _____ | _____ | _____ |

22. Are your daily activities in any way impaired because of your health?

None_____ A little Some_____ Significant Amount A lot _____

23. Some of our studies are concerned with people's memory and ability to think about things. We find that even people with very good memories seem to forget some things from time to time.

1. How would you rate your memory at the present time?

Excellent_____ Good_____ Average_____Fair_____Poor_____

2. Compared to last month, would you say your memory is.

Better now_____About the same____Worse now_____ .....than it was then.

3. Compared to two years ago, would you say your memory is.

Better now____About the same____Worse now .....than it was then.

24. These last questions are concerned with how you've been feeling lately.

1. During the past month, have you often been bothered by feeling down, depressed, or hopeless? Y N

2. During past month, have you often been bothered by little interest or pleasure in doing things? Y N

APPENDIX D

## EASE OF COMPREHENSION QUESTIONNAIRE

PARTICIPANT NUMBER_____

Place an X in the box that corresponds to the amount of agreement you have with the given statement.

| | Strongly Disagree 1 | Disagree 2 | Not Applicable 3 | Agree 4 | Strongly Agree 5 |
|---|---|---|---|---|---|
| 1. I thought the health information presentation was easy to understand. | | | | | |
| 2. I thought the health information was presented in a well organized manner. | | | | | |
| 3. I have a personal interest in this health topic. | | | | | |
| 4. I learned something new from this presentation. | | | | | |
| 5. I will be able to use this information. | | | | | |
| 6. I liked the format of the presentation. | | | | | |
| 7. In certain places, the health information seemed confusing to me. | | | | | |
| 8. I now have more ideas to discuss with my health professional(s). | | | | | |
| 9. The presentation gave me all the information I needed to understand the health information. | | | | | |
| 10. The health information required a lot of effort for me to understand. | | | | | |

APPENDIX E

MULTIPLE-CHOICE TEST

Please select the most correct answer option for each of the following questions.

1. One of the main factors leading to eye problems is:
   a) Glaucoma
   b) Aging
   c) Tearing
   d) Presbyopia
2. One of the best ways to protect your eyes is:
   a) Wear your glasses all the time
   b) Visit your ophthalmologist or optometrist yearly
   c) Have laser surgery
   d) Use sunglasses
3. Reading at arms length can be a sign of:
   a) Floaters
   b) Cataracts
   c) Presbyopia
   d) Glaucoma
4. Floaters can come from:
   a) being sensitive to light, wind, or temperature changes
   b) getting headaches or tired eyes
   c) an infected or blocked tear duct
   d) swelling or growths of the eye
5. You can treat crusting of eyelashes during sleep by:
   a) using warm compresses
   b) wearing reading glasses
   c) laser surgery
   d) oral medications
6. Cloudy areas in your vision may be a sign of:
   a) Corneal Diseases
   b) Dry eye
   c) Glaucoma
   d) Cataracts
7. If you feel itching, burning, or have some vision loss, you should have your eyes checked for:
   a) Cataracts
   b) Corneal diseases

c) Dry Eyes
d) Glaucoma

8. Regular physical exams are important because:
   a) they can detect glaucoma before it requires surgery
   b) you can reduce your risk of getting cataracts with early detection
   c) they can determine if using a home humidifier, special eye drops, ointments, or special contact lenses are necessary
   d) they can detect diseases like diabetes and high blood pressure than can cause eye problems if not treated

9. Persons at risk for eye disease include:
   a) those over 65
   b) African Americans over age 40
   c) those with a family history of diabetes
   d) A and B only
   e) B and C only
   f) A and C only
   g) all of the above
   h) none of the above

10. Sunglasses will:
   a) protect your eyes from too much sunlight
   b) block ultraviolet (UV) radiation
   c) raise your risk of getting cataracts
   d) A and B only
   e) B and C only
   f) A and C only
   g) all of the above
   h) none of the above

APPENDIX F

TEXT COMPREHENSION TASK

1. Are you holding the newspaper farther away from your eyes than you used to? Join the crowd — age can bring changes that affect your eyesight. Some changes are more serious than others, but no matter what the problem, there are things you can do to protect your vision. The keys are regular eye exams and finding problems early.

2. Common Eye Problems
   a. Presbyopia (prez-bee-OH-pee-uh) is the normal aging process you experience with the loss of ability to see close objects or small print. Holding a newspaper at arm's length is a sign of presbyopia. You might also get headaches or tired eyes when you read or do other close work. Reading glasses usually fix this problem.
   b. Floaters can be part of the normal aging process. Floaters are tiny specks that seem to float across your eyes. You might notice them in well-lit rooms or outdoors on a bright day. See your eye care professional right away if you see many new floaters and/or flashes of light.
   c. Tearing can come from being sensitive to light, wind, or temperature changes. If wearing sunglasses does not help, the tearing may mean a more serious eye problem, such as an infection or a blocked tear duct.
   d. Eyelid problems can come from different diseases or conditions. Common eyelid problems include red and swollen eyelids, itching, tearing, being sensitive to light, and crusting of eyelashes during sleep. You can treat crusting during sleep with warm compresses. Other less common eyelid problems, such as swelling or growths, can be treated with medicine or surgery.

3. Common Eye Diseases and Disorders
   a. Cataracts are cloudy areas in the eye's lens causing loss of eyesight. Cataracts often form slowly without any symptoms. Some stay small and don't change eyesight very much. Others may become large or dense and harm vision. Cataract surgery can help.
   b. Corneal diseases and conditions can cause redness, watery eyes, pain, lower vision, or a halo effect. The cornea is the clear, dome-shaped "window" at the front of the eye. Disease, infection, injury, and other things can hurt the cornea. Treatments range from changing your eyeglass prescription and using eye drops to cornea transplant surgery.
   c. Dry eye happens when tear glands don't work well. You may feel itching, burning, or have some vision loss. Dry eye is more common as people get older, especially among women. Treatments include using a home humidifier, special eye drops called artificial tears, ointments to treat dry eye, special contact lenses, or surgery.

d. Glaucoma comes from too much fluid pressure inside the eye that can hurt the optic nerve over time leading to vision loss and blindness. Most people with glaucoma have no early symptoms or pain from the extra pressure. Treatment may be prescription eye drops, medicines that you take by mouth, laser treatment, or surgery.

4. Five Steps to Protect Your Eyesight
   a. Have your eyes checked every year by an ophthalmologist or optometrist. If you wear glasses, they should be checked too.
   b. If you are at high risk for eye disease, you need to have a dilated eye exam. You are at risk if you are you over age 65, are African American and over age 40, or if you or people in your family have diabetes or eye disease.
   c. Have regular physical exams to check for diseases like diabetes and high blood pressure. These diseases can cause eye problems if not treated.
   d. See an eye care professional right away if you suddenly cannot see or everything looks dim or if you see flashes of light. Also see an eye care professional if you have eye pain, fluid coming from the eye, double vision, redness, or swelling of your eye or eyelid.
   e. Wear sunglasses that block ultraviolet (UV) radiation and a hat with a wide brim when outside. This will protect your eyes from too much sunlight, which can raise your risk of getting cataracts.

II. Adapted from National Eye Institute (NEI) National Institutes of Health http://www.niapublications.org/agepages/eyes.asp accessed July 19, 2006

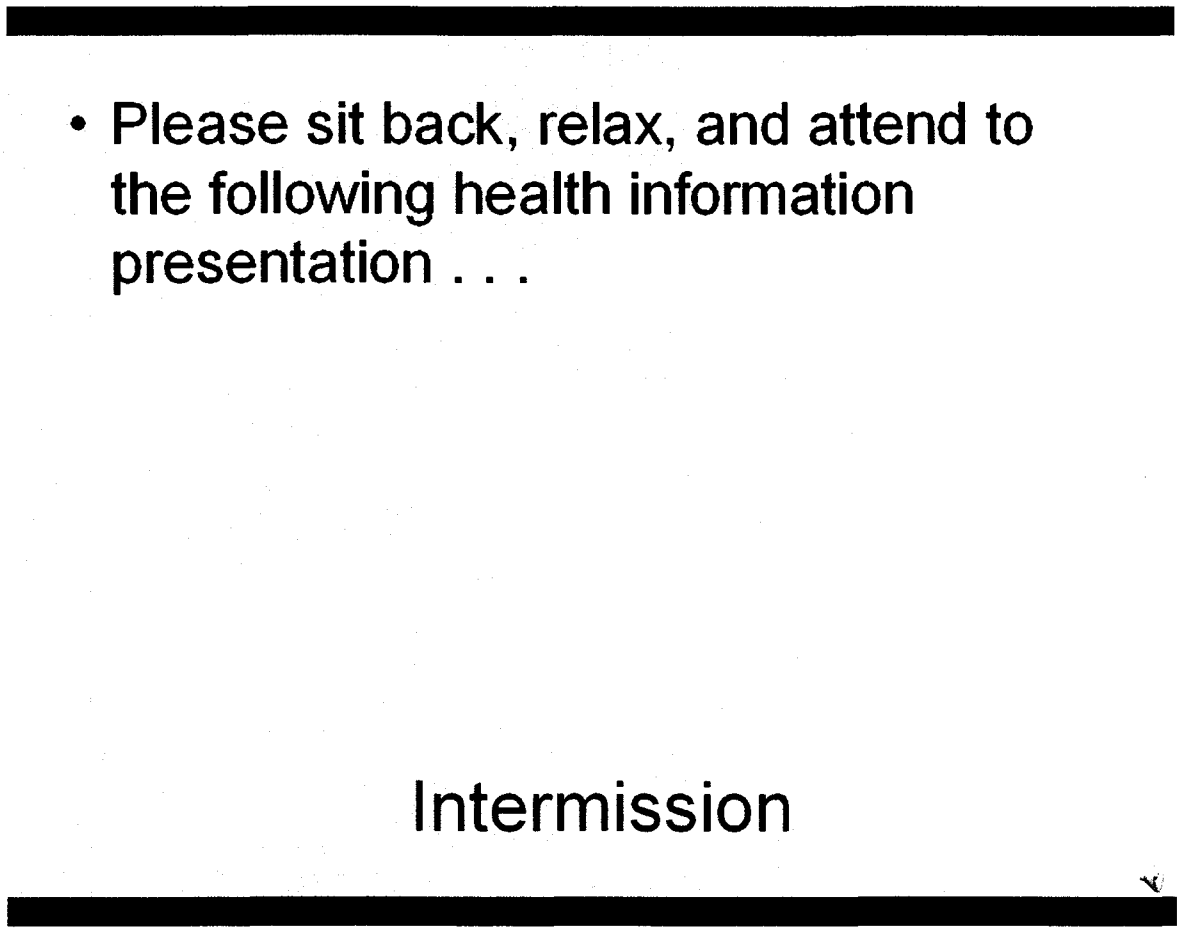
National Eye Institute (NEI)
National Institutes of Health

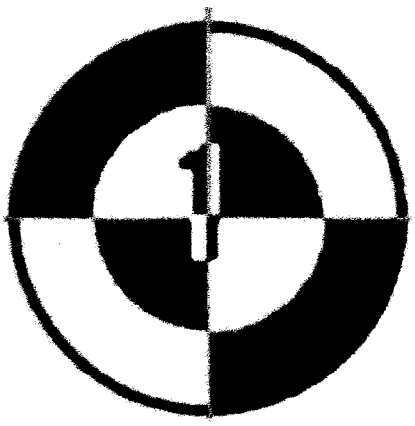
2020 Vision Place
Bethesda, MD 20892-3655
301-496-5248
www.nei.nih.gov

For more information on health and aging, contact:
National Institute on Aging Information Center
P.O. Box 8057
Gaithersburg, MD 20898-8057
800-222-2225 (toll-free)
800-222-4225 (TTY toll-free)

APPENDIX G

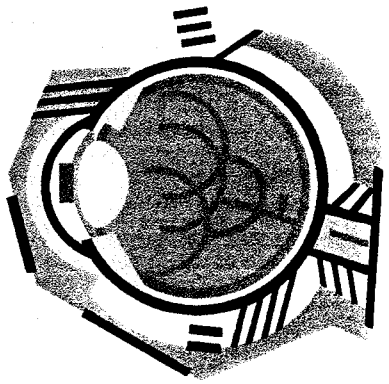
WINDOW SCREENS FOR EYES PRESENTATION






Now for our Feature Presentation

# Eyes



Adapted from the National Eye Institute (NEI)

National Institutes of Health

http://www.niapublications.org/agepages/eyes.asp

- *Are you holding the newspaper farther away from your eyes than you used to? Join the crowd — age can bring changes that affect your eyesight.*
- *Some changes are more serious than others, but no matter what the problem, there are things you can do to protect your vision. The keys are regular eye exams and finding problems early.*

Eyes

- Presbyopia (prez-bee-OH-pee-uh) is the normal aging process you experience with the loss of ability to see close objects or small print. Holding a newspaper at arm's length is a sign of presbyopia. You might also get headaches or tired eyes when you read or do other close work.
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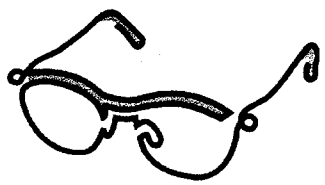
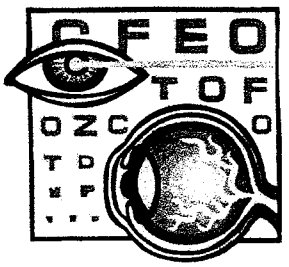


## Common Eye Problems

- Floaters can be part of the normal aging process. Floaters are tiny specks that seem to float across your eyes. You might notice them in well-lit rooms or outdoors on a bright day.
- See your eye care professional right away if you see many new floaters and/or flashes of light.




## Common Eye Problems

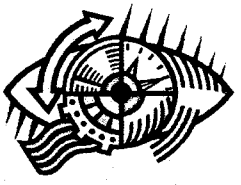
- Tearing can come from being sensitive to light, wind, or temperature changes. If wearing sunglasses does not help, the tearing may mean a more serious eye problem, such as an infection or a blocked tear duct.

## Common Eye Problems

- **Eyelid problems can come from different diseases or conditions. Common eyelid problems include red and swollen eyelids, itching, tearing, being sensitive to light, and crusting of eyelashes during sleep.**
- **You can treat crusting during sleep with warm compresses. Other less common eyelid problems, such as swelling or growths, can be treated with medicine or surgery.**

## Common Eye Problems

- Cataracts are cloudy areas in the eye's lens causing loss of eyesight. Cataracts often form slowly without any symptoms. Some stay small and don't change eyesight very much. Others may become large or dense and harm vision. Cataract surgery can help.



Common Eye Diseases and Disorders

- Corneal diseases and conditions can cause redness, watery eyes, pain, lower vision, or a halo effect. The cornea is the clear, dome-shaped "window" at the front of the eye. Disease, infection, injury, and other things can hurt the cornea.
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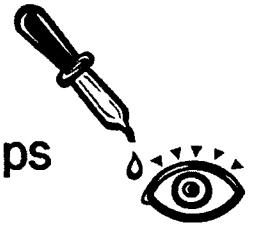

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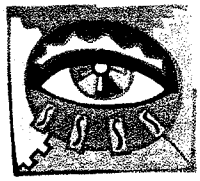

- Treatments include using a home humidifier, special eye drops called artificial tears, ointments to treat dry eye, special contact lenses, or surgery.

## Common Eye Diseases and Disorders

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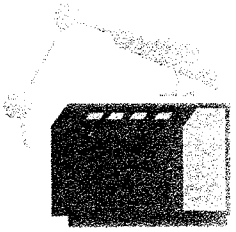
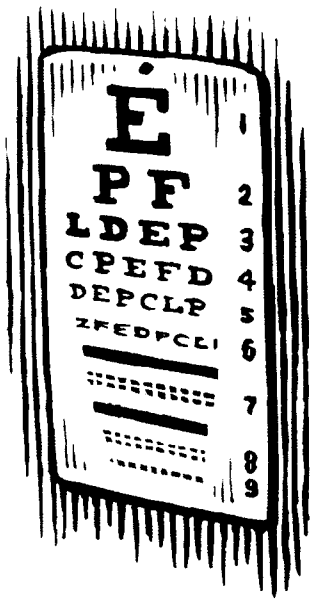


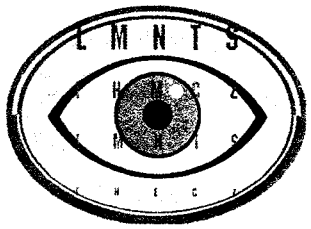
## Common Eye Diseases and Disorders

1. Have your eyes checked every year by an ophthalmologist or optometrist. If you wear glasses, they should be checked too.




## Five Steps to Protect Your Eyesight

2. If you are at risk for eye disease, you need to have a dilated eye exam. You are at risk if you are over age 65, are African American and over age 40, or if you or someone in your family have diabetes or eye disease.



## Five Steps to Protect Your Eyesight

3. Have regular physical exams to check for diseases like diabetes and high blood pressure. These diseases can cause eye problems if not treated.

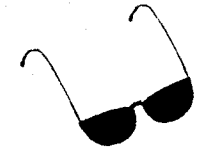
## Five Steps to Protect Your Eyesight

4. See an eye care professional right away if you suddenly cannot see, everything looks dim, or if you see flashes of light.

Also see an eye care professional if you have eye pain, fluid coming from the eye, double vision, redness, or swelling of your eye or eyelid.

## Five Steps to Protect Your Eyesight

5. Wear sunglasses that block ultraviolet (UV) radiation and a hat with a wide brim when outside. This will protect your eyes from too much sunlight, which can raise your risk of getting cataracts.



## Five Steps to Protect Your Eyesight

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