MENTAL IMAGERY AND IDIOM UNDERSTANDING IN ADULTS: EXAMINING DUAL CODING THEORY

by

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This study examined idiom understanding in 120 neurologically healthy adults, ages 20-29 (20s Group), 40-49 (40s Group), 60-69 (60s Group), and 80-89 (80s Group) years old. Each participant was administered a familiarity task, definition explanation task, mental imagery task, and forced-choice comprehension task. Twenty idioms, 10 transparent and 10 opaque, were used with no supporting contexts. Participants were asked to rate the familiarity of each idiom, to provide a definition of each, to generate a mental image of each, and to select the best definition of each from among four options. It was predicted that younger and older adults would perform equally well on the comprehension task but that older adults would perform poorer than younger adults on the explanation task. Additionally, mental imagery of idioms was expected to become more figurative with

advancing age, and participants were expected to perform better on highly familiar and transparent idioms than on less familiar and opaque ones.

Participants rated all 20 idioms as highly familiar, with the lowest familiarity rating for participants in the 20s Group. No significant differences were found on the forced-choice comprehension task across the four age groups although the 20s Group scored the lowest among all age groups. The 60s Group performed significantly better than the 20s Group on the definition explanation task, but no significant differences were found between the other age groups. No significant differences were found in generating mental images between transparent and opaque idioms, and mental images tended to be figurative rather than literal for both types of idioms.

The present study adds to our knowledge of idiom understanding across adulthood. Familiarity seemed to play a stronger role than transparency in idiom understanding in adults. Once an idiom was learned and stored as a lexical unit, people used the idiomatic meaning and generated figurative mental imagery immediately without accessing the literal meaning or the literal mental image.

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CHAPTER I

BACKGROUND AND INTRODUCTION

Figurative language uses "figures of speech," a way of saying something other than the literal meaning of the words, to express people's underlying goals and intentions. Figures of speech includes proverbs (Silence is golden, All roads lead to Rome), idioms (turn back the clock, skate on thin ice), similes (Jamie runs as fast as the wind) and metaphors (Life is a rollercoaster, Friends are a shadow). What makes figurative language special is that communicators need to not only understand the meaning of the phrase but also recognize the implied meaning of the phrase. People use different types of figurative language to achieve different goals. For example, people frequently use irony to guide another's action or to protect the self, and use idioms to be humorous and to clarify something (Roberts & Kreuz, 1994). Kempler, Van Lancker, and Read (1988) suggested that abstract verbal reasoning, concept formation, and quality of thinking are critical in figurative language processing since it is commonly used to express abstract concepts in a concise and concrete manner (Zempleni, Haverkort, Renken, & Stowe, 2007). Therefore, understanding the abstract and figurative meanings of words is an important way to appreciate everyday speech (Bottini, Corcoran, Sterzi, Paulesu, Schenone, Scarpa, Frackowiak, & Frith, 1994).

Among different types of figurative language, idioms are one of the most common forms of figurative language that are frequent in everyday language and are prevalent with diverse forms across languages (Bortfeld, 2002). Use of idioms can be seen in everyday speech. For example, someone might say "put your foot down" to encourage you to be decisive without hesitation, or people often say "it is a piece of cake" to emphasize how easy the job is. Idioms contain conventional meaning and are easily recognized because of their unique linguistic features and ample exposure in daily life. Although idioms vary on syntactically flexibility, decompositionality, transparency, and familiarity, given that arbitrary link between idioms and their figurative meanings, idioms are viewed as frozen phrases that act like mental lexicons or giant lexical units (Nippold, 2007). Therefore, understanding idioms requires holistic understanding of not only literal but also figurative interpretations (Nippold & Duthie, 2003), which makes idiom comprehension complicated and not always precise and clear.

Since the underlying meaning of figurative expressions is not understood like regular phrases, the question how young people acquire figurative competence is worth further exploration. Kempler and Van Lancker (1993) used The Familiar and Novel Language Comprehension (FANL-C) protocol to test the acquisition of familiar language such as proverbs and idioms on participants, age 3 to 18 years. They found that participants as young as eight years old comprehended novel sentences, such as "He's racing a truck against a horse" at adult level; however, not until 12 years of age for familiar phrases, such as "Rome wasn't built in one day" or "That's enough to drive a man to drink." Gibbs (1987) proposed that around the ages of eight or nine, children

consistently view idiomatic expressions as having figurative meanings. Furthermore, Kempler and colleagues (Kempler, Van Lancker, Marchman, & Bates, 1999) indicated that the comprehension of idiomatic and literal meaning followed two different developmental paths with literal interpretations developing faster and reaching adult level around age nine or 10 years, but idiomatic interpretations reaching adult levels not until the age of 15 years old. Young children were able to understand idioms literally during early childhood (Abkarian, Jones, & West, 1992), but the understanding becomes more figurative during the school-age and adolescent years with growing exposure to idioms, language experience, and world knowledge (Nippold & Rudzinski, 1993). Therefore, it was evident that literal meanings of idioms were acquired earlier than idiomatic meanings. Although idiom comprehension was expected to improve throughout the school-age years and well into the adulthood, even adults did not master all the idioms used in the study (Nippold & Duthie, 2003).

How idioms are processed is complicated and controversial. Common suggestions of idiom comprehension are literal meaning constructed first (Bobrow & Bell, 1973), idiomatic meaning established first (Gibbs, 1980), or both meanings activated simultaneously (Swinney & Cutler, 1979). Four hypotheses are generated according to the common suggestions of idiom comprehension. The idiom list hypothesis (Bobrow & Bell, 1973) claims that idioms are listed separately in memory. When people are not able to generate the meaning based on its grammatical analysis, people then look up the idiom list to find the correct interpretation. Different from the idiom list hypothesis, the lexical representation hypothesis (Swinney & Cutler, 1979) suggests that both literal and

idiomatic meanings are activated simultaneously, and it views idioms as long words that are stored and accessed like words. The third assumption, the configurational hypothesis (Cacciari & Tabossi, 1988), propose that both figurative and literal interpretations are processed in parallel, but people have to recognize the configuration of the idioms first through the *idiomatic key*, the point that figurative meaning emerged. Finally, the direct access hypothesis (Gibbs, 1980) states that people recognize the idiomatic meanings directly without accessing literal interpretations.

Idioms vary widely in difficulty depending on *familiarity*, a measure of how frequency an expression occurs in the language, *transparency*, a measure of the degree of correlation between its literal and nonliteral meanings of an idiom (Nippold & Tylor, 2002), and *decompositionality*, a measure of the degree of generating the meaning from each individual word of an idiom. Familiar idioms were reported to be better recalled (Schweigert, 1991), read faster (Cronk & Schweigert, 1992), and comprehended more easily (Nippold & Taylor, 2002) than less familiar idioms. Schweigert (1986) also suggested that the familiarity of the idiom needed to be taken into account in the models of idiom processing since it might play an important role in inconsistent results (Cronk & Schweigert, 1992; Schweigert, 1991). Nippold and Rudzinski (1993) conducted a developmental study to explore the effect of familiarity and transparency in idiom explanation. They pointed out that familiarity and transparency were tightly related to the wide differences in difficulty of individual idioms for both school-age children and adolescents. In addition, exposure and active analysis contributed to the learning of

figurative meanings of idioms, and opaque idioms were learned in a more holistic way while analyzing strategies were commonly used in learning transparent idioms.

Because of the wide variability among idioms, results from idiom comprehension studies were often inconclusive due to the types of idioms used in the study, different measurements utilized in idiom comprehension, the amount and the type of context that the idioms embedded in, and the focus of study tapping on different levels of process. Therefore, how to access the idiom comprehension process through a deep understanding method and how to establish the behavioral evidence of developing the figurative meaning of an idiom are challenging. Gibbs and O'Brien (1990) proposed that the active role of conceptual metaphors strengthened the link between idioms and their nonliteral meanings in idiom comprehension. Additionally, researchers believed that conceptual metaphors facilitated what the proverbs or idioms really meant according to the high consistency of people's mental imagery (Bortfeld, 2002; Gibbs, Strom, & Spivey-Knowlton, 1997). Gibbs and O'Brien (1990) pointed out that the best way to reveal tacit knowledge of idioms is through a detailed examination of people's mental images of the expressions. Nippold and Duthie (2003) also suggested that mental imagery may serve as an indicator of deep understanding of figurative meanings in idiom comprehension. Therefore, exploring mental images may be an excellent way to understand the underlying mechanism in the idiom comprehension process.

According to the dual coding theory (Pavio, 1971, 1986), there are two independent but interconnected systems, the verbal and imaginal system, attributed to the different retrieval effects between concrete and abstract words. A concrete concept is

better recalled and retained than an abstract concept because the concrete concept could be encoded both verbally and nonverbally, which results in the concreteness effect. Several behavioral studies (Sadoski, 1995; Sadoski, Goetz, & Fritz, 1993; Sadoski, Goetz, & Rodriguez, 2000; Sabsevitz, Meddler, Seidenberg, & Binder, 2005) and neuroimaging studies (Jessen, Heun, Erb, Granath, Klose, Papassotiropoulos, & Grodd, 2000; Kounios & Holcomb, 1994; Nittono, Suehiro, & Hori, 2002; Sabsevitz, Meddler, Seidenberg, & Binder, 2005; Swaab, Baynes, & Knight, 2002; West & Holcomb, 2000) showed that advantage existed in processing concrete words and concrete information in comparison to abstract information. In addition, the processing of abstract concept is left-lateralized and the processing of concrete concepts is bilateral. The dual coding theory suggests that the additional creation of mental imagery helps people comprehend and remember the concrete information; therefore, the activation of the imaginal system facilitates concrete language and information processing in the brain. Since the transparency of the idiom was one of the main factors in idiom comprehension and a key variable in the present study, it was important to explore the role of mental imagery in comprehending transparent and opaque idioms. Therefore, this study intended to examine if the dual coding theory is applicable to idiom comprehension and if the concreteness effect exists in the process of transparent idioms. In addition, examining the dual coding theory in idiom comprehension may add knowledge in understanding the relationship between mental imagery and figurative language.

Different from developmental studies in children and clinical studies in adults with language and cognitive impairments, the present study focused on idiom

comprehension in adults across the lifespan. Language performance in normal aging populations is rarely studied and has received less attention in comparison to adults with dementia, Alzheimer's disease, or cognitive impairments. However, some studies showed that both language production and comprehension declined with advancing age due to decrement in processing speed, working memory, and inhibitory efficiency (Burke, 1997; Carpenter, Miyake, & Just, 1994; Gunter, Jackson, & Mulder, 1995; KwongSee & Ryan, 1995; Waters & Caplan, 2005). In addition, difficulties in naming, reduced syntactic complexity, and decrement in verbal fluency are commonly observed during the age of 70 years old (Ardila & Rosselli, 1996), and word finding/lexical retrieval difficulties, tip of the tongue (TOT), disfluency in speech, and ambiguous references were reported to be common deterioration observed in elder's language production (Burke & MacKay, 1997). Several studies showed that older adults tended to produce less complex sentences compared to younger people (Kemper, Greiner, Marquis, Prenovost, & Mitzner, 2001; Kemper, Herman, & Lian, 2003; Kemper, Herman, & Liu, 2004) and seniors tended to use simpler grammatical forms to avoid imposing high memory demand (Kynette & Kemper, 1986)

Language comprehension, similar to language production, also showed declines with advancing age. Cohen (1979) reported that elders maintained surface comprehension but had deficits in language comprehension involving integration, inference, and construction. Additionally, normal aging affected comprehension of complex sentences, and the decline began after 60 years of age (Davis & Ball, 1989; Feier & Gerstman, 1980; Obler et al., 1991). Although the difficulties revealed in each study depending on the

tasks that researchers used to assess the performance (Glosser & Deser, 1992), most of complex linguistic abilities were affected by deterioration in attention mechanism of the working memory system and an increasing lack of inhibition capacity, a disturbance in the cerebral activity which activated multiple cortex areas during the complex tasks (Juncos-Rabadan & Iglesias, 1994; Kemper, Herman, & Liu, 2004). Generally speaking, in language production and comprehension, the greater the linguistic complexity, the more difficulty in language processing was found in normal older people (Emery, 1986). However, education (Ardila & Rosselli, 1996; Harris, Rogers, & Qualls, 1998; Juncos-Rabadan & Iglesias, 1994; Juncos-Rabadan, 1996; Mackenzie, 2000), gender (Ardila & Rosselli, 1996), verbal ability (Harris et al., 1998; Petros, Norgaard, Olson, & Tabor, 1989), and other factors, such a the influence of text genre (Harris et al., 1998; Petros et al., 1989), should be taken into account while studying language performance in normal aging populations, since these variables were reported to be strongly correlated to the language performance in older people.

Studies on how figurative language was processed in normal older people showed inconclusive results. Obler and Albert (1989) found no changes in metalinguistic tasks such as interpretation of proverbs and idioms in normal older people; however, proverb explanation showed slightly decline over 60 years of age and the decline reached significance around age of 70 in the Nippold, Uhden, and Schwarz study (1997). Metaphor interpretation performance was also found to be well maintained through the later adult years (Szuchman & Erber, 1990) although plausible executive function impairment was found to be related to the proverb comprehension deficits in normal

elderly in the study of Uekeermann, Thoma, and Daum (2008). Examining language abilities in normal aging populations was challenging because of different variables, such as education and verbal ability existing in individuals, different tasks, and types of figurative language tapping different cognitive and linguistic functions (Qualls & Harris, 2003). However, figurative language provided a functional and natural way to examine language performance, which may be more sensitive and reliable than standardized tests.

Figurative language is substantial in all language and is essential to everyday communication (Qualls & Harris, 2003); however, it is rarely studied and has received less attention in comparison with other aspects of language. Given that figurative language is less studied and rarely examined in normal aging populations, it is necessary to have ground knowledge of idiom processing in adults across the lifespan. Studies showed that language performance, both production and comprehension, declined with advancing age due to decrement in cognition and linguistic processing (KwongSee & Ryan, 1995; Waters & Caplan, 2005). However, with the growing population with dementia and Alzheimer's disease, the understanding of language performance in the normal aging population is relatively limited. In addition, standardized language tests may not be sensitive enough to distinguish language decline that results from normal aging or mild cognitive impairment, such as the early-stage dementia. Therefore, the purpose of conducting the current study was to explore idiom understanding in four age groups of adults by examining their explanation of idioms, the mental images they had while encountering idioms, and their comprehension of idioms using a multiple-choice task. This study was expected to provide normative data on idiom comprehension in

neurologically normal adults and elderly, which would be valuable and useful for clinicians to evaluate possible language deterioration with a more functional and practical approach. Additionally, both explanation and comprehension were examined in the present study to obtain a comprehensive understanding of how idioms were processed in adults across the lifespan.

Purpose of the Present Study

Given the need for research evidence in idiom comprehension in adults across the lifespan, the present study was designed to extend the study of Nippold and Duthie (2003). In their study, they examined the use of mental imagery in idiom comprehension in school-age children and 40 neurologically normal adults. Similar to their study, the present study also examined the relationship between idiom comprehension and mental imagery in understanding of transparent and opaque idioms. The results of the Nippold and Duthie study (2003) showed that transparent idioms were easier understood than opaque ones, and mental imagery was associated with the comprehension of both transparent and opaque idioms for both school-age children and adults. One recent study by Qualls and Harris (2003) examined idiom comprehension in normal elders. They examined the comprehension of different types of figurative language, including idioms, metaphors, and metonyms, with the possible effect of age, working memory, and reading ability. No age-related decline was found in figurative language comprehension in older adults in their study when a selection of response choices was provided. In addition, older adults performed better on idioms than metaphors and metonyms with the greatest

difficulty in metonyms. However, Qualls and Harris (2003) only used a force-choice task to test idiom comprehension and did not examine the effect of familiarity and transparency in idiom comprehension.

This study intended to include the effect of familiarity and transparency that are essential in idiom comprehension process and to examine idiom comprehension through different types of tasks -- explanations, mental imagery, and multiple choices -- in order to provide a more comprehensive understanding of idiom comprehension in the normal aging populations. Figurative language, especially idioms, was rarely studied in neurologically normal elderly. The results of proverb understanding in aging populations showed that proverb explanation reached peak around the age 20s and remained stable during the age 30s, 40s, and 50s, but slightly declined in the age 60s and the decline reached significant around the age 70s (Nippold, Uhden, & Schwarz, 1997). In addition, the Uekeermann, Thoma, and Daum study (2008) indicated that older people had impaired proverb comprehension and tended to choose literal meanings rather than figurative ones. Therefore, whether idiom comprehension declined like proverb comprehension with advancing age or it remained intact as suggested by Qualls and Harris (2003) was worth further study.

The purposes and rationales of the present study can be summarized as follows:

1. Figurative language is substantial in all language and is essential to everyday communication. Among different types of figurative language, idioms are one the most common forms in everyday language and are prevalent with diverse forms across languages.

2. Figurative language is less studied in comparison with other aspects of language in children and is even rarely examined in normal aging populations.
3. Studies showed that the best way to reveal tacit knowledge was through a detailed examination of people's mental images of idioms; therefore, exploring mental images in idiom comprehension is essential for researchers to understand the underlying mechanisms.
4. Mental imagery in figurative language development is expected to become more figurative with advancing age; however, no studies up to date examined the mental imagery generated during idiom comprehension in normal elderly populations.
5. Findings in language performance of normal older people are inconclusive in both language production and language comprehension tasks. Since different tasks yield different results, the explanation task and the comprehension task would be used in this study to provide a better understanding of idiom comprehension in the normal aging population.
6. Understanding language ability in normal aging is essential to distinguish language decline in normal aging, dementia, or other age-related cognitive declines.
7. Figurative language provides a realistic and practical way to evaluate the change of everyday speech, which provides useful, functional, and natural means for clinicians to evaluate language performance in the elderly.

CHAPTER II

LITERATURE REVIEW

The main focus of this study was to examine the applicability of the dual coding theory in idiom comprehension in adults across the lifespan. Therefore, literature in 1) idiom comprehension, 2) the dual coding theory, and 3) language in aging populations was reviewed to provide comprehensive and solid background knowledge of this study.

Idiom Comprehension

Idioms are one of the most common forms of figurative language that are frequent in everyday language and are prevalent with diverse forms across languages (Bortfeld, 2002). Idioms are complex and difficult to define; however, some characteristics are commonly seen and recognized in idioms. Four features in idiom processing were proposed by Oliveri, Romero, and Papagno (2004). First, the use of idiom is conventional. Secondly, idioms comprehension varies based on its transparency, and some of the idioms involve figuration. Thirdly, some of the idioms can be interpreted though their parts, but some of them are not decomposable and are stored as a complete phrase. The last feature is its syntactic frozenness. Gibbs (1987) pointed out that some idioms are syntactically

frozen, but some are syntactically flexible. Therefore, some idioms do not retain their figurative meaning if they are transformed into the passive, but some idioms retain figurative meaning even after transformed into the passive. However, none of these features applies to all idioms, which makes understanding of idiom comprehension even more complicated. According to Nunberg, Sag, and Wasow (1994), idioms are conventionalized and appear only in a limited number of syntactic frames. Idioms typically involve figuration and are used to describe and implicitly explain a recurrent situation of particular social interest or to imply an affective standpoint. Thus, several variables, such as decompositionality, familiarity, syntactical flexibility, transparency, and use of context, must be considered when examining idiom process.

Theories in the Idiom Comprehension Process

The process of idiom comprehension seems like muddy water in which researchers hold different views and hypotheses regarding how people process the literal and figurative meanings of idioms. Many idioms have both literal and figurative interpretations; therefore, how these two interpretative processes relate to each other raises researchers' interests (Needham, 1992). Bowbrow and Bell (1973) proposed the Idiom List Hypothesis that idiomatic meanings were acquired by combining words into a complex "idiom word" and searching through a mental "idiom word dictionary" to find the meaning of the idiom. In their study, participants were presented a set of sentences containing either four literal or four idiomatic sentences followed by one idiomatic sentence serving as the test sentence. Participants were asked to report the meaning they perceived first. The results showed that the number of first perceived idiomatic meaning

reported by participants increased when the preceding sentences were idiomatic sentences and that a similar increase was found for the number of first perceived literal meaning after participants saw a set of literal sentences. Therefore, they suggested that distinct idiomatic and literal processing modes existed and that idioms are listed separately in memory. When people's attempts to generate the idiomatic meaning from its grammatical analysis failed, people then looked up the idiom list for the correct interpretation (Bowbrow & Bell, 1973).

However, the Idiom List Hypothesis was questioned by Swinney and Cutler (1979). In contrast to the Idiom List Hypothesis, the Lexical Representation Hypothesis, proposed by Swinney and Cutler (1979), proposed that both literal and idiomatic meanings were activated simultaneously and idioms were viewed as long words that were stored and accessed like lexicon. Swinney and Cutler (1979) asked 20 undergraduates to make an on-line judgment of whether the phrase was meaningful on 23 grammatical idiomatic phrases, 23 matched grammatical controls with one word replaced from the idiomatic phrases, 30 non-idiomatic and grammatical phrases, and 76 ungrammatical word strings. It was found that idiomatic phrases were recognized as acceptable English phrases significantly faster than grammatical controls. Therefore, they claimed that idioms were stored and accessed as lexical items, neither from the idiom list nor by special processing mode.

Sixty college students participated in Estill and Kemper's study (1982) in order to examine the immediate comprehension process during the interpretation of idioms. Twenty-four sentence sets designed around idioms were used and each contained four

sentences: one sentence used the idiom figuratively, one sentence used the idiom literally, one sentence was ambiguous between the literal and figurative meanings, and one sentence was constructed with the final word of the idiom with non-idiomatic expression. Three types of cues, including identity cues, rhyme cues, and category cues, were defined and announced. Each participant was asked to press the button as fast as possible when hearing the word in the sentences that corresponded to the cues. It was revealed that participants responded more rapidly to the target words in idiomatic sentences than non-idiomatic control sentences. It showed that idioms were automatically processed as lexical items. In addition, this study supported that literal and figurative meanings were processed simultaneously because there was no reaction time advantage for either condition.

In order to test the idiom list hypothesis and the lexical representation hypothesis, 18 undergraduates participated in Glass's first study (1983). Thirty idioms were used to construct 120 pairs, including 30 literal paraphrases followed by their idioms, 30 literal paraphrases followed by irrelevant idioms, 30 figurative paraphrases followed by their idioms, and 30 figurative paraphrases followed by irrelevant idioms. Participants were asked to press a button if they understood the paraphrases and if the idioms had the same literal and figurative meanings as provided by preceding paraphrases. The results supported the lexical representation hypothesis, not the idiom list hypothesis. In order to clarify the confusion between literal and figurative paraphrases for interpretation, each paraphrase was labeled as either literal or figurative in the second experiment. It was revealed that literal and figurative interpretations were both accessed during idiom

comprehension. The overall findings indicated that the comprehension time for idioms was faster than for paraphrases and that the literal and figurative meaning of the idiom were always generated during idiom comprehension. Therefore, this study suggested that the figurative interpretation of the idiom was always retrieved along with the literal interpretation when people encounter an idiom.

Another study, conducted by Tompkins, Boada, and McGarry (1992), also supported that literal and figurative meanings of the idioms were activated simultaneously in people with brain damage. Twenty adults with right-hemisphere-damaged (RHD), 20 with left-hemisphere-damaged (LHD), and 20 neurologically normal controls performed an on-line word-monitoring task and an off-line definition task. In the on-line word-monitoring task, participants listened to a spoken sentence and pressed the button when the specified target word was presented. Response time was recorded in three experimental conditions, including idiomatic, literal, and control. In the off-line definition task, 12 highly familiar idioms, six from the word-monitoring task, were presented auditorily and visually. The findings from the online task indicated that all three groups responded more quickly on idiomatic phrases than on the same nouns in control context, and the idiomatic phrases were processed automatically regardless the context. The similar reaction time among three groups suggested that the initial activation and retrieval of familiar idioms remained intact regardless of the site of cerebral damage. Moreover, since the reaction time for literal and idiomatic context was equally fast, it was proposed that literal and figurative meanings of the idioms were activated simultaneously.

Different from the previous two hypotheses, Gibbs (1980) asserted that the literal interpretation was not necessary for idiom comprehension; therefore, people would not automatically compute the literal meaning of idioms. The Direct Access Hypothesis/Idiom Processing Hypothesis, proposed by Gibbs, stated that people recognized the idiomatic meanings directly without accessing literal interpretations. Four types of experimental stimuli were used in Gibbs' study (1980), including with or without context and literal or idiomatic context. In the with-context condition, each story ended in a target sentence followed by a paraphrase that was either literal or idiomatic. In the no-context condition, only the target sentence and one type of paraphrases were presented. In addition to eight stories with literal target sentences and eight stories with idiomatic target sentences, another 12 filler stories with false paraphrases were included. Participants were asked to make a judgment regarding paraphrases, and the time between onset of the display and the response button being pressed was recorded. It was found that it took less time for participants to process idiomatic interpretations than to process literal ones.

In the second experiment of Gibbs' study, participants were asked to listen to the same stories used in the first study and then to come back after 24 hours to write down what they remembered, especially the last line of each story. The findings showed that familiar and literal interpretations were better recalled. Therefore, in regular conversation, people remember literal and unconventional meanings better than idiomatic conventional meanings. It was suggested that the conventional meaning of the sentence was first analyzed and rejected, which resulted in longer time to process unconventional meanings

of idioms. In order to clarify if people needed longer time to process unconventional interpretations, the third experiment was conducted. The only difference between second and third study was two types of recall prompts were provided, including literal and idiomatic prompts. In addition, 40 sentences, including 16 idioms, were presented in a no-context condition. It was revealed that participants recalled better on literal interpretations than on idiomatic interpretations under either literal or idiomatic prompts in the with-context condition. Therefore, this study pointed out that whether the sentence was stated literally or idiomatically, the most important factor in language processing was the conventionality of the sentence. It was suggested that people would automatically analyze the conventional meaning of the sentence before deciding if the unconventional meaning was necessary to be processed.

In order to provide more evidence for the theory, 18 stories supporting the literal interpretations and 18 stories supporting idiomatic interpretations were used in another Gibbs' study (1986). The final sentence of each story served as a prime sentence, and each story was followed by three target sentences, literal interpretation, idiomatic interpretation, or unrelated sentence. Nine stories that did not have either idiomatic or literal meanings and were followed by non-meaningful sentences were served as fillers. Participants were instructed to press a button if they understood each sentence. After each story, a target string appeared on the screen. Participants were asked to press different buttons if the sentence was meaningful or not meaningful to them. It was revealed that participants responded faster on idioms than on literal interpretations. In the second experiment, the same stories and target sentences were used as materials, but the prime

sentences used in the second study only repeated major content words from the story without idiomatic expressions. It was found that nonliteral target sentences were strongly facilitated when participants read stories with the idiomatic interpretation. Different from the first experiment, literal target sentences were facilitated when the preceding prime sentences were literal. Based on these two experiments, it was concluded that the literal interpretation was not the default to understanding idioms since there was no difference in reaction time in judging paraphrases of the literal meanings and those of unrelated meanings.

Schweigert and Moates (1988) considered the influence of context and familiarity and further examined idiom comprehension by presenting familiar idioms in either literal or idiomatic sentences preceded by a short paragraph. Twenty idioms were written into 40 short stories ending with one idiom target sentence, either representing the literal or the idiomatical meaning. Twenty short stories ending with a control sentence without an idiomatic meaning and 40 sentences containing ambiguous words serving as fillers were also included. Fifty-seven undergraduates first were presented with sentences only and then read a short paragraph before being presented with the ending sentences. The measurement was the number of presentations that the participant needed to read each sentence correctly. Participants completed a cued recall task in which participants had to fill the missing words for the sentences presented 24 hours earlier in the experiment. It was found that idiom-literal sentences required more presentations than both idiom-figurative and control sentences. However, idioms presented literally were better recalled than idioms presented figuratively. The findings supported the Direct Access

Model that figurative meaning was retrieved and processed first and the literal meaning was processed only if the figurative meaning was inappropriate. Schweigert and Moates (1988) suggested that familiar idioms were more likely processed as lexical units than less familiar idioms. Therefore, familiar idioms were perceived as wholes instead of individual words. According to the direct access model, idioms used literally were first processed figuratively and then literally; however, idioms presented figuratively were only processed figuratively. Therefore, the recall advantage observed in literally presented idioms might result from extra processing time than idioms used figuratively.

Sixty-three undergraduates were recruited in the Needham study (1992), and stimuli were 18 experimental passages. Each passage contained a title, a passage with five full sentences of the figurative meanings of the idiomatic phrase, and one final partial sentence with three different versions, including idiom, anaphor, and control conditions. Three partial sentences were identical except the final noun of the target phrase. For example, she spilled the *beans*, she spilled the *carrots*, and she spilled the *beer* were created for the title "Carol lets out a secret". Eighteen experimental passages, 32 filler passages, and target words were presented to participants, and they had to decide whether or not the test word had appeared in the passage. The findings showed that facilitation was found in the anaphor condition, which had shortest response time, but the referents of potential anaphor in the idiom phrase were not activated. In the second experiment, materials and procedures were identical to the first experiment except the verbs in the target phrases were replaced. For example, she *dropped* the beans. Although the results also showed that facilitation was found in the anaphor condition, different

from the first experiment, the response time for the idiom condition was similar to the time for the anaphor condition. Therefore, the finding of the study supported Gibbs' Direct Access Hypothesis/Idiom Processing Hypothesis. Needham (1992) claimed that people did not compute full literal interpretation of idiomatic expressions when an idiomatic phrase was interpreted figuratively. If the figurative meaning was recognized at the early stage, then the processing of the literal meaning might be terminated at a very early stage.

The observed reaction time advantage for idioms found in Gibbs' studies (1980, 1986) was questioned by not measuring on-line processing, not reflecting how people process idioms during comprehension, and plausible reflecting integration process without testing the retrieval of meaning (Cacciari & Tabossi, 1988; Estill & Kemper, 1982; Needham, 1992). The Configurational Hypothesis, proposed by Cacciari and Tabossi (1988), argued that both figurative and literal interpretations were processed in parallel, but people had to recognize the configuration of the idioms first through the key point. In the first experiment conducted by Cacciari and Tabossi (1988), participants were visually presented with 60 sentences, nine idioms, and 51 filler sentences. Each sentence was followed by three target words, one semantically associated with the meaning of the idiom (idiom target), one associated with the meaning of the last word in the phase (literal target), and the last one was an unrelated word serving as the control. Participants had to judge if the string showed on the screen was an actual word while listening to a sentence. Although the results showed that idiom targets were responded to faster than literal targets and controls, it was questionable due to measuring post-perceptual events

instead of the online idiom comprehension process. There was possible awareness of experimental purposes by participants, and idioms used in the experiment could have unequally induced literal and figurative interpretations. Therefore, after the experimental biases were controlled, participants were presented 12 idiom sentences, 12 informal sentences, and 48 formal sentences that each were paired with three target words. It was found that the figurative meaning was not automatically activated when the sentences were not biased towards idiomatic interpretations. Different from the first experiment, idiomatic sentences were first processed only literally. It appeared that sometime after the last word in the sentence, the idiomatic interpretation might be detected. The results clearly showed that the interpretation of idiomatic expressions was a slow process and required some time to be activated. Therefore, Cacciari and Tabossi (1988) asserted that for non-predictable idioms, only the literal meaning was accessed first and then the recognition of the idiomatic configuration would take place after the key word has been accessed. In other words, processing of an idiomatic string was literal until sometime after the configuration emerged. Therefore, the Configurational Hypothesis was not consistent with either the lexical representation hypothesis or the direct access hypothesis.

The Graded Salience Hypothesis (GSH), suggested by Giora (1997), claimed that comprehension of figurative and literal language should be governed by a more general principle of salience depending on which salient meanings were processed first. If the literal and figurative meanings of the conventional metaphor were equally salient, both meanings would be processed in parallel. Giora (1997) stated that the salience of a word

or an utterance was a function of its conventionality, familiarity, and given context. According to the GSH, the idiomatic meaning of the familiar idiom should be activated in both idiomatically-biased context and literally-biased context since idiomatic meanings of the familiar idiom was more salient than its literal meaning. However, for the less familiar idioms, literal meanings should only be activated in the literally-biased context (Giora, 1999). Therefore, salient meanings have the privilege that they were always activated and accessed initially regardless of the type or length of context.

In one of the experiments of Giora and Fein (1999), the hypothesis that familiarity might affect the activation of literal and idiomatic meanings of the idiom was examined. Sixty primary school students, aged 12-13 years, participated in the study. Twelve familiar and twelve less familiar idioms were constructed in either literally-biased sentences or idiomatically-biased sentences. Participants were instructed to read the sentence and then complete one fragmented word that first came to mind. It was revealed that for the familiar idioms within the idiomatically-biased context, the salient idiomatic meaning was highly activated while the less salient literal meaning was hardly activated. On the other hand, both idiomatic and literal meanings were activated for familiar idioms in literally-biased context. For the less familiar idioms, both meanings were evoked in the idiomatically-biased context; however, the more salient literal meaning was highly activated, the less salient idiomatic meaning was activated in the literally-biased context.

The GSH focused on not only time courses of the idioms processing that were addressed in the lexical representation and configuration model but also the brain regions that were activated during the process. According to the GSH, salient meanings were

easier to access than less salient ones regardless of literal or nonliteral interpretations. Therefore, the degree of meaning salience decided which meaning was retrieved. While applying to idiom comprehension, the GSH argued that the right hemisphere was activated during the comprehension of nonsalient (literal) meaning, and the comprehension of salient (idiomatic) meaning was processed by the left hemisphere. In idiom comprehension, the idiomatic meaning was salient because it can not be decomposed but restored as a whole like mental lexicon; however, its literal meaning was compositional.

In order to investigate the role of the right hemisphere in understanding idiomatic sentences, Mashal and colleagues (Mashal, Faust, Hendler, & Jung-Beeman, 2008) conducted a behavioral divided visual field study using functional Magnetic Resonance Imaging (fMRI). Seventy-six ambiguous idioms, 38 followed by the target words related to the idiomatic meaning of the idiom, and 38 followed by the target words related to the literal meaning of the idiom, were presented to 32 college students in either the right visual field/left hemisphere (RVF/LH) or the left visual field/right hemisphere (LVF/RH). Additional 60 filler sentences followed by nonword targets were also presented. The results revealed that the reaction time was faster when target words related to the literal meaning of the idioms were presented in LVF/RH than in RVF/LH. Therefore, the right hemisphere was more sensitive than the left hemisphere on nonsalient, literal meanings of ambiguous idioms. In order to determine which regions of the right hemisphere were activated during the process of nonsalient meaning of ambiguous idioms, another fMRI study was conducted on 14 young adults, ages 21-31

years. Stimuli were 50 ambiguous idioms and 25 literal sentences differing from idioms in one or two words. For example, *kick the bucket* versus *lick the jar*. The findings indicated that neural activities increased in the right-lateralized brain regions when literal interpretations of idioms were processed. In sum, this study supported that literal, nonsalient interpretations of idioms were processed in the right hemisphere while the increased activation in the left hemisphere was observed during processing of idioms. The results of the behavioral tasks and fMRI studies were in agreement with the Graded Salience Hypothesis (GSH) that the right hemisphere was sensitive to nonsalient interpretations of idioms.

Laurent and colleagues (Laurent, Denhieres, Passerieux, Iakimova, & Hardy-Bayle, 2006) attempted to examine Giora's graded salience hypothesis through the event-related potentials (ERPs). Thirty adults, age between 21 to 50 years old, were recruited, and 240 experimental sentences followed by one target word either semantically related or not were used as stimuli. Six different stimulus categories were created, including 20 strongly salient idioms with related target words, 20 weakly salient idioms with related target words, 40 idiomatic fillers with related target words, 40 idiomatic fillers with non-related target words, 40 literal fillers with related target words, and 40 literal fillers with non-related target words. Participants were instructed to decide if the target word was semantically related to the meaning of the utterance. The findings revealed that the shortest reaction time was found in response to figurative targets that followed highly salient idioms and in response to literal targets preceded by weakly salient idioms. Therefore, the results supported Giora's Graded Salience Hypothesis that

more salient meanings were accessed faster as a result of conventionality, frequency, familiarity, or prototypicality and reached a sufficient level of activation more easily compared to less salient meanings.

Different theories in idiom processing were reviewed in order to provide a foundation of understanding how people comprehend idioms. In addition to these theories and hypotheses, how idioms were processed in the brain also raised researchers' interests. Literature in idiom processing was reviewed to provide further understanding in idiom processing.

Right Hemisphere or Left Hemisphere?

Language is commonly assumed to be processed in the left hemisphere with production in Broca's Area and comprehension in Wernicke's Area. However, growing evidence indicated that both hemispheres contribute to the comprehension of semantically related words (Chiarello, Burgess, Richards, & Pollock, 1990), indirect semantic priming (Kiefer, Weisbrod, Kern, Maier, & Spitzer, 1998), semantic priming (Belanger & Cimino, 2002; Mcdonald, Bauer, Filoteo, Grande, Roper, Buchanan, & Gilmore, 2005; Richards & Chiarello, 1995), the understanding the meanings of ambiguous words (Atchley, Burgess, Audet, & Arambel, 1996; Burgess & Simpson, 1988), the understanding of indirect speech (Wapner, Hamby, & Gardner, 1981), the comprehension of joke (Coulson & Williams, 2005), and making inferences (Beeman, 1993). The right hemisphere was assumed to play a critical role in figurative language comprehension, such as proverbs and idioms. Burgess and Chiarello (1996) reviewed studies related to cerebral asymmetries in metaphor and idiom comprehension and further

concluded that the right hemisphere played an important role in inferencing and in understanding the figurative language. They claimed that the right hemisphere was sensitive to the pragmatic information and activated a broad range of semantic information, which was essential for comprehending figurative language. Likewise, the left hemisphere was also important in figurative language comprehension, especially those idioms that involved in syntactic analysis and with preceding context. Since figurative language contains literal and figurative expressions and requires both semantic and syntactic knowledge, how figurative language is processed in the brain is worth further studied.

Van Lancker and Kempler (1987) examined the comprehension of familiar phrases, such as idioms, and novel sentences on 28 people with left hemisphere damage (LHD), mean age of 62.3 years, and 11 people with right hemisphere damage (RHD), mean age of 63.4 years. Stimuli were 10 concrete nouns, 10 familiar phrases, and 10 novel sentences with matching lengths and syntactic structures. Each phrase contained four line drawings. The foils were semantically-related words for nouns and variation of grammatical roles for novel sentences. Foils for the familiar phrases were one literal expression, one related or opposite expression, and one irrelevant expression. The results showed that the comprehension of familiar phrases was less impaired than syntactic abilities in participants with LHD. Participants with LHD performed better than those with RHD in familiar phrases but not words and novel sentences. The results supported that familiar phrases were stored and processed differently from the newly generated language, and the right hemisphere was specialized in comprehending inferential

meanings. Given that the opposite results was obtained from people with LHD and people with RHD, the findings of this study supported the critical role of the right hemisphere in the comprehension of familiar phrases, such a idioms, and formulaic speech.

Bottini and colleagues (Bottini, Corcoran, Sterzi, Paulesu, Schenone, Scarpa, Frackowiak, & Frith, 1994) measured the performance of six neurologically normal adults, age between 21 and 35 years, on three tasks, including metaphor task, sentence task, and lexical decision task, through the positron emission tomography (PET). In the metaphorical sentence task, new and unusual metaphors were used to explore the specific cognitive process. Participants were instructed to decide whether a sentence was metaphorical or not. In the literal sentence task, participants were asked to decide whether sentences were plausible or not at the literal level. In the lexical decision task, participants were asked to identify the non-word in a sentence-like string. It was revealed that processing of metaphors activated several areas in the right hemisphere compared to the processing of literal sentences. Additionally, an extensive activation in the left hemisphere was observed in the processing of complex sentences than single words. The results supported that the right hemisphere played a specific role in complex language that normally required a holistic or integrated approach to understand it. It was worth noting that mental images might be crucial to understand metaphors since four out of six participants reported that they used mental imagery during the metaphors task.

Anaki, Faust, and Kravetz (1998) investigated how lexical metaphors were processed in the two hemispheres by 56 undergraduates. The stimuli consisted of 30

priming Hebrew words, 90 target words, and 90 target non-words. The priming words had literal and metaphoric meanings, such as *rolling* and *feeble*. Thirty target words were related to the metaphoric meaning of the priming word, 30 target words were related to the literal meaning of the priming word, and 30 words were unrelated to the priming word. Stimuli were presented to either left or right visual fields, and participants were asked to determine whether the stimulus was a word or a non-word. The different activations of metaphoric and literal meanings were found in the cerebral hemispheres. The results supported the enhanced role of the right hemisphere in metaphoric comprehension of single word metaphors.

In order to understand the neural network underlying idiom comprehension and to identify which brain areas were responsible for different cognitive functions, Zempleni and colleagues (Zempleni, Haverkort, Renken, & Stowe, 2007) conducted a fMRI study on 15 participants, mean age at 30.8 years old. Four experimental conditions, including literal sentences with an ambiguous or an unambiguous idiom verses figurative sentences with an ambiguous or an unambiguous idiom, were created using 64 ambiguous and 32 unambiguous Dutch idioms. Each sentence was presented visually on the computer screen, and participants were instructed to read the sentence silently. Participants made judgments about the relatedness between the sentence and a word that appeared after the sentence. After the fMRI scan, a behavioral idiom comprehension task was carried out. Stimuli were 30 literally plausible idioms selected from the idioms used in the fMRI experiment with two extra new contexts that represented either the idiomatic interpretation or literal interpretation. Six conditions were created: an idiomatic sentence

followed by the idiomatically-related target word; an idiomatic sentence followed by the literally-related target word; an idiomatic sentence followed by the unrelated target word; a parallel condition created for the literal sentences. Similar to the fMRI study, participants were instructed to decide if the sentence-target pairs were related or not. It was revealed that idiom comprehension activated both hemispheres, and figurative language comprehension was more effortful in language areas compared to the literal processing. Moreover, the findings indicated that idiomatic sentences activated more areas that were typically for language processing compared to literal sentences, and the right hemisphere was more sensitive in ambiguous idioms than unambiguous ones.

Different from previous studies, Huber-Okrainec, Blaser, and Dennis (2005) examined idiom comprehension in relation to the literality, compositionality, and contextual bias in children with spina bifida meningomyelocele (SBM), a neurodevelopment disorder associated with agenesis and/or hyperplasia of the corpus callosum. Participants were 38 children with SBM and 38 typically developing children, age between seven to eighteen years old. Forty-eight highly familiar idioms varying on the literality and compositionality were stimuli. Two pictures, one representing figurative meaning and one representing literal meaning, were created for each idiom. Half of the idioms were presented verbally in isolated sentences and half of the idioms were presented verbally with a contextual sentence that was biased towards the figurative meaning. Participants were instructed to press the yes/no button as fast as they could to judge whether the picture represented the idiom. The accuracy and response time were measured. The results showed that children with SBM were impaired in idiom

comprehension, and the compositionality, literality, and context bias affected how children with SBM understood idioms. It was evident that children with SBM had great difficulties making inferences and understanding non-decomposable idioms. Huber-Okrainec and colleagues (2005) pointed out that the difficulties were associated with congenital agenesis of the corpus callosum, which further suggested that understanding idioms required the inter-hemispheric integration. The results were also supported by a recent ERP study done by Proverbio, Crotti, Zani, and Adorni (2009) on 15 undergraduate students in Italy. They proposed a bilateral involvement in idiom comprehension, and a direct access to the idiomatic meaning of the idiom without suppression of its literal meaning.

Whether idiom comprehension was processed bilaterally or unilaterally yielded inconclusive results. In addition to neuroimaging studies reviewed above, studies on people with brain damage also provided the direct and robust clinical evidence for the understanding of idiom comprehension in the brain. Therefore, literature reviewed in the following section focused on how people with widespread brain damage, such as dementia and Alzheimer's disease, and people with left or right brain damage comprehended idioms.

Idiom Comprehension in People with Brain Damage

Observations and clinical evidence from people with clinical dysfunctions provided valuable insights of which factors play critical roles during language processing. However, it is still not clear whether the right hemisphere or the left hemisphere is involved in idiom comprehension. Given that limited research in idiom comprehension

was studied in neurologically normal aging populations, literature review in people with brain damage may offer a window to explore the relationship between aging, brain activity, and figurative language processing.

Comprehension of figurative language, such as metaphors and proverbs, were examined in people with brain damage (Winner & Gardner, 1977; Brundage, 1996), people with traumatic brain injury (Moran, Nippold, & Gillon, 2006; Towne & Entwisle, 1993), people with aphasia (Brundage & Brookshire, 1995; Chapman, Ulatowska, Franklin, Shobe, Thompson, & McIntire, 1995; Ulatowska, Chapman & Johnson, 1995), people with dementia (Brundage, 1996; Chapman et al.,1997), and people with Alzheimer's disease (Amanzio, Geminiani, Leotta, & Cappa, 2008; Chapman et al.,1997). Since the focus of the present study was idiom comprehension, literature associated with idiom comprehension in widespread brain damage and focal brain damage was reviewed to understand idiom comprehension from different aspects.

People with Widespread Brain Damage

The abstract verbal reasoning, concept formation, and quality of thinking are critical in figurative language processing. However, people with widespread brain damage often lose the ability of abstract thinking and frequently substitute it with concrete interpretation (Kempler, Van Lancker, & Read, 1988). Obler and Albert (1984) pointed out that people with dementia had difficulties interpreting idioms and proverbs, and their interpretations were fairly concrete even in people with higher education. Individuals with early-stage Alzheimer's disease would have no difficulty explaining the idioms, but people with middle-stage Alzheimer's disease would have a hard time

explaining an idiom. However, if multiple choice responses were provided, people with middle-stage Alzheimer's disease were able to identify idiomatic interpretations.

Papagno and colleagues (Papagno, Lucchelli, Muggia, & Rizzo, 2003) investigated the relationship between idiom comprehension and the executive function on individuals with Alzheimer's disease (AD). In the first experiment, 15 people with probable AD were recruited; 40 unambiguous and familiar verbal idioms were used as stimuli. Participants were asked to choose a picture from two possible drawings when the experimenter read a sentence corresponding to an idiom. One of the drawings represented the idiomatic/figurative meaning and the other one displayed the literal meaning of the idiom. Participants with AD knew the meanings of the idioms but were unable to suppress the literal interpretation when it was overtly represented. Papagno and colleagues (2003) claimed that the activation of literal meanings might be faster and stronger than the activation of figurative meanings in people with AD, which was consistent with the results of the Stroop Test used to measure the inhibition function.

In the second study, fifteen people with AD different from the first study were asked to perform a sentence-to-picture matching task for idiom comprehension and also orally explain the meaning of each idiom. The same idioms from the first experiment were used. It was revealed that people with AD performed better in the oral task than in the sentence-to-picture matching task. According to the results of the two experiments, the literal meaning interference existed whenever the literal meaning of the sentence was available for people with AD. In addition to ineffective inhibition of the literal meaning, activation of the figurative meaning was not fast and sufficient during idiom

comprehension. Papagno and colleagues (2003) argued that since suppression played a key role in the idiom comprehension task, the executive function was critical in figurative language processing.

Kempler, Van Lancker, and Read (1988) administered three tasks on twenty-nine people diagnosed with AD and forty-three neurological normal older adults, age between 50 to 82 years old. Three tasks included single words, familiar phrases with idioms and proverbs, and novel phrases, and each task contained 10 stimuli. In the familiar phrases task, three foils, one contains the referential representation, one contains meanings that were opposite or related to the idiomatic meanings, and one irrelevant choice, were created. In the novel phrases task, all three foils were ungrammatical, such as subject-object reversal. Participants were instructed to choose a picture from four line drawings that best represented the stimuli. The results indicated that people with dementia had difficulty understanding abstract language, such as idioms and proverbs, compared to the neurologically normal elders. In addition, people with AD had difficulty recognizing the overall pattern of familiar phrases and matching the phrases to its complex meanings. It was suggested that people with AD had impairments in the holistic, integrative, and global processing and had difficulty processing familiar phrases that have holistic forms and integrated meanings. According to the error analysis, people with AD often chose concrete instead of related or irrelevant responses. It reflected a deficit in the processing of abstract meanings. The results also found that the performance of people with AD in figurative language was similar to people with the right hemisphere damage who also performed better in novel phrases than in familiar phrases.

A recent study done by Rassiga and colleagues (Rassiga, Lucchelli, Crippa, & Papagno, 2009) also investigated the comprehension of ambiguous literally plausible idioms in people with mild AD. Fifteen participants with mild probable AD and 15 neurologically normal participants with matched age, education, and gender performed two tasks, including a sentence-to-word matching task and a picture matching task. A total of 28 ambiguous idioms containing both figurative and literal meanings were used. In the sentence-to-word matching task, each idiom was paired with four words and participants needed to point to the word that matched the idiomatic meaning of the sentence. In the picture-matching task, each idiom was represented by four line-drawings containing one figurative interpretation, one semantic associated meaning, and two foil unrelated semantic meanings. The results showed that participants performed significantly better in the sentence-to-word matching task than in the picture-matching task. It was evident that people with AD were impaired with ambiguous idioms and were unable to suppress the literal interpretation of an idiom when the pictorial representation was available. In addition, a high variability in the picture-matching task in both AD participants and healthy elders was observed. Therefore, Rassiga and colleagues (2009) hypothesized that elders with good executive function would perform well on the idiom comprehension task; however, these with lower executive function would perform at a lower level.

However, the result of the study done by Papagno (2001) was not in line with previous studies. Thirty-nine people with mild dementia but with normal comprehension of easy commands were recruited. Metaphor and idiom comprehension tasks were

administered. In the idiom comprehension task, participants were asked to explain 20 opaque idiomatic phrases. Twenty-three out of thirty-nine participants were evaluated again after six to eight months. It was revealed that figurative language comprehension was preserved in most of the people with mild AD even at the later stage. However, the participants of this study had good comprehension in order to perform the tasks which created a bias in the findings. In the error analysis, the literal interpretation was commonly observed for idiom comprehension, but an attempt to generate the figurative meanings of metaphors was frequently presented.

In addition to people with brain damage, people with schizophrenia also have difficulty understanding nonliteral language, such as idioms and proverbs. The plausible explanations for the deficits were the failure to use the relevant context information to facilitate their understanding and to inhibit unrelated contextual information during encoding contextual-relevant information. Titone, Holzman, and Levyn (2002) recruited 32 individual diagnosed with schizophrenia, mean age at 38.8 years. The stimuli consisted of 24 literally plausible idioms and 24 literally implausible idioms which were further embedded in neutral sentence contexts as sentence primes. The idioms were non-decomposable, moderately predictable, and moderately frequent. Visual target words related to idiomatic and literal meanings of the sentence primes were selected, and fillers were randomly mixed with experimental items. Four experimental conditions, including idiom prime-idiom target, idiom prime-literal target, control prime-idiom target, and control prime-literal target, were designed. The latency and accuracy were measured. Participants were instructed to listen to the sentence primes and to make lexical decisions

to the visual target words. It was found that idioms primed significantly for literally implausible idioms but not for literally plausible idioms in people with schizophrenia; however, idiom priming was found in both literally plausible and implausible idioms for normal controls. Moreover, people with schizophrenia showed literal word priming for literally plausible idioms only, which reflected the possible interference of activation of both literal and idiomatic interpretations. It was evident that people with schizophrenia used idiomatic context to generate idiomatic meanings when no other interpretation of the sentence was available. Additionally, this population only showed impairments in idiom comprehension when they had to choose between plausible interpretations of idioms.

People with Focal Brain Damage

In addition to people with widespread brain damage, such as Alzheimer's disease and dementia, how people with focal brain damage processed idioms provided the unique clinical evidence for idiom comprehension. Studying idiom comprehension in this population not only extended our understanding of idiom processing in the brain but also provided the evidence for clinical assessments in figurative language comprehension after brain damage. The left hemisphere is commonly referred as a central place of language processing. However, studies (Bottini et al., 1994; Burgess & Chiarello, 1996; Van Lancker & Kempler, 1987) indicated that the right hemisphere in fact plays a critical role in figurative language processing. Therefore, studies in people with left or/and right hemisphere damage offer a path to understand how the left or right hemisphere is involved in the idiom comprehension process.

Bush and Drummond (1985) attempted to understand the comprehension and production of idioms in people with aphasia. Five people with fluent aphasia and five people with nonfluent aphasia, age between 23 to 69 years old, were presented 15 sets of pictures, each containing four pictures, in the comprehension task. Four pictures included one literal description, one idiomatic description, one literal variation, and one unrelated picture. Participants had to choose the picture that best explained the phrase. In the production task, participants were asked to provide the explanation for 15 idioms that were read by the experimenter. The findings showed that the production and comprehension of idioms were difficult for all people with aphasia regardless of the severity and the type of aphasia although participants with more severe aphasia performed less well on both comprehension and production tasks. Overall, the comprehension task was performed better than the production task. It was worthy noting that people with aphasia tended to select literal pictures over the literal variation or the unrelated pictures although they identified relatively more idiomatic representations in general.

Papagno and Genoni (2003) conducted serial tests on 10 people with aphasia to examine the relationship between idiom comprehension and syntactic processing. Participants suffered with aphasia and had the syntactic but not semantic deficits. Forty familiar verbal idioms were selected, and three pictures that each represented idiomatic meanings, figurative meanings, and unrelated situations were created. In the idiom comprehension test, participants chose a picture matching the idiom that was read by the experimenter. In the literal sentence comprehension task, participants chose from two

pictures that better matched the sentence. Lastly, in the grammaticality judgment test, 40 literal sentences and 40 idioms used in the idiom comprehension test were used. Half of the literal sentences and idioms were presented in their correct forms, but the other half of the stimuli contained an omission or substitution which violated syntactic rules. Participants were asked to judge if the word string was grammatically correct or not. The findings indicated that the idiom comprehension underwent syntactical analysis since the syntactic deficit interfered with idiom processing.

Whether comprehension of idioms was impaired or intact in people with left brain damage was also investigated in the study of Papagno et al. (Papagno, Tabossi, Colombo, & Zampetti, 2004) for which 10 people with aphasia were recruited. Thirty-four unambiguous idioms were used, and three line drawing pictures were created for each idiom, including one representing the possible literal expression, one showing idiomatic interpretations, and one representing the unrelated situation. Three tasks were administered, including a string-to-picture matching task, a single word comprehension task, and a literal sentence comprehension task. It was found that comprehension of idioms, measured by the string-to-picture matching task, was severely impaired in people with aphasia. However, this deficit could not be reduced to the impaired comprehension of either words or literal sentences since they performed better on word and sentence comprehension tasks than on the idiom comprehension task. To avoid the plausible interpretation bias from the picture matching task, Papagno and colleagues (2004) asked participants to provide verbal explanations for each idiom. It was revealed that idiom comprehension in people with aphasia was severely impaired. Moreover, the inference

was strong when the literal interpretation of an idiom was available for people with aphasia.

Cacciari and colleagues (Cacciari, Reatio, Colombo, Padovani, Rizzo, & Papagno, 2006) used the string-to-word matching task instead of the picture matching and definition tasks on 15 patients with aphasia to examine idiom comprehension. Twenty-three familiar ambiguous idioms, each pairing with four target words, were used, including one target word corresponding to the idiomatic expression of the string, one foil that was semantically related to the last word of the idiom string, and two unrelated foils. One of the unrelated foils was either an abstract or a concrete word depending on the nature of the idiom string, and the other unrelated foil was a noun that could plausibly complete the verb in the verb phrase. Participants were asked to point to the word that matched the idiomatic meaning of the string and to rate the familiarity of the idiom at the end of the experiment. The results showed that people with aphasia were more impaired in idiom comprehension compared to normal controls. Cacciari and colleagues (2006) claimed that the idiom comprehension in people with aphasia exceeded single-word level, which was in line with Papagno et al's findings (2004).

Papagno and Caporali (2007) intended to examine the effects of tasks and idiom types during idiom comprehension on people with aphasia. Fifteen individuals with aphasia were given the word comprehension task, oral naming task, and dual task that assessed the executive function. In the first experiment, forty familiar, opaque, and unambiguous verbal idioms were selected to further construct four line-drawing pictures for each idiom, including idiomatic and literal interpretations, content word related

situations, and unrelated situations. Participants were asked to choose the corresponding picture from the four options. Each idiom was also paired with four target words, including words corresponding to the idiomatic interpretation, words associated with the last word of the idiom string, unrelated concrete or abstract words depending on the nature of the idiom, and unrelated words that could plausibly complete the verb in the verb phase. Participants had to point to the word that matched the idiomatic meaning of the sentence. Participants were also asked to provide an oral definition of each idiom. In the second experiment, the only difference from the first experiment was that 15 ambiguous and highly familiar idioms were used as stimuli. The findings indicated that people with aphasia had difficulty in idiom comprehension and the degree of difficulty varied depending on the type of tasks and type of idioms used in the study. Their difficulties possibly resulted from their general language difficulties combining with a reduced inhibition mechanism of the literal interpretation. In addition, the literal interpretation was not activated or easily suppressed for non-ambiguous idioms. However, the literal interpretation remained activated and the inhibition was difficult and delayed for ambiguous idioms.

A recent study done by Norswski (2009) on three participants with aphasia also supported the findings that people with aphasia had more difficulties with interpreting transparent idioms. The literal interpretations were more easily activated than opaque ones, whose literal meanings were less easy to access. They used 60 Polish idioms containing equal numbers of decomposable or non-decomposable and transparent or opaque idioms in two multiple choice tasks, in which idioms were embedded in context.

In the first task, each of 30 idioms was paired with three target phrases matched in lengths and syntactic forms, including an idiomatic paraphrase, a literal paraphrase, and an unrelated foil phrase. Different 30 idioms were used in the second task, and the target phrases for each idiom included one idiomatic paraphrase, one unrelated foil containing the basic words from the idiom, and one filler phrase. It was revealed that transparent idioms were more difficult than opaque ones for people with aphasia, and they had tendency to interpret the idiom literally instead of idiomatically. When the literal interpretations were eliminated from the second task, participants performed better.

According to the studies reviewed above, it was evident that the left hemisphere was involved in idiom comprehension process, which was in line with the theory that language is processed mainly in the left hemisphere. However, the right hemisphere is assumed to play a critical role in figurative language comprehension. Therefore, the studies reviewed in the following section intended to explore the role of the right hemisphere during the figurative language processing, especially idiom processing. How people with right brain damage comprehend idioms was examined in the study of Myers and Linebaugh (1981). Six people with unilateral right hemisphere damage, six people with unilateral left hemisphere damage, and six neurologically normal controls read five two-sentence stories that each story delivered a common idiomatic expression. Each story was accompanied with five pictures, including the correct context-correct interpretations, correct context-literal interpretations, wrong context-correct interpretations, wrong context-literal interpretations, and correct context-opposite interpretations. Participants were asked to point to the picture that best described the story. It was found that people

with right hemisphere damage (RHD) tended to choose literal expressions and performed worse in comprehending figurative language compared to normal controls even though the supportive context was provided. In addition, people with RHD interpreted idioms by breaking them down into constituent elements rather than understanding them as a whole. Compared to people with RHD, people with left hemisphere damage used contextual information better in idiom comprehension. Therefore, the findings of this study suggested that people with RHD had difficulty comprehending the implication and intention of the idiomatic phrases.

Kempler and Van Lancker (1993) used the Familiar and Novel Language Comprehension (FANL-C) Test, a picture-pointing task requiring no verbal explanation, to test 13 people with unilateral right hemisphere damage and 13 people with unilateral left hemisphere damage in order to understand the loss of familiar language. The test contained 20 familiar phrases, including proverbs, idioms, and contextually bound social interaction formulas (e.g. *I'll get back to you later*) and 20 novel sentences (e.g. *He's racing a truck against a horse*). Each phrase was expressed by four pictures with one correct meaning, one related meaning to the familiar phrase, and two foils with concrete interpretations for the familiar phrases. The findings revealed that familiar phrases were processed in both hemispheres, while novel sentences were processed only in the left hemisphere. Therefore, the right hemisphere might play an important role in certain aspects of language processing.

Kempler, Van Lancker, Marchman, and Bates (1999) used the same test, the Familiar and Novel Comprehension Test (FANLC), to test participants' idiom

comprehension. Stimuli were 20 familiar idiomatic phrases and 20 literal sentences. Foils for idiomatic phrases included two foils related to the individual words in the stimuli sentence and the other foil was related to the figurative meaning of the idiomatic phrase. Participants were asked to choose one picture that matched the sentence read by the experimenter. In the first study, participants were 25 adults with left hemisphere lesions, mean age at 58 years, 16 adults with right hemisphere lesions, mean age at 65 years, and 42 neurologically normal adults, age between 40 and 79 years. The results indicated that the literal and idiomatic language was involved in different hemispheres in adults. It was evident that people with RHD performed poorly on familiar nonliteral expressions, but people with LHD were impaired in comprehension of literal expressions.

In order to understand how people with different regions of brain damage processed idiomatic meanings during online spoken sentence comprehension, one patient with Wernicke's aphasia, one patient with global aphasia, one patient with right hemisphere damage, and one age-matched neurologically normal elder participated in the Hillert study (2004). Stimuli were 16 common ambiguous German noun idioms, each embedded in two types of contexts, including idiomatically-biasing and literally-biasing contexts. Participants were instructed to listen to each sentence and were asked to press the keys when they saw a word or a pseudo-word present on the monitor. Both patients with Wernicke's aphasia and global aphasia performed as well as the normal control and accessed both idiomatic and literal meanings with no signs of impairments. Moreover, it was found that the patient with RHD in this study showed no difficulty accessing

idiomatic or literal meanings, which could be assumed that the posterior lesion of the right hemisphere might not affect idiomatic processing.

It was still not clear that if people with left hemisphere damage (LHD) were more impaired in literal language than in figurative language and whether the level of impairment in people with LHD was the same as in people with right hemisphere damage (RHD). Papagno and colleagues (Papagno, Curti, Rizzo, Crippa, & Colombo, 2006) compared how idioms were processed in 15 participants with RHD and 12 participants with LHD/aphasia. Stimuli were forty unambiguous verbal idioms with a variety of transparency. In the idiom comprehension task, participants were first asked to pick one picture from three pictures that best matched the sentence read by the experimenter and then to provide an oral definition of each item. In the literal sentence comprehension task, 40 sentenced were stimuli, and participants chose a picture that best described the sentence read by the experimenter from two options. The only difference between the two pictures was a single detail such as *a boy is pushing a girl* versus *a boy is pushed by a girl*. The results indicated that participants with LHD were more seriously impaired in both literal and idiomatic languages. The results of this study did not support the prevailing role of the right hemisphere in idiom comprehension, but it provided precious information regarding idiom processing. First, participants with LHD had the impaired linguistic analysis which affected their idiom processing. Secondly, participants with the frontal lobe lesion had difficulty inhibiting the literal meaning during the picture matching task. Thirdly, the use of string-to-picture matching task might underestimate the idiom comprehension ability of some people with brain damage.

In the Tompkins, Boada, and McGarry study (1992), twenty adults with RHD, 20 with LHD, and 20 neurologically normal controls performed an on-line word-monitoring task and an off-line definition task. In the on-line word-monitoring task, participants listened to the spoken sentences and pressed the button when the specified target words were presented. The response time was recorded in three experimental conditions, including idiomatic, literal, and control. In the off-line definition task, twelve highly familiar idioms, six from the word-monitoring task, were presented auditorily and visually. The findings from the online task indicated that three groups responded more quickly in idiomatic phrases than the same nouns in the control context, and the idiomatic phrases were processed automatically regardless of the context. The similar reaction time among three groups suggested that the initial activation and retrieval of familiar idioms remained intact regardless of the site of cerebral damage. In the offline definition task, both groups with unilateral brain damage performed worse than the control group. Tompkins and colleagues (1992) claimed that the idiom interpretation deficits in people with unilateral brain damage did not show in the early activation and the retrieval stage but rather in the later stage of information processing.

Cacciari and colleagues (Cacciari et al., 2006) proposed three possible explanations for the impairment of idiom comprehension in people with aphasia, including the impairment of the inhibition system, impairment of the recognition and activation mechanisms, and impairment of linguistic processing. Papagno et al's study (2004) also supported that people suffering with aphasia had difficulty suppressing the literal meaning during the idiom processing. The reasons that result in the impairment in

idiom comprehension for people with left hemisphere damage needs further research. However, it should be noted that there were methodology concerns regarding the two commonly used idiom tasks used to study people with impaired language, including string-to-picture matching and the oral definition task. The string-to-picture matching task might underestimate idiom comprehension since pictures which easily activated the literal interpretation strongly interfered with the figurative meaning. This point of view was also supported in Papagno et al's study (2006). Other than the string-to-picture matching task, given limited speech output in people with left-brain-damage, the oral definition task might also underestimate their actual comprehension (Cacciari et al., 2006).

Factors Involved in Idiom Comprehension

Nunberg, Sag, and Wasow (1994) suggested that the difficulties in analysis of idioms resulted from a confusion of the key semantic properties associated with idiomatic meanings, including conventionality, transparency and compositionality. Additionally, idioms vary on the transparency, decomposability, ambiguousness, and these factors affected how people interpret idioms (Cacciari, Reatio, Colombo, Padovani, Rizzo, & Papagno, 2006).

The relationship between the literal and figurative use of common idioms were examined in the Popiel and McRae study (1988). Sixty idioms were selected as stimuli and two questionnaires, each containing 30 idioms, were constructed. Each idiom was followed by its literal and figurative definition. Participants were instructed to rate each definition on a seven-point scale based on its frequency of use and familiarity. The

findings pointed out that the figurative interpretation of idioms were more frequently used and more familiar to participants compared to literal definitions. Moreover, subjects tended to rate higher for the frequency of use and familiarity on figurative interpretations than on literal interpretations, and the rating varied more widely on the literal ratings than on the figurative ratings.

Schweigert (1986) examined the differences between the comprehension of familiar and less familiar idioms on college students. Stimuli were eight idiomatic sentences, eight literal sentences, eight unbiased sentences, and 24 control sentences mixed with 76 filler sentences. Half of the idioms were familiar and the other half were unfamiliar based on the ratings. Participants were asked to read the sentences showed on the computer screen and to press a button if they understood the sentence. A recall task was administered about every five sentences. The finding indicated that it took a longer time for participants to comprehend a sentence containing a less familiar idiom than a sentence containing a familiar idiom. Moreover, the familiarity effect was also found in both idiomatic and literal sentences that were generated from the idioms. Therefore, Schweigert (1986) suggested that the familiarity of the idiom needed to be taken into account for the models of idiom processing, and the less familiar idioms would take a longer processing time compared to familiar idioms.

In another study of Schweigert (1991), stimuli were 12 most familiar and 12 less familiar idioms. One figurative paraphrase and one literal paraphrase were developed for each idiom with the target sentence ending in each paraphrase. Undergraduates were instructed to read out loud the sentence which was first presented only with one or two

words from the sentence and the presentation was continued until the participant read the entire sentence correctly. The number of presentations needed to read each sentence correctly was recorded, and a cued recall task was administered after the experiment. It was found that the number of presentations was significantly fewer for control sentences than the other sentences except the less familiar idioms used literally. Additionally, familiar idioms were better recalled than less familiar ones. Schweigert (1991) suggested that for less familiar idioms, the literal meaning might be processed initially as nonfigurative sentences. For those highly familiar idioms, the figurative meanings were processed first. The literal meanings were processed only if necessary. For idioms that fell in the middle of the familiarity spectrum, the processing time for both literal and figurative meanings might not be different.

An idiom can be classified based on the familiarity of its figurative meaning and the likelihood of evoking its literal meaning. Cronk and Schweigert (1992) attempted to determine the influence of the familiarity and literalness in idiom comprehension. Stimuli were 40 idioms that were equally divided into four categories, including familiar idioms with high literalness, less familiar idioms with high literalness, familiar idioms with low literalness, and less familiar idiom with low literalness. Each idiom was embedded into a sentence representing either the literal meaning or figurative meaning. Twenty control sentences with no idioms were constructed as fillers. The sentences were represented on the computer screen, and the reading time for each sentence was recorded. The findings indicated that the reading time was related to both of the familiarity and literalness. The familiar idioms were read faster than less familiar ones, and idioms with high literalness

were read more rapidly than those with low literalness. It was worth noting that the effect of familiarity appeared only when the idiom was used figuratively, and sentences containing less familiar idioms with lower literalness were the most difficult to comprehend. Therefore, both of the familiarity and literalness affected reading times of sentences containing idioms.

Titone and Connine (1994) examined the familiarity, compositionality, predictability, and literality of 171 idioms rated by 226 college students. The familiarity was rated based on the idiom's frequency of encounter and how well the participant knew the meaning of the idiom on a seven-poing scale. Participants were instructed to categorize idioms into three compositionality categories, including nondecomposability, abnormal decomposability, and normal decomposability. The difference between abnormal and normal decomposability was that if the idiom contained words that was directly related to their figurative interpretations. In addition, participants had to rate if the idiom had the plausible literal interpretation on a seven-point scale and to complete the phrase with the first word that came to mind as a way to evaluate the predictability of each idiom. The predictability was found to be positively correlated with the ratings of familiarity, frequency, and meaningfulness. Titone and Connine (1994) pointed out that 36% of the idioms in the study were judged uncategorizable in the compositionality, which suggested that the judgment of semantic analyzability was difficult.

How children and adolescents judged the idiom familiarity and idiom transparency was explored in the study of Nippold and Taylor (2002). Fifty children, mean age at 11;3 years, and 50 adolescents, mean age at 16;6 years, were given a

familiarity judgment task, an idiom comprehension task, and a transparency task. In the familiarity judgment task, participants rated 20 idioms based on their familiarity on a five-point scale. In the idiom comprehension task, participants were presented the same 20 idioms that embedded in a brief story context and then were asked to choose the best answer from four interpretations of the idiom. Lastly, in the transparency task, participants were instructed to indicate how closely the literal and figurative meanings were related using a three-point scale. The findings indicated that children were less familiar with idioms and performed worse in the comprehension task in comparison with adolescents. However, there was no difference between two groups on the transparency judgment task. Nippold and Taylor (2002) suggested that the transparency and familiarity were strongly correlated to idiom comprehension in children and adolescents and needed to be considered while examining idiom comprehension.

A more recent study done by Libben and Titone (2008) looked at the multidimensional nature of idiom processing. Two hundred and nineteen idiomatic expressions and 30 non-idiomatic literal phrases were rated based on nine dimensions, including the familiarity, meaningfulness, predictability, literal plausibility, global decomposability, normal decomposability, abnormal decomposability, verb relatedness, and noun relatedness. The global decomposability was defined as how each word in an idiom contributed to the overall figurative meaning, and verb and noun relatedness was viewed as to what extent that the constituent noun or verb was related to the overall figurative meaning. The results indicated that the familiarity was positively correlated with the meaningfulness and predictability but negatively correlated with the literal

plausibility. In addition, the meaningfulness was positively correlated with the verb and noun relatedness. It was also concluded that the decomposability effects took place when people were forced to pay attention to the semantic level, such as the meaningful judgment, rather than to the lexical level, such as the predictability of final words in the phrase. Additionally, high-familiar idioms involved the direct retrieval but low-familiar idioms required the decomposition for comprehension. The results of the study indicated that increasing the familiarity, literal plausibility, and global decomposability facilitated idiom comprehension. In general, idioms were represented and retrieved as units in memory and could interact with the ongoing compositional analysis of the meaning of the phrases. However, the decomposability could not be determined until the last word was encountered. Therefore, deciding whether the idiom was decomposable or not occurred in the very late stage of the processing.

Tabossi, Fanari, and Wolf (2009) asked 36 undergraduate students to read strings and then to press a button as soon as they saw a meaningful Italian phrase. The test materials were 16 decomposable idioms, 16 nondecomposable idioms, 16 clichés, and control strings that were created by replacing the first one or two words of the conventional strings. They found that all familiar verbal expressions were pressed faster than the controls, but no significant difference was found among three different types of conventional expressions. Additionally, in comparison to the predictability and decomposability, the familiarity played a major role in explaining the idiom superiority effect.

Summary of Idiom Comprehension

Idioms are essential in everyday conversation; however, they are less studied and have received less attention compared to other aspects of language. The results of how idioms are processed were in the debate depending on: the types of tasks used in the study, different levels of processing that the study measured, the types of idioms used in the study, and how researchers measured idiom comprehension. In addition to the difference in the research method, idioms varied widely in the transparency, familiarity, and compositionality that might impact how people interpret idioms. Although different models of idiom processing were proposed, how people interpreted idioms differently from regular phrases still remained unclear and debatable. According to the studies reviewed above, the right hemisphere was found to play an important role in idiom comprehension although the results were inconclusive. Therefore, interpreting idioms or familiar phrases may require the activation in both hemispheres. The clinical studies on people with widespread brain damage and focal brain damage also provided valuable and strong evidence for the role of both left and right hemispheres during idiom comprehension even though the results were not consistent throughout.

Idiom comprehension was examined by different theories and models 1) to understand the effect of familiarity, transparency, and compositionality on comprehending idioms, 2) to explore the role that the right or left hemisphere might have during the idiom comprehension process, and 3) to discover how people with widespread and focal brain damage processed idioms. However, how transparent and opaque idioms are processed is rarely studied. The dual coding theory (Paivio, 1971, 1986) postulated

that concrete words and abstract words are processed differently since concrete words activated both verbal and imaginal systems while abstract words are processed primarily by the verbal system. Because of the activation in both systems, concrete words are better retained and recalled compared to abstract words, which results in the *concreteness effect*. Therefore, this present study attempted to determine if the dual coding theory was able to explain how transparent and opaque idioms were processed differently and if the concreteness effect was able to apply to the idiom comprehension process when transparency of the idiom was taken into account.

Dual Coding Theory

Paivio (1971) claimed that the concrete language was retained better than abstract language. Therefore, the dual coding theory, proposed by Paivio (1971, 1986), assumed that there were two independent but interconnected systems, verbal and imaginal systems, attributed to the different retrieval effect between concrete and abstract words. Concrete words and phrases should be better recalled and retained than abstract words and phrases because concrete words and phrases could be encoded both verbally and nonverbally. Additionally, the dual coding theory suggested that abstract concepts were stored in the language dominated hemisphere, the left hemisphere, but that concrete concepts were processed in both hemispheres. Because of the two sets of processing and both verbal and imaginal representations for concrete words, concrete words were better recalled than abstract words. It was assumed that concrete nouns were learned through the sensory experience while the meanings of abstract nouns were derived mainly from the networks

that were mostly made up of abstract words (Sabsevitz, Meddler, Seidenberg, & Binder, 2005).

Concreteness Effect

One hundred and one undergraduate students were recruited in the study of Sadoski, Goetz, and Fritz (1993) in order to examine the effects of concreteness, familiarity, comprehensibility, and interestingness in a sentence recall task. Two concrete and two abstract sentences were written for each ten historical figures, and a total of 40 sentences were used as the stimuli. In the first part of the study, 22 students rated 40 sentences based on the comprehensibility, concreteness, familiarity, and interestingness. The rest of the 79 students read 20 sentences and then provided both immediate and delayed written recalls. It was revealed that the concreteness had most influence on the comprehensibility and on immediate and delayed recall tasks. The findings of this study provided the evidence for the dual coding theory because the concreteness had a greater effect on the comprehensibility and recall tasks compared to the content familiarity. In addition, the concreteness showed much greater effects on both immediate and delayed recalls than the comprehensibility, familiarity, and interestingness.

Sadoski (1995) further investigated whether the concreteness effects could be extended beyond the sentence level to the text. Paragraphs about historical figures, one highly familiar and one less familiar, were used as materials, and were further written in either concrete or abstract language. College students were first asked to rate the concreteness, content familiarity, and comprehensibility on a seven-point scale and then to read either concrete or abstract passages. Participants were asked to write everything

they could remember for each historical figure within 10 minutes after they read the passages. The results in the recall task showed that the difference between the concrete and abstract paragraph recall was significant for highly familiar figures, but was not significant for less familiar ones. In general, the concreteness effect in recalling concrete paragraphs was found, and the advantage of concreteness in recall was also found in concrete paragraphs with low familiarity content. In addition, the concrete content was better recalled when the concrete and abstract information were equally familiar. However, only when the abstract content was more familiar than the concrete content, they were able to be equally recalled. Thus, this finding was consistent with the dual coding theory.

Sadoski, Goetz, and Rodriguez (2000) investigated the concreteness effects on comprehension, interestingness, and memorability in four types of texts, including persuasive, expository, literary stories, and narrative. Eighty undergraduate students participated in the first study. Three concrete and three abstract texts for each text type were used as materials. In order to facilitate recalls, one abstract and one concrete title were written for each text. Half of the participants were presented 24 texts and asked to rate each text on seven-point scales based on the familiarity, concreteness, interestingness, and comprehensibility. The results of the rating indicated that the concreteness and comprehensibility were highly correlated. In the second experiment, participants read 24 texts with either all concrete or all abstract titles, and the titles were served as recall cues for participants to write what they remembered from the texts. The recalls were coded as gist, elaboration, or distortion. The results indicated that the gist recall was better for

concrete texts and was greater for both persuasive and narrative texts but weaker for literary texts. Overall, the concreteness was a strong predictor for the comprehensibility, interestingness, and recall. In addition, concrete texts were more comprehensible, interesting, and memorable than abstract texts.

Shibahara and Lucero-Wagoner (2002) studied how concrete words were processed differently in both hemispheres, and whether abstract words were only processed in the left hemisphere. Forty undergraduates were divided into two groups. The stimuli were 20 concrete and abstract words that each paired with a semantically related prime, such as *apple-orange*, a neutral prime composed of a row of four x's, such as *xxxx-orange*, and a semantically unrelated prime, such as *uncle-orange*. Participants were instructed to look at the prime without reading it aloud, but to read aloud for the target words. The results indicated that the priming occurred in both hemispheres and was activated greater in the right hemisphere than the left hemisphere for concrete words. Overall, abstract nouns were mainly processed in the left hemisphere, and there were hemispheric differences in processing concrete and abstract words.

Richardson (2003) investigated the concreteness effect through presenting concrete and abstract words in different types of sentences frames. This study tested the interaction between the effects of concreteness and meaningfulness in a cued recall. Twenty concrete and twenty abstract nouns with matched frequency were presented with meaningful and anomalous sentence frames. While the nouns were read by the experimenter, sixty undergraduates made judgments whether the word fitted into the sentence frame to make a meaningful sentence. Participants were provided with 40

sentence frames and asked to write down the word that had been read by the experimenter earlier but was considered against that sentence frame. It was found that the concrete nouns were better recalled than the abstract nouns. The meaningful sentence frames provided more effective cues than the meaningless sentence frames. Therefore, the results supported the dual coding theory. In the second experiment, participants were asked to perform a free recall of the words that had been read by the experimenter in three minutes. It was again found that the performance in a free recall was a function of the concreteness of the words and the meaningfulness of the sentence frames. Generally speaking, performance was better in the cued recall than in the free recall when the nouns were presented in meaningful sentence frames. However, there was no difference found between the free recall and cued recall when the nouns were presented in anomalous sentence frames. In addition, the increase in performance from the free recall to the cued recall was greater in concrete nouns than in abstract nouns. Therefore, both results from the free and cued recalls were consistent with the dual coding theory and supported that the concreteness and meaningfulness were additive in their effects.

Kellogg, Olive, and Piolat (2007) asked 60 undergraduates to write definitions of 10 concrete or abstract nouns and to perform a verbal or visual working memory task (WM) at the same time. The results showed that the interference of WM task was shown only when participants were writing the definitions of the concrete nouns but not the definitions of abstract nouns. Because participants did not need to generate the images while writing the definitions of abstract nouns, the interference did not show up. In addition, participants responded more slowly in defining abstract nouns while performing

the verbal WM task but not the visual WM task. Therefore, their findings were also consistent with the dual coding theory.

Different from studying on college students, Peters and Daum (2008) examined whether age-related changes in verbal memory affected recollection of the concrete and abstract words on a wide range of age group. Twenty-two young participants, aged 20-25 years, 20 middle-aged participants, age 33-51 years, and 23 older participants, age 52-72 years, saw 152 words equally drawn from four word groups, including concrete low frequency, concrete high frequency, abstract low frequency, and abstract high frequency. They were first asked to study words presented individually in an encoding trial. After 10 to 15 minutes, they were instructed to apply the remember/know techniques to recognize words from a group of words, which 152 old words were intermixed with 76 distracters. The findings showed that the age-related changes in recollection were affected by the word concreteness. The recollection of concrete words decreased more than recollection of abstract words. The recollection of concrete words showed a steady decline with age, but recollection of abstract words reduced only from the young to middle-aged groups. In addition, the word concreteness but not the familiarity had influence on age-related changes in recollection.

Dual Coding Theory in Neuroimaging Studies

Kounios and Holcomb (1994) used the event-related potentials (ERPs) to test the dual coding theory and the concreteness effect in the semantic processing. In the first experiment, twelve participants, age between 19 to 30 years old, were presented 40 concrete, 40 abstract, and 40 pseudo words formed from abstract words. They were

instructed to rapidly decide whether the word was an actual English word or not. In the second experiment, only concrete and abstract words from the first experiment were presented to 12 different participants, and they were asked to judge if the target word presented a concrete object or an abstract concept. The findings indicated that the concrete words activated more semantic information in memory than the abstract words. The concrete words also elicited greater activation in the right hemisphere than the left, which was consistent with the dual coding theory. Additionally, the difference between concrete and abstract words was larger in the right hemisphere and more anterior regions of both hemispheres. Therefore, the findings of the study supported the dual coding theory that different neurons were underlying the process during comprehension of concrete and abstract words.

West and Holcomb (2000) also utilized ERPs to examine the processing of concrete and abstract words under three levels of processing: image generation, semantic decision, and surface level evaluation. Thirty-six undergraduates were assigned to the three experimental conditions. In the imagery condition, participants were asked to form a mental image of each target word. In the semantic group, the participants were required to process the meanings of the target word without generating any mental images. In the surface condition, the participants only had to do a letter search, such as identifying if the letter "*n*" was in the word "*elephant/aptitude.*" Target words were 40 concrete and 40 abstract words embedded in eight types of sentences with varied difficulties and possibilities of generating mental images. The findings showed that the post-lexical processing was necessary to elicit the concreteness effect since there was no difference in

the reaction time and ERPs between the concrete and abstract words in the surface condition. The reaction time was shorter for the concrete words than abstract words especially in the imagery task. Therefore, this study supported the dual coding theory that the use of mental imagery and superior associative connections contributed to the processing advantage of concrete words.

Another ERPs study was done by Nittono, Suehiro, and Hori (2002). Twelve college students were asked to first rate the imageability of the words on a five-point scale and to recall as many words as they could after the presentation of the stimuli. The stimuli were composed of high imagery words, low imagery words, and non-words. It was revealed that the high imagery words were better recalled than the low imagery words, and the high imagery words had denser and stronger associative interconnections than the low imagery words. Moreover, the results indicated that high imagery words activated additional imagery-related networks that were located in the right hemisphere which were not activated by low imagery words.

Swaab, Baynes, and Knight (2002) also conducted an ERPs study and presented 320 word pairs auditorily to 12 adult participants. The stimuli were composed of high imageable and low imageable words, and the word pairs were either related or unrelated in meaning. For example, *pig-horse* was high imageable and related in meaning, but *bile-sentence* was low-imageable and unrelated in meaning. Participants were asked to decide whether the words in pairs were semantically related or unrelated. It was found that high imageable and low imageable words activated distinct areas, and the findings

supported the existence of two separate semantic systems, including verbal and image-based systems.

The concreteness effect and the dual coding theory were also investigated through the functional Magnetic Resonance Imaging (fMRI). Jessen and colleagues (Jessen, Heun, Erb, Granath, Klose, Papassotiropoulos, & Grodd, 2000) investigated the cortical regions that are responsible for the concreteness effect through the fMRI. Fourteen participants, mean age at 31.5 years, participated in this study, and experimental materials were 120 concrete and 120 abstract words. Participants were presented 80 words and were asked to encode as many words as possible for a later recognition task. During the recognition task, stimuli were consisted of 80 previously shown experimental words and 80 distract words, and participants were asked to identify previously presented words. During encoding phase, a stronger activation in the lower right parietal lobe was observed for the concrete words, which supported that the right hemisphere participated in the processing of concrete words. Moreover, the concrete words also activated areas in the left hemisphere that were outside of the primary language areas. Conversely, the abstract words presented a stronger activation in the left inferior frontal gyrus (Broca's area) and the right lateral occipital gyrus. Therefore, Jessen and colleagues (2000) claimed that the superior encoding of concrete words might result from the greater verbal context resources and the additional activation of a non-verbal, imagery-based system in the right parietal lobe.

Sabsevitz and colleagues (Sabsevitz, Meddler, Seidenberg, & Binder, 2005) also conducted an fMRI study to determine if the difficulty of the task affected the concreteness effect. The stimuli were composed of 60 easy concrete, 60 hard concrete, 60

easy abstract, and 60 hard abstract nouns. The task difficulty varied depending on if the meanings of the choice words were similar to the samples. Twenty-eight adults were asked to select the word that was most similar to the meaning of the sample noun. The results indicated that abstract nouns were mainly activated and processed in the left hemisphere while concrete nouns were processed bilaterally. Therefore, this study provided the evidence of bilateral activation during the processing of concrete nouns, which further supported the dual coding theory.

Another fMRI study done by Noppeney and Price (2004) asked 15 adults to choose the word that had a similar meaning to the sample word. The words were drawn from abstract concepts (*intent*, *attempt*), colors (*pink*, *red*), sounds (*tone*, *melody*), and hand movements (*squeeze*, *comb*). The results showed that the abstract concepts activated a left-lateralized frontal temporal system that was usually involved in semantic processing. Additionally, the abstract concepts and sensory-based semantics were processed in different neural systems. Noppeney and Price (2004) suggested people might generate a semantic context to obtain the meanings of abstract concepts because they could not be represented by real objects. Binder, Westbuy, McKiernan, Possing, and Wedler (2005) also examined the concreteness effect using fMRI by requesting participants to identify concrete and abstract words. Twenty-four participants, age between 20 to 50 years old, were asked to make the lexical judgment whether each stimulus was a word or a non-word on 200 stimuli, including 50 concrete words, 50 abstract words, and 100 non-words. It was evident that the concrete words elicited stronger activation bilaterally in contrast to the abstract and non-words. Additionally, the

abstract words had stronger activation in the left posterior inferior frontal areas compared to the concrete words and elicited mostly the left hemisphere in comparison to non-words. Therefore, this study was in line with the previous studies that the processing of concrete words was left-lateralized and the processing of concrete words was bilateral.

Fliessbach, Weis, Klaver, Elger, and Weber (2006) also examined the processing of concrete and abstract words during encoding and retrieval using fMRI. Twenty-one participants, age range from 19-43 years old, were presented 90 concrete and 90 abstract simple nouns in the encoding phase. The participants were asked to remember the words as well as possible. During the recognition phase, participants saw 180 previously presented stimuli intermixed with 180 distract words, and they had to decide if the word was definitely old, probably old, definitely new, or probably new. It was found that the concrete words were better memorized than the abstract words, but there were no areas activated more strongly by concrete words during the encoding phase. However, there was a strong bilateral activation in the inferior parietal regions for concrete words during the recognition phase. Contrast to the concrete words, the abstract words elicited a stronger activation in the left interior-frontal cortex during both encoding and recognition than the concrete words.

Other than the ERPs and fMRI, Mellet, Tzourio, Denis, and Mazoyer (1998) investigated the activation of cortical areas through Positron Emission Tomography (PET) when people listened to the definitions of concrete words. Eight participants, age between 20 to 25 years old, were presented to three experimental conditions, including generating mental imagery while listening to the concrete word definition condition (CONC),

listening to the abstract word definition condition (ABST), and a rest condition (REST). The participants in CONC and ABST conditions were instructed to listen to 15 words and their definitions and then recalled the words they had just heard. The findings indicated that participants recalled more concrete words than abstract words, and bilateral activations of the inferior temporal and the fusiform gyri were greater for concrete words than abstract words. It was also found that listening to the abstract word definitions elicited more intensive and extended activations in the language comprehension network (inside Broca's Area) compared to listening to the concrete words. Similar results were also found in a recent study conducted by Liu and colleagues (Liu, Xiang, Wang, Vannest, Byars, & Rose, 2008). They used the whole head magnetoencephalography (MEG) to examine how people processed concrete and abstract words. The findings also supported that concrete and abstract words were processed differently in the brain, and the difference existed not only in anatomical substrates, but also in the frequency of neural activations.

Literature reviewed above either fully or partially supported the dual coding theory or the concreteness effect. However, the reverse effect or opposite findings were revealed in other studies. Kiehl and colleagues (Kiehl, Liddle, Smith, Mendrek, Forster, & Hare, 1999) asked six participants, age 22 to 26 years, to make a decision whether the word presented was a real English word or not on a pool of concrete words, abstract words, and pseudo words. The fMRI was used to analyze the neural pathways involved in the processing of concrete and abstract words. The results showed that concrete words were processed more efficiently and accurately than abstract words. However, the

analysis of fMRI indicated that both left and right hemispheres involved in the processing of concrete and abstract words, and the processing of abstract words elicited a stronger activation in the right hemisphere in comparison to the processing of concrete words. The plausible explanation of less accurate and slower responses for abstract words might result from more extensive semantic processing. The findings of this study did not support the dual coding theory. Moreover, Kiehl and colleagues (1999) claimed that the right hemisphere was more heavily engaged in the processing of abstract words.

The findings in Fiebach and Friederici's study (2003) were also inconsistent with the hypothesis that the right hemisphere involvement was only found for concrete words. They analyzed how people processed concrete and abstract words through fMRI and asked participants to judge whether the stimulus was a German word or not. It was found that the decision time yielded no difference between the concrete and abstract words. In addition, the concrete words activated left basal temporal cortex, which usually involved higher-level visual processing and mental imagery. Similarly, abstract words elicited stronger activities in left inferior frontal region, which was related to retrieval of semantic information. Thus, this study argued that both concrete and abstract words activated comparable language networks.

Pexman and colleagues (Pexman, Hargreaves, Edwards, Henry, & Goodyear, 2007) used fMRI to examine 20 healthy adults, mean age at 26.5 years old, during a semantic categorization task. They found that abstract words elicited more widespread cortical activations than concrete words, and abstract words activated more strongly in the network regions associated to semantic processing, including temporal, parietal, and

frontal regions. In other words, the findings were not consistent with both the dual coding theory and context availability theory. It claimed that no cortical areas were activated more strongly for concrete words than for abstract words. Pexman and colleagues (2007) argued that the semantic categorization task required more extensive semantic processing than the lexical decision task; therefore, the representation of abstract concepts could be fully activated.

Three studies reviewed above mainly argued against the right hemisphere lateralization in the processing of concrete words and claimed that abstract words indeed activated similar or more widespread neural activities in comparison to concrete words. Different from these studies, Papagno, Capasso, Zerboni, and Miceli (2007) examined the concreteness effect on one participant with semantic dementia through a series of tests, including the lexical decision, word-picture matching, verb naming, and naming objects from pictures and definitions. It was found that the participant performed normally in lexical decision, word-picture matching, and verb naming; however, participant was impaired in naming objects from pictures and from definitions especially for concrete stimuli. The participant and five neurologically normal controls were asked to point to the word that was less familiar in meaning from two synonyms and one semantically related word. They found again that the participant with semantic dementia performed worse than controls on concrete words but not on abstract words. Since the participant had the focal atrophy of the left temporal lobe, Papagno and colleagues (2007) argued that the temporal lobe located in the left hemisphere did not involve in the processing of abstract words but the processing of concrete words.

Since the concrete content additionally activates the imaginal system, it was easier retained and recalled than the abstract content. According to the studies reviewed previously, the concreteness effect was found in words, sentences, and paragraphs, and the right hemisphere was activated by the concrete information based on neuroimaging studies. Although the results from few studies did not support the dual coding theory or the concreteness effect, most of the studies showed that an advantage existed in recalling and retaining the concrete information in contrast to the abstract information. The main interest of this study was to explore the relationship between mental imagery and idiom comprehension in adults across the lifespan; therefore, it was essential to review literature that focused on mental imagery and figurative language, especially idioms.

Mental Imagery and Figurative Language

Up to date, a very limited number of studies examined the use of mental imagery in figurative language comprehension. Gibb and colleagues (Gibb, Strom, & Spivey-Knowlton, 1997) attempted to provide the evidence that proverbs and their figurative meanings were linked by conceptual metaphors and that mental imagery motivated the figurative meanings of proverbs. Seventy-two college students were divided into three experimental conditions, including the proverb, literal alternative, and figurative definition. Sixteen highly familiar proverbs were selected as the stimuli, and the participants had to write down their mental images in response to four questions. The proverbs were formulated for the literal alternative condition and were also modified to present their figurative meanings for the figurative definition condition. Two yes/no questions regarding the storability and intentionality and two open-ended questions,

causation and manner, were asked to instruct participants to write down detailed mental images for each expression. The findings showed that the participants provided similar mental images and consistent knowledge about the events they described in the proverb condition in contrast to the literal alternative and figurative definition conditions. The participants provided consistent general images for the proverbs and offered detailed and consistent responses to questions regarding their mental images. It was proposed that the conceptual metaphors, not the familiarity, motivated what the proverbs really meant based on the high consistency of participants' mental imagery and responses to the questions. Gibbs and colleagues (1997) suggested that mental images revealed the conceptual knowledge underlying the meaning of linguistic expressions. Moreover, figurative meanings of proverbs were partly activated by conventional images and conceptual metaphors, which were a significant part of everyday thought.

Duthie and colleagues (Duthie, Nippold, Billow, & Mansfield, 2008) also examined the relationship between mental imagery and proverb understanding in school-age children, adolescents, and adults. The mental imagery task and proverb comprehension tasks were administered. Twenty concrete proverbs were used as the stimuli in both tasks. Participants were asked to write down their images of each proverb in the mental imagery task and were requested to choose a statement that best expressed the proverb's meaning from four possible choices. In the comprehension task, a four-sentence story was created for each proverb with a concluding proverb. The mental imagery was scored based on a four-point scoring system, including irrelevant, literal concrete-relevant, literal-metaphorical-relevant, and figurative-metaphorical-relevant.

The results indicated that mental imagery for concrete proverbs gradually increased with age, but the use of mental imagery was not significantly different between two young groups. Although adults reported more metaphorical images compared to children or adolescents, the literal concrete-relevant image was the most common of the mental images reported by participants. The findings indicated that adults have a more metaphorical understanding of proverbs than children and adolescents. Although some of the proverbs evoked stronger images than others, not all concrete proverbs were imagineable. In addition, the relationship between mental imagery and comprehension was significantly correlated for the children but not for the adolescents and adults.

According to the studies in proverb comprehension and mental imagery, metaphorical images existed and were activated during the proverb comprehension process. In addition to proverbs, mental image was also found related to idiom comprehension. Forming the arbitrary link between idioms and their idiomatic meanings was important in learning the meanings of idioms. Therefore, Gibbs and O'Brien (1990) investigated if people have the tacit knowledge of the metaphorical basis about idioms. In their first study, 24 undergraduates were asked to define 25 idioms and then to form a mental image for the expression. Idioms were categorized into five different meanings, including anger, exerting control, secretiveness, insanity, and revelation. Six probe questions were asked to reveal participants' mental images, containing causation, intentionality, consequence, negative consequence, and reversibility after they formed a mental image. The findings indicated that participants had similar schemas underlying their mental images with similar idiomatic interpretations. In addition, their responses to

the probe questions regarding the mental images were highly consistent and detailed. In general, the highly consistent mental images of idioms suggested the active role of conceptual metaphors in idiom comprehension and that conceptual metaphors motivated the link between idioms and their nonliteral meanings. Therefore, people know what the idioms really mean because of the influence that conceptual metaphors have on their mental images.

In their second study, the figurative definitions of each idiom were used as stimuli and the same six probe questions were asked. It was revealed that participants' mental images for the paraphrases of the idioms were inconsistent and varied compared to the mental images formed in the first study solely for the idioms. Therefore, it was suggested that mental images for idioms were not constructed solely on the basis of these phrases' figurative meanings. Moreover, people's mental images of idioms were constrained by the conceptual metaphors that partially linked the idiom and its figurative meaning. In the third study, Gibbs and O'Brien (1990) compared images formed for literal phrases to those formed for idiomatic expressions. It was found that mental images and responses to the probe questions were less consistent than those for idioms. It was suggested that the difference in mental images between idioms and literal phrases resulted from the constraining influence of conceptual metaphors. These conceptual metaphors provided tighter constraints in forming mental images for idioms and further resulted in consistent knowledge of their mental images and figurative expressions. However, it was unlikely that people would construct mental images for idioms during the normal processing. Given that the rapid processing for idioms, the familiarity with idioms allowed people to

recognize the figurative meanings without awareness of conceptual metaphors motivating the meanings of these expressions.

Cacciari and Glucksberg (1995) proposed two questions regarding the role of conceptual metaphors in the Gibbs and O'Brien's 1990 study. First, it was confounded when the idiom can be interpreted literally, such as *kick the bucket*. Visual images were highly possible to reflect literal meanings rather than figurative meaning. Secondly, according to the dual coding theory, concrete concepts would form mental images more easily than abstract concepts. Therefore, it was highly unlikely to automatically form a mental image for the idiomatic meaning which was more abstract than its literal meaning. Thirdly, based on the Stroop Test, people automatically generated the meanings of words, but the literal meaning of words was not inhibited. Therefore, Gibbs and O'Brien's hypothesis was questionable while it was used to explain the automatic activation of lexical meanings. In order to determine which interpretations of idioms, concrete-literal or abstract-figurative, were reflected in people's mental images in processing idioms, 20 undergraduates participated in an imagery production experiment. Twenty Italian idioms that varied in the transparency and familiarity were used as stimuli. Participants were asked to provide a paraphrase of each idiom, to form mental images for the idiom, and to describe it in details. It was found that the images reflected the concrete actions and events that the idiom indicated. The findings were in line with the concreteness effect that the concrete literal meaning of an idiom generated a mental image more easily than an abstract-figurative meaning.

In the second study of Cacciari and Glucksberg (2005), the main research question was whether mental images facilitated or interfered with idiom comprehension, and 96 undergraduates participated in the second study. The materials were 20 idioms used in the first study, 20 literal-concrete sentences, and 20 literal-abstract sentences. Each sentence consisted of one matching and one mismatching paraphrase. The participants were divided into two groups, non-imagery instruction group and imagery instruction group, and were asked to make a judgment if the paraphrase matched the target sentence. The difference between two groups was that the imagery group had to generate detailed mental images of the target sentence before the paraphrases showed on the screen. The reading time for three types of sentences in the non-imagery group was similar; however, abstract sentences took longer to respond in the imagery group. Moreover, the image generation increased the verification time for more difficult sentences and unfamiliar idioms. Regarding the error rates, participants made fewer errors in verifying idioms than verifying concrete or abstract sentences. In general, images that participants generated for idiom strings reflected literal rather than figurative meanings. Additionally, mental images did not facilitate idiom comprehension but prolonged the comprehension time. The participants also did not use mental imagery to perform the paraphrase verification task no matter if it was a concrete-literal, abstract-figurative, or idiomatic. Therefore, Cacciari and Glucksberg (2005) argued that images did not provide the evidence for conceptual metaphors in the idiom comprehension process, which was inconsistent with the Gibbs and O'Brien 1990 study.

In order to determine whether people access pre-existing conceptual metaphors during the online idiom processing, 34 undergraduates participated in the study of Gibbs, Bogdanovich, Sykes, and Barr (1997). Fifteen brief stories and 15 fillers were randomly divided into six test lists. Each list contained five stories ending with idioms, five stories ending with literal paraphrases, five stories ending with control phrase, and 15 filler stories. Three of the five phrases in each list ending with related targets, unrelated targets, or opposite types of targets. The participants were instructed to make a lexical decision to the letter strings, which appeared after the final phrase, as quickly as possible. The findings showed that participants took the similar time to process idioms and literal paraphrases, but longer to comprehend control sentences. Additionally, participants responded to the related targets faster than the unrelated targets after reading the idioms, but not after reading the literal paraphrases or control sentences. The findings supported that conceptual metaphors were accessed during the idiom comprehension process. Moreover, people accessed figurative meanings and literal meanings at the same time or even before they processed the literal meanings. In their second study, 36 undergraduates read 16 stories describing usual events. Each story ended in one of the two different idiomatic phrases expressing the same figurative meaning, including the consistent idiom motivated by the conceptual metaphor that reflected the idiom (*anger is heated fluid in a container*) and the inconsistent idiom motivated by a different conceptual metaphor (*anger is animal behavior*). Similar to the first study, the final phrases of the stories were followed by either related or unrelated targets. It was found that the participants responded faster to the targets after reading consistent idioms than inconsistent ones.

Therefore, people did not access the same metaphorical knowledge when reading idioms. It was concluded that the metaphorical knowledge may play a role in people's immediate understanding of certain idioms.

Bortfeld (2002) conducted a series of studies to investigate mental imagery in idiom comprehension in native and nonnative English speakers. In the first experiment, 25 native English speakers and 25 native Latvian speakers were recruited. Twenty five idioms under five concepts, including anger, revelation, secretiveness, insanity, and control, were used. Six probe questions were asked to reveal participants' mental images including causation, intentionality, manner, consequence, negative consequence, and reversibility. Participants were first asked to generate a sentence for each idiom using the phrase figuratively and then to form a mental image based on the literal meaning of the idiom. After the image generation, the participants were again asked to produce sentences for the idioms using the phase figuratively. The findings showed that both native and non-native speakers formed images reflecting the combination of figurative and literal meanings and had difficulty separating the phrases' literal meanings from the figurative meanings. Thirty undergraduate students rated the naturalness of each sentence that was produced before and after the participants generated the mental image for each idiom. The findings indicated that the naturalness of sentences increased after participants generated mental images.

In the second study, 25 native Chinese speakers were included instead of Latvin speakers. The stimuli were twenty-five idioms and questionnaires used in the fist experiment. It was revealed that both English and Chinese speakers reported highly

consistent responses about their images of English idioms. Therefore, the analysis of surface structures helped non-native speakers generate figurative meanings of idioms. General speaking, people were able to generate figurative meanings through the analysis of the surface structure of idiomatic phrases without additional supporting contexts. Given that highly similar images generated from native and non-native speakers, some specific conceptual structures might underlie some idiomatic phrases. It was suggested that our understanding of idioms must first map words to conceptual structures that are meaningful to the speakers, and then the conceptual mapping would become well established.

It was suggested that transparent idioms may be easier comprehend than opaque ones because of the involvement of mental imagery and the concreteness effect (Cacciari & Glucksberg, 1995). Nippold and Duthie (2003) examined the use of mental imagery in idiom comprehension on 40 school-age children and 40 adults. Twenty high familiarity idioms, including 10 transparent and 10 opaque, were used as the experimental items in two tasks, mental imagery task and idiom comprehension task. The participants were asked to write down their images when someone uses each of idioms listed in the booklet. After the mental imagery task, participants were required to interpret the 20 idioms by choosing the correct answer from four possible responses. Each idiom was embedded in a four-sentence story context with the final sentence containing the idiom used by a character in the story to facilitate comprehension. The results supported that the transparent idioms were easier to understand than the opaque ones, and adults outperformed school-age children on the idiom comprehension task. However, even

adults did not master all the idioms used in this study. Regarding the mental imagery task, it was revealed that for both groups, mental imagery was associated with the comprehension of both transparent and opaque idioms. Moreover, both idiom comprehension and mental imagery improved with increasing age. It was suggested that mental imagery would be automatically created once the figurative meaning of an idiom was learned. Although images triggered by opaque idioms were less sophisticated than the ones by transparent idioms, some images of opaque idioms reflected the deep figurative understanding. Therefore, mental imagery may serve as an indicator of deep understanding of figurative meanings in idiom comprehension. Additionally, the knowledge of idioms is expected to expand, and deepen and mental imagery is expected to become more figurative with advancing age.

Summary of Dual Coding Theory

The dual coding theory was commonly used to examine the difference in comprehension and recall between concrete and abstract words, sentences, concepts, and content. It was found that concrete concepts and content were easily remembered, recalled, and comprehended in comparison with abstract ones. This phenomenon was often referred to the concreteness effect. The concrete concept or content elicited additional right hemisphere activations, where the imaginal system was located. Therefore, it provided the sensational experiences for the concrete information and further resulted in better understanding and recall. The dual coding theory and the concreteness effect were evident from behavioral and neuroimaging studies. Although not all studies yielded the same results because of different stimuli and methods used across

the studies, the dual coding theory provided the strong ground knowledge for the differences observed between concrete and abstract words, sentences, content, and concepts.

Gibbs and O'Brien (1990) pointed out the active role of conceptual metaphors in idiom comprehension and further suggested that the conceptual metaphors motivated the link between idioms and their nonliteral meanings. Additionally, researchers believed that the conceptual metaphors motivated what the proverbs/idioms really meant according to the high consistency of people's mental imagery (Bortfeld, 2002; Gibb, Strom, & Spivey-Knowlton, 1997). Although a few studies argued that mental imagery did not facilitate the understanding but prolonged the processing time, the highly consistent mental images reported by people implied some specific structures underlying the understanding of figurative language. Duthie and colleagues (2008) argued that some proverbs evoked stronger images than others, bur not all concrete proverbs were imagineable. Therefore, how mental imagery was formed differently for transparent and opaque idioms remained questionable.

Most of the studies reviewed in idiom comprehension and the dual coding theory were limited to college student populations although a few of the studies examined children and adolescents. However, figurative language was rarely studied in older people. With the aging populations growing, it is important to understand the language performance in aging populations since cognitive decline is commonly observed in the elderly and their possible language decline may be observed. Since the focus of this study

is to examine idiom comprehension in adults across the lifespan, it is essential to have comprehensive knowledge regarding language in aging populations.

Language and Aging

It is commonly assumed that once language is acquired, it never goes away except if the language system is impaired due to brain damage such as stroke, traumatic brain injury, or dementia. However, studies showed that language performance, both production and comprehension, declined with advancing age due to decrement in processing speed (KwongSee & Ryan, 1995; Waters & Caplan, 2005), working memory (Carpenter, Miyake & Just, 1994; Gunter, Jackson, & Mulder, 1995; KwongSee & Ryan, 1995; Waters & Caplan, 2005), verbal working memory (DeDe, Caplan, Kemtes, & Water, 2004), and inhibitory efficiency (Burke, 1997; Hasher & Zacks, 1988;KwongSee & Ryan, 1995). Obler and Albert (1989) studied naming, discourse, comprehension, automatic speech, and metalinguistic abilities on 150 adults, ages between 30-79 years. They pointed out that naming ability decreased beginning in the 70s, but deficits in comprehension started as early as the 50s. However, increased elaboration in discourse was observed, and no change in metalinguistic tasks, such as word list generation and interpretation of proverbs and idioms, was found in the older group. Emery (1986) also pointed out that there was a direct relationship between linguistic complexity and performance deficits in elderly, and the semantic processing in the sentence level and the syntactic processing were significantly impaired in elders. In addition, it was evident that the greater the linguistic complexity, the more difficulty in language processing was

found in normal older people. Furthermore, Emery (1986) claimed that linguistic declined in normal elders was not a random occurrence, but an orderly and predictable sequence.

Although some researchers suggested that language deterioration was associated to normal aging (Emery, 1986; Olber & Albert, 1989), not all aspects of language declined with advancing age. Understanding how age affected language performance in normal aging was essential to further understand the relationship between more complicated figurative language and normal aging. Since this study elicited both receptive and expressive language performance, it was needed to review language production and comprehension in normal aging populations.

Language Production and Aging

It is suggested that there are different levels of deterioration in language while getting old. It is evident that difficulties in naming, reduced syntactic complexity, and decrement in verbal fluency are commonly observed during the age of 70 (Ardila & Rosselli, 1996). Elders might have difficulties accessing the appropriate lexical items, producing syntactically complex sentences, and integrating all story elements in a complex discourse structure (Juncos-Rabadan & Iglesias, 1994). Burke and MacKay (1997) also stated that spoken and written language production consistently showed age-related declines, and common deterioration observed in elders' language production included word finding/lexical retrieval difficulties, tip of the tongue (TOT), disfluency in speech and ambiguous references. Ulatowska, Cannito, Hayashi, and Fleming (1985) examined how information was told, retold, and summarized in different discourses such

as narrative, procedure discourse, and conversation. They found that there was an age-related decrement for the complex processing of discourse information in the later years of life, and the decrements might result from multiple causative factors rather than just cognitive impairments with advancing age.

In order to investigate the linguistic patterns in normal elderly and the differences of linguistic function between normal elders and individuals with AD, twenty middle-age adults, ages 30 to 42 years, twenty normal elders, ages 75 to 93 years, and 20 individuals with AD participated in Emery's study (1986). The Token Test, The Emery Test for Syntactic Complexity, The Chomsky Test of Syntax, and The Boston Diagnostic Aphasia Examination were used as linguistic measures. The results pointed out that there was a direct relationship between language deficits and age and between language deficits and linguistic complexity. In other words, the more complex the linguistic form was and the later the development of the linguistic form, the quicker the deterioration of the linguistic form. It was found that performance on the phonology tasks showed no difference between middle-age adults and normal elders except the speed of response. Additionally, there was no difference found between middle-age adults and normal elders in vocabulary ability. However, normal elders performed worse than middle-age control group in morphological and syntactic level. When the level of linguistic complexity increased, the normal elders showed more pronounced decrement in language ability. Therefore, normal elders performed as well as middle age adults did in lexicon, but performed worse in the word-internal morphological processing, and did even worse on the sentence level task since it was more abstract and complex.

Eight participants in each age category, 50-59, 60-69, 70-79, and 80-89, were recruited in the Kynette and Kemper study (1986). Each participant provided a 20 minute personal story about their lives. The number of different simple syntactic structures, the number of complex syntactic structures, the percentage of simple structures correctly produced, the number of different verb tense, and the percentage of verb tenses correctly produced were measured in order to detect the difference in syntax, tense, form class, lexical use, and disfluency across four age groups. The finding revealed that there was a reduction in accuracy of syntactic structures, verb tense, and form classes from 50 to 90 years; however, disfluency measured by fillers and fragments did not increase with age. Additionally, 50 and 60 year-olds used more complex structures with multiple embeddings, but 70 and 80 year-olds made more errors in the use of simple syntactic structures, correct past tense inflections, subject-verb number agreement, articles, and possessive markers.

It was suggested that elders had difficulties producing syntactically complex sentences because it would impose high memory demands. In order to further provide evidence for this hypothesis, Kemper (1986) studied the imitation of sentences on 16 healthy elders, ages between 70-89 years and 16 adults, ages between 30-49 years. A set of 32 sentences varying from grammatical correctness, length, position, and type of embedded clause were used as materials. The 32 sentences were read to the participants, and then participants were asked to repeat each sentence. The findings indicated that elders had impairment in syntactic processing and also had difficulties repeating long sentences with embedded clauses, which might result from memory limitations.

A group of nine normal middle-aged adults (50-60 years), a group of 11 normal elders (80-90 years), and a group of 10 elders (80-90 years) with mild cognitive impairments were compared on three discourse tasks including a retold narrative task, a retold instructional task, and a personal narrative task in the Richardson study (1990). The results revealed that normal elder adults and elderly adults with mild CI had more difficulties in the retold instructional task than the retold narrative task. Additionally, middle-aged adults included more essential procedure steps in the instructional task than normal elders and elders with mild CI. A decrease in the percentage of nouns used, an increase in the use of ambiguous pronouns, and the lack of indefinite reference were found in normal elders and elders with mild CI across three discourse tasks.

Juncos-Rabadan and Iglesias (1994) investigated if the reduced language abilities were associated with impaired attention in older adults across 14 languages. Sixty normal older adults, ages 50 to 91 years, in 14 languages, a total of 840 participants were further divided into three age groups, 50-59 years, 60-69 years, and 70-91 years and three educational levels, 0-4 years, 5-10 years, and beyond 11 years. Each subject was the native speaker of the language and was tested on different linguistic levels including morphology, syntax, lexicon, and language skills such as verbal fluency, comprehension, reading, and writing. The results indicated that aging was associated with linguistic deterioration in syntax, lexicon, morphology, phonology, and semantics. It seemed that semantic and conceptual knowledge, organization of semantics, and phonological lexicon were preserved; however, the deterioration was observed in synonyms, antonyms, and semantic opposites. In addition, the difficulty shown in the definition, comprehension,

repeating complex sentences, judgment, and syntax, morphology, and discourse subtests suggested that the decline resulted from the impairment in working memory and executive function.

Thirty young adults, 18 to 28 years of age, and thirty older adults, ages 70 to 80 years old, participated in Kemper and colleagues' study (Kemper, Herman, & Lian, 2003). Fifty-four experimental trials containing 36 different two-word combinations, 36 three-word combinations, and 36 four-word combinations were administered. Participants were asked to produce sentences by using the words presented on the computer screen. The results suggested that memory load affected sentence planning in older adults since the stimulus disappeared as soon as the participants began to speak. Moreover, older adults had difficulties retaining the words and tended to produce less complex, shorter, and less informative sentences when the numbers of words increased. .

Kemper, Herman, and Liu (2004) attempted to examine sentence production by young and older adults in controlled contexts, and twenty-four young adults, 18 to 28 years old, and 24 older adults, 70 to 80 years old, were recruited. Thirty-six left- or right-branching stems were used as the stimulus, and the participants were asked to complete the sentences with either right- or left-branching stems. In addition to the stems, 27 nouns referring human characters and 27 nouns referring locations were provided for participants to complete the sentences. Sentence length, grammatical complexity, and propositional density were measured. The findings showed that left-branching which required the participants to produce the main clauses in order to complete the sentences imposed greater burden on working memory. Therefore, older adults made more errors,

nonfluent responses, and fragments in contrast to younger adults while producing responses to the left-branching stems compared to those to the right-branching stems. Different from examining spoken language in older adults, Kemper, Greiner, Marquis, Prenovost, and Mitzner (2001) analyzed autobiographies collected from 90 participants who participated in the Nun study on grammatical complexity and idea density. The grammatical complexity was measured based on the clauses embedded in one sentence, and the idea density was assessed through the number of propositions per 10 words. It was found that grammatical complexity and idea density declined with age. Additionally, participants, especially above age of 61, produced less complex sentences and used more words to express the same idea. Furthermore, later autobiographies were vaguer and consisted of more repetitions than early written ones.

Different from the studies reviewed above, Glosser and Deser (1992) attempted to investigate the age changes in macrolinguistic and microlinguistic aspects of discourse production. They informally interviewed 14 middle-age adults, ages 43-61 years, and 13 normal elder, ages 67-88 years. Participants were interviewed individually for 10 to 20 minutes and were asked to describe their families and work experience. Microlinguistic language including syntactic omissions, syntactically complete sentences, subordination, verbal paraphasias, indefinite terms, and macrolinguistic language such as thematic coherence and discourse cohesion were measured. It was found that there was no difference on microlinguistic language measures between middle-aged adults and normal elders. However, macrolinguistic language ability was found to be impaired in normal elders since it required linguistic and nonlinguistic knowledge such as working memory,

long-term memory, and executive function. Normal elders in this study had difficulties integrating and organizing information into a theme- or topic-coherent discourse. Glosser and Deser (1992) claimed that normal elders' discourse was similar to individuals with probable Alzheimer's disease who showed significant impairments in nonlinguistic language, memory, and executive function.

Language Comprehension and Aging

The goal of comprehension is to obtain an understanding of described states of affairs and then the information needs to be stored for later use (Radvansky, 1999). Since working memory, inhibitory efficiency, and processing speed appeared to be affected by aging (Carpenter, Miyake, & Just, 1994; Gunter, Jackson, & Mulder, 1995; KwongSee & Ryan, 1995; Waters & Caplan, 2005), comprehension of spoken language might be also influenced by the deficits of these cognitive functions. According to the study of DeDe, Caplan, Kemtes, and Water (2004), an effect of age mediated through verbal working memory was the best-fit model for sentence and text comprehension. Obler, Fein, Nicholas and Albert (1991) also pointed out three possible factors contributed to the comprehension deficits observed in the normal aging populations including impairment in syntactic processing, shift in strategy, and age-related deficits in extralinguistic cognitive functions.

Cohen (1979) asked twenty participants in each group, highly educated old people (OHE), highly educated young people (YHE), old people with low education level (OLE), and young people with low education level (YLE), to listen to 16 short messages and to answer two questions according to the content. Half of the messages were classified as

simple, and the other half were complex. The messages were spoken in two different rates, slow and fast. Participants were asked one verbatim question that required reproduction of the presented facts and one inference question that participants had to draw inference from the presented facts. The results revealed that age-related deficits existed in inferential stage but not for the verbatim questions. The plausible reasons might be the decrease of processing speed and memory loss. The same participants were also asked to judge 16 messages which contained one anomaly and one making sense version. The findings showed that older groups performed worse than younger groups, and the mistakes were due to assessing incorrect prior knowledge. The third experiment carried out to compare the recall ability between old and young groups with high and low educational level. Same participants recalled a 300-word story, and the recalls were scored based on the total number of propositions, summary propositions which represented the gist of the story, and 24 modifiers including comparatives and quantifiers, temporal modifier, locatives, and logical connectives. It was revealed that old groups performed worse than young groups did because of the heavy memory load on the recall task. In general, elders maintained surface comprehension and had deficits in language comprehension involving integration, inference, and construction.

Sentence comprehension abilities in adults, ages 18 to 80 years, were compared in the Feier and Gerstman study (1980). Fifteen participants in each age group, 18 to 25, 52 to 58, 63 to 69, and 74 to 80 years were tested on vocabulary and digit span and were instructed to act out each stimulus sentence using small animals or human figures. Four types of sentences including self-embedded subject relative, self-embedded object

relative, right-branching subject relative, and right branching object relative, and three conjoined sentences with no subordinate clause were auditorily presented. It was suggested that the ability to comprehend sentences with subordinate clauses was stable until 60s, but the decline was observed beginning in the 60s. Age difference distinguished the performance of the two oldest groups from each other and from the two youngest groups. The oldest group made errors more frequently in their enactments and also made errors of a more serious nature compared to younger adults.

Davis and Ball (1989) investigated whether age-related changes occurred in comprehension of complex sentences. Fifteen participants in each age group, 25 to 35 years, 40 to 50 years, 53 to 60 years, 61 to 70 years, and 71 to 79 years, were tested on vocabulary and digit span, and were presented 24 sentences that emphasized either semantic or syntactic constrains in interpretations. Three constraint conditions were created. In the semantic condition, thematic roles of nouns were consistent with real world probabilities. In the syntax-I condition (implausible sentences), semantic cues based on the world knowledge were either weakened or confused. In the syntax-PR condition, sentences were plausible and reversible. Three types of questions were asked to test the comprehension of thematic roles in each sentence, and participants were asked to choose the best answer from three choices after reading the question. The findings indicated that normal aging affected comprehension of complex sentences and the decline began after age of 60. Additionally, older adults did not process the syntactic component effectively when sentences conveyed implausible information.

In order to determine which factors contributed to comprehension difficulty due to normal aging, 66 females were grouped into four age groups, 30-39 years, 50-59 years, 60-69 years, and 70-79 years and were presented 96 sentence-question pairs in the Obler et al. study (Obler, Fein, Nicholas, & Albert, 1991). Six syntactic types of sentences, active, passive, single negative, double negative, double embedded, and comparative, consisted of sentence-question pairs. Half of the pairs in each type were semantically plausible and the other half were semantically implausible. One question starting with "was" to elicit yes/no answer was followed by each sentence. The results showed that older participants took longer reaction time in the comprehension task, and the decline rates and patterns of decline varied depending on syntactic structures. Moreover, implausible and harder types of sentences, such as double embedded, double negative, and passive, elicited more errors in the elderly and showed more rapid decline.

Elders might have deficits in processing meaningful and implicit information without showing difficulty in processing the explicitly stated meaning. Therefore, Belmore (1981) studied how younger and older adults processed implicit and explicit meaning using a sentence verification task. Sixteen younger adults, ages 17 to 21 years, and 16 older adults, ages 58 to 74 years, participated in the study. Thirty two short paragraphs were used as stimuli. Each came with one sentence that paraphrased the stimulus paragraph and one sentence that represented a plausible influence from the paragraph. Half of the stimuli provided true paraphrase and inference, and the other half had false paraphrase and inference. An unexpected 20 minute delayed verification test without paragraphs was given. They found that participants processed inferences slower

than paraphrases on the immediate and delayed tests. The findings showed that older adults comprehended the meaningful language slower and less accurately than younger adults; however, younger adults outperformed older adults only on the delayed test not the immediate test. Although the latency data indicated that older adults' language processing speed was slow, it was not related to explicit or implicit meaning.

Similar to the language production tasks, the task types in language comprehension also significantly influenced participants' performance. Burke and MacKay (1997) argued that although the processing of words meaning maintained constantly in elders when the test measured on-line processing such as semantic priming, off-line processing might show different results because of examining if people remembered the sentences or paragraphs presented earlier. Therefore, when older people required to encode new information, they might show age-linked deficits. Radvansky (1999) also claimed that when the comprehension task taped on lower level of processing, such as remembering the information they encountered earlier, older people might show signs of difficulties. However, if the tasks assessed higher level of comprehension, older adults might do as well as young adults.

Factors Affect Language Performance in Normal Aging

Although studies reviewed in the previous section mainly focused on the language deterioration with advancing age, people did not necessarily show language declines as they became older. Using different types of tasks might result in inconclusive results. Other factors, such as education and gender, might also contribute to different language performance in aging populations. Cohen (1979) reported that elders with low education

levels performed worse on the comprehension tasks than did elders with higher education levels; therefore, the decline could be compensated by the higher educational level and continuing mental activity. Cohen (1979) stated that some of the tests commonly used to detect language deterioration in aging such as definitions of single words or word pairs might not be sensitive enough to reveal the decline. In addition, Mackenzie (2000) claimed that using specific linguistic tasks to examine language ability in older people might not represent a true language reduction because of the unestablished relationship between the tests and real life communication. Some factors such as anxiety, inability to see and hear the stimuli clearly, and task unfamiliarity might contribute to the age-related decrement in older adults' language ability. Therefore, it is critical to take those factors into account in order to truly represent language performance in older people.

Kemper and colleagues (Kemper, Kynette, Rash, O'Brien, & Sprott, 1989) investigated the relationship between individual differences such as education and memory ability, and if the syntactic complexity would be affected by different genres and modalities. Thirty young adults, ages 18 to 28 years, 37 adults, ages 60 to 69 years, 26 adults, ages 70-79 years, and 15 adults, ages 80-92 years provided one oral narrative language sample, one oral expository language sample, and one written narrative language sample during the interview. Language samples were analyzed on length, mean length per utterance (MLU), mean clauses per utterance (MCU), clause structures, and fluency. Additionally, 18 judges rated the language samples according to organization, clarity, and interestingness of the statements. The findings showed that the use of left-branching clauses showed age-related decrement for all three language samples.

Moreover, elderly adults produced fewer syntactical complex sentences to compensate the loss of memory capacity. It was noteworthy that elders' essays were rated more interesting and clearer than those of the young adults.

Mackenzie (2000) conducted a 10-minute conversation and a picture description task on 60 participants in each of the age group, ages 40 to 59 years, 60 to74 years, and 75 to 88 years. Each group was further divided into three subgroups according to participant's educational level. Conversational initiation, turn-taking, verbosity, topic maintenance, and referencing were measured. The number of relevant content units, the number of words, efficiency of imparting content, and occurrences of extraneous materials were examined in the "cookie theft" picture description task. The results showed that older participants failed to maintain topic, and their conversation consisted of poor turn-taking, unclear referencing, and verbosity. In the picture description task, older adults were less efficient and took longer time to transmit information than younger people. In addition, education rather than age appeared to be a significant factor in the picture description task, since the two-minute picture description task required less cognitive demand compared to conversation.

Petros and colleagues (Petros, Norgaard, Olson, & Tabor, 1989) attempted to examine if individuals' verbal ability and text genre difference had an influence on age difference in prose memory. Eleven younger adults with high verbal ability, ages 18 to 27 years, 19 younger adults with low-verbal ability, ages 18 to 30 years, 16 older adults with high-verbal ability, ages 60 to 79 years, and 13 older adults with lower-verbal ability, ages 65 to 84 years were asked to listen to three narratives and three expository stories.

Stories were presented at three different rates and were categorized into three levels according to the importance to the theme of the passage. The findings showed that older adults recalled fewer details than younger adults, and individuals with high-verbal ability recalled more information than those with low-verbal ability. Additionally, narratives were better remembered than expository passages. Moreover, participants recalled fewer details when the passage was presented at a faster rate and recalled more when the importance level increased.

In the study of Juncos-Rabadan and Iglesias (1994), they pointed out that individuals with high educational level performed better on 30 language subtests including morphology, syntax, lexicon, and language skills such as verbal fluency, comprehension, reading, and writing than those with low education level regardless of age. Juncos-Rabadan (1996) examined the effect of age, gender, education, and culture on telling narratives in normal elders. The total of 94 middle-age adults, mean age of 53.93 and 90 normal elders, ages 70 to 91 years, were asked to tell a story based on a six-picture "Nest story" from the Bilingual Aphasia Test (BAT). The findings pointed out that normal elders included fewer sense units, used simpler sentence structures, fewer numbers of cohesion links, but more descriptive and tangential sentences and place deixis than did middle-aged adults, which was a sign of decrement in narrative competence. In addition, individuals with higher education performed better in the story telling task and used the story structure better than those with lower education.

Aging affected differently on different language functions. In order to find out how education and gender play a role in language during normal aging, Ardila and

Rosselli (1996) conducted a study on 108 normal participants, ages 16 to 65 years, with different education levels. Participants were divided based on age, 16-30 years, 31-50 years, and 51-65 years, and education levels, 3-7 years, 8-12 years, and beyond 12 years. The cookie theft task from the Boston Diagnostic Aphasia Examination (BDAE) was used as the stimuli for the spontaneous oral language production. Language samples were analyzed based on nouns, verbs, adjectives, and grammatical connectors, such as conjunctions and pronouns. The findings showed that there was a reduction in words used in the spontaneous production across age groups, especially in the ages 31 to 50 years. In addition, spontaneous language was correlated to the education level and gender. People with higher education level used more words to describe the picture than did the people with lower education level. As regard to gender, females used greater number of words than did males even at the ages 51-65 years.

Harris, Rogers, and Qualls (1998) attempted to examine the influence of text genre, cognitive processing requirement, and repeated reading on written language comprehension in younger and older adults. Twenty-seven younger adults, ages 18 to 27 years, and 27 older adults, ages 64 to 80 years, were assessed on working memory, reading comprehension, and exposure to print. They were presented three expository passages, three narratives, and three procedural passages that each was followed by 12 verification statements. The results pointed out that older adults performed as well as younger adults did on the discourse comprehension task. It was worth noting that the age-related decline in language processing was alleviated in older adults with higher level of education and verbal ability. In addition, the text genre had an influence on reading

time; expository passages were read faster than narratives and procedural passages. Therefore, the findings of this study indicated that certain text processing skills were persevered across the adult lifespan.

Language Difficulties in People with Dementia

In addition to examining language performance in the normal aging populations, findings drawn from people with Dementia and Alzheimer's disease (AD) provided valuable insight of how and what aspects of language decline along with brain degeneration. Kemper and Zelinski (1994) compared the language changes in normal elders to those with dementia through word finding, syntax, and discourse. They found that people with normal aging had mild word finding difficulties due to decreased lexical retrieval ability. However, word finding was a prominent symptom in people with dementia, which occurred in every sentence. In terms of syntax, syntactic knowledge was preserved in the normal aging populations and people with dementia, but the performance declined because of the decrement in attention and memory. Normal elders were able to structure conversations and stories coherently and interestingly; however, discourses produced by people with dementia were confusing and incoherent.

Twenty-eight normal elders, mean age of 73 and 28 individuals with dementia, mean age of 80, took the cognition, memory/learning, and language/speech tasks in the Bayles study (1982). Five language tasks including naming, verbal description, sentence correction, sentence disambiguation, and story-retelling were used to evaluate participant's language ability. It was found that individuals with dementia did not recognize or correct the errors they made during the tasks. Additionally, individuals with

senile dementia often produced semantically inappropriate sentences. The results pointed out that syntax and phonology were not disrupted as semantics was, and there was no evidence showing that there was a naming deficit in individuals with dementia. However, individuals with dementia often produced empty and irrelevant utterances, and the frequency of producing irrelevant utterances increased as the severity of dementia progressed. It was evident that senile dementia affected the language ability profoundly with uneven rates in different components of the language system.

Lyons and colleagues (Lyons, Kemper, LaBarge, Ferraro, Balota, & Storandt, 1994) studied the relationship between the severity of dementia and syntactic complexity on 117 individuals with different severity of dementia. Participants' characteristics such as education, cognitive, and linguistic abilities were obtained, and a language sample was collected individually during a 2-hour interview. It was found that sentence length, grammatical complexity, propositional content, and verbal fluency were reduced with the increased severity of dementia. Individuals with mild dementia produced simpler, shorter and more incomplete sentences compared to individuals without dementia. Overall, there was a decline in the complexity and length of sentence produced by people with dementia possibly resulting from AD. Because of the cognitive decline in people with AD, they were less able to produce longer, complex, and multi-clause embedded sentences than did people without dementia.

It is difficult to identify the language changes due to normal aging or early stage of Alzheimer's disease; therefore, Chapman and colleagues (Chapman, Ulatowska, King, & Johnson, 1995) investigated discourse difference on 12 individuals with early

Alzheimer's disease (AD), ages 51 to 76 years, 12 normal elderly adults (OE), ages 80 to 92 years, and 12 normal adults with matched ages to the AD group as the control group (NC). Three pictures containing familiar life situations such as a son going to a college were used as stimulus to elicit language samples. Participants were asked to create a story about the picture but not to describe the picture. The findings pointed out that individuals with early AD did significantly worse in discourse coherence. Additionally, participants with early AD had difficulties transforming the description information into a narrative form while participants in the OE and NC groups had little difficulties with it. In addition, discourse coherence was impaired in individuals with early AD, although the results were not consistent for all individuals with early AD. Furthermore, the ability to provide information according to the frame and to transform information into a narrative form was preserved in normal aging individuals while it was impaired in people with early AD.

Kemper and colleagues (Kemper, Thompson, & Marquis, 2001) compared the grammatical complexity (D-level) and propositional content (P-level) in oral language samples produced by 30 normal elders, ages 65 to 75 years, and 30 elders with dementia. Language samples were collected annually up to 15 years for normal older adults and were collected every 6-month for up to 2.5 years for individuals with dementia. Participants were asked to response to one of the elicited questions such as "describe the person who most influences your life." It was found that linguistic ability declined in both grammatical complexity and propositional content in normal elders' spoken narratives between ages of 74 to 78 years. The results also showed that dementia accelerated the decline in linguistic abilities, and age was a major predictor in linguistic

decline for people with dementia. However, although linguistic abilities diminished sharply as dementia progressed, individuals with dementia were still able to express basic information. It was worth noting that linguistic ability in normal elders was found to decline between ages of 65 and 80 years.

In order to detect the early signs of AD without confounding with the language changes observed in normal aging, Chapman and colleagues (Chapman, Zientz, Weiner, Rosenberg, Frawley, & Burns, 2002) attempted to analyze discourse differences based on the gist and detail-level processing. The gist-based processing acquired information reconstruction, integration, and different cognitive and language functions than the detailed-level processing. Different from the gist-based processing, the detailed-level processing asked people to recall the details with little or no transformation of the content. Twenty-four individuals with mild AD, 20 individuals with mild cognitive impairments (MCI), and 25 normal elders participated in this study. A biographical narrative was read aloud to the participants while a written version of the narrative was provided. Participants were asked to provide a summary, a main idea, and a lesson as a measure of the gist-level processing, and detailed information about the narrative as the measure of the detail-level processing. The findings supported that people with MCI and AD were impaired in the gist-level and detail-level processing while the gist-level processing was preserved in normal elders.

Five individuals with AD and 27 neurologically normal elders were asked to provide a story based on a bank robbery picture in the study of Duong, Tardif, and Ska (2003). The narratives were collected every 6 month for five consecutive times. The ratio

of modalizing discourse to referential discourse (M/R ratio) and the repetition of expected ideas were calculated. Modalizing discourse was defined as participants' comments, judgments, or uncertainty while delivering their narratives such as "I think." The findings showed that individuals with AD used more modalizing discourse than normal elders did; however, the M/R ratio decreased from the first to fifth assessment session in most of the individuals with AD. Therefore, pragmatic abilities of individuals with AD were well preserved at the early stage since they produced large amount of modalizing discourse in order to maintain the conversation.

Fleming and Harris (2008) intended to determine if discourses provided definite information to distinguish normal elders and people with mild cognitive impairments (MCI). Eight adults with mild cognitive impairments and eight age-matched normal elders were asked to provide a spoken discourse sample about a trip to New York. It was revealed that normal elderly adults used more words and provided more detailed information than did people with MCI. The inability of retrieving words and supplying more detailed information was detected from the discourse analysis. Additionally, the inability to provide core elements in people with MCI reflected the reduced planning, organizing, and cognitive flexibility skills. As regard to the syntactic complexity, there was no difference between the normal elderly group and the MCI group. Therefore, the syntactic seemed spared in people with MCI.

Since the focus of the present study was idiom comprehension in adults across the lifespan, it was essential to review the literature about how elderly processed figurative language especially idioms. The literature of figurative language in normal aging

populations was limited. In the following section, how figurative language was acquired in children was reviewed first as ground knowledge, and then studies focusing on how normal elderly processed figurative language were reviewed to provide a comprehensive understanding of language ability in normal aging populations.

Figurative Language in Normal Aging

Figurative language is commonly used in everyday conversation and speech, but is acquired relatively late in comparison with regular sentences because of its multiple meaning and abstract thinking process. Kempler and Van Lancker (1993) used The Familiar and Novel Language Comprehension (FANL-C) protocol to test 175 participants, ages 3 to18 years, in order to understand the acquisition of familiar language. The test contained 20 familiar phrases including proverbs, idioms, and contextually bound social interaction formulas, and 20 novel sentences. Each phrase was expressed by four pictures with one correct meaning, one related meanings to the familiar phrase, and two foils with concrete interpretations of the familiar phrases. Participants were asked to point to the picture that best described the phrase. It was found that adult level comprehension was reached by 8 years of age on novel sentences but not until 12 years of age for familiar phrases.

How children and adolescents developed the understanding of literal and figurative meanings of idioms was investigated in the Kempler et al.'s study (Kempler, Van Lancker, Marchman, & Bates, 1999). Participants were 250 normal children, adolescents, and young adults, age three to nineteen years, and they were divided into 17 groups based on their age. It was found that the comprehension of idiomatic and literal

meaning followed two different developmental trajectories with literal interpretations developing faster and reaching adult level around age of nine or ten, but idiomatic interpretations reaching adult levels at the age of 15. Therefore, it was clear that literal meanings of idioms were acquired earlier than idiomatic meanings, and idiomatic interpretations improved only after the children's understanding of literal meanings reached ceiling. The dissociation appeared because the two types of idiom interpretations required different cognitive and neurological mechanism, and idiomatic expressions were more difficult comprehend than the matched literal expressions.

Figurative language was rarely studied in neurologically normal older adults. According to literature reviewed in the previous sections regarding language comprehension and production in normal aging populations, several nonlinguistic cognitive mediators such as declines in attention, memory, processing speed, and executive function affected language ability in neurologically normal elders. Although people with high educational level and strong verbal ability maintained their language ability even at their 70s, findings were inconclusive across different tasks, measures, and individual differences. Figurative language is commonly used in everyday speech, has special functions, and is processed differently from regular sentences. Therefore, it is necessary to review how neurologically normal older people processed figurative language.

An early study done by Boswell (1979) studied metaphoric processing on 30 retired adults, ages 62 to 86 years, and 31 high-school students, ages 17 to19 years. They were asked to construct a story or to invent an explanation for four metaphors such as "a

nation is a warm ocean" and then to rate the difficulty of generating explanations for each metaphor on a five-point scale. The analysis of judges' ratings revealed that high school students' interpretations were more literal and analytic; however, adults' explanations were more poetic and synthesizing. Therefore, the quality of metaphor interpretation clearly distinguished the two age groups; moreover, education was strongly associated to interpretation scores for two age groups.

The quality of the metaphor interpretations in young and old adults was examined through professional and nonprofessional judgments in the Szuchman and Erber study (1990). Thirty young adults, ages 20 to 30 years, and 30 older adults, ages 62 to 74 years, were instructed to make up a story or a situation using eight metaphors. Five English teachers served as professional raters and rated the interpretations on a seven-point scale ranging from very literal to very poetic. Sixteen younger adults and sixteen older adults who served as nonprofessional judges rated the same interpretations on a seven-point scale ranging from excellent to poor instead of poetic to literal. The findings indicated that the metaphor interpretation skills were well maintained through the later adult years.

Gregory and Waggoner (1996) studied how older and younger adults interpreted metaphors that described four emotions: happiness, anger, sorrow, and fear. Twenty-four college students and 24 older adults, mean age at 69.8 years, were presented 12 metaphors, three metaphors for each emotion. They were asked to select an emotion that best described each sentence and further provided an explanation for each metaphor. It was found that performance was similar on the forced-choice task but was different on the explanation task. Older adults tended to make up a story, but were less likely to

specify relevant attributes and connections between metaphor and emotion compared to younger adults. In general, older and younger adults used different explanation style and explained the basis of the meaning differently.

Nippold and colleagues (Nippold, Uhden, & Schwarz, 1997) conducted a proverb explanation task on 353 participants, ages 13 to 79 years, to examine the relationship between educational level and proverb understanding in adults. Eight groups, 13-14 years, 16-17 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years and 70-79 years, were asked to provide short written explanation for 24 proverbs. All proverbs were low familiarity with half of the proverbs concrete and the other half abstract. Each proverb was embedded in a four-sentence story with the proverb always occurring at the end of the story. The findings showed that proverb explanation reached peak around the age 20s and remained stable during the age 30s, 40s and 50s, but slightly declined in the age 60s, and the decline reached significant around the age 70s. Additionally, concrete proverbs were easier than abstract ones for the three younger groups; however, there was no significant difference between concrete and abstract proverbs explanation beyond the age 30s. Regarding the relationship between the education level and proverb explanation, adults with more years of formal education performed better than those with less education. It was suggested that lexical retrieval and storage might contribute to the poorer responses observed in older participants due to the common use of vague and unspecified terms. In addition, lifestyle factors, such as vocation, should be taken into account in interpretation of the proverb explanation task.

Qualls and Harris (2003) attempted to determine how age, working memory, figurative language type, and reading ability affected the comprehension of figurative language. Participants were 40 young African American adults, age between 17 and 31, and 40 older African American adults, age between 54 and 73. Participants were tested on working memory, reading comprehension, vocabulary, and figurative language comprehension which contained 20 idioms, 20 metaphors, and 20 metonyms. Each phrase was followed by four choices including one correct figurative interpretation, one correct literal interpretation, one incorrect opposite foil, and one incorrect elaborated foil. It was found that working memory and reading comprehension had significant influence on adults' comprehension of figurative language, and different cognitive processing supported the comprehension of different types of figurative language. No age-related decline was found in figurative language comprehension in older adults when a selection of response choices was provided. In addition, older adults performed better in idioms than metaphors and showed the greatest difficulty in metonyms.

Thirty-five young adults, 35 middle-age adults and 35 older adults were recruited to discover the relationship between proverb comprehension and executive function in the Uekeermann, Thoma and Daum study (2008). Participants were first asked to rate the familiarity for each proverb and then to choose the figurative meanings of each proverb from four possible choices, abstract-meaningful, abstract meaningless, concretistic-meaningful, and concretistic-meaningless. Executive function was measured by inhibition, set shifting, short-term, and working memory. The findings showed that older people had impaired proverb comprehension and made more errors in choosing

abstract-meaningless, concretistic-meaningless, and concretistic-meaningful. Familiarity of proverbs did not contribute to the deficits since proverbs were rated more familiar in older people compared to younger adults. Additionally, it was revealed that older people tended to choose literal meanings (concretistic-meaningful) rather than figurative ones. It was suggested that plausible executive function impairment was related to the proverb comprehension deficits because of older people's poorer performance in working memory and inhibition compared to younger adults. Therefore, older people who suffered executive function impairments had difficulty suppressing alternative literal interpretations of figurative expressions.

Summary of Language and Aging

Age had great impact on attention, memory, and executive function when people gradually approached to their 70s and 80s, and the decline found in overall cognition further negatively impacted language performance in older populations. Studies reviewed above showed that the greater the linguistic complexity, the more difficulty in language processing was found in normal older people (Emery, 1986). Additionally, difficulties in naming, reduced syntactic complexity, and decrement in verbal fluency are commonly observed during the age of 70 (Ardila & Rosselli, 1996). Moreover, older people tended to produce less complex sentences compared to younger people (Kemper, Greiner, Marquis, Prenovost, & Mitzner, 2001; Kemper, Herman, & Lian, 2003; Kemper, Herman, & Liu, 2004) to avoid high cognitive demands. As regard to comprehension, elders maintained surface comprehension but had deficits in language comprehension involving integration, inference, and construction (Cohen, 1979). Researchers pointed out that

normal aging affected comprehension of complex sentences, and the decline began after age of 60 (Davis & Ball, 1989; Feier & Gerstman, 1980; Obler et al., 1991).

However, variables such as education, verbal ability, and gender needed to be taken into account since studies showed the impact of these variables on language ability in the normal aging populations (Ardila & Rosselli, 1996; Harris, Rogers, & Qualls, 1998; Juncos-Rabadan & Iglesias, 1994; Juncos-Rabadan, 1996; Mackenzie, 2000; Petros, Norgaard, Olson, & Tabor, 1989). Additionally, different tasks might attribute to different performance observed in older people (Burke & MacKay, 1997; Glosser & Deser, 1992; Radvansky, 1999). For example, if the participant required encoding new information, it might show age-linked deficits. In addition, low demanding tasks, such as interview, showed no signs of decline compared to high demanding tasks, such as experimental tasks. No sign of decline was observed if participants were asked to perform an on-line task, such as semantic priming. However, language deficits were shown on the off-line tasks, such as information recall.

The study results in figurative language in the normal aging population were inconclusive. No change in the metalinguistic tasks such as interpretation of proverb and idioms was found in older people in the Obler and Albert study (1989). Similarly, Szuchman and Erber (1990) pointed out that metaphor interpretation performance was well maintained through the later adult years. However, declines in figurative language ability in normal elderly were reported in Nippold, Uhden, and Schwarz (1997) and Uekeermann, Thomas, and Daum (2008). Different tasks and measurements yielded different results in how normal older people processed figurative language. In addition,

Qualls and Harris (2003) claimed that different cognitive-linguistic abilities were required for comprehension of different types of figurative languages, and working memory and reading comprehension abilities were associated with figurative language comprehension.

Hypotheses of the Current Study

This study was expected to find that younger and older adults would perform equally well on the comprehension task because Qualls and Harris (2003) suggested that no age-related decline was found in figurative language comprehension in older adults when a selection of response choices was provided. Secondly, this study predicted that older adults would perform poorer than younger adults on the explanation task. Nippold, Uhden, and Schwarz (1997) indicated that proverb explanation reached a peak around the age 20s and remained stable during the 30s, 40s, and 50s, but showed a slight decline in the age 60s with the decline reaching significance during the 70s. Therefore, this study expected similar findings. Thirdly, according to Nippold and Duthie (2003), the knowledge of an idiom was expected to be expanded and deepened, and mental imagery was expected to become more figurative with advancing age. Therefore, mental imagery of idioms was expected to become more figurative with advancing age in the present study.

Fourthly, participants were expected to perform better on highly familiar idioms than on less familiar idioms across four age groups since familiar idioms were recalled better, read faster, and comprehended better than less familiar idioms (Cronk &

Schweigert, 1992; Libben & Titone, 2008; Nippold & Taylor, 2002; Schweigert, 1986; 1991). Lastly, according to Cacciari and Glucksberg (1995), concrete literal meanings generated mental images more easily than abstract-figurative meanings. Additionally, the dual coding theory (Paivio, 1971, 1986) suggested that concrete concepts would more easily form mental images than abstract concepts. Therefore, this study expected to find differences in mental images between transparent and opaque idioms, with better performance on transparent idioms than opaque ones. The hypotheses of this study were summarized as following:

1. Younger and older adults would perform equally well on the comprehension task.
2. Older adults would perform poorer than younger adults on the explanation task.
3. Mental imagery of idioms was expected to become more figurative with advancing age.
4. Participants were expected to perform better on highly familiar idioms than on less familiar idioms.
5. Participants were expected to perform better on transparent idioms than opaque idioms.

CHAPTER III

METHOD

Participants

Recruiting and Sampling

The participants in the present study were all neurologically healthy adults with no known brain damage, neurological disorders, or cognitive impairments, and had not been diagnosed with attention deficit disorders, anxiety, depression, schizophrenia, or any other psychiatric conditions. All participants were not under any psychiatric medications for attention deficit disorders / attention deficit hyperactivity disorders (ADD/ADHD), depression, or anxiety while taking the tasks. In addition, all participants were native English speakers according to participants' self reports. The tasks used in the present study might create disadvantages for English as second language individuals because of their English proficiency rather than idiom understanding. All participants were recruited from the Los Angeles-Long Beach metropolitan area in Southern California.

Participants who met the following exclusion criteria were excluded from this study even though they are neurologically healthy adults and within qualified age ranges. Exclusion criteria used in this study were as follows:

1. Participants whose first language was not English were excluded from this study.
2. Participants who were not able to read and write with corrected vision and appropriate motor writing skills were excluded from this study. Tasks used in this study required reading and writing; therefore, data collected from participants who were unable to read and write would be misrepresented.
3. Participants older than 60 year-old were given the Mini-Mental State Examination (MMSE) to evaluate mental state/cognitive functioning in order to exclude possible dementia (Folstein, Folstein & McHugh, 1975). Participants who did not meet the cutoff score, 24 out of 30 points of the MMSE task (Tombaugh & McIntyre, 1992), were still given the tasks, but the data points were excluded from this study.

Initially, a total of 134 individuals, 34 adults, ages 20-29 years (20s Group), 32 adults, ages 40-49 years (40s Group), 33 adults, ages 60-69 years (60s Group), and 35 adults, ages 80-89 years (80s Group), were recruited in the study. However, four adults in 20s Group were excluded because they did not complete all four tasks. Two adults in 40s Group were also excluded because of the incompletion of the tasks and the other one's first language was not English. Three adults in 60s Group were excluded because two of them did not complete the tasks and the other one's handwriting was not legible due to the poor hand coordination. Five adults in 80s Group were excluded because three of them did not complete the tasks and the other two did not meet the MMSE cutoff score requirement. Therefore, the total number of participants for the present study was limited to 120.

Participants' Characteristics

The participants (n =120) included in the present study were thirty adults, ages between 20 and 29 years old (M=23.93, SD =3.11), thirty adults, ages between 40 and 49 years old (M=44.07, SD =3.52), thirty adults, ages between 60 and 69 years old (M=64.77, SD =3.17), and thirty adults, ages between 80 and 89 years old (M=82.10, SD =2.73). There were 6 males and 24 females in 20s Group, 17 males and 13 females in 40s Group, 7 males and 23 females in 60s Group, and 8 males and 22 females in 80s Group. The total gender ratio was 31.7% male and 68.3% female.

Participants' highest education was converted into total years of education adapted from the study of Nippold, Uhden, and Schwarz (1997). The converting method for total education years was listed in Table 3.1. The distribution of education years was summarized in Table 3.2 and Figure 3.1.

The mean education length was 15.13 years (SD=2.00) for 20s Group, 15.50 (SD=2.43) for 40s Group, 15.47 (SD=2.15) for 60s Group, and 15.30 (SD=2.22) for 80s Group. A one-way, between-subjects analysis of variance (ANOVA) was conducted to analyze the effect of age on total education years. There was no significant main effects for the age difference, $F(3, 116) = 0.18$, $p = .91$, $\eta^2 = .01$. There were no significant differences among the four groups' total years of education.

Table 3.1. The Converting Method for Total Education Years

Highest Education	*Education Years*
High school diploma	12 years
Some college	13 years
Completed trade school	14 years
Associate of Arts (AA) degree	15 years
Bachelor of Arts (B.A.) or Bachelor of Sciences (B.S.),	16 years
Some grad school	17 years
Master's degree	18 years
Law degree	19 years
Ph.D	20 years

Table 3.2. The Education Distributions for Each Age Group

	20s Group	*40s Group*	*60s Group*	*80s Group*
High School	6	4	2	5
Some College	2	6	6	5
AA	6	3	3	5
BA/BS	12	8	12	7
MA/JD/PhD	4	9	7	8
Total	30	30	30	30

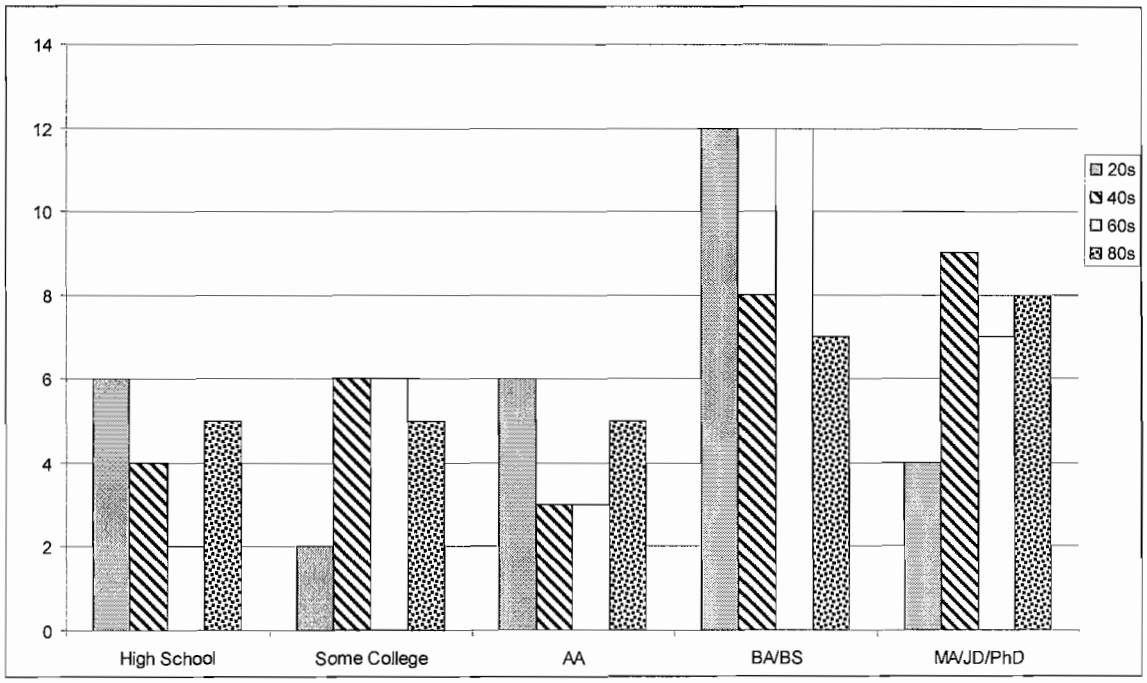

Figure 3.1. The Education Distributions for Each Age Group

The Mini-Mental State Examination (MMSE) was given only to 60s Group and 80 Groups to identify possible cognitive declines. All participants met the cutoff score, 24 out of 30 points of the MMSE task (Tombaugh & McIntyre, 1992), The mean MMSE score was 29.80 (*SD*=0.48, range=28-30) for 60s Group and 28.90 (*SD*=0.96, range=27-30) for 80s Group.

Materials

Stimuli

Twenty idioms, 10 transparent and 10 opaque idioms used in the Nippold and Duthie study (2003), were used as the stimuli in the present study. The complete list of

the idioms was provided in Appendix A. Each expression was a verb phrase with three to five words, such as "*put one's foot down*" or "*have a soft spot for something.*" The transparency rating was drawn from the study of Nippold and Rudzinski (1993). In their study, twenty adults living in western Oregon were asked to rate 100 idioms for the familiarity and transparency. These participants were asked to rate how closely the literal and figurative meanings of each idiom compared using a three-point scale (1 = closely related, 2 = somewhat related, 3 = not related). For the 10 transparent idioms used in the present study, the mean transparency rating was 1.63 (range = 1.15 - 1.90) and the mean transparency rating was 2.80 (range = 2.65 - 3.00) for the 10 opaque idioms. In addition, according to Nippold and Duthie (2003), the difference between the 10 transparent and 10 opaque idioms reached the statistically significant level.

Background Questionnaire

Participants' contact information, including both phone numbers and email addresses, age, gender, date of birth, date of test, primary language spoken at home, length of speaking English, length of living in the United States, current or previous occupation, and highest level of formal education achieved were collected from the background questionnaire. The background questionnaire was provided in Appendix B.

Familiarity Rating

The familiar rating task asked participants to rate each idiom and to circle the number that best described how familiar he or she was with the idiom. Two practice examples were provided to insure that the participants understood the purpose of the idiom familiarity task. A statement "*I have heard or read this idiom*" was asked after each

idiom was presented. Five responses, including never, once, a few times, several times, and many times, were provided. The participant was asked to circle only one response that best described his or her experience with the idiom. The familiarity rating task was provided in Appendix C.

Idiom Explanation/Mental Imagery Task

The same twenty idioms were used in Idiom Explanation/Mental Imagery Task with different orders to avoid the order effect. In each group, 15 participants were given A form and the other 15 were given B Form. The only difference between Form A and B was the order of idioms. Participants first were asked to write what they thought each idiom meant and then were asked to describe a situation where someone would use that idiom. Two practice examples were provided to instruct the participants to complete this task. This task was untimed, and participants were given a certain amount of space to write. In addition, no minimum or maximum number of sentences was required. The idiom explanation and mental imagery task were provided in Appendix D.

Idiom Comprehension Task

The same twenty idioms were used in Idiom Comprehension Task; this task was a forced-choice task. No context was provided for each idiom because the context may provide sufficient cues for participates to figure out the meaning of the idiom, which would create the ceiling effect in the present study. Participants were asked to circle the best interpretation for each idiom from four responses, and were encouraged to guess if they did not know the answer. Two practice examples were provided to instruct the

participants to complete this task. There was no time limit to complete the task. The idiom comprehension task was provided in Appendix E.

Procedures

The participants were tested either individually or in small groups of three to five people. Each participant was given the tasks in the same order: one-page background questionnaire, Familiarity Rating of 20 idioms, Idiom Explanation/Mental Imagery Task, and then Idiom Comprehension Task. Only one task was given at a time. Instructions for taking each task and examples were provided prior to the task. Participants older than 60 years-old were additionally given the Mini-Mental State Examination (MMSE) to evaluate their mental state/cognitive functioning after filling out the one-page background questionnaire.

After filling out the questionnaire, participants were asked to rate the familiarity of 20 idioms on a five-point scale based on their experience. After rating each idiom on familiarity, participants were asked to provide a written explanation for each idiom and then to describe a situation where someone would use that idiom. Participants then were asked to circle the best interpretation of each idiom from four possible choices. The idiom explanation and mental imagery tasks were submitted to the participants before the comprehension task was presented. This prevented participants from using the answer choices on the comprehension task to assist in explaining the idioms. In sum, the order of the tasks was consistent across all age groups as following: Background Questionnaire →

MMSE (if older than 60 year old) → Familiarity Rating → Idiom Explanation/ Mental Imagery Task → Idiom Comprehension Task.

All tasks used in this study were untimed since older groups might be disadvantaged by their slow processing speed. In addition, there was no minimum number of sentences for Idiom Explanation and Mental Imagery Task in order to avoid taxing the older participants' motor skills. The font was enlarged to improve the visibility for older adults.

Coding System

Idiom Comprehension Task

Participants' answer on Idiom Comprehension Task was scored either 0 for the incorrect response or 1 for the correct response. The total points of this task were 20 points.

Idiom Explanation and Mental Imagery Scoring

The coding systems adapted from the previous studies (Nippold & Duthie, 2003; Duthie et al., 2008) were used to score participants' explanations of the idioms on the Idiom Explanation and Mental Imagery Task. The points were assigned as follows.

Table 3.3. Idiom Explanation Scoring System

Points	*Scoring Criteria*
0	The response is inaccurate, a restatement, literal, or absent
1	The response is related but vague or incomplete
2	The response is accurate, clear, and complete

For example, responses to the idiom "*have a soft spot for something,*" which means to be kind to others or fond of something, were marked as follows (selected from participants' responses):

0 = A weak spot

1 = Someone is sensitive toward some aspect of object or person

2 = You like it more than other things

Participant's mental images were scored using the following scoring system.

Table 3.4. Mental Imagery Scoring System

Points	*Scoring criteria*
0	The response is irrelevant, a restatement, or absent
1	The response is relevant but vague or incomplete
2	The response is relevant, clear, and complete

For example, responses to the idiom "*have a soft spot for something,*" which means to be kind to others or fond of something, were marked as follows (selected from participants' responses):

0= Someone is asking for money in front of the store, your spouse gets upset and you tell them have a soft spot.

1= I have a soft spot when it comes to an older person needing help with doors, or wheelchairs. I always try to assist them.

2= Usually he didn't like Irish music but he had a soft spot for certain lines in Danny Boy, so he always gave money to any street musician who played it.

Please see Appendix F for more examples of participants' responses for Idiom Explanation and Mental Imagery Task, and Appendix G for examples of good mental imagery responses.

Interrater Reliability

Another investigator, who was trained and familiar with the scoring system, scored both Idiom Explanation Task and Mental Imagery Task. The level of agreement between two investigators was 96% for 20s Group, 93% for 40s Group, 83% for 60s Group, and 87% for 80s Group. The disagreements were discussed, and a second round of interrater reliability was conducted. The second round inter-rater agreement was 99% for all four groups. The disagreements were further discussed and then conducted a third round of interrater reliability check. All disagreements in scoring were resolved through discussion and reached 100% agreement.

CHAPTER IV

RESULTS

The dependent variables of this study were scores of Idiom Explanation Task, Idiom Mental Imagery Task, and Idiom Comprehension Task. The independent variable was age group. The data was analyzed by one-way analysis of covariance (ANOVA). Eta Square (η^2) was also calculated to report effect size. The significance level was set at $p < .05$. The familiarity rating of idioms and education years were further examined to discover their relationships with the idiom explanation, idiom comprehension, and mental imagery performance.

Age versus Idiom Comprehension

Hypothesis #1: Younger and older adults would perform equally well on the idiom comprehension task.

A one-way, between-subjects analysis of variance (ANOVA) was conducted to analyze the effects of age on the idiom comprehension task. The independent variable was the age group, with four levels (20s Group, 40s Group, 60s Group, and 80s Group). For 20s Group, the mean of the comprehension task scores was 17.50 (*SD* = 1.61). For 40s Group, the mean of the compression task scores was 18.20 (*SD* = 1.71). For 60s

Group, the mean of the compression task scores was 18.27 (*SD* = 1.64). For 80s Group, the mean of the compression task scores was 18.03 (*SD* = 1.40). The performance on Idiom Comprehension Task was summarized in Table 4.1.

Table 4.1. Performance on Idiom Comprehension Task (*n*=30 per group)

	20s	40s	60s	80s
M	17.50	18.20	18.27	18.03
SD	1.61	1.71	1.64	1.40
Range (0-20)	14-20	13-20	15-20	15-20

There was no significant main effect of age on idiom comprehension, $F(3, 116) = 1.42$, $p = .24$, $\eta^2 = .04$. In other words, there was no significant difference among the four groups' comprehension task scores. Measures of the idiom comprehension task scores in each age group were reported in Table 4.2.

Table 4.2. One-Way, Between Subjects Analysis of Variance on Idiom Comprehension

Source	*df*	*F*	η^2	*p*
Age	3	1.42	.04	.24
Error Between	116			
Total	120			

*$p < .05$. ** $p < .01$.

Age versus Idiom Explanation

Hypothesis #2: Older adults were expected to perform worse than younger adults on the explanation task.

A one-way, between-subjects analysis of variance (ANOVA) was conducted to analyze the effects of age on Idiom Explanation Task. The independent variable was the age group, with four levels (20s, 40s, 60s, and 80s Group). For 20s Group, the mean of the explanation task scores was 28.23 (*SD* = 4.18). For 40s Group, the mean of the explanation task scores was 30.30 (*SD* = 4.90). For 60s Group, the mean of the explanation task scores was 32.17 (*SD* = 5.72). For 80s Group, the mean of the explanation task scores was 30.50 (*SD* = 6.20). The performance on Idiom Explanation Task across four groups was summarized in Table 4.3.

Table 4.3. The Performance on Idiom Explanation Task (*n*=30 per group)

	20s	40s	60s	80s
M	28.23	30.30	32.17	30.50
SD	4.18	4.90	5.72	6.20
Range (0-40)	22-35	21-38	18-39	16-40

There was a significant main effect of age on idiom explanation, $F(3, 116) = 2.77$, $p = .04$, $\eta^2 = .07$. Follow-up tests were conducted to evaluate pairwise differences among the means using a Tukey HSD test (at $p < .05$). There was a significant difference obtained only between the comparison of 20s Group and 60s Group. The participants in 60s Group obtained significantly higher scores than 20s Group did on Idiom Explanation

Task. No statistically significant differences obtained among other group comparisons. Measures of the explanation task scores in each age group were reported in Table 4.4.

Table 4.4. One-Way Between Subjects Analysis of Variance on Idiom Explanation Task

Source	*df*	*F*	η^2	*p*
Age	3	2.77*	.07	.04
Error Between	116			
Total	120			

*$p < .05$. ** $p < .01$.

Age versus Mental Imagery

Hypothesis #3: Mental imagery of idioms was expected to become more figurative with advancing age.

A one-way, between-subjects analysis of variance (ANOVA) was conducted to analyze the effects of age on the mental imagery task. The independent variable was the same age groups. For 20s Group, the mean of the mental imagery task scores was 28.63 (*SD* = 4.68). For 40s Group, the mean of the mental imagery task scores was 30.93 (*SD*=5.00). For 60s Group, the mean of the mental imagery task scores was 30.23 (*SD*=8.72). For 80s Group, the mean of the mental imagery task scores was 27.60 (*SD*=8.69). The performance on Mental Imagery Task across four groups was summarized in Table 4.5.

Table 4.5. The Performance on Mental Imagery Task (n=30 per group)

	20s	40s	60s	80s
M	28.63	30.93	30.23	27.60
SD	4.68	5.00	8.72	8.69
Range (0-40)	20-36	18-38	8-38	9-40

There was no significant main effect of age on mental imagery performance, $F(3,116)= 1.38, p = .25, \eta^2 = .04$. There was no significant difference among the four groups' mental imagery task scores. Measures of the mental imagery task scores in each age group were reported in Table 4.6.

Table 4.6. One-Way Between Subjects Analysis of Variance on Mental Imagery Task

Source	*df*	*F*	η^2	*p*
Age	3	1.38	.04	.25
Error Between	116			
Total	120			

*$p < .05$. ** $p < .01$.

Familiarity Rating versus Idiom Comprehension, Explanation, and Mental Imagery

Hypothesis #4: Participants were expected to perform better on highly familiar idioms than less familiar idioms.

Pearson product-moment correlation coefficients were computed to assess the relationship between the familiarity rating and 1) idiom comprehension task scores, 2) idiom explanation task scores, and 3) mental imagery task scores. There was a significant correlation between the familiarity rating and idiom comprehension task scores, $r(120)= .34, p < .01$. There was also a significant correlation between the familiarity rating and idiom explanation task scores, $r\ (120) = .32, p < .01$. In addition, there was a significant correlation between the familiarity rating and mental imagery task scores, $r(120) = .30, p < .01$. The results of the correlation analysis were reported in Table 4.7.

Table 4.7. Pearson Correlation Coefficients among Familiarity Rating and Idiom Explanation, Mental Imagery, and Idiom Comprehension Task

	Idiom Comprehension	Idiom Explanation	Mental Imagery
Familiarity	.34**	.32**	.30**

*$p < .05$. ** $p < .01$.

Age versus Familiarity Rating

A one-way, between-subjects analysis of variance (ANOVA) was conducted to analyze the effects of age on the idiom familiarity rating. The independent variable was

the same age groups. The dependent variable was the raw scores of the familiarity rating. For 20s Group, the mean of the familiarity rating scores was 87.03 (*SD* = 7.95). For 40s Group, the mean of the familiarity rating scores was 91.13 (*SD* = 7.59). For 60s Group, the mean of the familiarity rating scores was 93.90 (*SD* = 7.17). For 80s Group, the mean of the familiarity rating scores was 90.33 (*SD* = 10.26). The performance on Idiom Familiarity Rating across four groups was summarized in Table 4.8.

Table 4.8. The Idiom Familiarity Rating across Four Age Groups (*n*=30 per group)

	20s	40s	60s	80s
M	87.03	91.13	93.90	90.33
SD	7.95	7.59	7.17	10.26
Range (0-100)	72-98	71-100	76-100	61-100

There was a significant main effect for the age difference, $F(3, 116) = 3.46$, $p = .02$, $\eta^2 = .08$. Follow-up tests were conducted to evaluate pairwise differences among the means using a Tukey HSD test (at $p < .05$). There was a significant difference obtained only between the comparison of 20s Group and 60s Group. The participants in 60s Group were more familiar with the idioms used in this study than the participants in 20s. No statistical significant differences obtained among other group comparisons. Measures of the explanation task scores in each age group were reported in Table 4.9.

Table 4.9. One-Way Between Subjects Analysis of Variance on Familiarity Rating Scores

Source	*df*	*F*	η^2	*p*
Age	3	3.46*	.08	.02
Error Between	116			
Total	120			

*$p < .05$. ** $p < .01$.

Transparent Idioms versus Opaque Idioms

Hypothesis #5: Participants were expected to perform better on transparent idioms than opaque idioms

A one-way, within-subjects analysis of variance (ANOVA) was conducted to analyze the effects of idiom transparency on idiom mental imagery. The independent variable was the idiom transparency, with two levels (transparent idioms and opaque idioms). For the transparent idioms, the mean of Mental Imagery Task scores was 14.54 ($SD = 4.01$). For the opaque idioms, the mean of Mental Imagery Task scores was 14.79 ($SD = 3.83$).

There was no significant effect of idiom transparency on mental imagery performance, $F(1, 238) = 0.24$, $p = .62$, $\eta^2 < .01$. There was no significant difference between the transparent and opaque idioms on mental imagery task scores. Measures of the mental imagery task scores in each idiom type were reported in Table 4.10.

Table 4.10. One-Way, Within-Subjects Analysis of Variance on Mental Imagery Task

Source	*df*	*F*	η^2	*p*
Age	1	0.24	<.01	.62
Error Within	238			
Total	240			

*$p < .05$. ** $p < .01$.

Education Years versus Idiom Comprehension, Explanation, and Mental Imagery

Pearson product-moment correlation coefficients were computed to assess the relationships between education years and 1) Idiom Comprehension Task scores, 2) Idiom Explanation Task scores, 3) Mental Imagery Task scores, and 4) Idiom Familiarity Rating Task scores. There was no significant correlation between education years and idiom comprehension task scores, $r\ (120) = .01, p = .96$, and between education years and idiom familiarity rating scores, $r\ (120) = .10, p = .29$. There was a significant correlation between education years and idiom explanation task scores, $r\ (120) = .27, p < .01$. There was also a significant correlation between education years and mental imagery task scores, $r\ (120) = .30, p < .01$. The results of analysis were reported in Table 4.11.

Table 4.11. Pearson Correlation Coefficients among Education Years and Idiom Comprehension, Idiom Explanation, Mental Imagery, and Idiom Familiarity

	Idiom Comprehension	Idiom Explanation	Mental Imagery	Idiom Familiarity
Education Years	.01	.27**	.30**	.10

*$p < .05$. ** $p < .01$

Relationships among Idiom Familiarity, Idiom Comprehension, Idiom Explanation, and Mental Imagery

Pearson product-moment correlation coefficients were computed to analyze the relationships among four tasks administrated in the present study, including 1) Idiom Comprehension Task scores, 2) Idiom Explanation Task scores, 3) Mental Imagery Task scores, and 4) Idiom Familiarity Rating scores for each age group.

For 20s Group, the analyses yielded statistically significant and strong correlations between Idiom Comprehension and Idiom Explanation ($r(30)=.65$, $p<.01$), between Idiom Comprehension and Mental Imagery ($r(30)=.50$, $p<.01$), and between Idiom Explanation and Mental Imagery ($r(30)=.82$, $p<.01$). However, the results were not statistically significant between Idiom Familiarity and Idiom Comprehension ($r(30)=.25$, $p=.19$), between Idiom Familiarity and Idiom Explanation ($r(30)=.23$, $p=.21$), and between Idiom Familiarity and Mental Imagery ($r(30)=.33$, $p=.08$). The results of analysis for 20s Group were reported in Table 4.12.

Table 4.12. Pearson Correlation Coefficients among Idiom Comprehension, Idiom Explanation, Mental Imagery, and Idiom Familiarity Rating Task for 20s Group

	Comp.	Exp.	Img.	Familiarity
Comp.	1	.65**	.50**	.25
Exp.	.65**	1	.82**	.23
Img.	.50**	.82**	1	.33
Familiarity	.25	.23	.33	1

Note. Comp.= Idiom Comprehension, Exp.= Idiom Explanation, Img.=Mental Imagery

*p<.05. **p<.01

For 40s Group, the result also showed statistically significant and strong correlations between Idiom Comprehension and Idiom Explanation (r(30)=.45, p=.01) and between Idiom Explanation and Mental Imagery (r(30)=.86, p<.01), and between Idiom Familiarity and Mental Imagery (r(30)=.50, p<.01). It also showed statistically significant, but moderate correlations between Idiom Comprehension and Mental Imagery (r(30)=.37, p=.04), and between Idiom Familiarity and Idiom Explanation (r(30)=.41, p=.02). There was no statistically significant correlation between Idiom Familiarity and Idiom Comprehension (r(30)=.17, p=.37). The results of analysis for 40s Group were reported in Table 4.13.

Table 4.13. Pearson Correlation Coefficients among Idiom Comprehension, Idiom Explanation, Mental Imagery, and Idiom Familiarity Rating Task for 40s Group

	Comp.	Exp.	Img.	Familiarity
Comp.	1	.45*	.37*	.17
Exp.	.45*	1	.86**	.41*
Img.	.37*	.86**	1	.50**
Familiarity	.17	.41*	.50**	1

Note. Comp.= Idiom Comprehension, Exp.= Idiom Explanation, Img.=Mental Imagery

*$p<.05$. **$p<.01$

For 60s Group, no statistically significant correlation was obtained between Idiom Comprehension and Idiom Explanation ($r(30)=.28$, $p=.14$), between Idiom Familiarity and Idiom Comprehension ($r(30)=.27$, $p=.15$), between Idiom Familiarity and Idiom Explanation($r(30)=.29$, $p=.12$), and between Idiom Familiarity and Mental Imagery ($r(30)=.24$, $p=.20$). A statistically significant and moderate correlation was found between Idiom Comprehension and Mental Imagery ($r(30)=.40$, $p=.03$), and a strong correlation was found between Idiom Explanation and Mental Imagery ($r(30)=.87$, $p<.01$). The results of analysis for 60s Group were reported in Table 4.14.

Table 4.14. Pearson Correlation among Idiom Comprehension, Idiom Explanation, Mental Imagery, and Idiom Familiarity Rating Task for 60s Group

	Comp.	Exp.	Img.	Familiarity
Comp.	1	.28	.40*	.27
Exp.	.28	1	.87**	.29
Img.	.40*	.87**	1	.24
Familiarity	.27	.29	.24	1

Note. Comp.= Idiom Comprehension, Exp.= Idiom Explanation, Img.=Mental Imagery
*$p<.05$. **$p<.01$

For 80s Group, the analyses yielded statistically significant and strong correlations between Idiom Comprehension and Idiom Explanation ($r(30)=.60$, $p<.01$), between Idiom Comprehension and Mental Imagery ($r(30)=.54$, $p<.01$), between Idiom Explanation and Mental Imagery ($r(30)=.88$, $p<.01$), but a moderate correlation between Idiom Familiarity and Idiom Comprehension ($r(30)=.46$, $p=.01$). The results of analysis were reported in Table 4.15. However, no statistically significant correlation was found between Idiom Familiarity and Idiom Explanation ($r(30)=.18$, $p=.36$), and between Idiom Familiarity and Mental Imagery ($r(30)=.29$, $p=.12$).

Table 4.15. Pearson Correlation Coefficients among Idiom Comprehension, Idiom Explanation, Mental Imagery, and Idiom Familiarity Rating Task for 80s Group

	Comp.	Exp.	Img.	Familiarity
Comp.	1	.60**	.54**	.46*
Exp.	.60**	1	.88**	.18
Img.	.54**	.88**	1	.29
Familiarity	.46*	.18	.29	1

Note. Comp.= Idiom Comprehension, Exp.= Idiom Explanation, Img.=Mental Imagery

*$p<.05$. **$p<.01$

Additionally, the accuracy of Idiom Comprehension, Idiom Explanation, and Mental Imagery Tasks for each idiom across four age groups was reported in Appendix H and Appendix J. Additionally, the frequency of familiarity rating for each idiom across four age groups was reported in Appendix I. Interestingly, all participants in 20s Group and 40s Group were unable to provide accurate and relevant responses for Idiom #20 "*go against the grain*" in Idiom Explanation and Mental Images Task. For Idiom #12 "*get the lead out,*" participants in 20s Group appeared to have less accurate and relevant responses on both Idiom Explanation and Mental Imagery Tasks, and also made more errors on Idiom Comprehension Task. Moreover, participants in 20s Group and 40s Group also showed more difficulties with Idiom #17 "*bring the house down.*" Otherwise, no specific trend was observed in the visual analysis.

CHAPTER V

DISCUSSION

The purpose of the present study was to examine how neurologically healthy adults, ages between 20-29, 40-49, 60-69, and 80-89 years old, comprehended idioms using the definition explanation task, mental imagery task, and forced-choice comprehension task. Moreover, the effects of familiarity and transparency of the idioms were also examined in this study to provide a comprehensive understanding of idiom comprehension. The first aim of the study was to evaluate whether younger and older adults performed equally well on the forced-choice idiom comprehension task. The second aim was to discover if younger adults performed better than older adults on Idiom Explanation Task, but provided less figurative mental images on Mental Imagery Task. The present study also discovered whether transparency and familiarity of the idiom affected idiom understanding.

Conclusions

Age Differences in Idiom Comprehension

The results generated from the comparisons of the four age groups showed that there was no significant difference on the forced-choice comprehension task across four age groups. The results supported the study of Qualls and Harris (2003) that no age-related decline was found in figurative language comprehension in older adults when a selection of response choices was provided. The results were also consistent with Gregory and Waggoner's findings (1996) that the performance on metaphors was similar on the forced-choice task but was different on the explanation task between younger and older people. Although no context was given for the comprehension task, the forced-choice task was still relatively easier than the explanation task. Therefore, different comprehension measures, direct versus indirect measures, and differences in inferential demand yielded different performance (Gregory & Waggoner, 1996).

Regarding the explanation task, it was predicted that older adults would perform worse than younger adults. According to Nippold, Uhden, and Schwarz (1997), proverb explanation reached a peak around the age 20s and remained stable during the age 30s, 40s and 50s, but slightly declined in the age 60s, and the decline reached significance around the age 70s. The present study focused on idiom comprehension with the age range expanded to 80s, and mixed findings were presented. The participants in 60s Group performed significantly better than 20s Group, but there was no significant difference between other age groups. One possible explanation of better performance in 60s Group was that the familiarity of idioms was rated significantly higher in 60s than in 20s. It was

critical to consider the familiarity of idioms since a significant correlation was found between the familiarity rating and the idiom explanation task scores.

In addition, participants in 20s Group performed the worst on Idiom Explanation Task among the four groups, and 40s Group and 80s Group performed equally well although the performance on the explanation task varied widely in 80s than in 20s. The results were also consistent with the familiarity rating that 20s rated lowest on the familiarity rating than other age groups, whereas 40s and 80s' ratings were similar. Participants in 80s Group did worse on the explanation task than 60s Group; however, it did not reach statistical significance, which was similar to Nippold and colleagues' finings (1997) that idiom explanation improved with advancing age from 20 years to 60 years old, but declined around 70s.

The results were also in line with Obler and Albert study (1989) that no changes were shown in the metalinguistic tasks, such as interpretation of proverbs and idioms in normal older people. Additionally, the metaphor interpretation performance was also found to be well maintained through the later adult years (Szuchman & Erber, 1990). Although participants in 80s Group in the current study performed slightly worse on Idiom Explanation Task, it did not reach the statistical significance. Therefore, it was concluded that no significant change was found in idiom explanation in older populations. It was worthy to note that 20s Group had difficulties on certain idioms, such as "*get the lead out*" and "*bring down the house*"; on the other hand, the errors that 60s and 80s made were heterogeneous and varied widely.

Researchers pointed out that difficulties in naming, reduced syntactic complexity, and decrement in verbal fluency were commonly observed during the age of 70 years old (Ardila & Rosselli, 1996). In addition, older people tended to produce less complex sentences (Juncos-Rabadan & Iglesias, 1994; Kemper, Greiner, Marquis, Prenovost, & Mitzner, 2001; Kemper, Herman, & Lian, 2003; Kemper, Herman, & Liu, 2004), had difficulties accessing appropriate lexical items, integrating story elements in a complex discourse structure (Juncos-Rabadan & Iglesias, 1994), and processing complex discourse information (Ulatowska, Cannito, Hayashi, & Fleming, 1985). However, the present study did not examine the sentence complexity, lexicon use, and information integration. Therefore, the decline commonly observed in research was not shown in this study since the focus of this study was idiom comprehension and processing, not producing complex discourse, naming, and integrating information.

The interpretation of idioms was viewed as a metalinguistic task, which was a higher level of linguistic and cognitive process. According to Emery's study (1986), when the level of linguistic complexity increased, the normal elders showed more pronounced decrement in language ability. Normal elders performed as well as middle aged adults in lexicon; performed worse during the word-internal morphological processing, and did even worse on the sentence level task since it was more abstract and complex. However, the interpretation of figurative language, such as idioms, metaphors, and proverbs, could yield different results in comparison to the results commonly observed in language decline with advancing age because of the way that idioms are stored and used. Idioms are viewed as part of the mental lexicon because they can not be decomposed but restored

and accessed as a whole like mental lexicon (Nippold, 2007; Swinney & Cutler, 1979). Although the definitions provided by 80s Group were less accurate in comparison with 40s and 60s Groups, it could not be overgeneralized to any other difficulties in the syntactic complexity and word finding ability in elderly reported in other studies since the syntactic complexity and use of lexicon were not measured in the present study.

Regarding language comprehension, research showed that elderly maintained surface comprehension, but had deficits in language comprehension involving integration, inference, and construction (Cohen, 1979). Moreover, normal aging affected the comprehension of complex sentences, and the decline began after age 60 years old (Davis & Ball, 1989; Feier & Gerstman, 1980; Obler et al., 1991). Although the present study tested idiom understanding using both receptive and expressive methods, idioms were viewed more like giant lexical units rather than regular phrases. The current study did not measure the comprehension of complex sentences, information integration, and inference; therefore, whether language comprehension declined with advancing age was out of the scope of the present study. According to the findings from the forced-choice comprehension task, it was concluded that idiom comprehension was maintained with advancing age when options were provided, which supported Qualls and Harris's findings (2003).

Based on the results of the idiom comprehension and explanation task, 80s Group did not perform significantly worse than the younger groups, and 60s Group outperformed other age groups on Idiom Explanation Task and Idiom Comprehension Task although the significant difference was only found between 20s and 60s Group on

the explanation task. No significant difference was shown in the comprehension task. Four age groups reached the ceiling while the forced-choice task was used to test the idiom comprehension. It was noteworthy that the results yielded from the explanation task followed a similar pattern shown in the familiarity rating. The 60s Group rated highest on the familiarity rating and scored highest on Idiom Explanation Task, followed by 40s and 80s Group with considerably similar ratings and scores. Therefore, the familiarity of the idiom seemed to play a critical role while asked to provide a definition or explanation for an idiom. The idioms used in the present study were more familiar to 40s, 60s, and 80s Groups; therefore, they performed better on the explanation and comprehension task. The generation difference might also exist in idiom comprehension across different age groups since 20s Group consistently had difficulties with certain idioms such as "*go against the grain,*" "*sing a different tune,*" and "*get the lead out.*"

The results of the present study indicated that idiom comprehension improved with age from 20s to 60s and well maintained into 80s if their cognitive functions did not decline. The results also showed that adults even in their early adulthood did not master all idioms. Idiom comprehension is a life long learning process. How people comprehended and understood idioms mainly depended on their exposure to and familiarity with the idiom. Some idioms, such as "*go against the grain*" and "*get the lead out,*" were used more frequently among older people than younger populations. But, some idioms, such as "*get into one's hair*" and "*go by the book,*" were widely known in all age groups. Therefore, it was critical to take all possible factors into account while exploring idiom comprehension in different ages.

It was noteworthy that some idioms were misinterpreted more frequently than others. For example, "*go against the grain*" was often misinterpreted as "*sail against the wind.*" "*Hold your head up*" was frequently misinterpreted as "*keep your chin up,*" while "*sing a different tune*" was easily misinterpreted as "*march* to *the beat of* a *different drum.*" "*Cast the first stone*" was often misinterpreted as "*break the ice.*" "*Bring down the house*" was easily misinterpreted as "*paint the town red.*" "*Blow off steam*" was frequently mistaken as "*blow your top.*"

The different results drawn from the forced-choice comprehension task and the explanation task also provided valuable information. Gregory and Waggoner (1996) claimed that different comprehension measures, direct versus indirect measures, and differences in inferential demand yielded different performance. The explanation task, a highly linguistic and cognitive demanding task, was more sensitive and more straightforward to detect possible language impairments or declines. Participants in 80s Group performed equally well as 40s and 60s Group did on the comprehension task, but received lower scores on the idiom explanation than 60s Group. Although the difference between the groups did not reach the statistical significant level, it provided different insights while examining idiom comprehension through different tasks.

Dual Coding Theory and Idioms

The results of Mental Imagery Task indicated that no significant difference in generating mental images between transparent and opaque idioms was found. Mental images generated from the idioms used in the present study tended to be figurative rather than literal for both transparent and opaque idioms. Although participants in the present

study had difficulty generating mental images for some idioms such as "*go against the grain,*" "*get the lead out,*" and "*sing a different tune,*" no trend for a certain type of idioms was observed. If the participant was not familiar with the idiom or was not able to provide a correct definition, he or she also had difficulty generating appropriate mental images for the idiom. Cacciari and Glucksberg (1995) suggested that transparent idioms may be easier to comprehend than opaque ones because of the involvement of mental imagery and the concreteness effect. However, the effect of idiom familiarity was not included in their study. According to the dual coding theory (Paivio, 1971, 1986), concrete concepts would more easily form mental images than abstract concepts. However, Nippold, Uhden, and Schwarz (1997) indicated that although some of the proverbs evoked stronger images than others, not all concrete proverbs were imageable. In addition, the relationship between imagery and comprehension was significantly correlated for the children but not for the adolescents and adults. When the idiom was highly familiar to people, the effect of idiom transparency reduced, and generating mental imagery was considerably easier for both transparent and opaque idioms. Given that all participants in the present study were adults, and all idioms were rated as highly familiar, it was not surprising that no significant difference in generating mental images was found between transparent and opaque idioms in the current study.

Nippold and Duthie (2003) proposed that the knowledge of an idiom was expected to expand and deepen, and mental imagery was expected to become more figurative with advancing age. Duthie and colleagues (Duthie, Nippold, Billow, & Mansfield, 2008) also indicated that adults had a more metaphorical understanding of

proverbs than children and adolescents. When mental images were compared between children and adults, the difference was more prominent since children were still in the learning process through understanding the connection and relationship between literal and figurative meanings. However, as soon as idioms were learned and stored as lexical units, mental images reported by adults tended to be figurative rather than literal.

It was also noteworthy that 80s Group received the lowest score on Mental Imagery Task compared to the other groups; however, it did not reach the statistical significant level. Moreover, 40s and 60s Group performed equally well on the imagery task and did better than 20s Group. Therefore, mental imagery became more figurative with advancing age from 20 years to 69 year old, but people in 80s Group provided less accurate mental images than the other groups did. Irrelevant mental images or wrong interpretation of the idioms were observed more frequently in 80s Group than in other age groups. Although 20s Group also received lower scores on the mental imagery task compared to 40s and 60s Group, the lower scores mainly resulted from not knowing the idioms, which was consistent with the familiarity rating. The 20s Group rated lowest on the familiarity rating in comparison to other age groups. Without the knowledge to provide an accurate definition for the idiom, it was not possible to form an appropriate and relevant mental image for the idiom.

Forming the arbitrary link between idioms and their idiomatic meanings was a critical process to learn idioms. According to the highly consistent mental images provided by participants, conceptual metaphors played the key role that motivated what the proverbs or idioms really meant (Bortfeld, 2002; Gibb, Storm, & Spivey-Knowlton,

1997). Gibbs and O'Brien (1990) suggested that conceptual metaphors motivated the link between idioms and their nonliteral meanings, and conceptual metaphors were accessed during the idiom comprehension process (Gibbs, Bogdanovich, Sykes, & Barr, 1997). Participants in the present study formed similar mental images for the idioms they were familiar with, which further supported the existence of conceptual metaphors. For example, a great performance for "*bring down the house,*" a celebration event for "*paint the town red,*" and following rules strictly like soldiers and police for "*go by the book*" were provided consistently across the four age groups.

Nippold and Duthie (2003) suggested that mental imagery would be automatically created once the figurative meaning of an idiom was learned. The present study showed that participants tended to leave the idiom definition in blank instead of generating from its literal meaning if they did not know the meaning of the idiom. This finding was different from what has been observed from children and adolescents. With the exposure experience and the maturity of understanding and using language, adults provided highly consistent mental images for familiar idioms; however, they did not generate figurative meanings through analyzing literal meanings or syntactical/semantic parts for unfamiliar ones. Thus, mental images provided a unique approach to access how conceptual metaphors work in the process of idiom comprehension, and to examine if both literal and figurative meanings had to be accessed during the idiom comprehension process. The results of the present study were consistent with Nippold and Duthie's findings (2003) that mental imagery may serve as an indicator of deep understanding of figurative meanings in idiom comprehension once the meaning of an idiom has been learned.

Factors Involved in Idiom Comprehension

Nunberg, Sag, and Wasow (1994) suggested that difficulties in the analysis of idioms resulted from a confusion of the key semantic properties associated with idiomatic meanings, including conventionality, transparency, and compositionality. Additionally, idioms varied on transparency, decomposability, and ambiguousness, which affected how people interpreted idioms (Cacciari, Reatio, Colombo, Padovani, Rizzo & Papagno, 2006). Therefore, the present study also examined the impact of familiarity and transparency during the idiom comprehension process.

Familiarity

According to Schweigert (1986), the familiarity of the idiom needed to be taken into account in the model of idiom processing. Nippold and Taylor (2002) also suggested that the transparency and familiarity were strongly correlated to idiom comprehension in children and adolescents, and needed to be considered while examining idiom comprehension. Participants in the present study rated all 20 idioms as highly familiar idioms. Although the familiarity rating increased from 20s to 60s, the rating surprisingly decreased slightly in 80s Group.

The results of the present study also supported the importance of taking idiom familiarity into account while examining the idiom comprehension process. It was found that the familiarity was significantly correlated to the scores on the explanation task, mental imagery task, and comprehension task. Therefore, when people were familiar with the idiom, people was able to provide an accurate definition, a relevant mental image, and also selected the best explanation from options even though no context was provided for

the idiom. It was also interesting to discover that people had difficulties providing definitions and images for some idioms even though the idioms were rated familiar. Thus, people might have heard of or were exposed to the idiom several times, but they did not understand the meaning of the idiom, or they grasped the wrong meaning of the idiom. For example, participants in the present study commonly misinterpreted "*go against the grain*" as being unique from rest of the people. Since familiarity was subjective and heavily depended on the personal experience and feelings, it was difficult to detect the influence of familiarity in idiom comprehension based only on the rating scale.

Literal interpretation was rarely shown across four age groups. Based on Graded Salience Hypothesis (GSH) (Giora, 1997), comprehension of figurative and literal language should be depending on its salient meanings. The salience of a word or an utterance is a function of its conventionality, familiarity, and given context. According to Giora (1997), in idiom comprehension, the idiomatic meaning is salient because it can not be decomposed but restored as a whole like mental lexicon. Schweigert and Moates (1988) made a similar statement that familiar idioms were more likely processed as lexical units than less familiar idioms. Therefore, it was not surprising to find that only figurative meanings were reported on the explanation task, and the mental image generated for each idiom tended to be idiomatic instead of literal. Since idioms were viewed and stored as mental lexicon, the figurative meaning of the idiom was activated first. Unlike children, who learned the idiom meaning through the context and the relationship between literal and figurative meanings of the idiom, adults tended to leave it in blank on the explanation and mental imagery task instead of guessing the meaning

through syntactic or semantic analysis of the idiom. In addition, the present study did not provide context for each idiom; therefore, it was difficult for participants to generate the meaning of the idiom using context cues.

Given that all the idioms used in the present study were rated as highly familiar, figurative meanings activated first and immediately without assessing and analyzing their semantic and syntax structures because the figurative meaning was more salient than its literal meaning (Giora, 1997). Moreover, mental images were more metaphorical than literal because of the easiness of activating conceptual metaphors which motivated the link between idioms and their nonliteral meanings and the salience of its figurative meaning rather than literal meaning.

Transparency

The transparent and opaque idioms were only compared on the mental imagery task in order to examine the difference of generating mental images between two types of idioms. The purpose of examining transparency in idiom understanding was to find out if the concreteness effect existed in idiom comprehension and if the dual coding theory was applicable to the idiom comprehension process. According to the dual coding theory (Pavio, 1976), mental images were more easily generated when people processed concrete concepts or information than abstract information. Cacciari and Glucksberg (1995) also suggested that transparent idioms may be easier to comprehend than opaque ones because of the involvement of mental imagery and the concreteness effect. Therefore, one of the research hypotheses was that participants would score better on transparent idioms than opaque ones since people were expected to generate mental

images for transparent idioms more easily. However, the difference on the mental imagery task between these two types of idioms was not found in the present study. Participants in the present study generated mental images associated to the figurative meanings for both transparent and opaque idioms if they were familiar with the idiom. Therefore, in the present study, familiarity seemed to play a stronger role than transparency while forming mental images for idioms. In other words, once an idiom was learned and stored as mental lexicon, people applied idiomatic meanings and generated figurative mental image immediately without accessing its literal meanings and mental images.

The transparency rating used in the present study was adapted from Nippold and Rudzinski (1993) in which 20 adults living in western Oregon were asked to rate 100 idioms for familiarity and transparency; therefore, participants in the present study did not rate the transparency for each idiom. However, similar to familiarity, the transparency rating was subjective and difficult to be applied to different studies and participants. Therefore, it was not surprising to discover that no significant difference on the mental imagery task was found between transparent and opaque idioms.

Education

The total years of participant's education was significantly related to the definition task and mental imagery task, but not to the comprehension task. It was not surprising to find the correlation since these two tasks were highly linguistic and cognitive demanding tasks and required sufficient understanding and knowledge of language that developed relatively late. Therefore, when people were exposed to

education longer, it was expected that they had more opportunities to deepen and expand their language knowledge. It was not unexpected to find that no significant correlation was found between education years and the comprehension task since the forced-choice task format was relativity easier than the tasks that required integration, inference, and organization.

Limitations and Future Research

Limitations

Some limitations were noted in the present study. First, idioms used in the study were highly familiar to the participants according to the familiarity rating. Therefore, it would be difficult to detect the different interpretation of transparent and opaque idioms since familiarity played a stronger role than transparency in idiom comprehension in the present study. Secondly, the subjects' definitions of idioms varied among the different age groups, and people tended to interpret their figurative meanings slightly differently. According to Gregory and Waggoner (1996), older and younger adults used different explanation styles and explained the basis of the meaning differently while they interpreted metaphors. Thus, the difference of interpreting idioms may not only create difficulties on scoring but also underestimate the comprehension of idioms. Thirdly, individual differences existed in all four age groups; however, the results represented only the performance of each age group in general. In addition, this study required participants to write down the definitions and mental images, which created great disadvantages for older participants. Poor control of hand movement and taking up to two

to three hours to finish all tasks were commonly observed in 80s Group. Although all tasks were untimed in the present study, writing was highly demanding and remained as a major difficulty for older participants to complete the tasks.

Another limitation was drawn from the lack of understanding of participants' language and cognitive performance. Although Mini-Mental State Examination (MMSE) was given to 60s and 80s Groups to rule out the possibility of cognitive decline due to aging, idiom comprehension was also associated with people's language ability. No standardized language test was administered in the present study, which might limit the scope of understanding idiom comprehension and overlook the connection between overall language performance and idiom understanding. Rassiga and colleagues (Rassiga et al., 2009) hypothesized that elderly with good executive function would perform well on the idiom comprehension task; however, elderly with lower executive function would perform at a lower level. The present study was not able to verify this hypothesis because no standardized cognitive test was given to establish the baseline of participants' executive function.

Moreover, the present study adapted Nippold's (2007) idiom transparency rating. However, transparency might differ from person to person depending on their interpretation and exposures to idioms. The concreteness effect might not be reflected on the mental imagery task because of the selection of transparent and opaque idioms based on a different study. Moreover, the high familiarity rating did not mean that people had complete understanding of the idiom. Using the idiom in an accurate and appropriate context is at a different processing level from only having heard of the idiom. Therefore,

the disconnection between familiarity and idiom comprehension was a major missing puzzle in the present study.

Future Research

Given limited research in idiom comprehension in normal aging populations and the lack of knowledge of the role of mental imagery in idiom comprehension, more research is warranted. Future research could use oral explanations instead of written explanations to avoid creating handwriting difficulties for elderly and to obtain more detailed information about their mental images. In addition, asking participants to rate the easiness of generating a mental image and to form images by providing specific prompts could offer more insights about creating mental images during idiom comprehension, since it was difficult to detect the process of producing mental images using behavioral tasks. In addition, future research should ask participants to rate not only familiarly but also transparency to collect complete information of people's idiom understanding. Familiarity and transparency are subjective to people depending on their life experience, understanding, and exposures. Therefore, adapting the transparency rating from other studies may not be sensitive enough to reflect idiom comprehension in different age groups.

The present study did not include low familiarity idioms; thus, it was difficult to identify how people interpreted their mental images differently between low familiar and highly familiar idioms. According to Nippold (2007), children learn idioms through analyzing literal meaning of the idiom and using context clues to figure out the figurative meaning. Therefore, it would be interesting to compare how people generate mental

images differently for low and highly familiar idioms without context, and how they interpret these idioms in different ways.

Understanding figurative language is an important way to appreciate daily language; however, it is rarely studied and explored in the research in children, adolescents, or adults. In order to indentify the subtle language changes resulting from mild Alzheimer's disease or mild cognitive impairments, it is necessary to have the fundamental knowledge of how people use language in a more practical and natural way. In addition, research beyond the scope of examining word finding function, syntactic structures, and information integration is needed to detect the subtle changes. People with widespread brain damage have often lost the ability of abstract thinking and frequently substituted concrete interpretation (Kempler & Van Lancker, 1988). Obler and Albert (1984) also pointed out that people with dementia had difficulties interpreting idioms and proverbs, and their interpretations were fairly concrete. Future research could expand the scope from the normal aging population to people with mild cognitive impairments and early stage of Alzheimer's disease to discover the possible changes in idiom comprehension. Researchers also could examine different types of figurative language, such as metaphors and proverbs, in the normal aging population to widen and deepen the understanding of figurative language, which is an important piece in later language development.

APPENDIX A

THE LIST OF IDIOMS USED IN THE PRESENT STUDY

(NIPPOLD & DUTHIE, 2003)

Transparent Idioms

1. Hold one's head up
2. Go by the book
3. Take someone under one's wing
4. Turn the other cheek
5. Run out of steam
6. Blow off steam
7. Skate on thin ice
8. Sing a different tune
9. Cast the first stone
10. Go through the motions

Opaque Idioms

1. Get in someone's hair
2. Get the lead out
3. Keep one's shirt on
4. Blow one's own horn
5. Put one's foot down
6. Beat around the bush
7. Bring the house down
8. Paint the town red
9. Have a soft spot in one's heart
10. Go against the grain

APPENDIX B

BACKGROUND QUESTIONNAIRE

Name: (please Print)_____
(first) (last)

Local phone:_____

Email (if any): _____

Age:_____

Birth date:_____

Today's Date: _____

Primary language spoken at home:_____
(e.g., English, Spanish, Chinese, etc.)

How long have you spoken English?_____

City and state of residence:_____

How long have you lived in the United States? _____

Gender: (circle one) male female

Current or previous occupation(s): _____

Highest level of formal education achieved: _____

(e.g., high school diploma, Associate of Arts, BA, BS, MA, etc.)

APPENDIX C

FAMILIARITY RATING

IDIOM FAMILIARITY TASK

Name: _____ _____
(first) (last)

Many people use idioms when they talk or write. Examples include *throw in the towel* and *go around in circles*. Some idioms are *common* and are used all the time. Others are *rare*, and are hardly ever used. And still others are somewhere in between – sometimes used but not very often.

I would like you to read a list of idioms and tell me how common or rare *you* think they are. Read each idiom and circle the number that best tells how familiar you are with that expression. There are no right or wrong answers. Just circle the number that seems to be the best answer for you.

Let's practice:

A. Throw in the towel

I have heard or read this idiom:

1. never
2. once
3. a few times
4. several times
5. many times

B. Go around in circles

I have heard or read this idiom:
1. never
2. once
3. a few times
4. several times
5. many times

There are 20 idioms in this booklet. Please answer each item. Draw a circle around the number of your answer choice.

1. Bring the house down

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

2. Turn the other cheek

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

3. Go through the motions

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

4. Hold your head up

   I have heard or read this idiom:
   1. never before
   2. once before
   3. a few times before
   4. several times before
   5. many times before

5. Blow one's own horn

   I have heard or read this idiom:
   1. never before
   2. once before
   3. a few times before
   4. several times before
   5. many times before

6. Get the lead out

   I have heard or read this idiom:
   1. never before
   2. once before
   3. a few times before
   4. several times before
   5. many times before

7. Blow off steam

   I have heard or read this idiom:
   1. never before
   2. once before
   3. a few times before
   4. several times before
   5. many times before

8. Have a soft spot for something

   I have heard or read this idiom:
   1. never before
   2. once before
   3. a few times before
   4. several times before
   5. many times before

9. Get in someone's hair

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

10. Take someone under one's wing

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

11. Put one's foot down

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

12. Keep one's shirt on

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

13. Paint the town red

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

14. Skate on thin ice

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

15. Go by the book

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

16. Run out of steam

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

17. Beat around the bush

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

18. Cast the first stone

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

19. Sing a different tune

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

20. Go against the grain

I have heard or read this idiom:
1. never before
2. once before
3. a few times before
4. several times before
5. many times before

APPENDIX D

IDIOM EXPLANATION TASK

Name:_____
(first) (last)

Your booklet contains a list of 20 idioms. Please explain what you think each idiom means. Then, describe a situation where someone would use that idiom. You may use a pencil or a pen to write your answers.

Look at the two examples below:

1. What does it mean to *get off the hook?*

It means you try to get out of something that you don't want to do.

Describe a situation where someone would use that idiom.

A girl was looking forward to a party on Saturday night. But then she remembered that she had agreed to baby sit the neighbor's child that same night. She didn't want to miss the party. She asked her dad, "How can I get off the hook?"

2. What does it mean to *turn back the clock?*

It means you want to be young again or to go back in time.

Describe a situation where someone would use that idiom.

A man was watching his granddaughter play basketball one evening. He remembered a time when he could run quickly, shoot baskets, and dribble just like his granddaughter. He felt a little sad. He told his friend, "I wish I could turn back the clock."

Please answer the following questions by yourself.

1. What does it mean to *have a soft spot for something?*

   Describe a situation where someone would use that idiom:

2. What does it mean to *cast the first stone*?

   Describe a situation where someone would use that idiom:

3. What does it mean to *get in someone's hair*?

Describe a situation where someone would use that idiom:

4. What does it mean to *skate on thin ice*?

Describe a situation where someone would use that idiom:

5. What does it mean to *paint the town red*?

Describe a situation where someone would use that idiom:

6. What does it mean to *hold your head up?*

Describe a situation where someone would use that idiom:

7. What does it mean to *put one's foot down*?

Describe a situation where someone would use that idiom:

8. What does it mean to *blow off steam*?

Describe a situation where someone would use that idiom:

9. What does it mean to *go by the book?*

Describe a situation where someone would use that idiom:

10. What does it mean to *go through the motions*?

Describe a situation where someone would use that idiom:

11. What does it mean for something to *go against the grain*?

Describe a situation where someone would use that idiom:

12. What does it mean to *bring the house down*?

Describe a situation where someone would use that idiom:

13. What does it mean to *get the lead out*?

Describe a situation where someone would use that idiom:

14. What does it mean to *blow one's own horn*?

Describe a situation where someone would use that idiom:

15. What does it mean to *beat around the bush*?

Describe a situation where someone would use that idiom:

16. What does it mean to *run out of steam?*

Describe a situation where someone would use that idiom:

17. What does it mean to *keep one's shirt on*?

Describe a situation where someone would use that idiom:

18. What does it mean to *sing a different tune*?

Describe a situation where someone would use that idiom:

19. What does it mean to *take someone under one's wing?*

Describe a situation where someone would use that idiom:

20. What does it mean to *turn the other cheek?*

Describe a situation where someone would use that idiom:

APPENDIX E

IDIOM COMPREHENSION TASK

Name: _____
(first) (last)

Introduction:

Your booklet contains a set of idioms. Please select the answer that best explains the meaning of each idiom. Draw a circle around the letter of your choice – A, B, C, or D.

Let's try some for practice.

Practice Problems:

1. What does it mean to *get off the hook?*

   A. to do many different things
   B. to think carefully about a problem
   C. to help other people when needed
   D. to get out of a situation

2. What does it mean to *turn back the clock?*

   A. to think about others
   B. to be young again
   C. to enjoy sporting events
   D. to understand a situation

Directions:
Now you are ready to answer the rest of the questions by yourself. Read the four answer choices carefully. If you aren't sure of the best answer, take a guess. Pick the one that you *think* is best. Make sure you don't skip any problems.

1. What does it mean to *skate on thin ice*?

    A. to almost miss something
    B. to make a bad decision
    C. to be in a dangerous situation
    D. to make someone angry

2. What does it mean to *go by the book?*

    A. to ignore suggestions
    B. to follow the rules
    C. to take a long time
    D. to be uncooperative

3. What does it mean to *sing a different tune*?

    A. to change one's mind
    B. to act selfishly
    C. to request special treatment
    D. to argue with others

4. What does it mean to *hold your head up?*

    A. to be honest
    B. to be friendly
    C. to be proud
    D. to be kind

5. What does it mean to *have a soft spot for something*?

    A. to feel sorrow
    B. to feel affection
    C. to feel weakness
    D. to feel freedom

6. What does it mean to *keep one's shirt on*?

   A. to think about others
   B. to act unselfishly
   C. to stay calm
   D. to do the right thing

7. What does it mean to *run out of steam?*

   A. to feel bored
   B. to feel annoyed
   C. to feel discouraged
   D. to feel tired

8. What does it mean to *put one's foot down*?

   A. to insist on something
   B. to act cautiously
   C. to be overly concerned
   D. to worry about others

9. What does it mean to *paint the town red*?

   A. to relax
   B. to celebrate
   C. to make plans
   D. to spend lots of money

10. What does it mean to *bring the house down*?

    A. to make people listen
    B. to make people watch
    C. to make people proud
    D. to make people applaud

11. What does it mean to *beat around the bush*?

    A. to try to impress someone
    B. to show pride in one's work
    C. to avoid discussing a topic
    D. to talk about one's self

12. What does it mean to *get in someone's hair*?

    A. to be playful
    B. to be naughty
    C. to be energetic
    D. to be annoying

13. What does it mean to *get the lead out*?

    A. to organize others
    B. to work faster
    C. to complain loudly
    D. to make a promise

14. What does it mean to *blow one's own horn*?

    A. to brag too much
    B. to be very busy
    C. to act unselfishly
    D. to try to lead others

15. What does it mean to *blow off steam*?

    A. to do something fun
    B. to feel frustrated
    C. to forgive someone
    D. to get rid of anger

16. What does it mean for something to *go against the grain*?

    A. to cause discomfort
    B. to cause happiness
    C. to cause jealousy
    D. to cause arguments

17. What does it mean to *turn the other cheek?*

    A. to solve a problem
    B. to ignore something
    C. to change one's behavior
    D. to listen to others

18. What does it mean to *go through the motions*?

A. to be frustrated
B. to day dream
C. to work without interest
D. to behave badly

19. What does it mean to *take someone under one's wing?*

A. to offer guidance to someone
B. to make a statement about someone
C. to wish someone good luck
D. to show appreciation to someone

20. What does it mean to *cast the first stone*?

A. to lie about others
B. to be overly helpful
C. to ignore a problem
D. to criticize another

APPENDIX F

SCORING EXAMPLES OF IDIOM EXPLANATION TASK REPORTED BY PARTICIPANTS ACROSS FOUR AGE GROUPS

The following examples are explanations of 20 idioms reported by participants across four age groups.
Score 0 = The response is inaccurate, a restatement, literal, or absent
Score 1 = The response is related but vague or incomplete
Score 2 = The response is accurate, clear, and complete

Idiom Explanation Task-Transparent Idioms

1. *Hold one's head up (to be proud, brave, courageous)*
   - 0 = To stay strong
   - 1 = To maintain your dignity
   - 2 = Be proud of yourself
2. *Go by the book (to follow rules and regulations)*
   - 0 = To go by the numbers
   - 1 = Too strict not being able to bend
   - 2 = Follow the rules or stated procedure exactly
3. *Take someone under one's wing (to offer protection or guidance)*
   - 0 = No irrelevant or inaccurate responses
   - 1 = Help them out
   - 2 = Take care of someone
4. *Turn the other cheek (turn away from anger and ignore it rather than retaliate)*
   - 0 = Look the other way
   - 1 = Take the punishment that you don't deserve
   - 2 = Not be angry. Do not take revenge
5. *Run out of steam (to run out of energy)*
   - 0 = Giving the same advice over and over
   - 1 = When you keep working and can't stop because you want to finish
   - 2 = Run out of speed or energy

6. Blow off steam (to get rid of anger)

0 = A person gets angry about a situation

1 = To go ahead and vent about something that is bothering you

2 = Release anger

7. Skate on thin ice (to take a big risk)

0 = This is one of the last warning; losing patience

1 = Take precaution

2 = Enter a danger situation

8. Sing a different tune (to change one's mind, opinion, or point of view)

0 = You go against the norm; change your mind

1 = To see things with s different and possibly better point of view

2 = To change your mind/opinion, usually without waiting to or expecting to

9. Cast the first stone (to criticize another)

0 = To be the first to initiate something

1 = You are judging someone

2 = To give the first insult

10. Go through the motions (to pretend to do something by acting as if one was really doing it)

0 = To go through the routine or procedure

1 = Doing things repeatedly; proceed through tedious, boring strategies.

2 = Do something when you heart is not in it

Idiom Explanation Task- Opaque Idioms

11. Get in someone's hair (to bother someone)

0 = Being too opinionated

1 = Someone not mind their own business and getting unnecessarily personal

2 = To annoy someone

12. Get the lead out (to start moving or move more rapidly)

0 = Getting into activity; Remove something or someone who is blocking others from improving

1 = To get started on something

2 = To hurry

13. Keep one's shirt on (to stay calm, to be patient)

0 = Suddenly be upset about a situation

1 = Don't get too excited

2 = To stay calm

14. Blow one's own horn (to brag)

0 = To be considered

1 = To commend yourself

2 = Praise yourself

15. Put one's foot down (to assert something strongly)

0 = To try to get something done that's hard to you

1 = To meant what you

2 = Make a final decision, don't change your mind

16. Beat around the bush (to avoid a topic, stall for time)

0 = To procrastinate

1 = Not stating the facts about a situation

2 = Speak about something indirectly

17. Bring the house down (to make others applaud a spectacular performance)

0 = Have a fun time

1 = To excite and deliver words of inspiration to a crowd or audience

2 = Do so well that the audience approves wildly

18. Paint the town red (to go out and celebrate)

0 = Going crowed showing off my accomplishments

1 = To go out and carefree

2 = To celebrate

19. Have a soft spot in one's heart (to be kind to others or fond of something)

0 = A weak spot

1 = Someone is sensitive toward some aspect of object or person

2 = You like it more than other things

20. Go against the grain (to do something that is the opposite of what is usually done)

0 = A person who does what they want

1 = To rub the wrong way

2 = Something to which you are not accustomed to doing

APPENDIX G

GOOD MENTAL IMAGES REPORTED BY PARTICIPANTS ACROSS FOUR AGE GROUPS

The following examples are mental images of 20 idioms reported by participants across four age groups. Mental images that received full score (score = 2) were selected as examples. The code numbers followed each example indicated the participant's age group and anonymous code. For example, 20-01 meant that the participant was in 20s Group and the subject code was 01.

Transparent Idioms

1. Hold one's head up (to be proud, brave, courageous)

A. Jessica did the right thing by not joining in with the cool kids and using pot. She was embarrassed to see them he next day at school because they had laughed at her the day before. Her mother said "I am so proud of you. When you go to school today you should hold your head up and be proud." (20-13)
B. Despite falling from the balance beam during the gymnastics finals, Cindy got up and back on the beam to finish her routine. She held her head up that day. (40-20)
C. The young child suffered from rheumatoid arthritis and was reluctant to start middle school, afraid that her peers would notice her bump and make fun of her. Her mother told her to hold her head up and walk straight and tall into the new classroom. (60-30)
D. Mother go daughter at school conference with teacher, "Dear, I want you to walk in there and hold your head up and the proud of your heritage" (80-4)

2. Go by the book (to follow rules and regulations)

A. A cop is accused of taking bribes, but all his co workers and bosses testify on his behalf. They state on the witness stand, "Bob would never take a bribe. He does everything by the book" (20-5)
B. You are doing your taxes, tempted to cheat, but decide you better go by the book. (40-12)
C. Policemen don't have a grey area when it comes to giving parking tickets because they go by the book (60-17)
D. Two policemen were arguing about a felon they just brought in. One cop wants to charge him on one count, while the other says he wants to go by the book, "in which case I will charge him for two counts" (80-4)

3. *Take someone under one's wing (to offer protection or guidance)*
   A. A person starting an internship may be taken under the wing of their supervisor who would sow them around, answer questions, make sure they're comfortable. (20-28)
   B. He was new at work so I took him under my wing to show him the right way to get the job done. (40-3)
   C. Claudine had been in her job for 20 years. When a new employee arrived, she took her under her wing. (60-14)
   D. A reasoned and very successful actor decided to take the young aspiring actress under his wing and funded a scholarship for her at a famous actor's college. (80-9)
4. *Turn the other cheek (turn away from anger and ignore it rather than retaliate)*
   A. An employer heard an employee spread rumors about him. His first impulse was to write up a citation. He thought better of it and told his wife at home "I decided to ignore it and turn the other cheek." (20-5)
   B. Sometimes my sister says really sarcastic and rude things and I just turn the other cheek instead of arguing with her and I don't say anything, so we don't have a fight. (40-6)
   C. Joey was being called names at school. His mom told him not to call names or fight, but to treat the other with respect. (60-29)
   D. The drunk was insulting the minister but the minister kept on beseeching the man to stop drinking. (80-16)
5. *Run out of steam (to run out of energy)*
   A. Students studying for finals decide to stop for the night, expressing that they have run out of steam. (20-22)
   B. I was a mile away from the finish line in the marathon then I ran out of steam. (40-3)
   C. After getting ready for the garage sale for house, I ran out of steam by the time buyers started to arrive. (60-14)
   D. I said I'd participate in this idiom explanation task. But now it seems I have run out of steam or used up all my energy. (80-20)
6. *Blow off steam (to get rid of anger)*
   A. The teenager leaves and complaints to her friend that her mom is not letting her take the car. She says to her friend "I need to blow off some steam. Let's go running." (20-5)
   B. Because work is so stressful, you tell a coworker that you are going to the gym to work out and blow off steam. (40-12)
   C. After the argument with his partner, the man ran three miles to blow off some steam and keep her blood pressure down. (60-30)
   D. Mother to son who has just come home in a looking anxious and up tight: "son, I want you to go to your room and stay there until you blow off steam and clam down." (80-4)

7. *Skate on thin ice (to take a big risk)*
   A. A mother and father set a curfew for their teenage son. He has come home late three times in one week. His mom or dad may tell him, "You are skating on thin ice." (20-7)
   B. An employee is constantly late to work and was warned 2 times by her boss to call and let him know but also it is not acceptable. The employer said to the employee "you're skating on thin ice." (40-4)
   C. The young woman was skating on this ice by walking home down a dark alley rather than following the busy public street. There had a few cases of women being mugged in the alley. (60-30)
   D. In 2006, many investment banks were skating on thin ice as they loaned money to those who could only pay back if housing process skyrocketed. (80-16)
8. *Sing a different tune (to change one's mind, opinion, or point of view)*
   A. Alex cheated on a test and passed. He bragged about it to his friends who told his teacher. The teacher said 'He's happy about it now, but when he finds out he's failing the class, he'll be singing a different tune." (20-28)
   B. "He thinks I'm too strict with him" said the father, "but when he has children of his own, he'll sing a different tune." (40-16)
   C. The woman said she would never meet a man through online dating sites-but sang a different tune after her divorce. (60-4)
   D. If a president has indicated that he favors universal health care and then changes his viewpoint to allow it only to the rich, he is singing a different tune. (80-20)
9. *Cast the first stone (to criticize another)*
   A. The judge said to a group of attorneys "which one of you is going to cast the first stone against this man?" As far as the judge was concerned, the suspect appeared innocent. (20-6)
   B. An example would be of Newt Gingrich's efforts against Bill Clinton following his denial of having an inappropriate relationship with an intern while failing to mention his own marital affair. (40-23)
   C. I don't want to be in the position of casting the first stone-I would prefer the other person imitate the confrontation. (60-28)
   D. Before you accuse her of misbehaving be sure you are free of misbehavior before you cast the first stone. (80-15)
10. *Go through the motions (to pretend to do something by acting as if one was really doing it)*
   A. If a person breaks up with her boyfriend, she may go to work the next day and Xerox papers, make phone calls, go to the meeting, but the whole time she's thinking of her boyfriend and she's not really "present" at work. (20-13)
   B. A man goes to his office ob the last day of his job. He is still required to complete his job responsibilities for the day, but he is really just going through the motions. (40-30)
   C. The employ pretended to enjoy the group seminar and went through the motions of being a team player. However, all she could think about was her upcoming trip to Hawaii. (60-30)

D. He really didn't agree with all the rules and regulations, but decided it would be easier to just go through the motions. (80-14)

<u>Opaque Idioms</u>

11. Get in someone's hair (to bother someone)

A. The older sister stated that her younger sister was in her hair. The older sister was trying to study for an exam and her little sister was constantly interrupting her. (20-6)
B. Whenever George has a disagreement with his wife, his mother always gets in his hair about how to make things better. (40-15)
C. I could say to my grandchildren who were running all over the kitchen while I was cooking. "Go outside for awhile. You're getting in my hair." (60-6)
D. If a messy person makes a mess in the room of a tidy person, he gets in the hair of the neat person. (80-20)

12. Get the lead out (to start moving or move more rapidly)

A. In a meeting, the employees were encouraged to work faster and get the lead out. (20-6)
B. Nancy was taking a very long time with the dinner dishes. Her mother told her, "Get the lead out! You've been washing that same plate for five minutes already. " (40-16)
C. The bus is coming and you are about to miss it. Run fast. (60-24)
D. During the race, John started lagging and could not keep up with the others. His coach urged him to get the lead out. (80-22)

13. Keep one's shirt on (to stay calm, to be patient)

A. A man at a bar takes offense at something he thought someone else said. He beings yelling at the man. The other man replies "Keep your shirt on. I was not talking to you." (20-5)
B. An 8 yr old boy is excited for his birthday party and his mom tells him to be patient and keep his shirt on. (40-14)
C. When he kept pressing me for an answer, I told him to keep his shirt on. I'd get to it as soon as I could manage. (60-13)
D. The husband waits for his wife to get dressed. He is told to wait with no complaints. (80-10)

14. Blow one's own horn (to brag)

A. The girl said "I don't want to blow my own horn but I think I got an A on my math test." (20-9)
B. The proud mom blew her own horn when she mentioned her children won the school spelling bee. (40-7)
C. The young man irritated his date because be continually bragged and blew his own horn. He was not interested in hearing about her accomplishments. (60-30)
D. I tell people how beautiful I am, how skilled a person I am. I do this over and over again. (80-6)

15. *Put one's foot down (to assert something strongly)*
    A. If a child asks for a cookie and his mother says "no," she might say "I'm putting my foot down." (20-28)
    B. My husband and I were not agreeing with how to handle a problem and I felt my solution was the better one. So I decided to put my foot down and insist we do what I suggested. (40-6)
    C. When children misbehave, someone must put their foot down to show them rules must be obeyed. (60-4)
    D. Your 10 year old is watching TV after 8:00pm. You say the rule in this house is no TV after 8pm. I'm putting my foot down-turn off TV. (80-29)
16. *Beat around the bush (to avoid a topic, stall for time)*
    A. When the police questioned Tommy the whereabouts of Misti, a Las Vegas showgirl, Tommy beat around the bush without alluding to the fact she was hiding in the truck of his Mazda. (20-30)
    B. You want to tell someone that you do not love them, so you try to say a lot of nice things first before you get it out. (40-1)
    C. Afraid of rejection, Tom beat around the bush in asking Carol for a date. (60-14)
    D. When I asked Sally why the car had a dent in the fender, what she told me had confusing statements so I couldn't figure it out. (80-19)
17. *Bring the house down (to make others applaud a spectacular performance)*
    A. The pianist's amazing performance brought the house down. (20-27)
    B. The band was planning to "Bring down the house" when playing at the concert. (40-13)
    C. The audience was so thrilled by the party that it brought down the house. (60-27)
    D. John made a speech about the finer aspects of poetry, and brought the house down with his eloquence and humor. (80-25)
18. *Paint the town red (to go out and celebrate)*
    A. The girls painted the town red when they got all dressed up and went to dinner and then to a dance club. They were celebrating their friend's engagement. (20-6)
    B. I got the job today so I went out to paint the town red to celebrate. (40-3)
    C. The friends of the bride-to-be rented a limousine and rode her club to club, painting the town red with their drinking and dancing. (60-30)
    D. After winning a close soccer game with a traditional rival, the whole team went out and painted the town red. (80-16)
19. *Have a soft spot in one's heart (to be kind to others or fond of something)*
    A. A person finds a stray dog or cat that will go to the pound but kept it as a pet because they have a soft spot for animals. (20-12)
    B. A person sitting in a park sees an ice cream truck approach. Remembering childhood. The person has a soft spot for snow cones. (40-2)
    C. I have a soft spot for chocolate. (60-26)
    D. Usually he didn't like Irish music but he had a soft spot for certain lines in Danny boy, so he always gave money to any street musician who played it. (80-16)

20. Go against the grain (to do something that is the opposite of what is usually done)

A. No relevant, clear, and complete response for 20s Group
B. No relevant, clear, and complete response for 40s Group
C. It goes against my grain to insult someone in front of others. (60-28)
D. Someone doesn't like flattering the boss's wife at a party but does it anyway to get promoted. (80-16)

APPENDIX H

THE ACCURACY OF EACH IDIOM IN IDIOM COMPREHENSION TASK ACROSS FOUR AGE GROUPS

A=Accurate; I=Inaccurate

		Transparent Idioms			
		20s	40s	60s	80s
			(*n*=30 per group)		
Hold one's head up	A	30 (100%)	29 (97%)	30 (100%)	28 (93%)
	I	0 (0%)	1 (3%)	0 (0%)	2 (7%)
Go by the book	A	30 (100%)	30 (100%)	30 (100%)	29 (97%)
	I	0 (0%)	0 (0%)	0 (0%)	1 (3%)
Take someone under one's wing	A	30 (100%)	30 (100%)	30 (100%)	30 (100%)
	I	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Turn the other cheek	A	29 (97%)	25 (83%)	24 (80%)	17 (57%)
	I	1 (3%)	5 (17%)	6 (20%)	13 (43%)
Run out of steam	A	28 (93%)	30 (100%)	29 (97%)	27 (90%)
	I	2 (7%)	0 (0%)	1 (3%)	3 (10%)
Blow off steam	A	26 (87%)	23 (77%)	28 (93%)	27 (90%)
	I	4 (13%)	7 (23%)	2 (7%)	3 (10%)
Skate on thin ice	A	21 (70%)	27 (90%)	25 (83%)	24 (80%)
	I	9 (30%)	3 (10%)	5 (17%)	6 (20%)
Sing a different tune	A	22 (73%)	24 (80%)	21 (70%)	23 (77%)
	I	8 (27%)	6 (20%)	9 (30%)	7 (23%)

Cast the first stone	A I	26 (87%) 4 (13%)	29 (97%) 1 (3%)	27 (90%) 3 (10%)	23 (77%) 7 (23%)
Go through the motions	A I	29 (97%) 1 (3%)	29 (97%) 1 (3%)	28 (93%) 2 (7%)	29 (97%) 1 (3%)

			Opaque Idioms		
Get in someone's hair	A I	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)
Get the lead out	A I	15 (50%) 15 (50%)	27 (90%) 3 (10%)	27 (90%) 3 (10%)	29 (97%) 1 (3%)
Keep one's shirt on	A I	27 (90%) 3 (10%)	29 (97%) 1 (3%)	29 (97%) 1 (3%)	29 (97%) 1 (3%)
Blow one's own horn	A I	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)
Put one's foot down	A I	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)
Beat around the bush	A I	30 (100%) 0 (0%)	30 (100%) 0 (0%)	29 (97%) 1 (3%)	29 (97%) 1 (3%)
Bring the house down	A I	26 (87%) 4 (13%)	27 (90%) 3 (10%)	29 (97%) 1 (3%)	30 (100%) 0 (0%)
Paint the town red	A I	30 (100%) 0 (0%)	28 (93%) 2 (7%)	30 (100%) 0 (0%)	30 (100%) 0 (0%)
Have a soft spot	A I	22 (73%) 8 (27$)	19 (63%) 11 (37%)	25 (83%) 5 (17%)	26 (87%) 4 (13%)
Go against the grain	A I	14 (47%) 16 (53%)	20 (67%) 10 (33%)	18 (60%) 12 (40%)	21 (70%) 9 (30%)

APPENDIX I

THE FREQUENCY OF EACH IDIOM IN IDIOM FAMILIARITY RATING TASK ACROSS FOUR AGE GROUPS

5=many times; 4=several times; 3=a few times; 2-=once; 1= never

		Transparent Idioms			
		20s	40s	60s	80s
			(*n*=30 per group)		
Hold one's head up	5	25 (84%)	23 (77%)	23 (77%)	15 (50%)
	4	4 (13%)	6 (20%)	6 (20%)	12 (40%)
	3	1 (3%)	1 (3%)	1 (3%)	3 (10%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Go by the book	5	23 (77%)	24 (80%)	25 (83%)	22 (73%)
	4	7 (23%)	4 (13%)	5 (17%)	5 (17%)
	3	0 (0%)	2 (7%)	0 (0%)	3 (10%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Take someone under one's wing	5	25 (84%)	26 (87%)	25 (83%)	17 (57%)
	4	4 (13%)	4 (13%)	5 (17%)	8 (27%)
	3	1 (3%)	0 (0%)	0 (0%)	4 (13%)
	2	0 (0%)	0 (0%)	0 (0%)	1 (3%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Turn the other cheek	5	25 (84%)	27 (90%)	27 (90%)	25 (83%)
	4	4 (13%)	3 (10%)	2 (7%)	5 (17%)
	3	1 (3%)	0 (0%)	1 (3%)	0 (0%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Run out of steam	5	17 (57%)	20 (67%)	27 (90%)	22 (73%)
	4	10 (33%)	8 (26%)	3 (10%)	2 (7%)
	3	1 (3%)	2 (7%)	0 (0%)	6 (20%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	2 (7%)	0 (0%)	0 (0%)	0 (0%)

Blow off steam	5	27 (90%)	24 (80%)	24 (80%)	23 (77%)
	4	2 (7%)	5 (17%)	4 (13%)	5 (17%)
	3	1 (3%)	1 (3%)	2 (7%)	1 (3%)
	2	0 (0%)	0 (0%)	0 (0%)	1 (3%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Skate on thin ice	5	19 (63%)	19 (64%)	23 (77%)	17 (57%)
	4	6 (20%)	9 (30%)	7 (23%)	10 (33%)
	3	5 (17%)	1 (3%)	0 (0%)	3 (10%)
	2	0 (0%)	1 (3%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Sing a different tune	5	13 (43%)	18 (60%)	19 (64%)	15 (50%)
	4	8 (27%)	6 (20%)	6 (20%)	12 (40%)
	3	8 (27%)	5 (17%)	4 (13%)	3 (10%)
	2	0 (0%)	0 (0%)	1 (3%)	0 (0%)
	1	1 (3%)	1 (3%)	0 (0%)	0 (0%)
Cast the first stone	5	13 (43%)	22 (74%)	20 (66%)	16 (54%)
	4	7 (23%)	4 (13%)	8 (27%)	10 (33%)
	3	8 (27%)	3 (10%)	2 (7%)	4 (13%)
	2	2 (7%)	1 (3%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Go through the motions	5	20 (68%)	25 (83%)	26 (87%)	19 (64%)
	4	7 (23%)	5 (17%)	4 (13%)	10 (33%)
	3	1 (3%)	0 (0%)	0 (0%)	1 (3%)
	2	1 (3%)	0 (0%)	0 (0%)	0 (0%)
	1	1 (3%)	0 (0%)	0 (0%)	0 (0%)
			Opaque Idioms		
Get in someone's hair	5	12 (40%)	15 (50%)	20 (67%)	13 (44%)
	4	14 (47%)	9 (30%)	7 (23%)	10 (33%)
	3	4 (13%)	4 (13%)	2 (7%)	7 (23%)
	2	0 (0%)	2 (7%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	1 (3%)	0 (0%)
Get the lead out	5	7 (23%)	16 (53%)	23 (77%)	20 (67%)
	4	4 (13%)	3 (10%)	3 (10%)	8 (27%)
	3	7 (23%)	6 (20%)	0 (0%)	1 (3%)
	2	1 (3%)	2 (7%)	0 (0%)	0 (0%)
	1	11 (38%)	3 (10%)	4 (13%)	1 (3%)
Keep one's shirt on	5	10 (34%)	15 (50%)	23 (77%)	22 (74%)
	4	8 (27%)	5 (17%)	2 (7%)	4 (13%)
	3	4 (13%)	9 (30%)	4 (13%)	3 (10%)
	2	1 (3%)	1 (3%)	0 (0%)	1 (3%)
	1	7 (23%)	0 (0%)	1 (3%)	0 (0%)

Blow one's own horn	5	17 (57%)	16 (53%)	23 (77%)	23 (77%)
	4	8 (27%)	11 (37%)	4 (13%)	6 (20%)
	3	4 (13%)	2 (7%)	3 (10%)	1 (3%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	1 (3%)	1 (3%)	0 (0%)	0 (0%)
Put one's foot down	5	27 (90%)	28 (93%)	26 (86%)	20 (67%)
	4	3 (10%)	2 (7%)	2 (7%)	6 (20%)
	3	0 (0%)	0 (0%)	2 (7%)	4 (13%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Beat around the bush	5	27 (90%)	28 (94%)	28 (93%)	25 (84%)
	4	3 (10%)	1 (3%)	2 (7%)	4 (13%)
	3	0 (0%)	1 (3%)	0 (0%)	1 (3%)
	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Bring the house down	5	12 (40%)	15 (50%)	17 (57%)	16 (54%)
	4	11 (37%)	11 (37%)	8 (27%)	9 (30%)
	3	5 (17%)	3 (10%)	4 (13%)	4 (13%)
	2	2 (6%)	1 (3%)	1 (3%)	0 (0%)
	1	0 (0%)	0 (0%)	0 (0%)	1 (3%)
Paint the town red	5	12 (40%)	17 (56%)	25 (84%)	17 (57%)
	4	9 (30%)	7 (23%)	4 (13%)	12 (40%)
	3	7 (24%)	2 (7%)	1 (3%)	1 (3%)
	2	1 (3%)	2 (7%)	0 (0%)	0 (0%)
	1	1 (3%)	2 (7%)	0 (0%)	0 (0%)
Have a soft spot	5	28 (93%)	21 (70%)	23 (77%)	17 (57%)
	4	0 (0%)	7 (23%)	4 (13%)	8 (27%)
	3	2 (7%)	2 (7%)	2 (7%)	4 (13%)
	2	0 (0%)	0 (0%)	0 (0%)	1 (3%)
	1	0 (0%)	0 (0%)	1 (3%)	0 (0%)
Go against the grain	5	15 (50%)	23 (77%)	24 (80%)	18 (60%)
	4	5 (17%)	6 (20%)	5 (17%)	8 (27%)
	3	6 (20%)	0 (0%)	1 (3%)	4 (13%)
	2	3 (10%)	0 (0%)	0 (0%)	0 (0%)
	1	1 (3%)	1 (3%)	0 (0%)	0 (0%)

APPENDIX J

THE ACCURACY OF EACH IDIOM IN IDIOM EXPLANATION AND MENTAL IMAGERY TASK ACROSS FOUR AGE GROUPS

(A=Accurate; V=Vague or Incomplete; I=Inaccurate)

		Idiom Explanation Task				Mental Imagery Task			
Transparent Idiom		**20s**	**40s**	**60s**	**80s**	**20s**	**40s**	**60s**	**80s**
			(*n*=30 per group)				(*n*=30 per group)		
Hold one's head up	A	9 (30%)	14 (47%)	20 (67%)	13 (43%)	8 (27%)	17 (57%)	16 (53%)	16 (53%)
	V	1 (3%)	2 (6%)	3 (10%)	5 (17%)	2 (6%)	0 (0%)	6 (20%)	2 (7%)
	I	20 (67%)	14 (47%)	7 (23%)	12 (40%)	20 (67&)	13 (43%)	8 (27%)	12 (40%)
Go by the book	A	28 (94%)	29 (97%)	27 (90%)	29 (97%)	30 (100%)	27 (90%)	26 (86%)	23 (77%)
	V	1 (3%)	1 (3%)	3 (10%)	1 (3%)	0 (0%)	1 (3%)	2 (7%)	5 (16%)
	I	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (7%)	2 (7%)	2 (7%)
Take someone under one's wing	A	28 (93%)	29 (97%)	29 (97%)	29 (97%)	27 (90%)	29 (97%)	27 (90%)	28 (94%)
	V	2 (7%)	1 (3%)	1 (3%)	1 (3%)	1 (3%)	0 (0%)	3 (10%)	2 (6%)
	I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (7%)	1 (3%)	0 (0%)	0 (0%)
Turn the other cheek	A	22 (73%)	23 (77%)	25 (83%)	20 (67%)	18 (60%)	25 (83%)	23 (77%)	18 (60%)
	V	5 (17%)	4 (13%)	3 (10%)	4 (13%)	3 (10%)	2 (7%)	3 (10%)	1 (3%)
	I	3 (10%)	3 (10%)	2 (7%)	6 (20%)	9 (30%)	3 (10%)	4 (13%)	11 (37%)
Run out of steam	A	29 (97%)	30 (100%)	28 (94%)	29 (97%)	28 (94%)	29 (97%)	26 (86%)	26 (86%)
	V	0 (0%)	0 (0%)	1 (3%)	1 (3%)	1 (3%)	0 (0%)	2 (7%)	2 (7%)
	I	1 (3%)	0 (0%)	1 (3%)	0 (0%)	1 (3%)	1 (3%)	2 (7%)	2 (7%)
Blow off steam	A	28 (94%)	24 (80%)	17 (57%)	9 (30%)	28 (94%)	25 (83%)	18 (60%)	6 (20%)
	V	1 (3%)	2 (7%)	3 (10%)	4 (13%)	1 (3%)	2 (7%)	1 (3%)	1 (3%)
	I	1 (3%)	4 (13%)	10 (33%)	17 (57%)	1 (3%)	3 (10%)	11 (37%)	23 (77%)

		Idiom Explanation Task				Mental Imagery Task			
Transparent Idiom		**20s**	**40s**	**60s**	**80s**	**20s**	**40s**	**60s**	**80s**
			(*n*=30 per group)				(*n*=30 per group)		
Skate on thin ice	A	21 (70%)	23 (77%)	18 (60%)	18 (60%)	28 (94%)	23 (77%)	17 (57%)	15 (50%)
	V	8 (27%)	4 (13%)	6 (20%)	6 (20%)	1 (3%)	3 (10%)	6 (20%)	2 (7%)
	I	1 (3%)	3 (10%)	6 (20%)	6 (20%)	1 (3%)	4 (13%)	7 (23%)	13 (43%)
Sing a different tune	A	13 (43%)	16 (53%)	17 (57%)	21 (70%)	13 (43%)	16 (53%)	18 (60%)	17 (57%)
	V	2 (7%)	2 (7%)	0 (0%)	0 (0%)	2 (7%)	2 (7%)	0 (0%)	2 (7%)
	I	15 (50%)	12 (40%)	13 (43%)	9 (30%)	15 (50%)	12 (40%)	12 (40%)	11 (36%)
Cast the first stone	A	13 (43%)	14 (47%)	15 (50%)	14 (47%)	17 (57%)	14 (47%)	10 (33%)	13 (43%)
	V	6 (20%)	7 (23%)	6 (20%)	6 (20%)	4 (13%)	5 (16%)	11 (37%)	6 (20%)
	I	11 (37%)	9 (30%)	9 (30%)	10 (33%)	9 (30%)	11 (37%)	9 (30%)	11 (37%)
Go through the motions	A	18 (60%)	22 (73%)	23 (77%)	17 (57%)	18 (60%)	24 (80%)	22 (73%)	15 (50%)
	V	4 (13%)	5 (17%)	3 (10%)	5 (16%)	3 (10%)	2 (7%)	3 (10%)	4 (13%)
	I	8 (27%)	3 (10%)	4 (13%)	8 (27%)	9 (30%)	4 (13%)	5 (17%)	11 (37%)
Opaque Idiom									
Get in someone's hair	A	29 (97%)	28 (93%)	25 (84%)	29 (97%)	29 (97%)	26 (87%)	21 (70%)	23 (77%)
	V	1 (3%)	2 (7%)	4 (13%)	0 (0%)	1 (3%)	4 (13%)	5 (17%)	4 (13%)
	I	0 (0%)	0 (0%)	1 (3%)	1 (3%)	0 (0%)	0 (0%)	4 (13%)	3 (10%)
Get the lead out	A	6 (20%)	20 (67%)	25 (83%)	20 (67%)	6 (20%)	23 (77%)	21 (70%)	16 (53%)
	V	1 (3%)	3 (10%)	0 (0%)	3 (10%)	2 (7%)	0 (0%)	2 (7%)	6 (20%)
	I	23 (77%)	7 (23%)	5 (17%)	7 (23%)	22 (73%)	7 (23%)	7 (23%)	8 (27%)
Keep one's shirt on	A	21 (70%)	22 (73%)	25 (84%)	21 (70%)	21 (70%)	23 (77%)	20 (66%)	19 (63%)
	V	2 (7%)	5 (17%)	1 (3%)	7 (23%)	2 (7%)	3 (10%)	5 (17%)	8 (27%)
	I	7 (23%)	3 (10%)	4 (13%)	2 (7%)	7 (23%)	4 (13%)	5 (17%)	3 (10%)

		Idiom Explanation Task				Mental Imagery Task			
Opaque Idiom		**20s**	**40s**	**60s**	**80s**	**20s**	**40s**	**60s**	**80s**
			(*n*=30 per group)				(*n*=30 per group)		
Blow one's own horn	A	25 (83%)	27 (90%)	28 (94%)	27 (90%)	27 (90%)	24 (80%)	27 (90%)	23 (77%)
	V	3 (10%)	2 (7%)	1 (3%)	2 (7%)	1 (3%)	4 (13%)	1 (3%)	3 (10%)
	I	2 (7%)	1 (3%)	1 (3%)	1 (3%)	2 (7%)	2 (7%)	2 (7%)	4 (13%)
Put one's foot down	A	26 (87%)	25 (83%)	27 (90%)	25 (83%)	28 (93%)	27 (90%)	25 (83%)	22 (73%)
	V	4 (13%)	3 (10%)	3 (10%)	5 (17%)	2 (7%)	1 (3%)	2 (7%)	5 (17%)
	I	0 (0%)	2 (7%)	0 (0%)	0 (0%)	0 (0%)	2 (7%)	3 (10%)	3 (10%)
Beat around the bush	A	29 (97%)	25 (83%)	27 (90%)	27 (90%)	27 (90%)	25 (83%)	26 (86%)	17 (57%)
	V	0 (0%)	3 (10%)	1 (3%)	1 (3%)	2 (7%)	2 (7%)	2 (7%)	5 (16%)
	I	1 (3%)	2 (7%)	2 (7%)	2 (7%)	1 (3%)	3 (10%)	2 (7%)	8 (27%)
Bring the house down	A	5 (17%)	8 (27%)	18 (60%)	16 (53%)	10 (33%)	18 (60%)	22 (74%)	26 (87%)
	V	7 (23%)	10 (33%)	6 (20%)	11 (37%)	2 (7%)	1 (3%)	4 (13%	1 (3%)
	I	18 (60%)	12 (40%)	6 (20%)	3 (10%)	18 (60%)	11 (37%)	4 (13%)	3 (10%)
Paint the town red	A	22 (74%)	24 (80%)	27 (90%)	26 (87%)	24 (80%)	26 (86%)	24 (80%)	26 (86%)
	V	4 (13%)	4 (13%)	2 (7%)	4 (13%)	2 (7%)	2 (7%)	3 (10%)	2 (7%)
	I	4 (13%)	2 (7%)	1 (3%)	0 (0%)	4 (13%)	2 (7%)	3 (10%)	2 (7%)
Have a soft spot	A	24 (80%)	19 (64%)	22 (73%)	20 (67%)	25 (83%)	25 (83%)	21 (70%)	22 (73%)
	V	3 (10%)	7 (23%)	8 (27%)	7 (23%)	3 (10%)	2 (7%)	4 (13%)	2 (7%)
	I	3 (10%)	4 (13%)	0 (0%)	3 (10%)	2 (7%)	3 (10%)	5 (17%)	6 (20%)
Go against the grain	A	0 (0%)	0 (0%)	11 (37%)	9 (30%)	0 (0%)	0 (0%)	11 (37%)	10 (33%)
	V	0 (0%)	0 (0%)	2 (6%)	4 (13%)	0 (0%)	0 (0%)	0 (0%)	3 (10%)
	I	30 (100%)	30 (100%)	17 (57%)	17 (57%)	30 (100%)	30 (100%)	19 (63%)	17 (57%)

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