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Age Group Differences In Recall of Relevant and Irrelevant Words

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AGE GROUP DIFFERENCES IN

RECALL OF RELEVANT AND IRRELEVANT WORDS

By

DANIEL J PADILLA

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A Thesis Submitted to the

Department of Human Factors & Systems in

Partial Fulfillment of the Requirements for the Degree of

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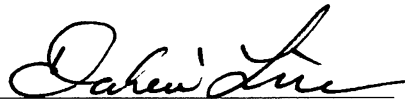# AGE GROUP DIFFERENCES IN RECALL OF RELEVANT
AND IRRELEVANT WORDS

By

Daniel J. Padilla

This thesis was prepared under the direction of the candidate's thesis committee chair, Christina Frederick, Ph. D., Department of Human Factors & Systems, and has been approved by the members of the thesis committee. It was submitted to the department of Human Factors & Systems and has been accepted in partial fulfillment of the requirements for the degree of Master of Science in Human Factors & Systems.
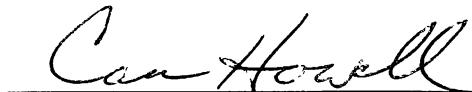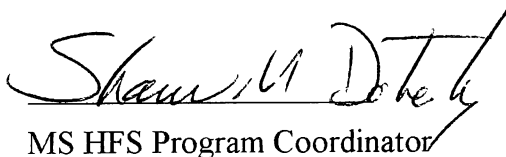
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ABSTRACT

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Many studies have shown that older adults tend to perform more poorly on memory tasks, when compared to younger people Conversely, studies have also indicated that there may be ways to combat this decline in age related memory performance by using memory aid techniques In addition to memory aid techniques, word familiarity may be used to increase memory performance because working memory for familiar words benefits from the availability of long-term phonological memory representations, which act to "clean up" the decaying memory traces of items in the list retrieval stage This memory study compared word recall performance of younger and older adult age groups using words that are familiar (relevant) and unfamiliar (irrelevant) to each of the specific age groups The study found evidence that among older and younger adults, there is better recall for both words created by and used for their specific generations, in addition to words related to an age-specific life activity This study also found evidence that the older age group exhibited higher levels of false recall than younger adults for both the familiar words and conceptually linked words

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Within the next fifteen to twenty years our country will be a different place for

many reasons   There will be improvements in transportation, technology, nutrition,

healthcare, but maybe one of the most noticeable changes to be seen will be that the

"face" of America will seem much older   Currently, the largest age group found in the

United States, are people who were born between the years 1946-1964 (The U S Bureau

of the Census, 1996) This group, which has affectionately been termed "Baby

Boomers," are now in their fifties, but will all be seniors within the next twenty years

Today there are about thirty-four million elderly, who are sixty-five years or

older, or about one-eighth of the population of the United States By the year 2020, this

population will increase to over fifty-five million, and to seventy million elderly by the

year 2030, which has been estimated to be close to a quarter of the total U S population

The U S Bureau of the Census (1996) attributes this dramatic increase in our aging

population to the Baby Boomers becoming sixty-five and older   This group will be come

sixty-five starting in the year 2011, and will continue reaching sixty-five through the year

2030 It has been forecasted that on any day during this period, about ten thousand people

will become sixty-five, or in other words, close to four million people a year

The increase in the number of older people will be due largely to the way

Americans live and die Many years ago, the major cause of death was due to infectious

disease, which caused acute and sudden deaths at relatively young ages (The National

Center for Health Statistics, 1999) Improvements in sanitation, nutrition, and living

conditions greatly reduced deaths from those causes and added many years to the average

lifespan The National Center for Health Statistics (1999) reported that the average life expectancy has increased by nearly ten years just since 1950, and by about fifteen years since the Social Security system was implemented in the 1930's Life expectancy will continue to increase in the future and is projected to be nearly twice as long in 2050 as it was in 1900 Projections for the year 2050 indicate that people who reach age sixty-five can expect fifteen to thirty additional years of life, and those who reach age eighty-five can plan on living another five to fifteen years

The most important implication of this longer life span is the number of additional years for which care and assistance may be required The sheer number of people who will need care, as well as geographic distance and other complicating factors, means that not all families will be able to provide informal, unpaid care for every family member who needs it Lindley (1989) estimated that about half of noninstitutionalized people age eighty-five or older have one or more problems performing activities related to daily living These are the core daily personal care activities that are necessary for people to live independently They include the ability to bathe, dress, toilet, feed oneself, and the ability to move around

One element necessary to perform activities of daily living would be that of memory In older aged people memory deficits may be present and exacerbate problems in other areas of functioning Remembering daily events, activities, and routines is difficult for all of us at times Certain conditions associated with aging can result in memory loss ranging from forgetting to take medication at a designated time, to not being able to remember one's own address, or getting lost in one's own neighborhood

Memory in Older Adults

There are many ideas and theories about why older people perform more poorly

on memory tasks when compared to younger people. One of the more popular theories, is

that there is a reduction in attentional capacity to process information as we age. This

means that there is a reduction in cognitive processing ability that will limit an older

person's ability to use effective encoding and retrieval strategies to aid in memory

performance (Salthouse, 1991). In other words, the idea is that older persons may do

more poorly than their younger counterparts on memory tasks that require considerable

attentional resources and mental effort. This example of memory can be seen from a well

known experiment done by Bromley (1958) in which older and younger subjects were

asked to repeat previously listened to lists of digits in reverse order instead of the more

usual or typical forward task. With the reversal of this task, it was found that the older

participants usually did worse. These results suggested that the added mental effort

needed to reverse the digits led to performance decreases in the older age group.

A number of studies suggest that older adults have impaired working memory

function, potentially due to either a reduction in available resources or to the inefficient

use of such resources (Craik, Morris, & Gick, 1990). Therefore, in conditions in which

working memory is unable to be used effectively (i.e., high memory load), it may be

difficult for older adults to remember or maintain a particular strategy. This may be

mainly true when the strategy itself places a high memory load on the older adults (i.e.

tasks with complex rules, multiple components, or that require manipulation of elements).

In terms of memory studies that have been done regarding age, one of the most

consistent age-related findings is that older subjects are, for the most part, poor at tasks

requiring free recall on information as opposed to tasks requiring only recognition (Craik & McDowd, 1987). Unlike the matching process that is found in recognition, the process of recall requires a person to create or retrieve information. The process can be cued recall, in which the subject is asked to recall items that were presented to them on an initial training, or initial presentation list. This is slightly different than a free recall task, in which the subject is given no recall assistance, because the subject is given a hint, or a cue, about the items on the original list.

For example, in a cued recall task, the subject may be asked to recall what item on a list was paired with the word window, or which item on the list began with a prefix. In addition to cued recall, there is also free recall. An example of this could be trying to remember all items on a list of animals or some type of general theme. Researchers believe that this process of retrieving information from memory that occurs during recall requires more extensive mental processing than occurs during recognition, which basically states that recognition for individuals should be easier than recall and results in better performance (Hultsch, 1975).

In general, most people either young or old are better at recognition tasks than at recall tasks. This can be explained by the fact that recall requires more active retrieval processes and is a less automatic process than what is found with recognition (Craik, Byrd, & Swanson, 1987). Since older people seem to have fewer processing and attentional resources compared to that of younger people, it is easily understood that older people would do less well on memory tasks that require more self-initiated efforts on their part, like free recall.

False Recall and Memory

Unfortunately, one of the negative aspects of free recall and recognition can occur, and may be seen when subjects are tested on information that was previously presented to them. Sometimes, subjects occasionally recall information that was never presented to them. This recalling of material that was not presented to the subjects is called false recall, and was derived from a well known study done by Deese (1959) in which participants heard lists of words and were asked to recall each list immediately after presentation. Each list comprised the twelve most frequently produced responses to a single theme word. Specifically, the subjects were presented with lists of semantically-linked words that converged on non-presented words. For example, for the list consisting of items such as *thread, pin, eye, sewing, sharp, point, prick, pain, hurt, injection,* the converging link was *needle*. When he presented the subjects with lists of this type of recall, Deese found that the subjects often incorrectly recalled the non-studied converging link word, which resulted in a high probability of falsely recalling these critical theme words.

Two well-known pieces of research are relevant to the explanation of false recall. The first comes from Deese's (1959) study in which it was noted that the probability of a theme word occurring as a false recall was proportional to the average associative length of that word to the other words in that list. The second comes from a study done by Underwood (1965) using a continuous recognition task in which participants made old/new judgments to a list of words. Occasionally the target word was associatively related to two through five words presented earlier in the sequence. Significantly more false alarms occurred to these targets than to unrelated control words, with the false alarm

effect being stronger in cases with four or five previously related words than with two or three words.

These and other results are consistent with an activation-based account, such that false memories are created during encoding when presented words activate associated words within a semantic group. Roediger and McDermott (1995) suggested two possible consequences of such spreading activation. The first, is that participants may become consciously aware of the critical lure in the study and so falsely recognize the critical theme as a result of confusing the source of activation. The second possible consequence is that participants may be unaware of the associative response during study time, but may still falsely recognize the critical lure at testing because of its increased level of activation. This evidence suggests that false memories can result from both conscious and non-conscious processes.

A number of studies have used Roediger and McDermott's (1995) paradigm to explore potential factors influencing the nature and prevalence of false memories in order to provide a more complete explanation for their occurrence. The results demonstrate that the phenomenon of false memories is powerful. For example, both Gallo, Roberts, & Seamon (1997) and McDermott and Roediger (1998) found that even participants who had been specifically forewarned about falsely recognizing related words still persisted in doing so. McDermott (1996) observed that although multiple study and test opportunities caused the number of false memories to decline, they were still substantial even after five study/test trials. Furthermore, Payne, Elie, Blackwell & Neuschatz (1996) found that false recognition actually increased over repeated testing under conditions, unlike McDermott, in which no additional study opportunities were provided.

This experiment like many other previous studies is attempting to explore the relationship between age and recall. Unlike some previous experiments, which have studied the combination of age and recall factors, this study will also focus on the relationship of recall being increased due to word relevance or conceptual word familiarity of the lists used for older and younger subjects. More specifically, we will examine how subject matter, and vocabulary relevant to particular age groups will influence recall for words. In addition to examining increased recall due to word relevance, false recall will also be examined in order to see if one of the results of word relevance to a particular age group will be an increase in false recall. The applications of this study have the potential to be generalized to many aspects of our society, because increased memory recall due to word relevance may be used to help improve activities of daily living for older adults, especially in the next twenty years when a large elderly population will be present in the United States.

The purpose of this research is to determine if relevant or familiar words will be more easily recalled than irrelevant words, especially in terms of how they relate to the recall in older people. The information obtained from this study will help in gaining a better understanding of how to possibly develop training aids for older persons. With the development of memory training aids and increased memory, older adults may be able to better perform their activities of daily living in addition to improving mood and decreasing symptoms of depression (Bolla, 1991).

Human Factors, Aging and Memory

As previously stated, the problem being faced by elderly people is that their memory abilities may be negatively affecting their activities of daily living. In addition to

for use In addition to blood glucose meters, other home healthcare systems are often relatively complex, and existing instructions are not adequate Safe and effective use of home health care technologies that target older adults will need to start requiring behavioral science based design changes and development of adequate training

Currently, there are many ways to assist and aid older persons' memory abilities to assist in daily tasks Products can be purchased in local stores or easily made at home Each individual may have different needs, so devices and techniques should be tailored to suit that specific person Small modifications to daily items used to trigger memory can also be useful, such as those discussed by Health Letter (1989) For example, checklists can help remind a person to do certain tasks Homemade labels can also help people to remember the contents of a cabinet, drawer, or closet A prominently displayed digital clock and easy to read calendars can help remind the person of the day and time Marking routines, appointments, special occasions, and future events on the calendar can also be helpful

Commercially available training devices can also help older people with their memory abilities Small recorders can be pre-recorded with reminder messages or, when set ahead of time, a small timer with memory recorders can prevent a person from forgetting about an activity that needs to be done at a certain time Another situation in which older adults may want to look into commercially available products, would be that many older people need to take one or more kinds of medication on a daily basis Medication organizers can help eliminate this problem by containing compartments for different types of pills for up to seven consecutive days, with some even containing pill

this, within the next fifteen to twenty years, our country's largest age cohort will be that of the elderly. With this large cohort, and the combination of these two factors, is anything being done to remedy problems resulting from the graying of our society? The answer is yes.

Currently, the term engineering psychology is used to refer to the applied science whose goal is to understand how humans sense, process, and act on information. This aspect of psychology applies that knowledge to the design and training for new and existing technologies to make them safe, efficient, and easy to use. To accommodate older populations, it is necessary to understand age-related differences in sensing, processing, and acting on information. It is also necessary to apply that knowledge to ensure that products and systems are safe, efficient, and easy to use by older adults (Fisk & Rogers, 2002).

In a study done by Hancock, Fisk, & Rogers (2001) examining usability problems with everyday products such as toiletries, over the counter medications and healthcare products, it was found that close to eighty percent of the elderly respondents reported usability problems. In addition to this, about half of the respondents reported memory problems such as forgetting actions to perform or following procedures. Some of the subjects may have considered these memory problems merely annoyances, but many usability problems are not just annoyances. They have the potential to be dangerous.

An example of this danger may occur in the area of healthcare technology. Many elderly individuals use blood glucose meters as discussed in research by Gardener-Bonneau (2001), which reported a task analysis that showed that some self-reported, easy to use systems required more than fifty substeps for the performance of three basic steps

alarms that hold medication and sound an alarm when it is time to take the medication

(Herrmann & Petro, 1990).

Mnemonic Use and Memory

There are also noncommercial ways, such as memory strategies to increase recall,

to help the memory abilities of older people. One memory strategy is called using

mnemonic techniques. This memory method allows easier encoding, storage, and

retrieval of information of either a verbal or visual nature. Some types of mnemonic

techniques that people naturally make use of without formal training or instruction

include rehearsing pertinent information over and over again, while another type is what

researchers call chunking (Bellezza, 1983). In chunking, items are grouped together in

clusters forming images to link items, which in turn make up a unique story line for the

individual to remember. In some instances the individual will make up a story line that is

so absurd, that the task at hand is easily remembered.

Another type of mnemonic device uses acronyms to remember names, or some

object in the environment that needs to be remembered. This type of mnemonic has been

mostly found to be used by music students in helping to remember notes between lines

and by medical students in remembering anatomical items (Salthouse & Prill, 1987).

Some mnemonics are not impulsively used by many people, which make these types of

mnemonics fall into the category of technical mnemonics, such as the method of loci and

peg word methods.

The fact that mnemonics and other memory strategies are very useful and helpful

in terms of memory, has been described by many researchers, such as Dunlosky &

Hertzog (1998). In their work there was no effect of age on the ability to produce useful

encoding strategies during a paired-recalled paradigm, although increased performance

for both age groups was associated with the use of more detailed encoding strategies.

Hill, Allen, & Gregory (1990) found similar evidence suggesting that older adults can

both self-generate and successfully apply mnemonics during a verbal free recall task, and

that more detailed strategies such as categorization lead to enhanced recall. Camp and

colleagues also suggested that older adults are able to self generate strategies similar to

younger adults, and demonstrated that participants who used strategies typically

associated with "deep" encoding showed enhanced levels of recall, regardless of age

(Camp, Markley, & Kramer, 1983).

Some researchers disagree that memory strategies are useful for memory

enhancement for older adults. It is felt that recall is thought to benefit from active,

strategic encoding and then requires active, strategic search of memory during retrieval. It

is further discussed that older adults have been found to show impairments in recall

paradigms that require strategic encoding and/or strategic retrieval (Sanders, Murphy,

Schmitt, & Walsh, 1980). For example, using a paired-associate learning paradigm,

Rogers & Gilbert (1997) have examined age differences in the use of retrieval strategies,

with results from these studies suggesting that age-related memory impairment on recall

tasks is due to a decreased use of retrieval strategies. Most importantly, older adults who

were as successful at using retrieval strategies as younger adults showed no evidence of

memory impairment.

This result was also seen in a study done by Hultsch (1975) in which he obtained

evidence that elderly subjects experience problems both of storage and retrieval.

Categorized word lists in the experiment were presented under cued or noncued free

recall conditions. in which it was found that cueing led to an increase in the number of categories recalled by older subjects. However, the older subjects recalled significantly fewer words per category than the young subjects, and cueing did not benefit the old subjects more than the young. indicating an age-related storage deficit.

Training Age and Memory

Adults of all ages have been found to be able to complete memory tasks at about the same rate and show about the same magnitude of benefit from training. A study by Baron and Mattila (1989) showed that prior to memory training young and old adults performed tasks with comparable accuracy. but older adults were substantially slower. During training with a deadline procedure, both age groups performed more quickly. but had a higher error rate. On the other hand, when the deadline procedure was relaxed, the young and older adults performed with equivalent accuracy. and the speed differences between the groups were substantially decreased. which suggested that the older adults improved their speed of memory response more than the younger adults did.

Another intervention may be to train older users in ways that are most beneficial for memory enhancement. Wiedenbeck and Zila (1997) evaluated different training methods with younger and older users. Older users benefited most from training that told them exactly how to accomplish an activity for certain tasks. and training that was more conceptual for other tasks. The researchers concluded that matching the training approach to specific tasks could allow older users to perform almost as well as younger users.

Other similar research done by Kramer. Larish. Weber. & Bardell (1999) showed that the problem with memory tasks in older adults was not so much that they faired worse than the younger adults, by not being able to remember. but instead were inhibited

by time constraints. The older group needed more time to remember, whereas the younger adults could do this aspect more quickly. The older subjects were observed to have difficulty in flexibly setting and modifying processing priorities among concurrently performed tasks. The variable-priority training that each older subject received targeted this skill, thus improving their performance on the memory related task.

Another study that focused on training and age was developed and performed over a fourteen year time period by Saczynski & Willis (2001), in which two thirds of the individuals that received five hours of memory training showed reliable improvement. Of those trained whose performance did decline, forty percent showed that their performance was at or above their level of performance fourteen years prior to the training.

With this knowledge in hand regarding training, a goal of product designers is to take into account the capabilities of the users and the context in which they act. A review of the literature on skill acquisition and aging reveals basic principles, such that it is not the case that older adults cannot memorize, or that they memorize less than younger adults, but rather, there are age related differences in processing methods; one must consider the task variables, the context, and the type and amount of training being provided (Fisk & Rogers, 2000).

As was discussed previously, older adults do exhibit declines in abilities related to skill acquisition such as working memory, but proper instructional design that takes into account intact abilities and compensates for declining abilities holds much more promise for helping older adults to improve their performance. Additional training can help older adults maintain the level of proficiency they have (Craik & Salthouse, 2000). Thus, there

is a crucial need for research programs that focus on age related changes that affect older adults' ability to interact with technology successfully in all aspects of life.

The main focus of this study is to examine the correlation between familiar words and memory performance. To answer the question, "Is memory better for familiar words than unfamiliar words?" one needs to take into account research done by Hulme, Maughan, and Brown (1991). On the basis of their results they proposed that working memory for familiar words benefits from the availability of long-term phonological memory representations, which act to "clean up" the decaying memory traces of items in the list at the retrieval stage. Therefore, the size of the lexicality effect in memory provides a test of the ability to access phonological representations and a more strict test of the integrity of verbal memory processes.

Similar results were also discussed in research done by Nation, Adams, Bower-Crane, and Snowling (1999) in which it was found that the tested subjects performed like controls when recalling familiar words, but when unfamiliar words were encountered, the subjects recalled much fewer of the words. These results were further expressed by Nation & Snowling (1999), in which it was stated that when knowledge of unfamiliar words is poor, reduced recall for these items is entirely to be expected.

Knowing the information that has been previously presented about word familiarity and how it may relate to increased recall, the next question to ask is; do older adults have language or vocabulary differences that may lead to some words being more familiar for them when compared to the vocabulary of younger adults? This question is answered by researchers such as Langacker (1972), who found that one finds that

vocabulary differences include discrepancies in the inventory of lexical items as well as differences in the properties of shared vocabulary items.

Through vocabulary, people may reveal facts about their own sex, education. occupation, culture, and age. There are differences between the language of the younger generation and older adults. The language of the young changes from the language of the old, and one element contributing to this change is the mass media (Langacker, 1972). There are other factors, which might account for differences in the young adults' vocabulary and speech compared to that of older adults. Shuy (1998) explains that these factors are aspects of sociolinguistics, such as that a person's speech will reflect to some degree their socioeconomic status since norms for communication skills are acquired as part of the process of socialization. Even though other factors may influence language differences between older and younger people, it is evident that the media has been a primary influence on the language of those to which it is exposed (Langacker, 1972).

Langacker (1972) furthers this discussion by stating that the media's contribution to the speech of younger people compared to that of elderly adults can be seen clearly and distinctly. The semantics of the contrasting age groups was different due to the topics of discussion. Older adults talked about radically different things than younger adults, and that requires an appropriate lexicon. The topic of discussion is dependent among younger people, to a great degree, on the media to which they are exposed.

The Present Study

This study unlike other memory recall studies will examine memory differences in terms of recalling relevant and irrelevant words among older adult groups compared to that of young adult age groups. One purpose of this study is to establish if elderly adults

exhibit better recall of words that are relevant to, and used exclusively by, their age group, than words that are irrelevant to their age group. The same question will be examined regarding the younger adults, in seeing if they too will perform better on recall tests due to the fact that the word lists are used by and relevant to their age group. A second purpose of the study is to examine recall differences in younger and older groups, based not on word familiarity, but on conceptual familiarity of words on a word list. For instance, is a word list made up of commonly understood words for both age groups, but one list is more personally relevant to one age group (e.g. a list of words centered around retirement plans might be more conceptually relevant for a group of 60 year olds than for a group of 20 year olds), then will recall for the list be better in the group for whom it is more relevant? The final purpose of this study will also be to examine this relationship using word list with conceptual relevance for young and old groups.

Thus, this study will test the following hypotheses. Among older and younger adults, it is predicted that there will be: (a) a main effect of age on both correct recall & false recall, such that older adults will perform more poorly than younger adults; (b) the older adults will have better recall than younger adults for old familiar words; (c) the older adults will have better recall than younger adults for old conceptual words; (d) the younger adults will have better recall than older adults for young familiar words; (e) the younger adults will have better recall than older adults for young conceptual words; (f) within age group differences will also appear. It is hypothesized that for the older group, individuals will exhibit higher levels of recall for the older age word lists than the younger word lists.

Method

Participants

The participants being tested were categorized into two groups, the young adult and older adult age groups. Power analysis had determined that for sufficient power in the current study, there was a need for at least 8 participants for each of the eight groups, resulting in a minimum of 64 participants overall in the study.

The younger adult age group participants were undergraduate students from Embry-Riddle Aeronautical University who received credit in an introductory psychology course. The older adult age group participants were people found in the communities of the greater surrounding Daytona Beach, Florida area. Some of these elderly subjects resided in elderly senior centers or resided in owned homes throughout the community. These elderly participants performed in the study for altruistic purposes of knowing that information gathered from the experiment would be used to further science, since undergraduate course credit cannot be given to this age group of participants.

Based on information presented by Nichols, Rogers, Fisk, and West (2001), in which information regarding age classifications from studies such as The Journal of Psychology and Aging, in addition to Human Factors Journals, it was found that the older adult age group should consist of adults from age ranges of 60-82 years old, while the younger age group should consist of participants from age ranges of 18-31 years of age. For procedural standardization, all the subjects that had participated in the study did not have any clinically diagnosed deficits of memory or forms of dementia. Prior to beginning the experiment, the subjects were tested using a Wais cognitive screening test

to see if they had a cognitive level sufficient enough to be able to perform in the research

In addition to the cognitive screening test, a vision screening test was also administered

that simply consisted of a few directions in size fourteen font that if unable to be followed

by the participant, the data would then be discarded after the data had been collected by

the experimenter

Measures

Four word lists were created for use in the study These lists were generated by

polling individuals of both the younger and older age groups in order to get an idea and a

range of relevant familiar (slang) words of that particular group A list of 25 relevant

younger familiar words and a list of 25 relevant older familiar words were then gathered

In addition to this, a list of 25 conceptual older words and 25 conceptual younger words

were also gathered The familiarity of the four word list were then validated with five

older and five younger people that would not participate in the study using a Likert Scale

that required the person being polled to answer if the word observed should be given a

score ranging from 1-5, with 1 meaning the word observed is least recognizable to a score

of 5, which means the word observed is the most recognizable After the word lists had

been validated by the five young and the five older non-participating subjects, the words

were then scored The means of each of the words on the different lists were then

calculated with the top fifteen mean scores of each of the four lists to be used as word

lists in the study

The first word list consisted of the "older generation" slang words that are

familiar to, and used by the older adults subjects, while the second list, consisting of the

"younger generation" slang words that are familiar to, and used by the younger adult

subjects. The third word list tested the conceptual familiarity effect, in which we will

examine if older adults show better recall for words related to an age-specific familiar life

activity such as the healthcare/medical area. This was determined due to the fact that the

elderly are exposed to medical area more than other age groups. The Agency for Health

Care Policy and Research (1998) states that during the period of 1994-1998, one in four

persons ages 65-74 years, and one in three persons 75 years of age and older report poor

health. In that same time period use of hospice care by persons 65 years of age and over

increased by eighty-three percent to 25 patients per 10,000 population.

The fourth list tested the conceptual familiarity effect of younger adults for words

related to their age-specific life activity. Unlike the older adult age group which has

words that deal with healthcare and the area of medicine, for the younger adult age group

it had been determined that words relating to education were to be used due to the fact

that the younger adult age group entails a large school age population of persons ages

eighteen to twenty-four which are comprised of high school seniors and college-aged

students (U.S. Bureau of the Census, 1999).

This purpose of this study is to examine if younger adults show better recall for

words related to unfamiliar age-specific life activities compared to that of older adults, as

well as for both familiar words and conceptually linked words. This study additionally

tried to examine if older adults exhibit higher levels of false recall than of their younger

counterparts. Prior to beginning the study subjects were given a consent form to

complete, followed by a demographics form in which the subject will be required to state

age, gender, and health. Once this has been done, the subjects' final steps before the lists

were presented were to complete the visual screening measure in addition to the cognitive

screening task. These forms and measures aided in determining if the subject's data should have been accepted or rejected based on health, vision, and cognitive ability.

The first group of participants were the young adult age group, who received words relevant to their age, such as slang terms from their particular generation presented to them. The second group was also a young adult age group, but presented with words that were irrelevant to their age group, such as slang terminology and expressions of the older adult generation. The third and forth groups were in a similar fashion as the first and second group, such that the elderly adult age group had words relevant to their age group presented to them, followed by the fourth group with elderly adults that had words irrelevant to their age group presented to them. The fifth group was a young adult age group with the young conceptual word list.

The conceptual words unlike the relevant and irrelevant words are words or terminology used by either elderly or younger people, yet may mostly pertain to one group or another. For example, the conceptual word list relevant to the younger adults will have a list of words that deal with a education/school theme, whereas the older adult conceptual word list are to be words that deal with healthcare issues, medicine, or going to the hospital. Even though either age group may experience these themes, it is believed that the particular age group should have more exposure, acceptance, and more of a familiarity to the theme in question based on information presented earlier in the study. The sixth group consisted of young adults with the elderly conceptual words (terms that deal with going to the hospital and medical issues). The seventh group were elderly adults with the list of elderly conceptual words followed by the eighth and final group of

elderly adults with a young adult conceptual word list comprised of words with an educational/school theme.

The young participants received a post experiment briefing followed by course credit awarded to them for their participation in the study. The participants were told that the results of the experiment would be available to them after all the participants have completed all the study's group trials. The participants were also told not to discuss any of the events that occur due to the fact that they may affect the results of other future sessions. Keeping this in mind, the participants were not told the names of the other future participants.

The experimenter displayed/projected the word lists to the participants, in addition to timing the display rate of each list word. For shut in subjects, or subjects tested individually, the experimenter timed the subjects after they began examining the word list on the sheet of paper presented to them. After the participants had seen the complete list of words, the experimenter directed the participants to complete the distracter task given to them. Following this, the experimenter then instructed the participants to recall as many words from the presented word list as possible on a sheet of paper handed out to them in a set amount of time. The experimenter then collected all the participant's papers that had the recalled information written on them

Instruments Apparatus

Since subjects were tested in groups, the easiest way for the experimenter to perform the test was in a manner in which information could be projected to a mass audience. With this in mind, the best way to project information, especially timed list information, would be in the use of Microsoft Power Point. By using a Power Point

presentation, the experimenter would be able to present a projected word on a large

screen or panel for a larger audience in an auditorium like setting. Each of these projected

lists contained 15 words that were either relevant or irrelevant based on the age group

being tested. This projected presentation was most beneficial in use with the younger

adult participants, in which testing took place in a university auditorium setting. The

same can be said in terms of testing older adult participants, which may have taken place

in a forum area of a senior elderly adult community. In situations where participants may

be tested individually, for example, in cases where "shut in" elderly were not able to

congregate in a forum type of setting, other means of presentation were needed. In these

cases, paper packets with the printed word list information on them were used instead of

the power point presentation. The use of paper enabled the experimenter an easier means

in which to present and perform the test to these special case subjects. In addition to the

shut in participants, situations where the participant groups were larger than ten and the

experimenter wanted to test more than one cohort at a time due to convenience and time

constraints. In these specific situations the experimenter opted to use a paper presentation

rather than power point.

Performance Measurement

The experimenter timed each display using a stopwatch of the target word to be

recalled at a typical presentation rate of 8 s per word with no delay between words based

on similar previous research done by Roediger & McDermott (1995). For the "shut in"

elderly subjects or younger subjects who were tested individually, a packet containing the

necessary screening test and demographic sheets were given. In these packets, there was

a page that contained a list of fifteen words, in which the subject had 120 s to examine, or

in other words, 8 s per word (15 words x 8 s/word = 120s). The timing of each target

word being displayed in addition to timing the distracter task and timing the period

allotted for recalling the lists of words were measured using a stopwatch. During results

analysis, the experimenter then computed the number of correct recalled words in

addition to examining words that were falsely recalled that were presented from each

word list displayed.

Design

The purpose of this study was to investigate if words that are cohort and

conceptually relevant to a certain age group would be better recalled than cohort

irrelevant and non-conceptually relevant words by subjecting participants to a memory

recall test. The experiment consisted of a 2(age) x 4(word lists) between subjects design.

None of the participants knew that their performance at recalling either

relevant/irrelevant words or conceptual/non-conceptual words was being compared to

that of other subjects of the same and different age groups. The independent variables

were the two different age groups (the elderly & young adults), and the four different

types of word lists (irrelevant, relevant, conceptual, & non-conceptual words). The

dependent variables in this experiment were the number of words recalled correctly and

incorrectly from both the elderly and young age groups, and the number of items falsely

recalled by each group.

Procedure

Instructions given prior to testing were given by the experimenter regarding the

format and procedures of the test. These instructions informed the participants that their

memory would be tested for recall and that they would have to try to remember as many

words as possible as possible for a memory test that would follow sometime when the list presentation was over Following the instructions, all the participants were presented with lists of 15 words in blocked fashion The words were presented in at least 32-point, uppercase, Times New Roman font, and to be presented/projected sequentially in the center of the screen at a constant rate of 8 s per word with no delay between words This presentation rate and the numbers per word list were selected because these factors are typical in this type of research (Roediger & McDermott, 1995)

The word lists presented to the participants consisted of verbs and nouns presented randomly Evidence has been found that there is a neuroanatomical distinction between the processing of nouns and verbs (Daniele, Giustolisi, Silveri, Colosimo, et al , 1994) These findings suggest that the temporal lobe of the left hemisphere of the brain might be significantly involved with the processing of nouns while the frontal lobe of this hemisphere might play a crucial role in the processing of verbs Furthermore, a particularly strong distinction is made between the mental organization of nouns and verbs These organizational patterns are reflected in people's memory for semantically related nouns and semantically related verbs versus semantically unrelated nouns and verbs

Huttenlocher and Lui (1979) tested this proposition and found that semantic relatedness affected the short-term memory for both nouns and verbs, but the effect for nouns was stronger than the one for verbs, suggesting that there is a organizational difference between these two word categories The relation of this difference to age was also investigated Both older adults and younger adults showed the same patterns of results-semantic relatedness affected the recall of nouns more than recall of verbs In

addition to a random order of nouns and verbs, the word list will incorporate relevant,

irrelevant, conceptual, and non-conceptual words based on information taken from

surveys of elderly and young adults in addition to Internet information gathered regarding

the terminology and vocabulary of these two different age groups.

After the participants were presented with the whole list of words (either the

relevant, irrelevant, conceptual, and non-conceptual based on age group), the participants

were then instructed to do a distracter mathematics task, in which the time allotted for

this distracter task was three and a half minutes based on similar research done by Zacks,

Radvansky, & Hasher (1996). After the distracter task had been completed, the

participants were then instructed to recall as many words as possible by writing them

down on a piece of paper within a 3 minute period.

This period has been extended from similar research (Stadler, Roediger, &

McDermott, 1999) in which participants were given two minutes, based on the fact that

the older participants may feel rushed due to time constraints, in addition to slower motor

control ability that has been exhibited (Kramer, Larish, Weber, & Bardell, 1999). After

this time period is over, the experimenter collected the papers, while informing the

participants the need to not divulge information about the test to others for the fact that

testing would be continued at future dates with other participants. Following this, the

experimenter instructed the participants of who to contact regarding the experiment's

results once the testing of all participants was completely finished and results tallied.

Results

Data

The data from the dependent variables were collected for the sixty-four

participants The data were then divided between the levels of the independent variables

of the two different age groups (the elderly & young adults), and the four different types

of word lists (young familiar, old familiar, young conceptual, & old conceptual words)

and summarized (see Tables 1 & 2) Hypotheses were tested for significance and effect

size using an analysis of variance for a between subjects design (see Table 3)

Correct Recall

The results indicated that the overall model examining the effects of age and word

type on recall was significant, $F(1,63) = 6\ 27$, $p< 01$, eta squared $= 44$, power $=\ 99$

Specifically, the young adult participants correctly recalled more words than that of their

older aged counterparts, $F(1,63) = 27\ 26$, $p< 05$, eta squared $=\ 33$, power $=\ 99$ On

average the younger age group correctly recalled 9 75 words from the list of 15 words,

while the older age group had a mean recall level of 7 09 words There was not, however

a significant effect of word type used in the lists, $F(3,61) =\ 77$, $p>\ 05$, eta squared $= 040$

On the other hand, there was an significant interaction between age group and word type,

$F(3,61) = 4\ 77$, $p< 05$, eta squared $=\ 204$ A Bonferroni Post Hoc test was conducted to

see which of these interactions (age with word type) were significant A significant

difference was found between the younger adults with young familiar words and older

adults with young familiar words, mean difference 4 88, $p< 05$ (see figure 1) A

significant difference was also found between the young adults with young familiar

words and older adults with young conceptual words, mean difference 3 75, $p< 05$

Results indicated that there were significant differences found between younger adults

with young conceptual words and older adults with young familiar words, mean

difference 5 25, p< 05. A significant difference was found between younger adults with

young conceptual and older adults with young conceptual words, mean difference 4 12,

p< 05 The final significant differences found between younger adults with older familiar

words and older adults with young familiar words, mean difference 4 25, p< 05

Within Group Age Differences for Correct Recall

A one-way ANOVA was used to test the hypothesis that older individuals would

exhibit higher overall recall for the older age word lists than for the younger age word

lists In this analysis, word list was used as an independent variable with correct recall as

the dependent variable The ANOVA was significant, $F(3,61) = 5$ 86, p< 01, eta squared

= 39, power = 92 Following the one-way ANOVA, a Bonferroni Post Hoc test was

conducted to determine where significant differences in recall existed for the word lists

type used for the older adults

The results from the Post Hoc test indicated that among the different word lists,

there were significant differences for the older age group in the old familiar word list

condition compared to the older age group exposed to young familiar words, mean

difference 2 75, p< 05 There were significant differences for the older age group in the

old conceptual word list condition compared to the older age group exposed to young

familiar words, which had a mean difference of 3 00, p< 01 There was no significant

difference in recall between older adults in the older conceptual word list condition or the

older familiar wordlist condition and adults in the young conceptual word list condition

False Recall

For false recall, the ANOVA model reached significance, F(1,63) = 3 17, p< 01, eta squared = 28, power = 92 Results indicated that the younger adults engaged in less false recall on the word lists than the older aged adults, F(1,63) = 4 76, p< 05, eta squared = 078 On average, the younger age group falsely recalled fewer words (about half) than the older aged group, with the younger age group having a mean of 44, while the older age group had a mean of 81 of words falsely recalled (see Tables 4 & 5) There was also a significant effect of word type in predicting false recall, F(3,61) = 5 20, p< 05, eta squared = 218 A Bonferroni Post Hoc test was conducted to determine where significant difference existed between word list type used for false recall The results from the Post Hoc test indicated that among the different word types there was only a significant difference between the young conceptual and young familiar words, mean difference 94, p< 05, with false recall being significantly higher for the young conceptual word list There was no significant interaction between age and word type in predicting false recall, F(3,61) = 62, p> 05, eta squared = 032 (see Table 6)

Table 1.

Descriptive Statistics For Correct Recall

Age Group	Word type	N	Mean	Std Deviation
Old	Old Conceptual	8	8 38	1 06
	Old Familiar	8	8 13	1 36
	Young Conceptual	8	6 50	2 07
	Young Familiar	8	5 38	1 92
	Total	32	7 09	2 01
Young	Old Conceptual	8	8 50	1 31
	Old Familiar	8	9 63	3 29
	Young Conceptual	8	10 62	1 60
	Young Familiar	8	10 25	2 66
	Total	32	9 75	2 38

Table 2.

Descriptive statistics For Correct Recall (Continued From Previous page)

Age Group	Word Type	N	Mean	Std. Deviation
Old & Young Total	Old Conceptual	16	8.44	1.15
	Old Familiar	16	8.88	2.55
	Young Conceptual	16	8.56	2.78
	Young Familiar	16	7.81	3.37
	Total	64	8.42	2.56

Table 3.

Analysis of Variance of Age Group and Word Type For Correct Recall

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Age Group	112.89	(1,63)	112.89	27.26	.00
Word Type	9.55	(3,61)	3.18	.77	.516
Age Group* Word Type	59.30	(3,61)	19.77	4.77	.005

Table 4.

Descriptive Statistics For False Recall

Age Group	Word Type	N	Mean	Std Deviation
Old	Old Conceptual	8	1 13	835
	Old Familiar	8	63	744
	Young Conceptual	8	1 25	1 035
	Young Familiar	8	25	463
	Total	32	81	859
Young	Old Conceptual	8	38	518
	Old Familiar	8	50	756
	Young Conceptual	8	88	641
	Young familiar	8	00	000
	Total	32	44	619

Table 5.
Descriptive Statistics For False Recall (Continued From Previous page)

Age Group	Word Type	N	Mean	Std Deviation
Old & Young Total	Old Conceptual	16	75	775
	Old Familiar	16	56	727
	Young Conceptual	16	1 06	854
	Young Familiar	16	13	342
	Total	64	63	766

Table 6

Analysis of Variance of Age Group and Word Type on False Recall

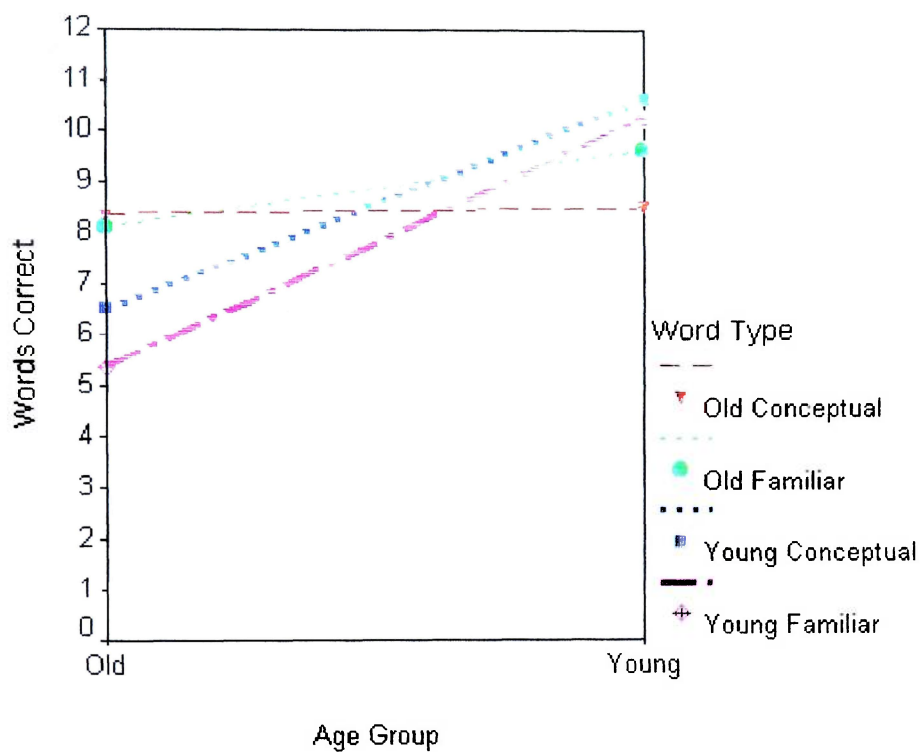| Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig
Age Group	2 25	(1,63)	2 25	4 76	033
Word Type	7 38	(3,61)	2 46	5 20	003
Age Group* Word Type	875	(3,61)	292	616	607

Figure 1. Interaction effect of age and word type on correct recall.

Discussion

Results of the present study indicate that younger adults do significantly better on recalling a list of words presented to them compared to older adults. This finding is consistent with research done by Craik & McDowd (1987) in which it was reported that one of the most reliable age-related findings is that older subjects are particularly poor at tasks requiring free recall of information. This has also been discussed in research done by Craik & Salthouse (2000) who stated that in general, memory differences are most pronounced between younger and older adults when the memory task requires the older person to use a completely self-initiated memory strategy, like free recall. In addition to this, there is considerable evidence that attentional capacity declines as most people age, which means there is a reduction in the ability to use efficient encoding and retrieval processes. If the memory task does not allow a person to process the material in an automatic fashion, or if the material is presented in such a way that it overwhelms the sensory capabilities, then older people will do generally do worse than younger people (Craik, Byrd, & Swanson, 1987).

In comparing the results for the effect of word type on correct recall, there did not seem to be a significant difference between the lists as they related to recall ability. Thus, there was not a significant difference in mean number of words recalled across the four different lists of words presented to the participants. This result may be attributed to the fact that the four different word lists possibly were not " "familiar" enough to the participants to bring about great differences in amount of recall due to words used. In other words, the conceptual word list may have needed to be researched further in order to find a topic or subject that specifically pertains to one age group and not the other.

Unfortunately this is not a realistic goal. Even if one was to find a subject matter that specifically dealt with a particular age group's life activities, there would still be some sort of carry-over to other age groups. For example, medical and healthcare terminology was determined to be specific to the older aged group, due to the fact that the elderly are exposed to medical area more than other age groups based on information stated by The Agency for Health Care Policy and Research (1998). This subject matter may not have been age-specific enough due to the fact that younger people also may have exposure to this area due to personal illness or hospitalization of a friend or family member.

For the familiar word lists, there was the possibility that regional differences could have played a role in recalling words for both age groups. For example, the words were validated using people who were mostly from the Daytona Beach area, and then were applied to students attending Embry-Riddle Aeronautical University who are mainly from different parts of the country. It is possible that we saw some regional vocabulary variations in word familiarity (Shuy, 1998). These regional differences could also explain results obtained for the older familiar words. Even though there was not a significant difference on recall for word type, significant mean differences were observed among the different conceptual and familiar words used within the older age group. For individuals presented with conceptual and familiar word lists that pertain to their age-specific group, mean recall was approximately two words greater recall than that of their non-age-specific familiar word list.

The results of the data examining correct recall indicated that there was a significant interaction effect of age and word type on recall. This evidence is consistent with research done by Nation, Adams, Bower-Crane, and Snowling (1999) in which it

was found that, the tested subjects performed like controls when recalling familiar words, but when unfamiliar words were encountered, the subjects recalled much fewer of the words. The research also stated that when knowledge of unfamiliar words is poor, reduced recall for these items is entirely to be expected. Langacker (1972), found that vocabulary differences include discrepancies in the inventory of lexical items as well as differences in the properties of shared vocabulary items. Through vocabulary, people may reveal facts about their own sex, education, occupation, culture, and age. There are differences between the language of the younger generation and older adults. Since there are these differences in language between younger and older persons, and people in general recall words more when they are familiar to them, then it's understandable to see why we should have significant differences between the groups discussed.

For false recall, results indicated that the younger adults had lower levels of false recall than the older aged adults. This has been found to be consistent with previous research done by McCabe and Smith (2002) that revealed there are greater rates for false recall for older adults than that of younger adults. The study goes on to further explain that age differences in false recall can be attributed to age-related decline in attentional control of relevant processing pathways.

False recall did vary by word list. False recall levels were found to be more prominent with the conceptual word lists than the familiar word lists. Since the conceptual word lists were lists of age-specific activities (medical/healthcare & education), they had themes. Research by Deese (1959) explains why lists consisting of items of a theme increase false recall. When he presented the subjects with themed lists and measured false recall, Deese found that the subjects often incorrectly recalled the

non-studied converging link word, which resulted in a high probability of falsely

recalling critical theme words.

Specifically, word list differences in false recall were found only among the

young conceptual and young familiar words. This is possibly attributed to the fact that the

older adults would have had a hard time falsely recalling the young familiar words

because many of the words may have seemed very unusual, less understandable, and

exclusive of any theme. On the other hand, rate of false recall were highest for the young

conceptual words relating to education. This list may not have been as age group specific

as was thought, and may also have been primed all participants to recall related themed

words as being on the list.

Conclusion

The results from this study sustain much of the research that has been done previously on the topic of age and memory recall Additionally, the study supports the hypothesis that people perform better on words they perceive as self-relevant, either conceptual words or familiar words Even though the younger participants fared better than their older aged counterparts on many different aspects of the experiment, there is still hope for the older adults We have learned that people, young or old, perform better with subject matter and words that with which they are familiar Knowing this, further research needs to be done concerning age, memory, and word relevance

Furthermore, human factors can benefit from the results learned from the uniqueness of this recall memory study compared to recall studies that have been done in the past This is especially evident, in terms of developing instructions for older individuals It was learned that older adults' recall performance increased when they encountered words of relevance (either familiar or conceptual) This knowledge can be used during instructions or product manual development Writers need to take into account the population that might be working with the product at hand This is especially true for directions on medical device labels, or prescription pills, where a large population of elderly people use these products Manufacturers also need to take into account that elderly individuals do not perform as well on recall memory tasks with words that are not relevant to their age group For example, on set-up instructions for home entertainment equipment a manufacturer may want to avoid using words that are considered to be "generational", words that are primarily understood by younger aged adults, such as technical slang terminology characterized by modern day language

conventions or technical terminology that has been abbreviated, instead of fully spelled out or described.

In the future, the information that can be gained from this research and others that may follow could help in the area of human factors by increasing the usability of products for older adults. Human factors professionals need to further explore better alternatives for usability, and the dangers that may occur when products are not user-friendly, such as products in the area of healthcare technology as reported by Gardener-Bonneau (2001). Most products today are not designed with older individuals in mind. This lack of attention should be examined more since this cohort will have one of the largest populations in the U.S. within the next twenty years.

In addition to the development of better usability of commercial memory aids, noncommercial aids, such as memory strategies to increase recall, should be examined as well as interventions that may be used to train older users in ways that are most beneficial for memory enhancement. This study addresses in small but promising manner, one way in which recall ability may be facilitated in older adults. Future researchers are urged to take these laboratory-based results and actual devise studies that could replicate this study in a real-life setting.

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Appendix A

Vision Test Quote

Always bear in mind that your own resolution to succeed is more important than any one thing.

Abraham Lincoln (1809-1865)

Appendix B

Consent Form

Daniel J Padilla, Researcher
Dr Christina Frederick-Recascino, Academic Advisor
Embry-Riddle Aeronautical University
Human Factors and Systems
Daytona Beach, FL 32114

The experiment you are about to participate in is designed to investigate the relationship between word recall performance between different age groups You will be given a list of words and instructed to memorize them Next, you will be asked to solve a series of mathematical problems You will then be asked to write down as many of the words on the list that you can remember In addition to this, you will also be asked to provide some basic demographic information about yourself It is highly requested that you do not communicate with other participants during the testing phase of the experiment Your entire participation should run for approximately 25 minutes

All information that you provide will be held in confidence by the researcher and at no time will your name be reported along with your responses There are no known risks associated with this experiment and you are free to withdraw at any time Your voluntary participation is most appreciated by myself and by the University Please feel free to ask any questions that you might have

If you would like a summary of this experiment's findings, please place your request at ﹍padilla39@erau edu

Statement of Consent

I have been adequately informed of the intent of this experiment My participation is voluntary and I understand that I may withdraw my participation at any time

Participant's name (please print) _____

Signature _____Date _____

Appendix C

Initial Student Questionnaire

Age:_____

Gender: ☐ Male ☐ Female

Education:

☐ Less than High School ☐ High School ☐ Some college ☐ College graduate

Occupation /Previous Occupation: _____

How would you rate your over-all health?

☐ Excellent ☐ Good ☐ Fair ☐ Poor

Chronic Diseases: ☐ Yes ☐ No
If Yes-
☐ Heart Disease ☐ High blood pressure ☐ Diabetes ☐ Other_____

Medications taken regularly: ☐ Yes ☐ No
If Yes- Please list below

_____

_____

_____

_____

Appendix D

WAIS Cognitive Skills Test & Scoring Key

Digit Symbol

1	2	3	4	5	6	7	8	9	SCORE
—	⊥	⊐	⌐	⊔	○	∧	✕	=	

SAMPLES

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

Digit Symbol Test Scoring Key

Age Group	Minimum Score
18-19	45
20-24	49
25-34	40
35-44	36
45-54	27
55-64	22
65-69	17
70-74	12
>74	9

Appendix E

Old Familiar Word List

Dame
Greaser
Chipper
Keister
Lad
Yap
Griddle
Britches
Vittles
Frolic
Jane
Hep cats
Moll
Peepers
Reds

Appendix F

Young Familiar Word List

Wack
Phat
Vexed
Amped
Urk
Buff
Geek
Chillin'
Dawg
Dweeb
Dis
Clubbin'
Tekkie
Air head
Bling

Appendix G

Young Conceptual Word List

Lecture
Project
Assignment
Pencil
Backpack
Homework
Major
GPA
Professor
Notes
Semester
Paper
Study
Auditorium
Book

Appendix H

Old Conceptual Word List

Chronic
Hypertension
Inflammation
Treatment
Examine
Virus
Pulmonary
Needle
Lymph
Edema
Platelet
Benign
Operate
Renal
Deductible

Appendix I

Mathematic Problems Distracter Task

Please solve the following mathematic problems

291 + 741	87 -34	23 × 6	125 ÷ 5

45 + 22	484 -323	14 ×14	65 ÷13

18 + 17	121 -101	18 × 3	72 ÷ 9

53 + 47	76 -62	46 × 22	84 ÷14

77 + 14	168 -114	16 ×11	412 ÷ 4