ABSTRACT

Semantic and Phonological Relationships to Word Retrieval during Aging

By Lynne Christofaris

Previous research has shown an age-related decline in word retrieval and has explored the lexical system's role in word retrieval. This study examined how semantics, phonology, and age relate to word retrieval. Twenty healthy adults participating in the study completed a battery of verbal tests and a questionnaire investigating the impact of word retrieval deficits and strategy use. Data showed age related word retrieval deficits primarily in the length of time needed to complete tasks. Less frequent strategy use was reported by older adults. Semantic and phonological knowledge were not found to be impacted by the aging process or to be related to word retrieval abilities. Results support the theory that declines in executive functioning are partly responsible for word retrieval deficits. The study also suggested that confrontational naming tasks may not be sufficient measures of word retrieval.

Semantic and Phonological Relationships to Word Retrieval during Aging

A Thesis

Submitted to the faculty of Miami University

in partial fulfillment of

the requirements for the degree of

Master of Arts

Department of Speech Pathology and Audiology

by

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2008

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CHAPTER I

Introduction and Review of the Literature

Word Retrieval Difficulties

Difficulty in word retrieval is a leading complaint of the elderly. When the problem is severe, it is often a hallmark of aphasia and one of the most obvious early signs of dementia. In fact, older adults report that the inability to produce a well known word is the largest cognitive problem associated with aging (Burke & Shafto, 2004). Such difficulties could impede communication in both single-word naming situations and conversational contexts (Heller & Dobbs, 1993).

Current models of language production theorize that verbal information is stored within a vast network of interconnected nodes organized into a semantic system of word meanings and a phonological system of word sounds and spellings. (Burke & Shafto, 2004). Naming and lexical retrieval involve complex cognitive behaviors thought to entail multiple steps and diverse processes (Tingley, Kyte, Johnson, & Beitchman, 2003; Nicholas, Obler, Albert, & Goodglass, 1985). The mechanisms of word retrieval interact in complex stages involving both semantic and phonological systems. Word production is thought to proceed from concept formation in two steps: matching a conceptual representation to the mental lexicon and then activating the phonological representation of the word (Saffran, 1999). Complete access to lexical and phonological memory is necessary for the accurate production of a word. The act of retrieving a word happens so quickly that humans do not differentiate between access to semantic and phonological systems in normal speech. However, when a break down of word finding occurs, individuals are forced to search within the cognitive system in an attempt to make complete connections between the semantic and phonological systems, thus "finding the word."

The current study examined the word retrieval abilities of healthy, aging adults on a variety of word finding tasks. It further explored the semantic and phonological processing abilities of adults, and how these skills

may relate to word retrieval. This study also investigated the executive functioning skills of adults by examining strategy use and speed of processing on word retrieval tasks. It was hypothesized that:

1) Performance on tests of word retrieval abilities will display an age related decline.

2) Scores on semantic processing tests will not be affected by aging. However scores on phonological processing tests will show an age related decline.

3) Subjects who perform well on phonological processing tests will also perform well on word retrieval tests.

4) Errors on confrontational naming tasks will more often be phonologically related than semantically related, regardless of age.

5) Older adults will report less frequent use of strategies and greater difficulty in "finding the word" with increasing age.

6) Older adults will require longer processing time than their younger counterparts in tests of word retrieval.

Verbal Abilities during Aging

Differentiating between declines in cognitive functioning due to normal aging and age-associated diseases has been an area of research gaining much attention as the well known "baby boomer" generation reaches their elder years. The association between increasing age and a modest decline in verbal abilities is a normal relationship based on past research. The verbal abilities affected by the aging process include word fluency, speed of information processing, learning, word retrieval, and short-term memory. These cognitive processes are considered the verbal abilities most affected by the aging process (Schum & Sivan, 1997). Schum and Sivan point out the many difficulties in accessing an "optimally healthy" elderly population as they assessed the verbal abilities of normal aging participants in their study. The researchers administered the Multilingual Aphasia Examination (MAE) to 54 healthy participants, ages 70-90 years old. Of the nine tests on the MAE, Sentence Repetition and the Token test showed declines in performance with

increasing age. Both of these tests involve serial auditory information processing, with heavy demands on short-term memory and sustained attention. Older adults performed within the normal range on all other tests of the MAE, indicating that healthy older adults are likely to perform as well as younger, similarly educated peers on verbal tasks. These findings led the researchers to conclude that deficits in linguistic functioning in older adults may be indicative of disease processes.

       Schum & Sivan (1997) suggested that the impact of aging on cognition is most linked to declines in working memory and executive functioning with other studies finding similar results (Humes, & Floyd, 2005; Hough, 2004). However, many studies have shown certain types of memory ability such as vocabulary and fact recognition to remain intact or increase with age (Salthouse, 1991; Maylor, 1994; Balota & Duchek, 1988; Bowles & Poon, 1985). These intact abilities are often referred to as *crystallized intelligence*. (Dahlgren, 1998). Therefore, language abilities such as lexicon are part of crystallized intelligence. The age related decline in word retrieval is especially noteworthy because many language abilities are maintained throughout aging. Previous studies have attempted to describe and understand the content and nature of the decline in naming abilities during the aging process (Baressi, Nicholas, Connor, Obler, & Albert, 2000; Burke & Shafto, 2004; Tingley, Kyte, Johnson, & Beitchman, 2003). A meta-analysis of word retrieval studies by Feyereisen (1997) used an experimental effect size to conclude that there is an age-related decline in confrontational naming, but it is less understood why this occurs.

Tip of the Tongue Phenomena

       Dahlgren (1998) focused on studying the "tip of the tongue (TOT) phenomena" as it relates to memory and aging. A TOT is defined as a moment when a speaker seems to have accessed a word's meaning adequately, but is unable to complete the phonological form of the word. Previous experimental studies have shown that retrieval of proper names is the primary source of TOTs in young and older adults (Burke & Shafto, 2004).

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Dahlgren (1998) examined age and knowledge on TOT rates across three age groups of 186 participants with similar educational levels. Participants completed the Weschler Adult Intelligence Scale-Revised (WAIS-R) vocabulary subtest which showed middle aged and older adults scored significantly higher on vocabulary than younger adults ($p<.05$). The study also included administration of a battery of general knowledge questions that were designed to elicit TOTs for common nouns. Results showed that older adults experienced significantly more TOTs than the young or middle age adults. General knowledge was assessed by questions covering academic content such as vocabulary, history, math, and science. There was also significant positive correlations between the number of TOTs and general knowledge, and between age and general knowledge. However, when knowledge level was held constant, the amount of TOTs across age groups did not differ, indicating that knowledge level is an substantial factor in word retrieval. The results highlight the importance of assessing level of knowledge as a contributor to TOTs, as it appears that impairment of word retrieval may have meaningful links to knowledge rather than age entirely. During moments of TOTs participants were asked to identify the first letter of the word, with results showing that younger participants were able to correctly recall this phonological feature more often. The data indicated that TOTs occur when all phonological information is not available for complete activation of recalling a word.

Semantic and Phonological Access

Other studies have also found that naming failures can be attributed to an impairment in accessing the phonological form of the word (Barresi et al., 2000; Evrard, 2002). Baressi et al. found that older adults benefited from phonemic cues, suggesting that semantic knowledge was intact. However the researchers also noted that for older adults in their 70's and 80's, phonemic cues were not as facilitating. To gain better understanding of the difference in semantic versus phonological failure they looked at consistency of naming errors across multiple sessions. In doing so they presumed that consistent

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naming errors across sessions were indicative of a loss of semantic knowledge for that item (semantic degradation). In contrast, inconsistent naming errors implied that there was impaired access to the phonological form of the word. According to the semantic degradation hypothesis, word meaning and conceptual knowledge of a particular target may be weakly represented or interconnected. Therefore, the subjects would not benefit from phonological cues. Barresi, et al.'s data of inconsistent naming errors supported the widely accepted notion that naming failures among normal elderly individuals are most often attributed to impaired access to the phonological representation of the word form. However, by examining consistent naming error data, their results also suggested that semantic degradation contributed to object-naming failures in the oldest group of adults compared to the two younger age groups.

Based on previous research in this area, the present study investigated the relationship between normal aging and access to the semantic and phonological systems during word retrieval. Furthermore, it was hypothesized that there would be an age related decline in phonological skills, which could account for the impaired access to the phonological system during word retrieval. It was also hypothesized that semantic skills would show no age related decline, reflecting crystallized intelligence. Regardless of age, it was hypothesized that a richer phonological system would result in better word retrieval skills.

Complexity of the Word Retrieval System

A widely known and accepted hypothesis that examines the neurological basis for impaired word retrieval is called The Transmission Deficit Model, created by Burke and Shafto (2004). It postulates three factors that weaken connections of word retrieval in the normal brain: Aging, lack of recent activation of representations, and/or lack of frequent activation of representations. In this model, activation of the spoken/written word form fails because aging has caused connections among phonological representations to weaken, thus reducing the transmission of excited synapses. According to

the model, activating a word frequently or recently should offset age related deficits. However, in normal aging the weakened connections among the lexical system commonly result in the failure to retrieve words.

A number of studies have shown that older adults make more errors in naming pictures than young adults (Feyereisen, 1997, Nicholas, Obler, Albert, & Goodglass, 1985). Older adults also have been found to have more ambiguous references and filler words as they reformulate thoughts during discourse, suggesting that they have difficulty retrieving words during connected speech (Burke & Shafto, 2004; Heller & Dobbs, 1993). Multiple studies have also found that older adults experience more TOTs than young adults in everyday life (Burke, MacKay, Worthley, & Wade, 1991; Heine, Ober, & Shenaut, 1999). From a neurocognitive standpoint, a TOT is a remarkably complex phenomenon as researchers have delved into the vast network of interconnected nodes organized in semantic and phonological systems to postulate why word retrieval errors occur. Figure 1 from Burke & Shafto (2004) represents the complexity of the semantic and phonological systems as they relate to word retrieval.
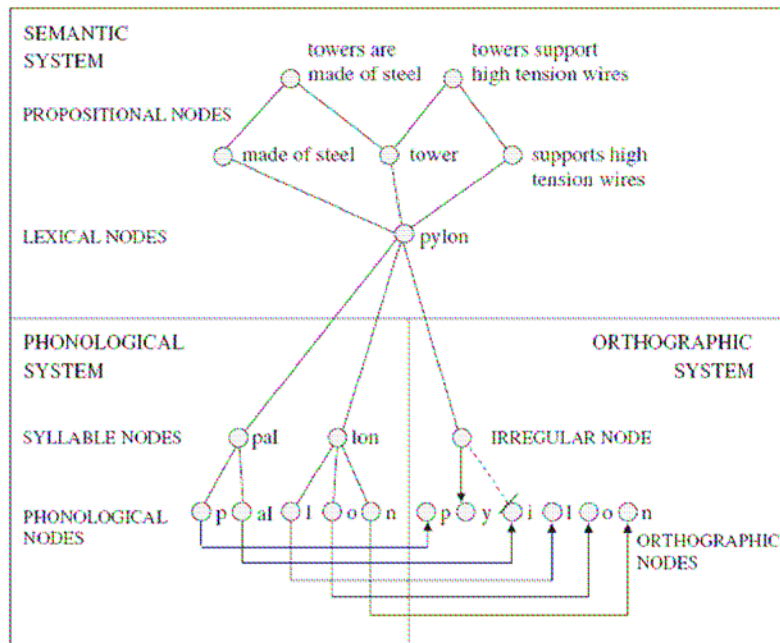

Figure 1. Semantic and Phonological Systems (Burke & Shafto, 2004).

During speech, word production begins with activation of semantic representations and transmissions of excitation to lexical representation of words (Burke & Shafto, 2004). To activate these semantic representations, one must access the semantic memory system, a hierarchically organized network of concepts representing objects, facts, words, meanings, and relationships. An intact semantic memory system is vital for accurate identification and naming (Hough, 2004). However, most research regarding word retrieval has determined that age-related retrieval failures are more prevalent for phonological information than semantic information (Dahlgren, 1998; Taylor & Burke, 2002; O'Hanlon, Kemper, & Wilcox, 2005). This occurrence is based on the knowledge that the architecture of the phonological system is more vulnerable to transmission deficits than the semantic system because the phonological system relies on one-to-one connections. As shown in Figure 1, the semantic system relies on highly interconnected relationships, so deficits in one connection are offset by other connections to the same feature (Burke & Shafto, 2004). Therefore, accessing an intact phonological system is ultimately responsible for the accurate production of a word.

Other studies attempting to determine where the break down occurs in word retrieval have found that the degradation of the semantic memory system and impaired access to the phonology of the word are both part of the problem (Baressi, et. al, 2000; Evrard, 2002). The researchers postulate that connections between the semantic and phonological systems may be weakened, causing a word retrieval deficit. Proponents of the interaction between semantic and phonological levels rely on the findings that errors are often mixed between phonological and semantic influences, such as substituting "cabbage" for "carrot." Fay and Cutler (1997) found that errors made by normal speakers were most often syntactically and/or semantically related malapropisms. A malapropism is a word phonologically related to the target word. This further suggests that there is an interaction between lexical levels during retrieval, rather than a strictly sequential order to retrieving

words. Most research regarding the tip of the tongue phenomena (TOT) has determined that the "feeling of knowing" occurs because semantic memory has been accessed successfully, but a breakdown occurs before complete phonological access, caused by weakened phonological connections (O'Hanlon, Kemper, & Wilcox, 2005; Burke, MacKay, Worthley, & Wade, 1991).

<center>*Remediation of Deficits*</center>

As researchers have examined the semantic and phonological systems, some studies have specifically sought to determine how to improve word retrieval in the aging population. A principle termed *summation of priming* by Burke et. al. (2004) proposes that some memory networks can compensate for transmission deficits by allowing priming from several different semantic connections to converge on a critical piece of information for activation. However, when there are very few semantic connections, such as for proper names, the summation of priming can not alleviate the deficit. This model of thinking led researchers to hypothesize that an enriched semantic network will compensate for deficits by summation of priming, causing less word retrieval deficits. However results indicated otherwise. Dahlgren (1998) found that a greater level of knowledge/semantic memory led to a greater number of TOTs. This implied that the more semantic connections available, the less priming phonological nodes received. However it is unknown if this lack of priming is due to weakened connections from aging or the individual variability of semantic memory structures.

Some studies examined how enrichment of semantic or phonological information may facilitate word retrieval in older adults (Schwartz & Smith, 1997; White & Abrams, 2002). White and Abrams isolated specific syllables of a word and measured the effect of repetition of these syllables to help older adults retrieve a missing word. In doing so, they also attempted to outline a trajectory rate for the increase in transmission deficits across older age by dividing the experimental group into a young-old group (60-72 years) and old-old (73-83 years). They found that young and young-old adults were

significantly more able to resolve TOTs when presented with the first syllable of the word than the middle or ending syllables of the word. However, the old-old adults did not exhibit significant priming in TOT resolution when presented with any of the syllables. This suggests that the transmission deficits across old-old adults' connections were greater, making them less able to resolve TOTs. The study points out that phonological priming appears to have differential effects on word retrieval across age and further supports the theory that connections between nodes in the semantic and phonological systems weaken with increasing age.

The current study attempted to determine if a richer phonological system would allow for lessened problems with word retrieval. This varies from other studies in which cueing systems were utilized to determine if enriching phonological information may be helpful. During day to day living, cueing is not a viable option because conversation partners are often unaware of the word the individual is looking for. By determining if a strong phonological system will contribute to less word retrieval problems, a more applicable solution to anomia may be found. If the current hypothesis is validated, future studies may want to determine methods to enrich the phonological system through orthographic, phonemic, or phonological practice which may result in less difficulty with word retrieval.

Language rehabilitation specialists have used semantic and phonemic cues as tools to improve word finding abilities in adults and children with various language impairments. Multiple research studies have examined the effects of semantic versus phonemic cueing treatments for adults with brain-injuries, with many results indicating that both treatments result in improvement in word retrieval facilitation for many individuals (Wambaugh, 2003; Wambaugh, et. al., 2001; Kiran, 2007). Research examining the efficacy of the use of such cues as they relate to word retrieval for healthy adults is limited. One such study found that younger adults may benefit more from the support of semantic related information while older adults benefit more from phonological information during retrieval (Naveh-Benjamin, Craik,

& Shaul, 2002). By utilizing picture-word pairs with semantically related words, the researchers found that young adults were significantly more supported by cueing of semantic relationships during retrieval than older adults. Naveh-Benjamin et. al. (2002) reported that the performance of older adults' may be optimized by cognitive support during encoding and retrieval. There was a significant interaction between providing semantic cueing at the level of encoding and phonological cueing at the level of retrieval for optimal performance of older adults. This further suggests that word retrieval of older adults may be better remediated by strengthening phonological abilities.

However, most studies of word retrieval rely on cueing paradigms that are generated and guided by the examiner and participants are aware that cues are related to the target word. This changes the typical retrieval process where the participants may independently generate strategies during the retrieval process. Older adults are generally less able to utilize conscious recollection strategies (Light & LaVoie, 1993) for memory tasks and may do so less in day to day word retrieval. A more accurate depiction of typical word retrieval strategies may examine the independent use of strategies by subjects and call for less intrusive cueing by researchers. Information regarding strategy use in the present study was gleaned from subjects through self-reported strategies using a questionnaire. Subjects reported on incidence of word retrieval failures, strategy use, and impacts on communication. No known studies have addressed the preferences of adults for cues or strategies used during word retrieval.

Relationship of Executive Functions

The ability to use strategies effectively relies on the executive functioning of the cognitive system which is highly involved in word retrieval. To access the complex lexical system, executive functioning plays a crucial role. One must filter and sort targeted words that are grouped within similar categories, both semantically and phonologically. When a breakdown of word retrieval occurs, many individuals use strategies as they attempt to recall the word by relying on any available information related to the target word.

Previous studies have shown that older adults tend to use memory strategies to a lesser degree than young adults (Light & LaVoie, 1993; Naveh-Benjamin, Brav, & Levy, 2007)   However, when explicitly instructed to use an associative strategy by making associations in order to recall a word, older adults benefited more than young adults (Naveh-Benjamin, Brav, & Levy, 2007). This study also found that relational strategy use at both the level of encoding and at the level of retrieval is most beneficial for older adults. This indicates that older adults are less independently using strategies, however such strategies prove to be beneficial for the elderly when they are instructed to utilize them. An overall decline in the speed of mental processing is also associated with aging (Gordon-Salant & Fitzgibbons, 2001; Humes & Floyd, 2005). These impairments in executive functioning may further contribute to impaired word retrieval in older adults. Executive functioning is a part of the cognitive system that allows individuals to integrate past expereince with present action. It involves higher level cognitive processes such as planning, sequencing, organizing, strategizing, attending and sorting sensory input. The executive functioning deficits of older adults become especially evident in tasks relying on spontaneous use of strategies, time pressured tasks, or tasks relying on a rapid rate of stimulus presentation. The current study examined certain aspects of executive functioning across age by analyzing the frequency of strategy use by adults during word retrieval as well as the time needed to complete word retrieval tasks of confrontation naming.

Paraphasias

Past research has examined error types of individuals with aphasia by analyzing paraphasic type and circumlocution patterns. Paraphasias are errors in word production. They are classified as either verbal paraphasias, which are substitutions related semantically such as "ring" for "bracelet", or literal paraphasias, which are substitutions related phonemically such as "really" for "ready." When individuals are at a loss for a word, they will often attempt to repair the block by providing any available information about the target word, often being semantically or phonologically related. *Conduite*

d'approche is a term describing the tendency to make repeated attempts at a word but not necessarily getting closer to the target. When the brain is injured, the ability to use a semantic or phonological route to facilitate naming may be impaired. Roth, Nadeau, Hollingsworth, Cimino-Knight, and Heilman (2006) examined naming skills of an individual with a left side brain injury who consistently utilized a semantic *conduite d'approche* during spontaneous speech. Interestingly, when given phonemic cues, his naming was then characterized by a large number of phonemic paraphasias in an unsuccessful phonological *contuite d' approche*. In healthy individuals, the brain may attempt a similar constraining process when searching for a word. This manifests itself as semantic or phonological errors in word retrieval. Again pointing to the Transmission Deficit Hypothesis, this constraint for the elderly may occur as part of the phonological form of the word has been accessed, but not entirely. This is the basis for the current hypothesis that error types would more often be phonologically related than semantically. By examining error types, further investigation of the roles of the phonological and semantic systems was incorporated into the present study.

Statement of Purpose

The purpose of the current study was to examine the relationships among semantic, phonological, and executive systems involved in word retrieval. Understanding how semantic and phonological processing contribute to word retrieval allows us to better understand these cognitive systems as they relate to word retrieval deficits of healthy older adults. This study also helps to determine how the use of strategies relates to word retrieval as well as the impact word retrieval deficits have on communication across age. Since many studies have determined that word retrieval deficits in normal aging are attributed to impaired phonological access or weakened connections between semantic and phonological systems, it was hypothesized that older adults would perform worse than young adults on word retrieval tasks. It was also hypothesized that older adults would perform similarly to younger adults on semantic processing tests, but poorer on

phonological processing tests. By investigating the subjects' semantic and phonological knowledge, word retrieval was thoroughly examined to determine why some individuals experience more TOTs while others do not. Strength in phonological skills was expected to result in better word retrieval abilities. In addition, by examining the use of strategies and the length of time needed to complete the tasks, we may further understand how executive functioning contributes to the word finding difficulties of older adults.

CHAPTER II
Methods
Participants

This study included one group of 20 subjects, ages 18-84. The mean age of subjects was 47.65 years old with an even ratio of males to females. Subjects were residents of Ohio, recruited in the Southwest and Northeast areas of the state. Subjects were recruited by direct or indirect acquaintances of the examiner. Announcements were posted on the campus of Miami University and surrounding Oxford, OH area to recruit volunteers who wanted to participate in a study on word finding.   All participants met the study's inclusion criteria, which follows. The subjects' years of education ranged from 13 to 19 years of education with a mean of 16.5 years of education. Socioeconomic status was not a factor in the recruitment of subjects. As subjects were recruited a brief screening to determine that subjects met the criteria for inclusion followed. Subjects were also required to provide names of current medications taken and asked to schedule the meeting for testing at a time when medications would not interfere with cognitive tasks.

Inclusion and Exclusion Criteria

The inclusion criteria included:

1) Adults between the ages of 18-88 years of age
2) English as primary language

3) Negative history for each of the following: Neurological or psychiatric disorder, cognitive, or learning disabilities

4) High school degree or equivalent

5) Mini-Mental State Examination score of 25 or higher

Exclusion criteria for all subjects included the following:

1) A medical history positive for a neurological insult, disorder, organic brain disease or loss of consciousness

2) Known history of cognitive or learning disability

3) Inability to pass vision and hearing screenings

4) Speech or language disorder

5) English as a second language

Procedure

After determination of meeting inclusion/exclusion criteria, the participants then underwent a battery of tests related to word retrieval, semantic, and phonological processing abilities. All participants also filled out a questionnaire about word finding and strategies typically utilized for word finding. See Appendix 1 for questionnaire. The following are tests included within the experimental design.

Tests of semantic processing abilities:

1) Woodcock Johnson III Test of Achievement: Test 17, Reading Vocabulary (Woodcock, McGrew, & Mather, 2001)

2) Weschler Abbreviated Scale of Intelligence (WASI) Vocabulary subtest (Weschler, 1999).

3) Test of Adolescent/Adult Language-3 (TOAL-3) Subtest 1- Listening/Vocabulary (Hammill, Brown, Larsen, & Wiederholt, 1994)

Tests of phonological processing abilities:

1) Woodcock Johnson III Test of Achievement: Test 7, Spelling (Woodcock, McGrew, & Mather, 2001)

2) Woodcock Johnson III Test of Achievement: Test 13, Word Attack (Woodcock, McGrew, & Mather, 2001)

3) Woodcock Johnson III Test of Achievement: Test 20, Spelling of Sounds (Woodcock, McGrew, & Mather, 2001)

4) Woodcock Johnson III Test of Achievement: Test 21, Sound Awareness (Woodcock, McGrew, & Mather, 2001)

Tests of word retrieval:

1) Controlled Oral Word Association Test (COWAT) (Benton & Hamsher, 1978)

2) Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 1993)

3) Woodcock Johnson III Test of Achievement: Test 14, Picture Vocabulary (Woodcock, McGrew, & Mather, 2001)

Research Questions

1) Will subjects' performance on tests of word retrieval abilities display an age related decline?

2) Will scores on phonological processing tests show an age related decline?

3) Will subjects who perform well on phonological processing tests also perform well on word retrieval tests?

4) Which type of errors on confrontational naming tasks will occur more often: phonological or semantic?

5) Will older adults report less use of strategies and greater difficulty in "finding the word" with increasing age?

6) Will older adults require longer processing time than their younger counterparts in tests of word retrieval?

CHAPTER III

Results

Methodology

Testing was administered in three phases. Phase 1 involved completion of paperwork, word finding questionnaire (Appendix 1), and administration of the Mini Mental State Examination (MMSE). Phase 2 involved completion of the semantic and phonological processing tests. Phase 3 was comprised of the administration of word retrieval tests listed above. The order of testing was varied by alternating phase 2 and phase 3 tests. Each test of Phase 3 was timed to determine a rate of completion measured in seconds needed to complete the task. During Phase 3, all errors on confrontational naming tasks were recorded to examine any trends in error types. The unit of measurement for each included test was the total number of correct answers. Instructions were provided in the same manner for every client with no cueing allowed. Data from the semantic and phonological processing tests were analyzed to determine if any correlation to age or word retrieval abilities existed. Word finding tests were analyzed according to error types and rate of completion. The questionnaire examined personal preferences for word retrieval strategies and the impact of word finding deficits as they relate to age. Overall scores were analyzed for each subject separately and then used to generate data samples across a continuum of age using Person Product Correlation and paired T-Tests. An alpha level of .05 was used to determine significance for all statistical tests.

Analyses of Data by Hypothesis

Hypothesis 1: Performance on tests of word retrieval abilities will display an age related decline.

The scores of all word retrieval tests were examined with a trend analysis, Pearson Product Correlation test to determine the relationship

between age and word retrieval. Table 1 presents the means, standard deviations, and range of scores for included word retrieval tests. Figure 2 demonstrates the relationship between these word retrieval tests (y axis) and age (x axis).

Table 1

Descriptive Statistics of Word Retrieval Tests

Test	Mean	Standard Deviation	Min-Max
COWAT	45.95	12.40	18-64
BNT	55.10	2.594	50-59
WJ Picture Vocabulary	35.90	3.059	30-44
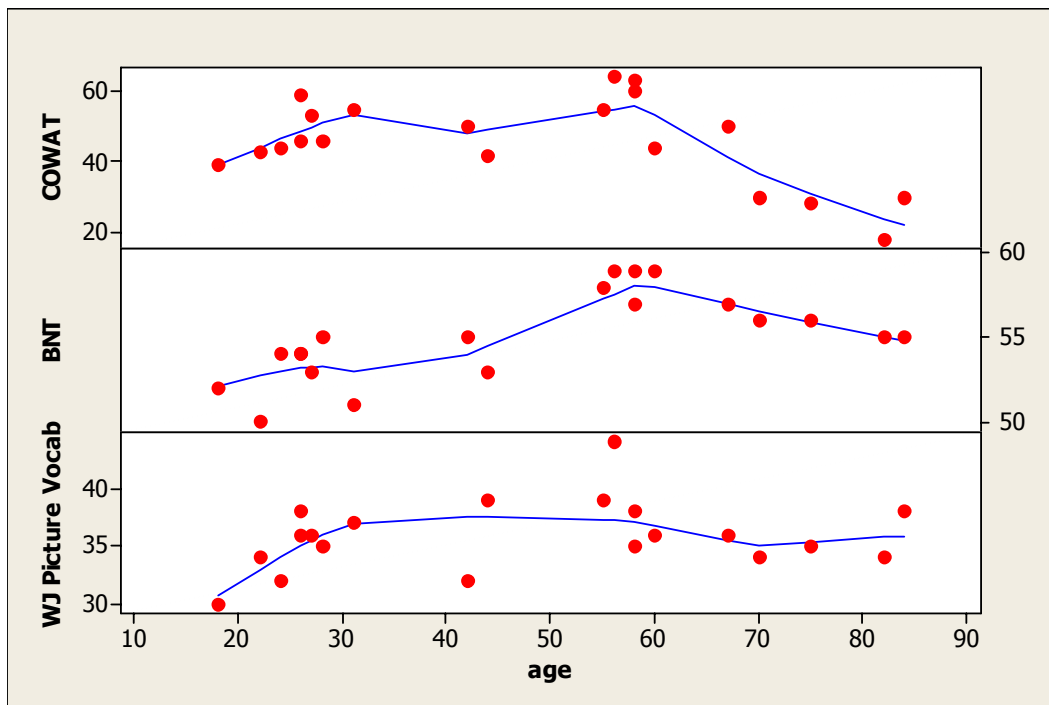
Figure 2. Word Retrieval Test Scores Across Age

Results showed a negative but not significantly strong relationship between age and Controlled Oral Word Association Test (COWAT) performance, r= -.406, p= -0.076. This effect was not found to be significant at the .05 alpha level. The COWAT is a word retrieval task in which subjects spontaneously produce common nouns beginning with a letter provided by the clinician. As Figure 2 displays, the COWAT performance seems to be stable during young adulthood and then decline after age 60.

There was a positive and significant relationship between age and scores on the Boston Naming Test (BNT), r=0.618, p= .004. This demonstrates an increase in scores on the BNT with increasing age. However, Figure 2 shows that this increasing trend with age peaks around age 60 at which time a downward trend is noted.

The Woodcock Johnson III Test of Achievement: Test 14 (WJ III ACH Test 14), a test of picture vocabulary, was included in this study. Similar to the BNT, this subtest assesses confrontational naming skills. However, performance on this test was not meaningfully related to age, r=0.261, p=0.266. Figure 2 shows that scores on the WJ III ACH Test 14 seem to climax during the third decade of life and then remain stable.

Hypothesis 2: Scores on semantic processing tests will not be affected by aging. However, scores on phonological processing tests will show an age related decline.

Examination of scores on the semantic and phonological processing tests centered on the relationship between semantic or phonological performance and aging. Test scores in each area were compiled for statistical analyses. Tests of semantic processing included the WJ III ACH Test 17-Reading Vocabulary, the WASI Vocabulary Subtest and the TOAL-3 Subtest 1-Listening/Vocabulary. Tests of phonological processing included WJ III ACH Test 7-Spelling, Test 13-Word Attack, Test 20-Spelling of Sounds, and Test 21-Sound Awareness. Table 2 displays the means, standard deviations, and ranges for the semantic and phonological processing tests included in the

study. It was hypothesized that phonological processing tests would show an age related decline. Semantic processing abilities were not expected to show an age related decline based on previous research that showed semantic knowledge not to be affected by aging (Dahlgren, 1998). A Pearson Product correlation coefficient revealed that there was no significant relationship found between age and semantic, r= 0.138, p= 0.561, or phonological, r= 0.264, p= 0.261, test scores as can be seen in Figure 3.

Table 2

Descriptive Statistics of Semantic and Phonological Tests

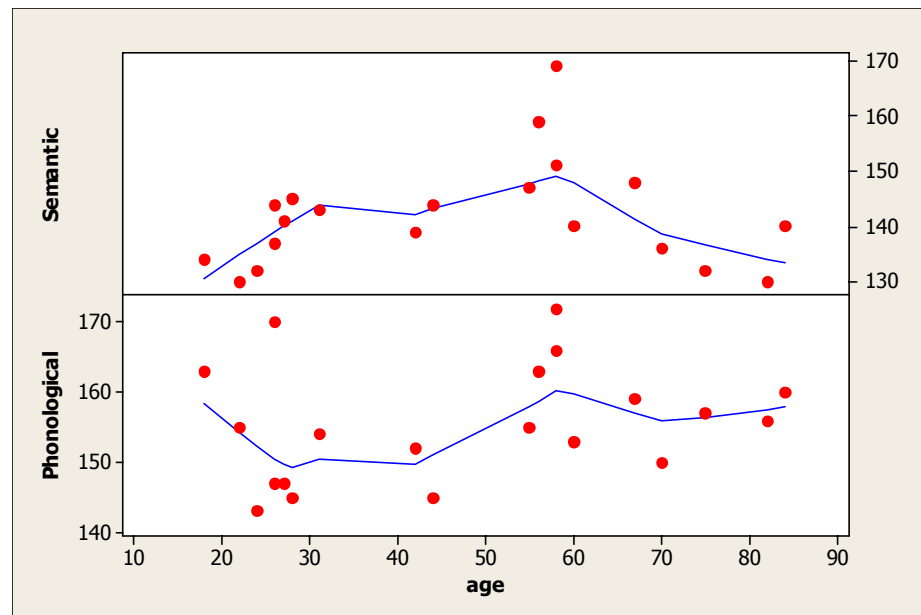| Test	Mean	Standard Deviation	Min-Max
Semantic	142.05	9.76	130-169
Phonological	155.60	8.31	143-172

Figure 3. Semantic and Phonological Test Scores in Relationship to Age

Hypothesis 3: Subjects who perform well on phonological processing tests will also perform well on word retrieval tests.

It was hypothesized that subjects who performed well on phonological processing tests would also perform well on word retrieval tests. Although there was a positive relationship between phonological skills and word retrieval abilities, the relationship was weak. Specifically, the correlation coefficient between phonological tests (WJ III ACH Tests 7, 13, 20, and 21) and the BNT was $r= 0.339$, $p=0.144$. The findings were similar for the COWAT, $r= 0.342$, $p= 0.140$, and the WJ III ACH Test 14-Picture Vocabulary, $r=0.259$, $p= 0.270$. Mean, Standard Deviation, and Range of scores can be seen in Table 2 for phonological tests and Table 1 for word retrieval tests.

Hypothesis 4: Errors on confrontational naming tasks will more often be phonologically related than semantically related, regardless of age.

A paired T-Test was used to compare the errors made on word retrieval tasks that required confrontational naming (BNT and WJ III ACH Test 14-Picture Vocabulary) to determine if errors would more often be phonologically related than semantically related, regardless of age. T-test analysis indicated that phonological errors were not more prevalent than semantic errors, $T=-7.29$, $p=1.0$. Table 3 portrays the means and standard deviations for semantic and phonological errors. The large difference in means between semantic and phonological errors is further discussed in the study.

Table 3
Semantic and Phonological Errors on Word Retrieval Tests

Errors	Mean	Standard Deviation
Semantic	5.65	3.083
Phonological	0.45	0.51

Hypothesis 5: Older adults will report less frequent use of strategies and greater difficulty in "finding the word" with increasing age.

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Using a questionnaire, self reported information about word retrieval strategies, impact of word retrieval on communication, and the frequency of difficulty retrieving words were obtained. It was postulated that as age increased, subjects would report a decrease in the frequency of strategy use as well as report lessened ability to successfully "find the word" during word retrieval. Upon data collection it was noted that all subjects reported that when they have difficulty finding a word they want to use during speech, they are usually eventually able to "find the word." Subjects were asked to rate how bothersome the occurrence of difficulty finding a word during speech is on a scale from 1 to 5 with 1 being "not bothersome" and 5 being "very bothersome." In general, subjects did not rate their word retrieval difficulties as bothersome on a scale 1 to 5. (M= 2.15, SD=1.18).

Adults across ages reported the use of retrieval strategies. Pearson Correlation Coefficient Analyses indicated that older adults reported less frequent use of strategies during word retrieval difficulty, r=-0.065, p= -0.002. Figure 4 shows that the reported decline in strategy use also begins a downward trend around age 60. This validates the hypothesis that older adults are using strategies less frequently and independently to enable word finding.
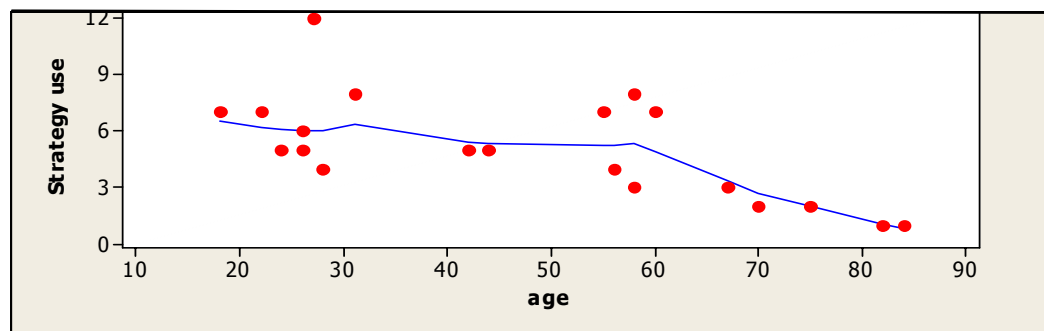

Figure 4. Reported Strategy Use during Word Retrieval

Regardless of age, the reported strategies utilized most frequently during moments when subjects are unable to find the word can be seen in

Table 4. The most commonly reported strategy utilized was telling conversational partners that they are unable to find the word.

Table 4

Most Commonly Reported Strategy Use

Strategy	Percentage of Reported Use
Tell conversation partner you can't find the word	80%
Pause	60%
Use a different, yet similar word	55%
Visualize the concept in your head	55%
Describe the word's meaning to conversation partner	50%
Perform a motion (tap finger, move feet, shake hand, etc)	45%

Subjects were asked to report how often they have difficulty finding a word they want to use during speech. There was great variability in the responses of how often subjects experienced word retrieval difficulty, as indicated by the descriptive analyses (M=29.60, SD=36.58, and range=149.00). Pearson Correlation Coefficient analyses found no significant relationship between age and frequency of reported word retrieval difficulty per month (r=0.193=, p= 0.414). This reflects that older adults did not report an increase in word retrieval difficulty with age. In general, subjects did not feel that the environment/situation influences word retrieval (M=1.75) or that the topic influences word retrieval (M=1.75). This information was determined on a five point scale with 1 being "no influence" and 5 being "great influence." Overall, subjects indicated that word retrieval difficulty does not pose a great impact on their ability to communicate with others (M=1.8, SD= 0.696, range=2.0) on a scale of 1 to 5 with 1 being "no impact" and 5 being a "great impact." Despite older adults failing to report an increase in occurrence of

word retrieval difficulty, a significant relationship between age and impact on communication was found (r=0.442, p=0.051). This demonstrates that as people age, word retrieval deficits become significant enough to impact communicative ability.

Hypothesis 6: Older adults will require longer processing time than their younger counterparts in tests of word retrieval.

It was also hypothesized that the length of time required to process information would increase as a function of age in tests of word retrieval. Processing time was measured in seconds needed to complete the confrontational naming tasks. The average time was calculated at 416.30 seconds (SD=117.20, Range=418.0). The relationship between age and processing time was moderate and significant (r=0.512, p=0.021, showing significance at the .05 alpha level. Figure 5 demonstrates the relationship between the length of time needed to complete word retrieval tasks in seconds (y axis) and age (x axis).
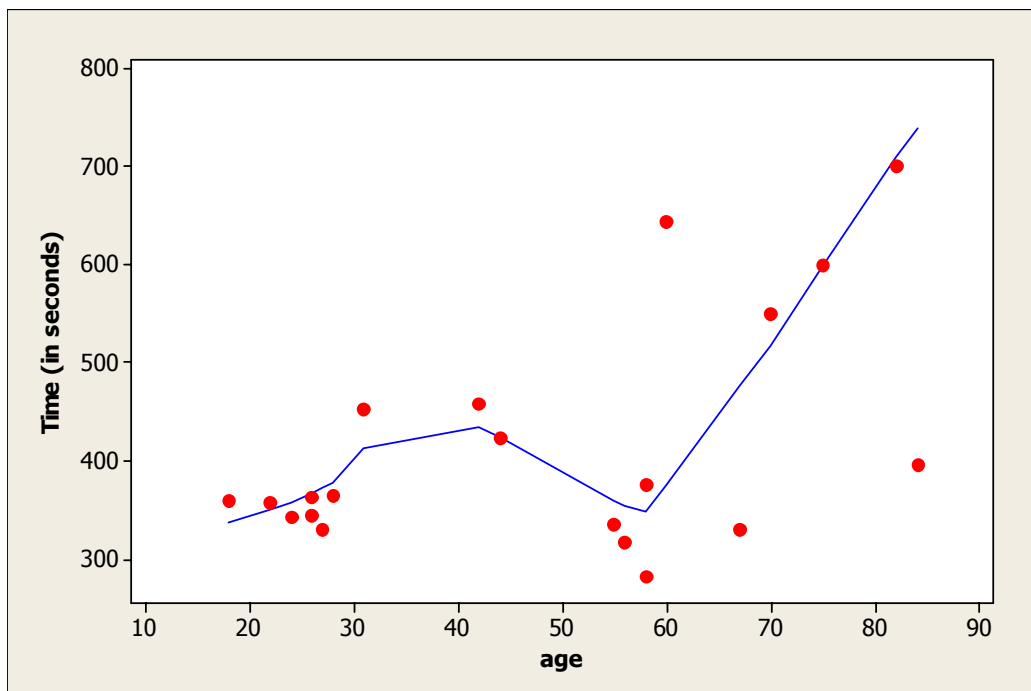

Figure 5. Time Needed to Complete Word Retrieval Tasks

CHAPTER IV

Discussion

Background

The present study investigated word retrieval abilities in adults. The findings support the notion that aging is associated with decline in some aspects of word retrieval. Specifically, the aging process was related with a decline in performance on timed tasks that require fast processing times such as verbal fluency (i.e., the COWAT) becoming especially observable after the age of 60. The increased processing time was also found during naming tasks such as the BNT and WJ III ACH Test 14-Picture Vocabulary. While those scores did not seem to decline as a function of age, older adults required significantly longer processing time for completion. The present findings are consistent with previous research (Barresi et.al., 2000, Burke & Shafto, 2004, Dahlgren, 1998). Barresi et. al. discussed the concept of Semantic Degradation in which word meaning and conceptual knowledge of a particular target may be weakly represented or interconnected. The current study demonstrated that word retrieval abilities may be impacted by the aging process primarily due to an increased length of time needed for processing and a decline in the active use of strategies during word retrieval. This may reflect the weakened connections within the lexical system as well as the decline in executive functioning skills with increasing age.

Interpretation of Results

Word Retrieval & Aging

It is important to highlight the difference between the types of word retrieval tasks in relationship to the results. The COWAT is a test of the spontaneous ability to generate words beginning with a provided letter in 60 seconds, where as the BNT and WJIII ACH Test 14 require subjects to generate words in confrontation to stimulus items. The main difference between these types of tasks is that the COWAT requires the incorporation of executive functioning skills such as self monitoring, organization, and speed.

This type of task may closer replicate spontaneous discourse than a confrontational naming task.

In the present study, performance on the BNT increased until around age 60. The positive relationship between age and scores on the BNT has also been found by other researchers (Scmitter-Edgecombe, Vesneski, & Jones, 2000). These results imply that vocabulary continues to increase with age and therefore one cannot dismiss the notion that the BNT may not be sensitive enough to demonstrate age related changes in word retrieval. The findings indicate that the major difficulty in picture naming with increasing age lies in the retrieval of the picture label rather than in semantic identification with the picture. Also, it is possible that certain test items are more familiar to older adults than younger adults. Consequently, the confrontational naming score was not affected by aging but rather older adults required longer processing time to generate the picture label.

Semantic and Phonological Knowledge during Aging

In the current study, subjects across ages performed similarly on the semantic and phonological processing tasks. The variability in performance suggest that a larger number of subjects would probably be needed in future studies to detect aging effects. In addition, perhaps the types of task used in the study were not demanding enough to adequately portray abilities. In the future, a more accurate method of measuring the relationship of semantic/phonological skills to aging would be to utilize a time series design. Future studies may also find it pertinent to control the level of education, rather than obtain subjects with a variety of years of education as the current study did, as this may have contributed to the variability observed in semantic and phonological abilities. However, it is likely that results of the present study support previous research indicating that during the aging process, knowledge is not lost but rather the ability to access such knowledge becomes more arduous, leading to difficulty in word retrieval. The results reflect crystallized intelligence in both verbal areas of semantics and phonology.

Phonological Skills and Retrieval

The study found a positive, yet not significant, relationship between phonological skills and word retrieval ability. Areas of phonological abilities that were assessed included a spelling test, a test of pronouncing non-real words, a spelling test of non-real words, and a sound awareness in which subjects were required to rhyme, blend, segment, delete and manipulate phonemes in various ways. During word retrieval, the phonological information needed for the word is accessed in a hierarchical manner within the lexical and phonological systems, at which time the sequence of sounds and/or letters must be recalled entirely for proper retrieval. It is plausible that this breakdown may occur at many stages during retrieval as word are accessed from various systems and categories based on meaning, function, descriptions, previous experience and details such as emotionally laden memories. As Burke and Shafto (2004) postulated in the Transmission Deficit Hypothesis, infrequent and or lack of recent access to certain words may cause retrieval to be more difficult. Having a solid foundation of phonological ability may not transfer to phonological retrieval. This may reflect previous research speculating that impaired retrieval is caused by weakened phonological *connections* (O'Hanlon, Kemper, & Wilcox, 2005; Burke, MacKay, Worthley, & Wade, 1991) rather than weakened available phonological *information*. It may also indicate that phonological abilities in general do not impact word retrieval.

Types of errors: Semantic or Phonological

During confrontational naming tasks, subjects made a significant higher amount of semantic errors than phonological errors. This result could be due to the fact that many semantic errors may have occurred because the subjects did not actually know the answer and just guessed. Semantic errors are more likely to occur when the subject is unfamiliar with a stimulus item. The study did not substantially differentiate between an error versus an uncertain answer provided by the subject, which may have affected overall error reporting. Also, the greater number of semantic errors in comparison to

phonological errors may indicate that normal aging adults' word retrieval errors occur due to difficulty retrieving words from the semantic network differently in discourse tasks than in naming tasks.

Self-reports of strategy use and impact on communication

The present study utilized a self-reported questionnaire to obtain information regarding word retrieval strategies. Adults reported using strategies less frequently as a function of age. This is in agreement with previous research that found older adults are generally less able to utilize conscious recollection strategies (Light & LaVoie, 1993). The use of strategies is associated with good executive functioning abilities. A decline in executive functioning and speed of processing has been associated with normal aging in the present study and in other research (Salant & Fitzgibbons, 2001, Schum & Sivan, 1997). The present study reflects that older adults struggle with processing information quickly which may manifest itself as a communication breakdown due to word retrieval difficulty. Once the breakdown occurs, older adults seem to use less strategies to work through the breakdown. It is also interesting to note (Figure 5) that the older adults have a high degree of variability in the length of time needed to complete word retrieval tasks. This reflects the individual variability that may reflect certain lifestyle or educational pursuits.

Implications and Limitations

Overall results of this study reflect the importance of executive functioning in relationship to word retrieval. Less independent use of strategies and longer processing time needed may partly explain why word retrieval difficulty seems to greatly impact verbal abilities during the aging process. The conscious use of strategies to facilitate word retrieval may alleviate some of the difficulty older adults experience and reduce the length of time needed to retrieve words, therefore reducing the impact on conversational speech. Further research regarding what facilitating strategies can be used effectively during word retrieval may be beneficial. It may also be beneficial to more closely examine certain lifestyle or educational endeavors

that may be related to improved word retrieval in older adults. The study indicated that word retrieval difficulty may not be adequately portrayed by confrontational naming tasks and should be studied using more spontaneous stimuli where subjects must come up with answers from memory or in verbal fluency tasks rather than in response to naming tasks. Examination of discourse tasks allow for a more natural and spontaneous language sample and therefore may also demonstrate reported word retrieval difficulties more sufficiently. For instance the use of semi-structured tasks such as picture description may allow for the assessment of TOT as well as the types of words that are being generated by older adults.

Other limitations of the current study include a small number of subjects as well as the variability in educational levels of subjects. Subjects were recruited by contacts of the examiner which may have limited the selection, as race and socioeconomic status were similar for all subjects. These factors may have impacted findings by not demonstrating adequate power in analyzing data.

Despite the involvement of semantic and phonological networks in word retrieval, the study was not able to determine a relationship between these abilities to word retrieval. It is possible that the types of tasks used were not sensitive enough. Future studies may want to examine semantic and phonological abilities to word retrieval in conversational discourse. It may also be important to study semantic and phonological *organization* and *access* rather than *knowledge* in general. By understanding how individuals store and access words from the semantic memory system, a more conclusive representation of word retrieval may be obtained. Future studies may want to examine semantic mapping tasks where individuals produce webs of related concepts. Making word associations and categorization tasks may also reflect how individuals integrate and retrieve concepts within the memory system. Phonological access may also be further examined by designing tasks similar to the COWAT where a letter is provided and subjects produce words fluently in response. However, using a variety of sounds and syllables as prompts

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may further reflect how phonological information is accessed. Studies may also want to use the Transmission Deficit Hypothesis to offset age related deficits by implementing more frequent and recent activation of a variety of words. In conclusion, the findings of this study reinforce the notion that as normal aging occurs it is not a loss of knowledge experienced, but rather the ability to readily access such knowledge that diminishes. The study also displays the conspicuous influence executive functioning has on word retrieval during aging demonstrated by decreased strategy use and longer processing time needed.

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APPENDICES

Appendix A

WORD FINDING QUESTIONNAIRE   Subject ID
                                                #_____
                                                _

Age___   Gender___

1. Approximately how often do you have difficulty finding a word you
   want to use during speech?

   __ times per day

   __ times per week

   __ times per month

2. On a scale of 1 to 5, how bothersome is this occurrence?

   1   2   3   4   5

   Not bothersome   Very
   bothersome

3. When this occurs, are you usually able to eventually find the word?

   YES   NO

4. Please check anything that applies from the list below during the
   moment you are unable to find the word:

   ___ Use a different, yet similar word

   ___ Use a different, unrelated word

   ___ Think about the sounds or letters of the word

   ___ Visualize the concept in your head

   ___ Tell your conversation partner that you can't find the word

___ Keep talking about the current subject and assume it will come later

___ Change the subject

___ Perform a motion (tap fingers, move feet, shake hand, etc)

___ Describe the word's meaning to your conversation partner

___ Go through the alphabet and search for the first sound of the word

___ Pause

___ Use filler words such as "um, uh, etc"

5. Of the above strategies, please circle the three that you most often do when unable to find a word.

6. On a scale of 1 to 5 how does this occurrence impact your ability to communicate with others?

    1   2   3   4   5

    No impact   Great impact

7. On a scale of 1 to 5 how does the environment or situation seem to influence how much this happens?

    1   2   3   4   5

    No influence   Great influence

8. On a scale of 1 to 5 how does the topic seem to influence how much this happens?

    1   2   3   4   5

    No influence   Great influence

Consent Form

I.   Information for Subjects
        Before agreeing to participate in this study, it is important that
        the following information be read and understood. The following
        form describes the purpose, procedures, time commitment, risks
        or discomforts, benefits, and confidentiality of records involved
        in this study.
    a. Description of the Research

I, _____ agree to participate in a research study
of which the purpose is to examine word retrieval abilities in
neurologically normal adult volunteers. This study will be conducted by
Lynne Christofaris, a graduate student in the Department of Speech
Pathology and Audiology at Miami University.

    b. Research Procedures

I understand that I will participate in approximately two to three hours
of testing during one session. During this study, I will be asked to
complete tests of my verbal abilities such as vocabulary, word
sounds/spellings, general knowledge, and word retrieval. Parts of the
session will be recorded to ensure proper scoring. I understand that
the recordings will be erased following the data recording.

    c. Time required for participation

I understand that participation in this study consists of one meeting
with the researcher. The duration of the meeting will be approximately
120 to 180 minutes. Two 10 minute breaks will be included in the
session.

    d. Risks

Some testing tasks may be difficult. Poor performance does not
indicate any cause of concern as people perform differently on a wide
range of various tasks.

    e. Benefits

All subjects will examine their own use of strategies for word retrieval using a questionnaire. Subjects will also be exposed to cueing techniques commonly used to repair a word finding deficit. This study will contribute to scientific literature as it will help us understand more about how semantic and phonological knowledge contribute to word retrieval abilities. It will also provide more information about cognition during normal aging.

f.   Alternative treatments-Not applicable
g.   Confidentiality

The records of this investigation shall be treated as confidential. I understand that my name will not be associated with the test results, unless I request in writing that my results by shared with my physician or others associated with my care.

h.   Voluntary Participation

Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitles. I am free to discontinue participation at any time without penalty or loss of benefits to which I am otherwise entitled.

i.   Questions About the Study

Any questions that I may have concerning any aspect of this investigation will be answered by the researcher, Lynne Christofaris, who can be contacted by phone (216-973-0575_ or by email at christld@muohio.edu.

j.   Rights of Participants

I also understand that I may call or email the Office for the Advancement of Research and Scholarship by phone (513-529-3734) or by email at humansubjects@muohio.edu for questions I may have about my rights as a subject.

k.   Compensation for Injury- Not applicable
Thank you for your participation. We are very grateful for your help and hope that your involvement will be a worthwhile experience for you.
- -
2. Consent Documentation
I, the undersigned, have read and understood the above explanation and have given consent to my voluntary participation in the study "Semantic and Phonological Relationships to Word Retrieval During Aging."

_____
Subject Signature

_____
Date

_____
Investigator Signature

_____
Date