

THE ROLE OF WORKING MEMORY AND IDIOM COMPOSITIONALITY IN IDIOM  
COMPREHENSION

by

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## Abstract

Figurative language use is not limited to poetry or literature but is a ubiquitous part of speech. Studies that looked at figurative language comprehension have shown that some cognitive mechanisms, such as working memory, may be involved in figurative language comprehension. For example, individuals with high working memory span tend to produce deeper metaphor interpretations. The current work was interested in how working memory is involved in a particular figure of speech comprehension: idioms.

An *idiom* is a phrase whose meaning cannot be simply deduced from the literal meanings of the words that comprise that idiom. Idioms can vary according to their compositionality, which refers to the extent with which meanings of the idiom constituents provide cues for the idiom's idiomatic meaning. A number of researchers agreed upon certain idioms being decomposable and other idioms being fixed. The two different types were used in the Main Study. Models of idiom comprehension also vary from traditional "lexical look-up" models that consider idioms as multi-word lexical units stored as such in speakers' mental lexicons to "nonlexical" models, such as the Configuration Hypothesis, that states that an idiom as a whole does not have a separate lexical representation in the mental lexicon. Both models are considered in this work. Finally, understanding idiomatic expressions may require inhibiting irrelevant literal information. For example, literal meanings of the words *dogs* and *cats* in an idiom *it is raining cats and dogs* have to be inhibited in order to gather the figurative meaning of the expression. Thus, the main objective of the current work was to assess the role of working memory in idiom comprehension, as well as to explore whether idiom compositionality had an effect on how fast idioms were interpreted, while also considering implications for the two main models of idiom comprehension.

A Preliminary Study narrowed down the list of idioms to the 26 that were used in the Main study, ensuring that both types of idioms did not differ in familiarity or length. The Main Study consisted of four tasks: working memory (Operation span task), inhibition (reading with distractions), idiom comprehension, and familiarity. Seventy-three general psychology students participated in the Main Study. The data were analyzed by several regression analyses and *t*-tests. The main finding was that there seems to be a difference in a way the two accepted types of idioms are interpreted: fixed idioms were interpreted faster than decomposable idioms. This is consistent with the lexical lookup hypothesis but only for fixed idioms and suggests that readers may not have to analyze the literal word meanings of fixed idioms when interpreting them, thus making their interpretation faster, since retrieving is faster than computing. Neither familiarity nor idiom length could account for this difference. On the other hand, neither operation span nor the number of critical errors committed by participants on the inhibition task predicted how long it took participants to interpret either type of idioms. Several possible explanations for such results are discussed, as well as the limitations and future directions.

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# CHAPTER 1 - Introduction

*If natural language had been designed by a logician, idioms would not exist.*

Philip Johnson-Laird, 1993

## Overview

Language is central to most human activity. Language is used in chatting, teaching, reading a book, planning a vacation, and other various activities. Interestingly, in everyday conversations speakers rely heavily on figurative as well as literal language. Contrary to common belief, figurative language use is not limited to poetry or literature. It has been estimated that figures of speech occur at a rate of 6 per minute in ordinary speech (Pollio, Barlow, Fine, & Pollio, 1977). Speakers constantly talk about *paying one's dues* but how they *need more hands* in order to accomplish a task on time since *time is money* and everyone could use more of it. In essence, figurative language is a way for speakers to say something that they mean without literally saying that. In fact, figurative language is not exclusive to poetic language, but it is rather “a ubiquitous part of spoken and written discourse” (Roberts & Kreuz, 1994).

The study of figurative language looks at such popular and commonly known figures as metaphor, irony, and simile but also more unusual and rare figures of speech such as syllepsis (a verb taking on a different meaning as clauses that it modifies unfold) or parison (the use of one or more embedded words in successive phrases) to name a few. However, hyperbole, idiom, indirect request, irony, understatement, metaphor, rhetorical question, and simile have emerged as eight common distinct types in psychological literature (Roberts & Kreuz, 1994). They are summarized in Table 1.

Table 1

Eight Distinct Types of Figures of Speech

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<u>Name</u>	<u>Brief Description</u>	<u>Example</u>
Hyperbole	An exaggerated claim	To wait an eternity
Idiom	An expression whose meaning is not predictable from the usual meanings of the words that constitute the phrase	Hang one's head
Indirect request	A request phrased as a question or a comment	I sure would like that phone
Irony	A statement that actually means the opposite of what was said	"How do you like this beautiful spring day?" uttered on snowy May 2 <sup>nd</sup> in Kansas
Understatement	Something is presented as less significant than it actually is	"It is just a minor cut" when it is, in fact, quite deep.
Metaphor /Simile	Implicit comparison/ Explicit comparison	Airplanes are birds/ Airplanes are like birds
Rhetorical question	A question that does not require an answer	You think?

---

These eight categories have been discussed and researched by linguists and psychologists alike. Roberts and Kreuz (1994) developed a taxonomy that indicated how each of these eight

figures of speech was used to accomplish certain discourse goals. For example, a simile was most often used to clarify something, an indirect request was used to be polite, and a hyperbole was used to be humorous.

Overall, it was shown that each figure of speech could be primarily used for specific discourse goals and certain discourse goals are accomplished through the actual use of these figures (Roberts & Kreuz, 1994). Thus, there is a variety of reasons for speakers to use figurative language instead of speaking literally, with different figures of speech being used to accomplish different discourse goals.

Studies similar to the one conducted by Roberts and Kreuz (1994) have mostly been interested in figurative language production; however, a few others have looked at figurative language comprehension (Qualls & Harris, 2003; Salthouse, 1994). The current work was interested in how figurative language is comprehended, in particular, the figure of speech called idioms. While a number of idiom comprehension theories were developed by linguists and psycholinguists alike some years ago (Swinney & Cutler, 1979; Gibbs, 1980; Cacciari & Tabossi, 1988), the cognitive mechanisms behind the process are yet to be fully understood.

## **Working Memory and Figurative Language**

### ***Figurative Language Comprehension***

According to Qualls and Harris (2003), appropriate figurative language comprehension requires language, pragmatics, and world knowledge, as well as cognitive processes that altogether presuppose higher abstract thinking. Yet, only a few studies have looked at the mechanisms involved in figurative language comprehension and a number of those studies have shown that working memory (WM) is related to figurative language comprehension (Salthouse,

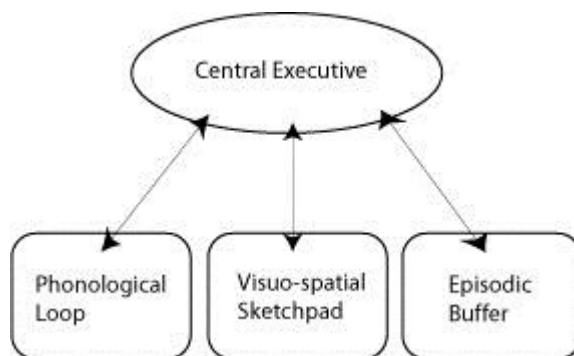
1994; Qualls & Harris, 2003). For example, older adults who show a decline in WM capacity have a decreased ability to comprehend figures of speech (Salthouse, 1994).

### ***Baddeley's WM Model***

Working memory refers to a temporary storage where the information is kept in a state of activation while it is being processed. One of the best known and accepted WM models is the model first proposed by Baddeley and Hitch (1974). The current model (Baddeley, 2003) is presented in Figure 1.

Figure 1

Baddeley's Model of Working Memory



According to Baddeley and Hitch (1974), working memory can be divided into three subsystems: the phonological loop, the visuospatial sketchpad, and the central executive. The phonological loop is concerned with verbal and acoustic information, the visuospatial sketchpad is concerned with visual information, and the central executive serves a role of a supervisory, attentionally-limited control system. The episodic buffer has recently been proposed as the fourth subsystem of the working memory (Baddeley, 2000).

However, various types of information are generally combined while performing a certain task (e.g. visual and verbal). As mentioned above, the central executive is the subsystem that ensures the successful completion of such tasks: it is involved in the control and regulation

of the working memory system (Baddeley, 2000). On the other hand, the same information needs to be stored and combined as it is being attended to. The episodic buffer has been proposed to be largely that storage system that mostly deals with combining information from the visuo-spatial sketchpad and the phonological loop. Thus, rather than dealing with attentional control, the episodic buffer combines information that it receives from different modalities.

Therefore, working memory involves storage as well as executive mechanisms. As mentioned above, WM has been shown to be related to figurative language comprehension. Furthermore, WM span has been shown to be a robust predictor of a variety of cognitive skills, such as reading comprehension, learning, reasoning, mental calculation, and language comprehension (Baddeley, 2003; Qualls & Harris, 2003).

Furthermore, executive processes have been shown to be the main predictor of individual differences in working memory span. Kane, Bleckley, Conway, and Engle (2001) stated that “individual differences in working memory capacity reflect the degree to which distractors capture attention away from actively maintaining information such as a goal state” (p.170). Thus, the ability to inhibit potentially irrelevant information is dependent on working memory capacity. This difference may be evident in participants’ ability to interpret figurative language expressions.

### ***WM and Metaphor Comprehension***

However, only a few studies have looked at the role of working memory in figurative language comprehension (Chiappe & Chiappe, 2007; Qualls & Harris, 2003), and the majority of these concentrated on metaphor comprehension. Part of the reason is that metaphor processing requires a great deal of inhibition as individuals need to suppress the literal meanings of the words that comprise a metaphor as well as have enough resources to have access to an adequate

semantic neighborhood of the predicate. For example, let us consider a metaphor *lawyers are sharks*. The semantic neighborhood of *sharks* may include such words as *dangerous*, *sharp teeth*, *cunning*, *vicious* etc. To understand this metaphor, a person must know enough to be able to choose the correct comparisons that apply to the metaphor and inhibit the irrelevant ones (e.g. *sharp teeth* should be ignored). Thus, low working memory capacity individuals may fail to adequately inhibit the literal interpretation or not have the resources with which to activate the required semantic neighborhood. The results seem to confirm such an explanation (Blasko, 1999; Chiappe & Chiappe, 2007).

For example, Blasko (1999) reported that individuals with high working memory span produced deeper, more detailed interpretations of metaphors. Chiappe and Chiappe (2007) went a step further, showing that working memory functions together with general verbal knowledge to make unique contributions to metaphor processing. Overall, the results indicated that high working memory span individuals may have greater resources to devote to inhibiting the irrelevant information than do low-span individuals (Chiappe & Chiappe, 2007).

## **Idioms**

As mentioned above, the current work examines idiom comprehension. Idioms are one of the figurative language types that constitute a substantial proportion of everyday language (Makai, Boatner, & Gates, 1995) and are among the most commonly used figures of speech in everyday communication (Thoma & Daum, 2006). Most native speakers are familiar with many idioms that are unique to their culture and language. Most such utterances are not new creations by the speakers themselves but rather transfer from generation to generation. However, not much attention has been paid by psycholinguists to idiom comprehension and the cognitive processes that it involves.

An *idiom* is a phrase where the words together have a meaning that is different from the combination of the dictionary definitions of the individual words. Generally speaking, idioms are referred to as phrases whose figurative meaning cannot be simply deduced from the literal meanings of the words that constitute that idiom. For example, an idiomatic expression *spill the beans* in its figurative sense means to give away a secret or a surprise. Yet, the individual words *spill* and *beans* do not evoke such an association when used in isolation. Many such idioms are known as fixed expressions which become an essential part of the speaker's native language.

According to Sprenger, Levelt, and Kempen (2006), fixed expressions are “phrasal units” (p.161). Such expressions as idiomatic expressions, sayings, and proverbs are all types of these phrasal units. The present study was particularly interested in idiomatic expressions (or idioms) as the relationship between the words that comprise such expressions is often very indirect or even completely non-existent.

For example, English native speakers know that *skating on thin ice* typically means being in a risky situation even though the literal meaning of the phrase does not necessarily entail that. Yet, that literal meaning is not excluded completely and indeed would be preferred within a certain context (for example, somebody talking about actually attempting to skate on thin ice in a lake). On the other hand, the literal meaning of the words that comprise the idiom *raining cats and dogs* would most likely not help speakers produce its idiomatic meaning *heavy rain*.

### ***Idiom Characteristics***

Idioms vary according to their literal plausibility, transparency, and compositionality (Glucksberg, 2001). Some idioms are plausible in both figurative and literal meanings (e.g. *spill the beans* can have either meaning depending on the context) while other idioms are not (e.g. *under the weather* is literally anomalous and only makes sense if interpreted figuratively).

Transparency and compositionality go hand in hand and refer to the extent with which the meaning of the idiom constituents can help infer that idiom's meaning. While compositionality relates more to the extent with which the meanings of the words that constitute an idiom provide cues for its idiomatic meaning, transparency relates more to how easy it is for the speakers to understand why a certain figure of speech has been used (Thoma & Daum, 2006).

However, no matter how little the meaning of the words that constitute an idiom and the idiomatic meaning are related, idioms still usually consist of phrases and more often than not behave somewhat like phrases. Phrases are syntactically flexible and so are some, but not all, idioms. An idiom *let the cat out of the bag* could be used in both active and passive forms (e.g. "Who let the cat out of the bag? It was let out by..."). The same example also demonstrates how a constituent of an idiomatic phrase (in this example, *the cat*) can be used anaphorically by the pronoun *it* (Glucksberg, 2001).

On the other hand, such idioms as *kick the bucket* are usually classified as fixed because any syntactic or lexical alteration of the idiomatic expression will detach the idiom from its nonliteral meaning (e.g., *\*The bucket was kicked by John* or *\*What did John kick?* cannot easily access the idiomatic meaning). As a result, we can see how the degree of compositionality, or mobility, varies greatly among idioms (Glucksberg, 2001), with some idioms being fully mobile (e.g. *skating on thin ice*) and others almost totally fixed (e.g. *by and large*).

For example, as mentioned above, it is common knowledge that, literally speaking, skating on thin ice is prototypically risky; thus, the idiom *skating on thin ice* can be used to describe or refer to any situation with that high degree of risk. Thus, literal reference to such situations can help speakers interpret its meaning by decomposing the idiom and knowing the meaning of the words that it is comprised of. On the other hand, a speaker cannot break down the



idiom *by and large* into its components in order to help understand the idiom. Thus, such meanings are assigned more arbitrarily than compositional idioms (Glucksberg, 2001). Similarly, different idiom comprehension theories have been proposed in part based on the compositional/non-compositional nature of idioms.

### ***Idiom Comprehension***

According to Cacciari et al. (2007), the meaning of an idiomatic expression can be readily acquired after the expression has been recognized as an idiom. As mentioned above, words that comprise an idiom almost always also have a literal meaning attached to them. As a person sees the first word of the expression, this literal meaning may be activated first. However, as more constituents appear, the recognition of the idiom is triggered.

According to Vespignani, Canal, Molinaro, Fonda, and Cacciari (2009), as more familiar words appear and the context is increasingly specified, the sense of familiarity with an idiom increases until it reaches a threshold after which the idiom is recognized and the specific idiomatic meaning is retrieved from semantic memory. As a result, the literal meaning of the words that comprise the idiomatic expression has to be inhibited in order for the figurative meaning to be retrieved successfully. Thus, speakers have to account for the unitary nature of idioms while still considering literal interpretations of the single words that comprise these idioms. Miller & Johnson-Laird (1976) suggested that these literal meanings are also processed and become active during idiom comprehension. Overall, the processes that underlie idiom comprehension are still controversial.

Traditional “lexical look-up” models (Swinney & Cutler, 1979; Gibbs, 1980) consider idioms as multi-word lexical units that are stored as such in speakers’ mental lexicons. According to these models, idiom comprehension boils down to simple memory retrieval as

opposed to being elaborated via linguistic processing. As a result, the more familiar idioms are accessed faster than less familiar ones since the speakers are supposedly not engaging in any sort of complex linguistic processing. Furthermore, idiom comprehension is assumed to be faster than the comprehension of non-idiomatic expressions since there is no compositional analysis involved and rather the global figurative meaning of the idiom is retrieved.

However, some recent studies have shown that some syntactic analysis of the expression still occurs. Peterson, Burgess, Dell, and Eberhard (2001) used a sentence-priming task in which incomplete sentences were presented both auditorily as well as on the computer screen in a set of experiments. Sentences were primed for either a literal or idiomatic interpretation. For example, *The man was old and feeble and it was believed that he would soon kick the...bucket* was used to prime the idiomatic interpretation. On the other hand, *The soccer player slipped when he tried to kick the... ball* was used as a sentence to prime a literal interpretation.

In one of the experiments, participants were asked to choose between syntactically appropriate (e.g. noun) and inappropriate (e.g. verb) choices to complete these sentences.

<u>Example</u>	<u>Syntactically appropriate</u>	<u>Syntactically inappropriate</u>
The man was old and feeble and it was believed that he would soon kick the...	bucket	Go
The soccer player slipped when he tried to kick the...	Ball	Run

Results indicated that participants were faster with noun completions for both primed conditions. Peterson et al. (2001) concluded that idiom processing is subject to syntactic analysis since it took participants longer to name the verb targets than the noun targets (599 and 575 ms), respectively). Furthermore, this syntactic effect did not differ between idiomatic and literal sentences. Therefore, Peterson et al. (2001) concluded that some syntactic analysis still occurs during idiom processing.

These findings, together with findings by Cacciari and Tabossi (1988) and others, tend to support the “nonlexical” models of idiom comprehension, in particular, the Configuration Hypothesis that was initially proposed by Cacciari and Tabossi (1988). The Configuration Hypothesis states that each word in an idiom is represented as an individual lexical unit and an idiom as a whole does not have a separate lexical representation in the mental lexicon. Thus, every word in the idiom is processed one after another, until there is enough information to identify the word sequence as an idiom. Only then is the idiomatic meaning retrieved (Cacciari, Padovani, & Corradini, 2007). Overall, according to the Configuration Hypothesis, the time it takes to identify a string of words as an idiom depends on how early the idiomatic meaning is activated.

## **Present Research**

The main objective of the current work was to assess the role of working memory in idiom comprehension, as well as to explore whether idiom compositionality has an effect on how fast the idiom is interpreted.

The present study looked at whether compositionality of an idiom had any effect on how the idiom is interpreted. Some degree of inflexibility has been traditionally identified as one of the key properties of idioms (Nunberg, Sag, & Wasow, 1994). As mentioned above, idioms have

traditionally been thought of as having word-like representations in the mental lexicon (Swinney & Cutler, 1979). This would suggest that the syntactic and semantic information about the individual words that comprise a familiar idiom do not play a role in the comprehension of this idiom as a whole (Sprenger et al., 2006). However, many idioms can be considered what Nunberg et al. (1994) called decomposable, or idioms that consist of words that carry individual meanings that are in some way related to the overall meaning of that idiomatic expression.

For example, the literal meaning of the decomposable idiom *it takes two to tango* indeed means that one needs to take a partner to dance a tango, just like one needs to find someone to help them with something in the figurative meaning of the same idiomatic expression. Thus, the roles and relationships between the words that comprise an idiom are actually mapped onto their figurative counterparts. However, the literal meanings of the words comprising an idiom *raining cats and dogs* have absolutely no semantic relationship to their figurative counterparts.

Thus, in decomposable idioms each of the constituent words contributes to the overall meaning of the expression, while the fixed idioms may indeed be perceived as a whole unit. As a result, the literal meanings of the decomposable idioms may be more readily available than the literal meanings of the fixed idioms. Therefore, the literal meanings of the decomposable idioms are activated and may provide additional information that needs to be inhibited as compared to fixed idioms where the literal meaning is not as readily available.

However, some researchers have argued that literal meanings of the words of an idiom are always activated and that speakers cannot fail to process that linguistic information (Sprenger et al., 2006). Therefore, we looked at whether there was a difference in how fast decomposable and fixed idioms were interpreted. We predicted that fixed idioms would be interpreted faster than decomposable idioms. Such findings could indicate that the literal meaning of semantically

decomposable idioms was readily available which, in turn, may interfere with the process of idiom comprehension. As a result, the increased amount of information to be inhibited could affect the time required to interpret decomposable idioms.

We also looked at whether there was a difference between the time it took participants with higher working memory span (HWMS) to interpret idioms, as compared to participants with lower working memory span (LWMS). We expected Ospan to predict the time it took participants to interpret decomposable idioms, such that participants with higher working memory span were expected to be faster at giving interpretations. If the literal meaning of decomposable idioms is activated, there may be an increased amount of information that needs to be inhibited. As a result, the increased amount of information to inhibit when comprehending decomposable idioms could affect the time it takes to interpret this type of idiom as compared to fixed idioms which are expected to be interpreted faster. Since it has been shown that HWMS participants have greater inhibitory control (Glucksberg, 2001), it could assist them in interpreting decomposable idioms faster.

Finally, familiarity has always been considered as one of the important idiom characteristics. The fairly rigid wording of an idiom must be recognized as a unit with a nonliteral meaning for it to be interpreted as an idiom. Also, familiarity might quite reasonably predict idiom comprehension times, with more time required for less familiar idioms. Thus, we wanted participants to be similarly familiar with all idioms used in our study, and a preliminary study was conducted to make sure we accounted for familiarity.

### *Hypotheses*

Based on the discussion above, the following hypotheses were tested.

**H1a:** Fixed idioms will be interpreted faster than decomposable idioms.

**H1b:** There will be no difference in the speed with which participants interpret fixed and decomposable idioms.

**H1c:** Decomposable idioms will be interpreted faster than fixed idioms.

If hypothesis 1a is supported, this may be an indication that fixed idioms are indeed represented as one unit in the mental lexicon and the individual components of an idiom are bound together. This would be consistent with some previous research supporting “lexical look-up” models as well as the traditional view on idioms as fixed expressions (Nunberg, Sag, & Wasow, 1994; Swinney & Cutler, 1979). Such a result may indicate that both literal and figurative meanings are activated when participants interpret decomposable idioms, while only the figurative meaning is activated when they interpret fixed idioms. As a result, fixed idioms are interpreted faster as participants are not required to choose between the two meanings.

On the other hand, results could indicate that there will be no difference in the time it takes for participants to interpret idioms (Hypothesis 1b), regardless of idiom type. These results would support the ideas proposed by Sprenger et al. (2006), who stated that the literal meaning of the idioms is always activated. It would further support the compositional nature of the idioms and the Configuration Hypothesis, indicating that analysis of specific words that constitute an idiom play a role in its interpretation.

Although not predicted by any model, it would be interesting to see whether Hypotheses 1c is supported. If it is supported, it could be intriguing to explore as to why this is the case. One possible explanation could be the fact that decomposable idioms are more connected to reality than fixed idioms which is why it may be easier for participants to interpret them. For example, as mentioned above, the meaning of an idiom *skating on thin ice* could be deduced by thinking of the literal meaning of this phrase; since skating on thin ice would, indeed, be risky, the idiomatic

meaning could be figured out by considering that literal interpretation. On the other hand, it is almost impossible to come up with a real life situation in which a literal reading of the idiom *by and large* would be plausible.

**H2a:** Ospan will predict the speed with which participants interpret decomposable idioms, such that HWMS participants will interpret decomposable idioms faster than LWMS participants.

**H2b:** Ospan will not predict the speed with which participants interpret decomposable idioms.

The WM span measure used in the current study was Ospan. According to Unsworth, et al. (2005), Ospan measures the amount of attention available on a moment-to-moment basis while asking participants to complete two tasks simultaneously, solving a math problem and remembering letters in the correct position. Ospan was chosen since it has been shown that it correlates well with other measures of WM memory, has good internal consistency ( $\alpha = .78$ ) and test-retest reliability (.83) (Unsworth, et al., 2005) as well as being less specifically tied to a particular language or language skills.

As mentioned above, HWMS participants are expected to have greater inhibitory control that should help them deal with irrelevant information in a more efficient way as compared to participants with LWMS. If Hypothesis 2a is supported, this will, on the one hand, suggest that HWMS participants have greater inhibitory control and may be more successful at inhibiting the literal meaning of the words of the decomposable idiom when interpreting it. On the other hand, this will also indicate that LWMS participants may be less successful at inhibiting the literal meaning that is activated when they see a decomposable idiom.

The results could also indicate that differences in WMS are not involved in interpreting decomposable idioms (Hypothesis 2b). In particular, this may indicate that literal meanings of the decomposable idioms are not sufficiently taxing on the participants' WM such that

participants are not necessarily required to utilize WM resources in order to inhibit this irrelevant literal information.

**H3a:** Ospan will not predict the speed with which participants interpret fixed idioms.

**H3b:** There will be a difference in the time it takes HWMS and LWMS participants to interpret fixed idioms, such that Ospan will predict RTs for fixed idioms and participant with higher WM span will be faster at interpreting fixed idioms.

As mentioned above, according to the “lexical look-up” models, the literal meaning is not expected to be activated when fixed idioms are presented. Thus, there should be no time difference in how long it takes HWMS and LWMS participants to interpret these idioms.

Interestingly, if fixed idioms are interpreted faster by HWMS participants and Hypothesis 3b is supported (assuming that idioms are equally familiar to participants in both groups), this may serve as evidence that the literal meaning is activated even in the case of fixed idiom interpretation. Idioms in the proposed study will be presented individually (out of context); thus, the literal meanings of the words that comprise the idioms may be activated first; as a result, HWMS participants may be more successful at inhibiting this information than LWMS participants.

This final set of hypotheses (the fourth set) was proposed based on the discussion above that HWMS participants tend to be better at inhibiting irrelevant information as shown by a number of studies (Glucksberg, 2001). One of the aims of the current work was to expand previous research on idiom comprehension by looking at the actual mechanisms behind idiom comprehension (e.g. WMS). Thus, this ability to better inhibit could be the mechanism that could help us explain the expected difference in time it takes to read fixed and decomposable idioms. For this reason, an inhibition task was added to the study.



The inhibition task required participants to read two types of texts, control and experimental, out loud while trying to ignore irrelevant information that was interspersed within the texts (Connelly, Hasher, & Zacks, 1991). The control texts had irrelevant information presented in the form of XXXX, while the text that participants were required to read (the story text) was presented in italics. The experimental texts also had the text of the story presented in italics and the irrelevant information (the distracting material) in normal font; however, the irrelevant information in experimental texts actually consisted of words and phrases that were meaningfully related to the story. Thus, it was expected that it would be more difficult for participants to inhibit this type of irrelevant information (the actual words and phrases) as compared to the irrelevant information used in control texts (XXXX). Samples of both types of text are presented in Appendix F.

The second part of the inhibition task required participants to answer multiple-choice questions about the story that they read. There were four questions per story and each question had six possible answers; only one answer was correct. Out of the five incorrect answers, four were plausible answers that were unrelated to the story while the last one, while also incorrect, served as a distracter in the experimental texts. Since participants were asked to inhibit that distracting information while reading the experimental texts, if they chose this answer, it was considered to be a critical error since it may have indicated that participants failed to inhibit that irrelevant information. As mentioned above, participants with higher working memory span tend to be better at inhibiting such irrelevant information; thus, we expected participants with higher working memory span (Ospan task) to make fewer critical errors as compared to participants with lower working memory span. Based on this discussion, the following, last, set of hypotheses has been proposed.

**H4a:** Ospan will not predict the number of critical errors committed by participants, such that there will be no significant difference in the number of errors committed by HWMS and LWMS participants.

**H4b:** Ospan will predict the number of critical errors committed by participants, such that HWMS participants will commit fewer critical errors than LWMS participants.

**H4c:** The number of critical errors committed by participants is expected to predict the amount of time it takes them to comprehend an idiom, such that the more critical errors a participant makes, the more time it takes them to comprehend an idiom.

**H4d:** Ospan will predict the amount of time it takes participants to read experimental texts, such that participants with higher WM span will be faster at reading experimental texts as compared to control texts.

**H4e:** Ospan will not predict the time it takes participants to read control texts.

**H4f:** Participants will be faster at reading control texts than experimental texts.

## **CHAPTER 2 - Preliminary Study**

A preliminary study was conducted first to investigate the familiarity of idioms by native English language speakers and to choose idioms for use in the main study. Idiom familiarity may play a crucial role in idiom comprehension. If participants are not familiar with the idioms, literal meaning of the words of the idiom is expected to be activated first and, possibly, remain the only meaning that is activated. To account for that and to ensure that all participants are equally familiar with the idioms used in the main study, a preliminary study was conducted in order to choose idioms for the main study for familiarity.

As mentioned above, there has been much debate as to what it means when an idiom is said to be decomposable. Nonetheless, the forty-four idioms chosen for this study have been

agreed upon by a number of researchers as being either fixed or decomposable (Nunberg et al. (1994); Horn (2002)). These idioms are presented in Appendix A.

## **Method**

### ***Participants***

Sixty-five university students participated for partial credit in General Psychology classes. Only native English speakers participated in the study to ensure they had a common cultural exposure to a society from which the idioms were drawn. Based on that criterion, two participants had to be eliminated as they were not native English speakers. Thus, data from a total of sixty-three participants were used in the preliminary study.

### ***Procedure***

Participants completed an online survey using the SONA system. They were presented with 44 idioms (22 decomposable and 22 fixed idioms) in random order and asked to rate how familiar they were with each idiom on a seven-point scale (from 1 indicating “never heard” to 7 indicating “heard very often”) and give an interpretation for each idiom. The survey is presented in Appendix B.

### ***Results***

The results of the preliminary study are presented in Table 2. Sixteen decomposable and twelve fixed idioms had a mean familiarity rating (MFR) above 5 on a 7-point scale. Upon closer look, seventeen of the decomposable idioms had a mean familiarity rating above 4.6 with the largest difference of only .2 among the mean ratings but a .7 drop to the next mean value of 3.8. On the other hand, 13 of the fixed idioms had a mean familiarity idiom rating above 4.9 with the largest difference of .4 among the means but a whole 1 point drop to the next mean value of 3.9. As a result, idioms with mean familiarity rating below 4.9 were excluded from all further

analyses from both groups. The resulting group mean for decomposable idioms with MFR of 4.9 and above was 6.08. The group mean for fixed idioms with MFR of 4.9 and above was 5.84.

Table 2

MFR of Decomposable and Fixed idioms

<u>Decomposable Idioms</u>	<u>MFR</u>	<u>Fixed Idioms</u>	<u>MFR</u>
Jump on the bandwagon	6.6	Kiss ass	6.6
Break the ice	6.5	Hit the road	6.5
Spill the beans	6.3	Hit the hay	6.5
Let the cat out of the bag	6.1	Raise hell	6.2
Draw the line	6.1	Hit the sack	6.1
Add fuel to the flames	6.1	Keep one's cool	6.1
Take a stand	6.1	Get off one's ass	6
Pull strings	6.0	Lose one's mind	5.9
Take care of	5.9	Make light of	5.5
Keep tabs on	5.7	Drop a bomb	5.38
Pull the plug	5.7	Blow one's cool	5.3
Step on someone's toes	5.6	Kill the messenger	5.0
Bury the hatchet	5.5	Kick the bucket	4.9
Keep the ball rolling	5.3	Fly the coop	3.9
Grasping at straws	5.1	Go to heaven	3.6
Lay one's cards on the table	4.6	Make the scene	3.3
Take a back seat	3.9	Grasp the nettle	2.8

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Make much of	3.8	Shoot the bull	2.6
Take up arms	3.7	Shoot the breeze	2.2
Read the riot act	1.5	Make tracks	2.1
Pass the hat around	1.2	Hit the ceiling	2.1
Beat swords into plowshares	1.1	Saw logs	2.0

---

Note. seven point scale (1 = never heard, 7 = heard very often) and n = 63

In order to control for idioms' length for the main study, we counted the number of content words in each idiom. Function words were not included. Function words are words that serve to express grammatical relationships with other words in a sentence (Chung & Pennebaker, 2007). It has been shown that people tend to pay less attention to function words and largely ignore them while reading (Chung & Pennebaker, 2007). Thus, we did not count function words when counting the number of words in the idioms. The results are presented in Table 3.

According to the results, the mean number of words for fixed idioms was 2.00. The mean number of words for decomposable idioms was 2.25. Since we needed to have an equal number of idioms in each group for the Main Study, two idioms from the decomposable group had to be excluded. Furthermore, we needed to account for the length of the idioms. Thus, we chose all decomposable idioms that consisted of two words which gave us twelve idioms.

Table 3

Number of words in decomposable and fixed idioms

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<u>Decomposable Idioms</u>	<u># of Content Words</u>	<u>Fixed Idioms</u>	<u># of Content Words</u>
Jump on the bandwagon	2	Kiss ass	2
Break the ice	2	Hit the road	2
Spill the beans	2	Hit the hay	2
Take a stand	2	Raise hell	2
Let the cat out of the bag	3	Hit the sack	2
Draw the line	2	Keep one's cool	2
Add fuel to the flames	3	Get off one's ass	2
Pull strings	2	Lose one's mind	2
Take care of	2	Make light of	2
Keep tabs on	2	Drop a bomb	2
Pull the plug	2	Blow one's cool	2
Step on someone's toes	2	Kill the	2
Bury the hatchet	2	messenger	
Keep the ball rolling	3	Kick the bucket	2
Grasping at straws	2		
Group Mean # of Words	2.25		2

---

We examined the three decomposable idioms that consisted of three words: *keep the ball rolling* (MFR = 5.3), *add fuel to the flames* (MFR = 6.1), and *let the cat out of the bag* (MFR = 6.1). Consistent with our decision to use the most familiar idioms, *keep the ball rolling* was

excluded as having the smallest MFR out of these three idioms. *Let the cat out of the bag* and *add fuel to the flames* were further analyzed according to the number of syllables as well as the number of letters in order to decide which of the two idioms to exclude. The results are presented in Table 4.

Table 4

Number of letters and syllables\* in *let the cat out of the bag* and *add fuel to the flames*

<u>Idiom</u>	<u>Number of Letters</u>	<u>Total Number of Syllables</u>
<i>Let the cat out of the bag</i>	15	3
<i>Add fuel to the flames</i>	13	3

Note: Only content words are considered in letter and syllable count.

As we can see, both idioms had the same number of syllables. However, *let the cat out of the bag* consisted of more letters (15). Thus, *let the cat out of the bag* was excluded and *add fuel to the flames* was added to the decomposable group for the Main Study.

The final two groups of 26 idioms selected for the Main Study are presented in Table 5. The group mean for decomposable idioms with MFR of 4.9 and above was 5.99 and the group mean for fixed idioms with MFR of 4.9 and above was 5.84. The mean number of words in an idiom in the decomposable group was 2.08 and the mean number of words in an idiom in the fixed group was 2.00. Thus the two types of idioms did not differ in either familiarity or length.

Table 5

Final List of Idioms Used in the Main Study

<u>Decomposable</u>	<u>MFR</u>	<u># of Words</u>	<u>Fixed</u>	<u>MFR</u>	<u># of Words</u>
Jump on the bandwagon	6.63	2	Kiss ass	6.63	2
Break the ice	6.50	2	Hit the road	6.50	2
Spill the beans	6.30	2	Hit the hay	6.46	2
Take a stand	6.10	2	Raise hell	6.20	2
Draw the line	6.10	2	Hit the sack	6.10	2
Pull strings	6.00	2	Keep one's cool	6.10	2
Take care of	5.90	2	Get off one's ass	6.00	2
Pull the plug	5.70	2	Lose one's mind	5.90	2
Bury the hatchet	5.50	2	Make light of	5.50	2
Grasping at straws	5.10	2	Drop a bomb	5.38	2
Add fuel to the flames	6.10	3	Blow one's cool	5.30	2
Keep tabs on	5.70	2	Kill the	5.00	2
Step on someone's toes	5.60	2	messenger		
			Kick the bucket	4.90	2
Group Mean	5.99	2.08		5.84	2



## **CHAPTER 3 - Main Study**

### **Method**

#### ***Participants***

Seventy-three university students participated for partial credit in General Psychology classes. Similarly to the preliminary study, the main study was restricted to native English speakers. All 73 participants fulfilled that requirement. Forty-six participants were female (63%) and 27 participants were male (37%). The mean age for participants was 19.7 years old. Participation was strictly voluntarily and participants were notified that they could quit at any time without penalty and all participants signed an informed consent form. All participants were tested individually.

#### ***Procedure***

Participants signed up using the SONA system. Upon arrival at their scheduled time, they were escorted to a small room by a researcher. They were first provided with the informed consent form followed by a quick demographic questionnaire (Appendix C) and the overall instructions (Appendix D).

The main study involved four tasks: the first task assessed working memory capacity, the second task assessed the ability to inhibit irrelevant information, the third task assessed idiom comprehension, and the fourth final task assessed participants' familiarity with the idioms used in the study. Participants were provided additional instructions immediately prior to each of the four tasks (Appendix E).

## **Materials**

### ***WM Task: Operation Span Task***

The Operation span task (Ospan) measures the amount of attention available on a moment-to-moment basis, which is the total amount of focused attention available minus the attentional resources allocated to suppressing irrelevant thoughts competing for attention (Unsworth et al., 2005). The Ospan task requires participants to first judge whether a mathematical problem visually presented on a computer screen has been solved correctly or not (e.g.  $(9 - 3 \times 2 = 3)$ ; True or False?). The next screen presents participants with a single letter that participants are asked to remember. After a number of trials, participants are asked to recall the letters in the correct order. Thus, participants are asked to pay attention as well as remember the letters.

The number of trials after which participants were required to recall the letters in the correct order varied between three and seven trials, after which participants were required to remember the letters in the correct order from the previous set of trials as well as pay attention and judge the mathematical problems correctly. Participants completed twelve sets (each set consisted of three to seven math problems, each followed by a letter to be recalled at a later time) with a total of 54 trials (a single math problem followed by a single letter) and proceeded to the second task of the study, the inhibition task, as soon as they were done. Participants were shown an example of a trial to familiarize them with the task prior to beginning.

### ***Inhibition Task***

As soon as participants completed the Ospan they proceeded to the next part of the experiment. As mentioned above, each participant was tested individually. Prior to completing the task, participants were given additional instructions (Appendix E) as well as shown two trial

texts (one experimental and one control). Participants were not allowed to follow along with a marker (e.g. a finger) while reading. They were required to read aloud the story, beginning with the title, and click the “next” button as soon as they were done reading the entire story. Since all participants were tested individually, the researcher was present throughout the entire experiment to ensure that they followed the instructions precisely.

The inhibition part of the main study consisted of two parts. The first part required participants to read a series of passages aloud, beginning with the title. Eight stories, each approximately 125 words in length, were used as materials (Connelly, Hasher, & Zacks, 1991). Four stories were considered to be experimental and four stories were control stories. In both types of text, the text of the story was printed in italics. Distracting words, which appeared only in the experimental texts, were printed in standard font. Distracting words consisted of four different words or short phrases, each of which was meaningfully related to the story. Each distracter appeared 15 times, for a total of 60 distracting items per story; no word or phrase followed itself immediately. On average, an interruption occurred every four to five words. Control texts had XXXX printed instead of distracting words, imitating the appearance of the distracters. Distracters in control texts followed the same pattern of appearing after four to five words, on average; however, the number of Xs did not necessarily corresponded to the exact number of letters in distracting words used in experimental stories. Examples of both types of text are provided in Appendix F. Participants were told about the two types of text as well as shown an example of each prior to beginning the task. Participants were explicitly instructed to do their best to ignore the distracting material.

The second part of the inhibition task required participants to answer four multiple-choice questions about the text that they had just read (see Appendix F for an example). Each question and answers were presented on a separate screen and participants were asked to choose only one answer that they deemed to be correct. Each question had six possible answers: one that was correct and five that were incorrect. As mentioned earlier, 4 of the incorrect answers were plausible answers but unrelated to the text of the story. The fifth incorrect answer was one that served as a distracter in experimental texts. In other words, it was one of the words or phrases that served as distracting material in experimental texts that participants were required to inhibit, i. e., not pay attention to while reading aloud. Since participants were required to inhibit that irrelevant information, if they chose the distracter as their answer, it was considered to be a critical error since it may have indicated that they failed to inhibit that information and this was one of the cognitive mechanisms that we were interested in. An example of a question and the six possible answers is given in Appendix F.

### ***Idiom Comprehension Task***

Participants were given idioms and asked to write interpretations for each. There was a total of 26 idioms, 13 decomposable and 13 fixed idioms, presented in random order for each participant. As mentioned above, idioms selected for the study had been agreed upon as being either fixed or decomposable by a number of researchers (Nunberg et al., 1994; Horn, 2003). All idioms used in the study had a similar mean familiarity rating as well as were of similar length as established during the preliminary study. The familiarity group mean for decomposable idioms was 5.99 and the group mean for fixed idioms was 5.84. The mean number of content words in an idiom in the decomposable group was 2.08 and the mean number of content words in an idiom in the fixed group was 2.

Idioms were presented individually on the computer screen. The interpretations of the idioms as well as the latencies to arrive at these interpretations were recorded. Latencies were determined by the amount of time that passed between the onset of the idiom on the screen and when the participant first pressed the spacebar in order to begin typing. Participants were given clear instructions to first read the idiom at their normal reading pace and not to press the spacebar until they knew the interpretation of the idiom and knew exactly the interpretation that they wanted to type. Since participants were tested individually, the researcher was able to pay close attention and ensure that all participants followed the instructions. Prior to completing the task, participants completed six practice trials that were identical to the actual task but with different idioms to ensure that they understood what they were required to do.

### ***Idiom Familiarity Task***

The familiarity task included presenting participants with the 26 idioms used in the idiom comprehension task and asking them to rate how familiar they had been with these idioms prior to participating in the study. Participants were asked to answer the question of how often they had heard or read that idiom before participating in the study and rate their answers on a seven-point scale, anchored 1 = never heard to 7 = heard very often (the same scale used in the preliminary study).

## **Results**

All statistical analyses used the .05 level of significance. Three participants out of the 73 who participated in the study had to be excluded due to not meeting the 80% accuracy requirement on the math part of the Ospan task (discussed below). One more participant had to be excluded from all analyses due to technical difficulties and the resulting inability for them to

participate in all parts of the study. Thus, the final number of participants who completed all parts of the study was 69.

***Working Memory Task (Ospan)***

The working memory score (WM score) for each participant was manually calculated by the researcher. First, the accuracy on mathematical problems had to be accounted for. Consistent with previous research, the acceptable accuracy level was set at 80% (Conway, Kane, Bunting, Hambrick, Wilhelm, & Engle, 2005; Turner & Engle, 1989). As mentioned above, three participants out of the 73 who participated in the study had to be excluded due to not meeting the 80% accuracy requirement on the math part of the WM task.

The rest of the participants' data was analyzed further and each participant received one point for each correctly remembered letter in a given set, regardless of order. The total number of letters that were recalled correctly constituted the final WM span score for that participant. The highest WM span score possible was 54. The range of scores in this study was from 24 to 54, with a mean of 41.84, results consistent with similar studies (Unsworth et al., 2005; Rai, Loschky, Harris, Peck, & Cook, 2011). The results are presented in Table 6.

Table 6

Ospan Results

<u>Participant #</u>	<u>Ospan Score</u>	<u>% Accuracy</u>	<u>Participant #</u>	<u>Ospan Score</u>	<u>% Accuracy</u>
1	44	83	38	50	93
2	44	85	39	47	93
3	41	94	40	47	94
4	47	83	41	42	91
5	48	96	42	28	89
6	42	87	43	32	87
7	33	91	44	44	100
8	45	89	45	27	87
9	31	94	46	48	96

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10	26	81	47	39	94
11	51	83	48	43	87
12	44	94	49*	32	78
13	49	89	50	52	98
14	25	89	51	51	98
15	35	93	52	31	89
16	54	85	53	52	96
17	37	81	54	33	81
18	54	94	55*	44	65
19	31	96	56	32	93
20	47	96	57	45	91
21*	49	78	58	45	89
22	47	94	59	24	83
23	48	94	60	40	93
24	42	91	61	48	91
25	36	98	62	37	94
26	37	83	63	33	83
27	47	100	64*	42	94
28	53	94	65	45	94
29	45	96	66	44	94
30	49	96	67	27	85
31	45	98	68	49	91
32	52	93	69	28	89
33	32	87	70	43	89
34	47	93	71	44	94
35	43	91	72	52	96
36	50	85	73	40	94
37	44	87			

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\*Participants excluded from all subsequent analyses

### *Inhibition Task*

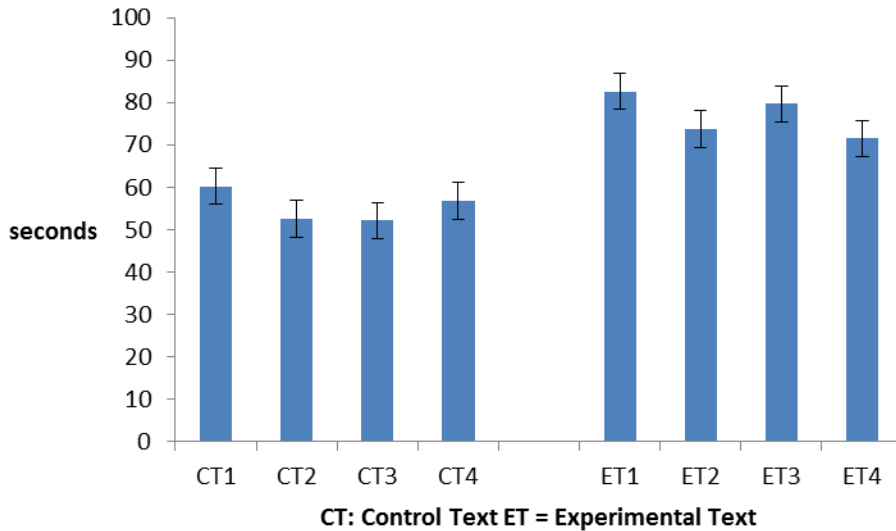
The results from the inhibition task were analyzed in the following ways. First, the times it took the 69 participants to read the experimental and the control texts was compared. Mean reading times by individual text are presented in Figure 1.

Overall, participants were significantly faster at reading the control texts than the experimental texts as indicated by the paired samples t-test (mean RT for control texts = 55.77,

mean RT for experimental texts = 79.37;  $t(68) = 15.091, p < .001$ ). These findings supported Hypotheses H4f and were consistent with previous research (Connelly, Hasher, & Zacks, 1991).

Figure 2

Mean RT for Control Texts (CT) and Experimental Texts (ET) on Inhibition Task



Note: Error bars with standard error;  $p < .05$

Second, the experimental texts were further coded to calculate the number of critical errors the participants committed. As mentioned above, each story had four questions that participants were required to answer. We calculated a total number of critical errors for each participant and used it as a predictor in subsequent analyses. As mentioned above, an error counted as a critical error if a participant chose the critical distracter as their response. The minimum number of critical errors committed was zero and the maximum number was five, with a mean of 2.57. A simple regression indicated that Ospan predicted the number of critical errors committed such that participants with lower WM span committed significantly more critical



errors than participants with higher WM span ( $F(1, 67) = 6.304, p = .014, \beta = -.293$ ), a result that supports Hypothesis 4b.

Another simple regression showed that Ospan predicted the time it took participants to read experimental texts on the inhibition task, such that participants with higher WM span were faster at reading experimental texts ( $F(1, 67) = 7.023, p = .01$ ), which supported Hypothesis 4d. At the same time, Ospan did not significantly predict the time it took participants to read control texts ( $F(1, 67) = 1.402, p = .241$ ), which supported Hypothesis 4e.

### ***Idiom Comprehension Task***

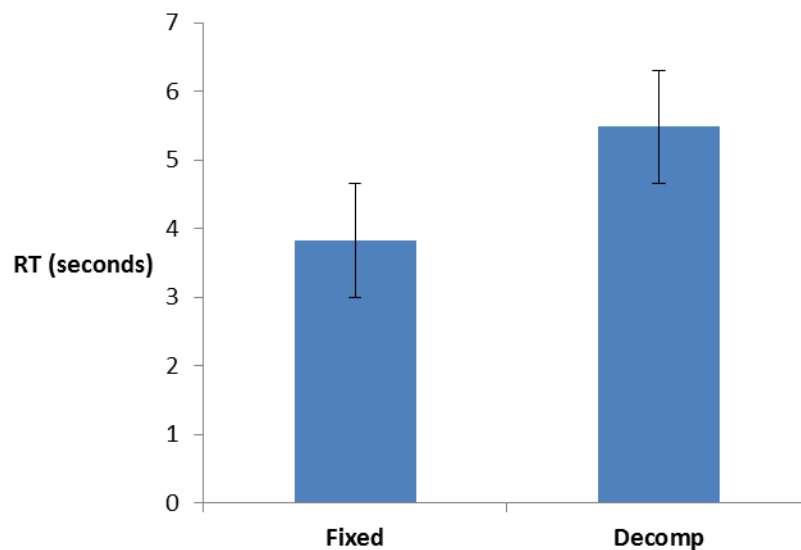
The idiom comprehension task was the third task of the Main Study. Prior to analyzing the data, every response given by each participant was judged as to whether the idiom interpretation given was correct or incorrect. The list of idioms and what the researcher considered correct interpretations is given in Appendix G. However, we were looking for the gist interpretation rather than the verbatim interpretation from the participants. Idiom interpretations were thoroughly examined by three researchers and any concerns were resolved via a discussion. If an interpretation was judged to be incorrect, that participant's response and their response time for that particular idiom were deleted.

After examining all the responses given by the participants, we noticed that 38 out of 69 participants (55%) interpreted the idiom *get off one's ass* in the same way: "leave someone alone", "stop bothering someone" etc. The correct interpretation that we were originally looking for was "to become active". However, since more than half of the participants gave the same "incorrect" interpretation, it was agreed to accept "leave someone alone" as a correct interpretation as well. There were no such adjustments for any other idioms.

Cohen's  $k$  was run to determine if there was agreement between the idiom interpretations' raters. There was very strong agreement between the raters,  $k = .905$ ,  $p < .001$ . We have also looked at the number of comprehension errors committed by participants and neither the Ospan nor the number of critical errors predicted the number of errors on the idiom comprehension task ( $p > .05$ ). Thus, there was no significant difference between the HWMS and LWMS participants on the number of comprehension errors. Overall, 7.1% of decomposable idiom interpretations and 7.2% of fixed idiom interpretations were incorrect and excluded from all analyses. Furthermore, 1% of RT data was trimmed on both ends and, thus, was also excluded from the analyses. Mean RT to comprehend and signal readiness to write for decomposable idioms was 5.48s and mean RT for fixed idioms was 3.82s, presented in Figure 3.

Figure 3

Mean RT for Fixed and Decomposable (Decomp.) Idioms



Note: Error bars with standard error;  $p < .05$

A paired samples t-test revealed a significant difference between the time it took participants to interpret the decomposable and fixed idioms, such that participants were faster at interpreting fixed idioms ( $t(68) = 6.630, p < .001$ ) which supported Hypothesis 1a.

Overall, Ospan was not a significant predictor of the time it took participants to interpret decomposable idioms as indicated by a simple linear regression ( $F(1, 67) = .009, p = .925, \beta = -.012$ ; Hypothesis 2b; Figure 4). Ospan also did not predict the time it took participants to interpret fixed idioms ( $F(1, 67) = .052, p = .820, \beta = -.028$ ; Hypothesis 3a; Figure 5).

Figure 4

Residuals Versus the Fitted Values (Ospan as predictor; Decomposable Idioms)

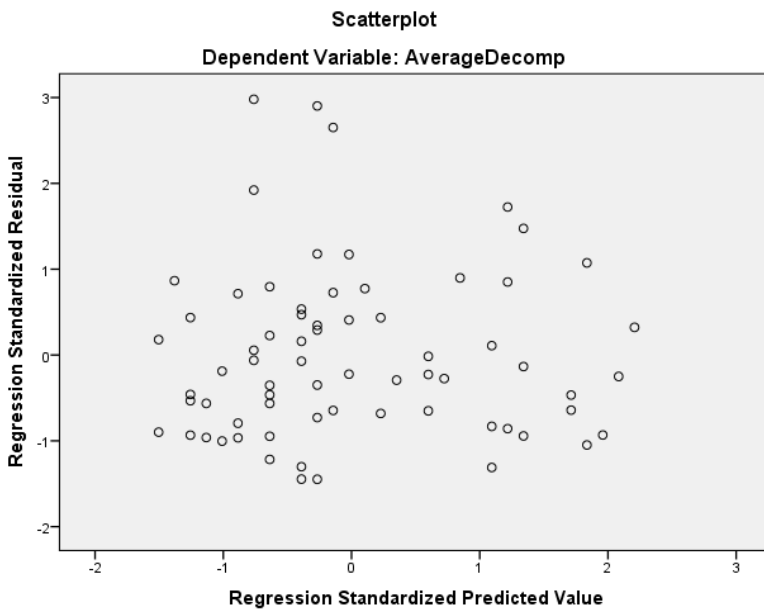
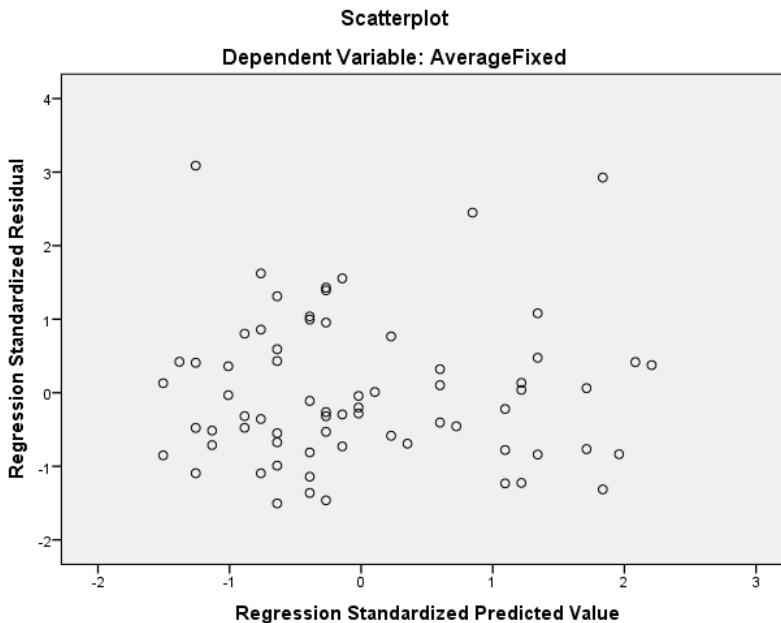


Figure 5

Residuals Versus the Fitted Values (Ospan as predictor; Fixed idioms)



Another multiple regression analysis indicated that the number of critical errors committed by participants on the inhibition task did not significantly predict the amount of time it took them to interpret either decomposable or fixed idioms ( $F(1, 68) = .527, p = .753$ , and  $F(1, 68) = .533, p = .749$ , respectively). The Ospan x Number of critical errors interaction was also not significant ( $F(1, 68) = .778, p = .708$  for decomposable idioms RT and  $F(1, 68) = .873, p = .618$  for fixed idioms RT).

Finally, two simple linear regressions indicated that the average time it took participants to read experimental texts (ET) did not predict the time it took them to interpret either the decomposable idioms ( $F(1, 67) = .497, p = .483$ , Figure 6) or fixed idioms ( $F(1, 67) = .430, p = .514$ ; Figure 7).

Figure 6

Residuals Versus the Fitted Values (ET RT as predictor; Decomposable Idioms)

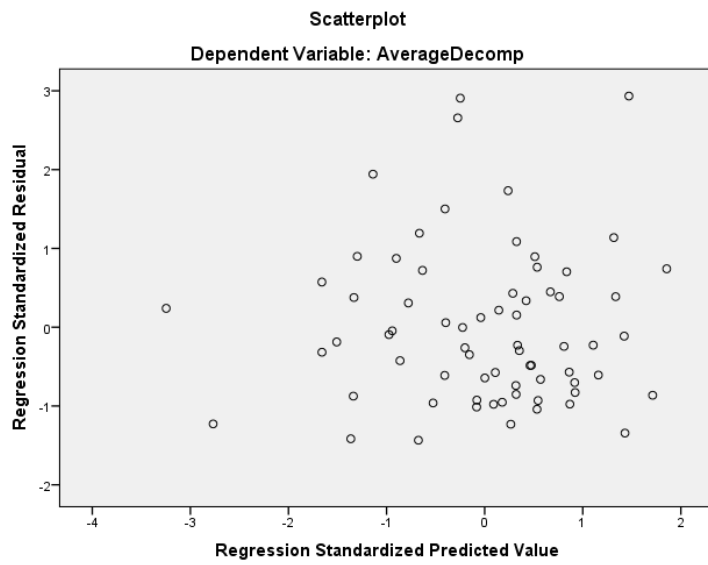
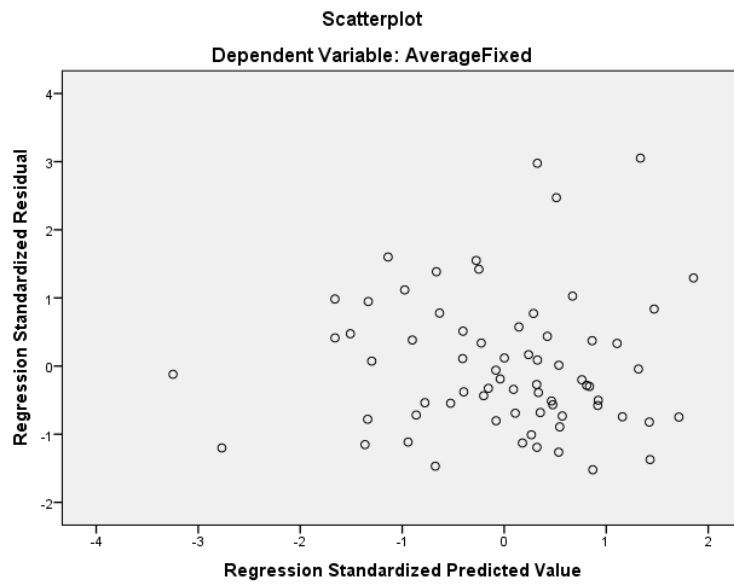


Figure 7

Residuals Versus the Fitted Values (ET RT as predictor; Fixed Idioms)



### *Idiom Familiarity Task*

The familiarity task results were analyzed in the same way as in the preliminary study.

The mean familiarity ratings (MFR) for all 26 idioms are presented in Table 7.

Table 7

MFR of decomposable and fixed idioms (Main Study)

<u>Decomposable</u>	<u>MFR</u>	<u>Fixed</u>	<u>MFR</u>
Jump on the bandwagon	6.54	Kiss ass	6.22
Break the ice	6.37	Hit the road	5.94
Spill the beans	5.81	Hit the hay	5.89
Take a stand	5.84	Raise hell	5.71
Draw the line	5.65	Hit the sack	5.52
Pull strings	4.68	Keep one's cool	5.41
Take care of	5.67	Get off one's ass	5.74
Pull the plug	4.60	Lose one's mind	5.78
Bury the hatchet	4.75	Make light of	4.69
Grasping at straws	2.64	Drop a bomb	4.62
Add fuel to the flames	5.47	Blow one's cool	4.44
Keep tabs on	5.28	Kill the	4.16
Step on someone's toes	5.78	messenger	
		Kick the bucket	4.5
Group MFR	5.31		5.28

## **CHAPTER 4 - Discussion**

### **Idiom Comprehension**

Hypothesis 1a was strongly supported, such that fixed idioms were interpreted significantly faster than decomposable idioms. As mentioned earlier, such results could be an indication that fixed idioms are represented as one unit in the mental lexicon and the individual components of an idiom are bound together. Furthermore, such results provide support for “lexical look-up” models, though only for fixed idioms, as well as the traditional view on idioms as fixed expressions (Nunberg, Sag, & Wasow, 1994; Swinney & Cutler, 1979).

This finding was in contrast to Gibbs, Nayak, & Cutting (1989) who have originally proposed that fixed idioms should be interpreted faster (as has been shown in our study) but who have shown that decomposable idioms were interpreted faster than non-decomposable idioms. They argued that this demonstrated that the literal meaning had to be activated first when it comes to decomposable idioms and actually help the speakers comprehend decomposable idioms, thus making them faster at interpreting them since the literal meaning in this case may have actually been helpful in computing the idiomatic meaning.

However, the results of our study demonstrated that fixed idioms were interpreted significantly faster. The main difference between our study and the one conducted by Gibbs et al. (1989) is the fact that we not only presented idioms out of context (similarly to their study) but also carefully accounted for idiom familiarity and length in our study, trying to make sure that the speed with which participants interpret idioms depended solely on the compositional/ non-compositional nature of an idiom. Since fixed idioms were interpreted faster and there was no context to help the participants deduce the idiomatic meaning, it could be argued that such results

suggest the fact that the literal meaning might be activated in the case of decomposable idioms and the extra time that participants need to interpret a decomposable idiom is required in order to inhibit the literal meaning and come up with the idiomatic meaning of the idiom. Since fixed idioms were not decomposable but were highly familiar, no literal meaning was expected to be activated at all and participants were quicker at coming up with the idiomatic meaning since that was possibly the only meaning activated. On the other hand, since Gibbs et al. (1989) did not account for familiarity, the fixed idioms used in their study could have been unfamiliar to participants and since the words comprising fixed idioms provide little (if any) help in figuring out the meaning of the idiom, it could have resulted in longer RTs.

Thus, it would be interesting to conduct a study and use the same idioms in both the literal and idiomatic contexts. It is possible that when idioms are presented in context, the type of context could automatically trigger either the literal or the figurative meaning. In such a situation, idiom compositionality could aid comprehension and result in faster times when participants read texts with decomposable idioms. However, when idioms are presented out of context, as was done in our study, there are no cues that can help activate either the literal or the idiomatic meanings. As a result, familiar fixed idioms could be interpreted faster since their idiomatic meanings would be more readily available.

## **WM and Idiom Comprehension**

### ***Ospan task***

Hypotheses 2b and 3a were supported showing that Ospan did not predict the time it took participants to interpret either decomposable or fixed idioms. On the one hand, we expected that Ospan would not predict the speed with which participants interpret fixed idioms and our expectations were supported (Hypothesis 3a). As mentioned above, and as supported by our



findings that fixed idioms were interpreted faster, such results may indeed support the lexical look-up model and indicate that fixed idioms are represented in the mental lexicon as a single unit, thus not requiring participants to inhibit any irrelevant information.

On the other hand, and unexpectedly, Ospan did not predict the speed with which participants interpreted decomposable idioms either. As suggested above, this may indeed indicate that participants are not required to utilize WM resources to comprehend decomposable idioms or that the information that needs to be inhibited is not taxing enough. While an explanation that there is not enough information to be inhibited may sound mundane, we consider it the most plausible for this particular study. As mentioned above, we have controlled for idiom familiarity and since all idioms were similarly (and highly) familiar to participants, this could have affected the speed with which participants interpreted idioms, making interpretations faster. Thus, even if the literal meaning was activated during decomposable idiom comprehension, since these idioms were familiar and appeared out of context, not a lot of information was present that needed to be inhibited (for example, the amount of information that participants were required to inhibit during the inhibition task was much larger). Thus, the idiom comprehension task may not have been demanding enough to see a difference as a function of size of memory span. However, it was the right task to see the difference in interpreting decomposable and fixed idioms.

### ***Inhibition task***

The inhibition task was used in order to try and figure out whether the inhibition mechanism is in play when it comes to interpreting idioms. The results have shown that, consistent with previous research, Ospan predicted both the number of critical errors committed by participants and the amount of time it took them to read experimental texts (supporting

Hypotheses 4a and 4b). Such results seem to further illustrate that participants with higher working memory span tend to be better at inhibiting irrelevant information which has been shown by their ability to read experimental texts faster and commit fewer critical errors, as compared to LWMS participants. However, neither the number of critical errors nor the amount of time it took participants to read experimental texts predicted the time it took participants to interpret the idioms.

On the one hand, such results may indicate that working memory and, in particular, the inhibition mechanism, may not play a crucial role in idiom comprehension. However, while Ospan is a widely used WM measure, this is definitely not the only WM measure available. Reading span is another measure of WM capacity that is used and could be utilized in future studies (Conway et al., 2005). One of the main critiques against the use of the reading span as a measure of WM capacity is the fact that reading span is much more tied in to the participant's verbal ability than, for example, the Ospan (Conway et al., 2005). This was the main reasoning behind our choice of Ospan as a WM measure for our study. However, since we are working with idioms and, ultimately, language comprehension, the reading span might have been a better measure of WM capacity after all.

Additionally, verbal proficiency would be an interesting variable to consider in our research. It would be interesting to see whether participants with higher verbal proficiency interpret idioms faster. On the one hand, such a relationship could indicate that participants are processing idioms as one chunk. Perhaps, they have encountered idioms more often as well as used idioms more in general. This could provide support for the lexical look-up models. On the other hand, if participants with lower verbal ability are slower at interpreting idioms, it could indicate that they may indeed be processing every single word in the idiom before arriving to its

figurative meaning. The Configuration hypothesis would be supported if such results find support.

Finally, such measures of WM as counting span and visuo-spatial tasks are also available. In order to get a better WM score, several WM measures could be used and one composite score could be calculated for each participant. This composite score could be a much better representation of participants' WM and could help us see the differences that were not found in this paper.

Most importantly, as proposed above, the irrelevant information that needs to be inhibited when interpreting decomposable idioms may simply not be demanding enough for participants' WM. It could, in part, be accounted for by idioms' familiarity. Since we carefully controlled for idioms' familiarity, participants were indeed highly familiar with the idioms of both types used in the study and, thus, may have had an easier/ faster time coming up with interpretations than if they were presented with less familiar idioms. This question could be addressed in future studies.

Furthermore, as mentioned above, different words may be activated that are associated with the literal meanings of the words that make up an idiom. Interestingly, while participants with higher working memory span may indeed be better at inhibiting this irrelevant information, another explanation could be offered as well. As mentioned in the introduction, these associated literal word meanings make up the semantic neighborhoods that are attached to each of the words that make up that idiom (e.g. *bloody*, *cunning*, *smart* are just a few examples to illustrate the semantic neighborhood of the word *shark*). Participants with higher working memory span may be better at more efficiently narrowing down their search for the appropriate associations. Thus, they may be more efficient in their search of long term memory. As a result, participants

with lower working memory span may merely be slower at comprehending rather than having trouble in comprehending idioms at all.

It must also be mentioned that, similarly to most studies on idioms, the current study had to be restricted to a set of idioms that we chose to use in the study since it is simply impossible to use every single idiom in one study. While the idioms used had been agreed upon by a number of researchers to be belonging to one of the two groups that we studied (decomposable and fixed idioms), we could still possibly see results consistent with our predictions if a different set of idioms were used.

For example, idioms that are in a form of a sentence (e.g. *it takes two to tango*) could represent an interesting subset of idioms for our line of research. On one hand, if we are right that idioms used in our study were not taxing enough for participants' working memory, such idioms as *it takes two to tango* could tap into this problem and we could possibly see the expected, though not supported, results in the current study. In this case, there may be more information that participants are required to pay attention to and inhibit, thus possibly being more taxing for the WM.

On the other hand, it would be interesting to investigate such sentential idioms and try to explain what processes are going on during such idioms' comprehension. For example, the Configuration hypothesis could find support here since these idioms are represented as full sentences and the comprehension could start from inferring literal meaning first and figurative meaning next as more and more words are presented.

## Conclusion

Thus, the main finding of the present study is that there seems to be a difference in a way the two accepted types of idioms are interpreted. One type of idioms, fixed, may indeed not require speakers to analyze the literal word meanings of idioms when interpreting them, thus, making their interpretation a faster process since retrieving is faster than computing. As a result, participants do take longer to interpret the decomposable idioms as compared to the time it takes them to interpret fixed idioms, and this difference cannot be attributed to length or familiarity.

Nonetheless, up until now, most works on idiom comprehension that utilized either the Configuration or the lexical look-up models have considered idioms within context. The results have indicated that the higher the degree of compositionality, the faster the idiom interpretation seemed to happen; however, few have considered whether idiom compositionality has any effect when idioms are used out of context.

While it seems counterintuitive to study idioms out of context, one of the goals of our research was to study the role of compositionality in idiom comprehension. By using idioms out of context, as well as accounting for other factors such as familiarity and length, we tried our best to ensure that no other factor (e.g. context) other than compositionality was affecting idiom comprehension in our study.

Moreover, while some researchers did consider idiom compositionality as one of the possible factors that can affect idiom comprehension, many other authors did not. By controlling for other important idiom characteristics such as idiom length and familiarity, as well as by using idioms out of context, we have shown that idiom compositionality is an important factor that affects idiom comprehension and that must be considered in idiom research.

Interestingly, some researchers have proposed using compositionality as a continuum (Gibbs et al., 1989) and asked participants to rate the degree of compositionality of each idiom used in the study. This is a very interesting idea and could be used in future research as well. Participants could indeed consider idioms to vary on a continuum of compositionality and this could, in turn, affect how they comprehend idioms, e.g. it could affect the speed with which idioms are comprehended. Thus, future research could utilize the possible different levels of idiom compositionality and consider participants' ratings on the degree of compositionality of an idiom.

Furthermore, according to the results of our study, Ospan did not predict how long it took participants to interpret either type of idioms. However, as suggested above, a different measure of working memory, or several measures, could be used that may tap into the WM mechanism at play better.

Moreover, comparing two different populations could help us tap into the working memory mechanism and its role in idiom comprehension better. For example, one of the future studies could look into idiom comprehension by both bilingual and monolingual speakers. One of the main benefits of bilingualism (the ability to speak two languages) has been shown to be the fact that bilingual speakers have enhanced executive control (Bialystok, 2011). Several studies have shown that bilinguals outperform monolinguals on a variety of tasks that require effortful and controlled attention (Bialystok, 2011), task switching (Prior & MacWhinney, 2010), and the classic test of executive control, the Stroop task (Bialystok, Craik, & Luk, 2008).

One of the main explanations proposed for such findings was that bilinguals always have both languages active at the same time and bilinguals have to constantly choose between the two

options, choosing which language to pay attention to in a given moment. Thus, it could be interesting to see whether this bilingual advantage demonstrated on a variety of tasks has an effect on how bilinguals interpret idioms as compared to monolinguals, given that both groups are equally familiar with the idioms.

Finally, the results of the study could be applied in clinical settings. Multiple studies have been conducted using different figures of speech (including idioms) and patients with some type of language disability (e.g. schizophrenia). Proverb comprehension has even been used as a diagnostic tool (Thoma & Daum, 2006). We could see a difference in figurative language comprehension if we further looked at the compositionality of idioms that are used in such studies. Fixed idioms could, indeed, be interpreted faster if they are represented as one unit; however, decomposable idioms could also be interpreted faster by schizophrenic patients as now words that comprise an idiom could actually help them deduce that figurative meaning.

In conclusion, the study of idioms is important because it gives us insight into how people learn and comprehend figurative language as well as allows us to study the relationship between language and thought in more detail. Furthermore, the study of idioms can give us insights into how other figures of speech such as metaphors and proverbs are processed as well. While the results of our main study strongly supported the lexical look-up model when it comes to fixed idiom comprehension, decomposable idiom comprehension seems to be better explained by the Configuration hypothesis. It could be interesting to run a study to establish the effects of context on idiom comprehension while controlling for such factors as idioms' compositionality, length, and familiarity. Nonetheless, for now, idioms may be so complex that we are left with accepting "the plurality of theories that have been proposed to account for different aspects of idiomatic language" (Cacciari & Tabossi, 1993).

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## Appendix A - Idioms Used in Preliminary Study

### Decomposable Idioms

Pull strings	(never heard) 1 2 3 4 5 6 7 (heard very often)
Spill the beans	(never heard) 1 2 3 4 5 6 7 (heard very often)
Step on someone's toes	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pass the hat around	(never heard) 1 2 3 4 5 6 7 (heard very often)
Bury the hatchet	(never heard) 1 2 3 4 5 6 7 (heard very often)
Let the cat out of the bag	(never heard) 1 2 3 4 5 6 7 (heard very often)
Draw the line	(never heard) 1 2 3 4 5 6 7 (heard very often)
Break the ice	(never heard) 1 2 3 4 5 6 7 (heard very often)
Add fuel to the flames	(never heard) 1 2 3 4 5 6 7 (heard very often)
Keep the ball rolling	(never heard) 1 2 3 4 5 6 7 (heard very often)
Lay one's cards on the table	(never heard) 1 2 3 4 5 6 7 (heard very often)
Read the riot act	(never heard) 1 2 3 4 5 6 7 (heard very often)
Grasping at straws	(never heard) 1 2 3 4 5 6 7 (heard very often)
Keep tabs on	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pull the plug	(never heard) 1 2 3 4 5 6 7 (heard very often)
Open the floodgates	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make short work of	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take advantage of	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a stand	(never heard) 1 2 3 4 5 6 7 (heard very often)
Jump on the bandwagon	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pay attention	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a back seat	(never heard) 1 2 3 4 5 6 7 (heard very often)

### Fixed Idioms

Kick the bucket	(never heard) 1 2 3 4 5 6 7 (heard very often)
Shoot the breeze	(never heard) 1 2 3 4 5 6 7 (heard very often)
Saw logs	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the sack	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the road	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make tracks	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a powder	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the ceiling	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make the scene	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make water	(never heard) 1 2 3 4 5 6 7 (heard very often)
Raise hell	(never heard) 1 2 3 4 5 6 7 (heard very often)
Kill the messenger	(never heard) 1 2 3 4 5 6 7 (heard very often)
Shoot the bull	(never heard) 1 2 3 4 5 6 7 (heard very often)
Fly the coop	(never heard) 1 2 3 4 5 6 7 (heard very often)
Give the lie to	(never heard) 1 2 3 4 5 6 7 (heard very often)
Grasp the nettle	(never heard) 1 2 3 4 5 6 7 (heard very often)
Chew ass	(never heard) 1 2 3 4 5 6 7 (heard very often)
Screw the pooch	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make a face	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the hay	(never heard) 1 2 3 4 5 6 7 (heard very often)
Kiss ass	(never heard) 1 2 3 4 5 6 7 (heard very often)
Drop a bomb	(never heard) 1 2 3 4 5 6 7 (heard very often)

## Appendix B - Idiom Familiarity Survey

An *idiom* is a phrase where the words together have a meaning that is different from the dictionary definitions of the individual words. Idioms are very popular in everyday conversations as they are a way of speakers to say something that they mean without literally saying that. We are interested in how familiar people are with the following idioms. There are no right or wrong answers, and your responses are totally anonymous.

Gender:

Age:

Race/ Ethnicity

Are you a native English speaker?

If not: a. How long have you been speaking English?

b. What is your native language?

***How frequently have you read or heard the following idioms? Please, circle the answer***

### Decomposable Idioms

Pull strings	(never heard) 1 2 3 4 5 6 7 (heard very often)
Spill the beans	(never heard) 1 2 3 4 5 6 7 (heard very often)
Step on someone's toes	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pass the hat around	(never heard) 1 2 3 4 5 6 7 (heard very often)
Bury the hatchet	(never heard) 1 2 3 4 5 6 7 (heard very often)
Let the cat out of the bag	(never heard) 1 2 3 4 5 6 7 (heard very often)
Draw the line	(never heard) 1 2 3 4 5 6 7 (heard very often)
Break the ice	(never heard) 1 2 3 4 5 6 7 (heard very often)
Add fuel to the flames	(never heard) 1 2 3 4 5 6 7 (heard very often)

Keep the ball rolling	(never heard) 1 2 3 4 5 6 7 (heard very often)
Lay one's cards on the table	(never heard) 1 2 3 4 5 6 7 (heard very often)
Read the riot act	(never heard) 1 2 3 4 5 6 7 (heard very often)
Grasping at straws	(never heard) 1 2 3 4 5 6 7 (heard very often)
Keep tabs on	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pull the plug	(never heard) 1 2 3 4 5 6 7 (heard very often)
Open the floodgates	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make short work of	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take advantage of	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a stand	(never heard) 1 2 3 4 5 6 7 (heard very often)
Jump on the bandwagon	(never heard) 1 2 3 4 5 6 7 (heard very often)
Pay attention	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a back seat	(never heard) 1 2 3 4 5 6 7 (heard very often)
<i><u>Fixed Idioms</u></i>	
Kick the bucket	(never heard) 1 2 3 4 5 6 7 (heard very often)
Shoot the breeze	(never heard) 1 2 3 4 5 6 7 (heard very often)
Saw logs	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the sack	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the road	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make tracks	(never heard) 1 2 3 4 5 6 7 (heard very often)
Take a powder	(never heard) 1 2 3 4 5 6 7 (heard very often)
Hit the ceiling	(never heard) 1 2 3 4 5 6 7 (heard very often)
Make the scene	(never heard) 1 2 3 4 5 6 7 (heard very often)

Make water (never heard) 1 2 3 4 5 6 7 (heard very often)

Raise hell (never heard) 1 2 3 4 5 6 7 (heard very often)

Kill the messenger (never heard) 1 2 3 4 5 6 7 (heard very often)

Shoot the bull (never heard) 1 2 3 4 5 6 7 (heard very often)

Fly the coop (never heard) 1 2 3 4 5 6 7 (heard very often)

Give the lie to (never heard) 1 2 3 4 5 6 7 (heard very often)

Grasp the nettle (never heard) 1 2 3 4 5 6 7 (heard very often)

Chew ass (never heard) 1 2 3 4 5 6 7 (heard very often)

Screw the pooch (never heard) 1 2 3 4 5 6 7 (heard very often)

Make a face (never heard) 1 2 3 4 5 6 7 (heard very often)

Hit the hay (never heard) 1 2 3 4 5 6 7 (heard very often)

Kiss ass (never heard) 1 2 3 4 5 6 7 (heard very often)

Drop a bomb (never heard) 1 2 3 4 5 6 7 (heard very often)



## Appendix C – Demographics Questionnaire

Participant #:

Gender:

Age:

Race/ Ethnicity

Are you a native English speaker?

If not: a. How long have you been speaking English?

b. What is your native language?

## Appendix D – Overall Instructions

Thank you for signing up for our study! The study will consist of 4 parts that will all be conducted on a computer. For the first part of the study, you will be asked to judge whether a mathematical problem that is visually presented on the computer screen was solved correctly or not (e.g.  $(8/2) + 1 = 9$ ; True or False?). The math problem will be followed by a screen with a single letter that you have to remember. After a number of trials, you will be asked to recall the letters in the correct order.

For the second part of the study, you will be asked to read texts out loud and answer multiple-choice questions about the texts. You will have an opportunity to familiarize yourself with the task and ask any questions you may have prior to the task.

For the third part of the experiment, you will be presented with 26 idioms, one at a time. You will be asked to give interpretations for each of the idiom that you see on a computer screen. Make sure you know the interpretation before you press the space bar. You will have an opportunity to familiarize yourself with this task through 6 trial runs as well.

Finally, the fourth part of the experiment will consist of a quick survey regarding various elements of the experiment. The survey will also be conducted via the computer.

You will have additional instructions presented on the screen prior to each of the tasks and have an opportunity to ask questions.

Do you have any questions before we begin?

## Appendix E – Detailed Instructions

### Part 1 Instructions

This task is a test of a special type of memory called “working memory”. The task has two parts. First, on each trial you will first see a simple math problem with a solution that is either or correct or incorrect. For each problem, you will have four seconds to decide whether the solution is correct or incorrect. You will answer by clicking on either the “correct” or the “incorrect” button that will appear in the screen.

Second, after the four seconds are up, a letter will be displayed on the screen. The letter will only be presented for one second, so make sure you’re watching the screen closely. You’ll be asked to remember this letter later.

After that, another math problem will be presented, and so on.

After a random number of trials, you will be asked to recall all of the letters that followed the math problems in the order that you saw them. On the recall screen, there will be a box where you can type in the letters that you remember – make sure that you type them in the order that you saw them!

Your score on this task will depend on two things:

First, you will receive points for as many letters as you can remember, but only if you recall them in order.

Second, you must answer all equations correctly. You will not receive points for recalling letters if you did not accurately judge whether the equations were correct or not.

Do you have any questions?

### Part 2 Instructions

This is the second part of the study.

For this part of the study you will be asked to complete two tasks. The first task requires you to read a series of passages aloud, beginning with the title. The second task requires you to answer four multiple-choice comprehension questions that would immediately follow each story. Please, read clearly and accurately as well as try to remember what you read so that you are able to answer the comprehension questions. Click below to see the practice text.

During the following task, you will be presented two types of text just like what you have just read. The text of the story will always be printed in italics and distracting material will be printed in a standard font. We want you to completely ignore the distracting material and only read the text printed in italics. Always read the title. You will be presented 4 comprehension questions immediately after each story. Click below when you are ready to begin the task.

### Part 3 Instructions

This is the third part of the study.

You will now be presented with 26 idioms, one at a time. An idiom is a phrase where the words together have a meaning that is different from the dictionary definitions of the individual words. Please, read each idiom at your normal reading pace. Once you have read the idiom and think you know its meaning, click in the textbox on the screen to start typing. Only click in the textbox when you know the interpretation! Write down your idiom interpretation. When you are done writing, press Enter and proceed to the next idiom.

You will have an opportunity to familiarize yourself with this task through 4 trial runs. Feel free to ask any questions you may have during the trial runs. Click the button below when you are ready to continue to the 4 practice trials.

#### Part 4 Instructions

This is the fourth and final part of the experiment. Please, fill out the following survey asking how familiar you were with the idioms used in the previous task (Part 3) before participating in the study. There are no right or wrong answers. Please click below to continue.

## Appendix F – Inhibition Task Materials

Example of an experimental text:

### The Bus Ride

*Sharon Brown's unreasonable car had fallen apart the park to the point of train pass being a total write-off. She auto needed the park to get around unreasonable town so auto she applied to the park get a monthly discount unreasonable bus pass. She didn't auto relish train pass the idea train pass of riding the the park unreasonable bus but the unreasonable passes the park were not expensive, auto they fit auto well the park into her unreasonable budget. The train pass transit service unreasonable also train pass allowed the park her to do all unreasonable of the auto activities train pass she needed her unreasonable car for, such as auto shopping, train pass visiting friends train pass and going to train pass the zoo. The auto zoo trips unreasonable were train pass especially nice the park since the park she liked train pass to go auto there the park at least unreasonable once the park a month. With the bus auto she would not have unreasonable to worry the park about auto paying the five unreasonable dollar parking fee train pass which she had the park always perceived auto as unfair. The more unreasonable she thought about train pass it, the more auto that Sharon the park realized that auto the idea unreasonable of taking the park the bus train pass was a good auto one.*

Example of a question with 6 possible answers:

Sharon's \_\_\_\_\_ had fallen apart.

- 1) car
- 2) auto
- 3) life
- 4) purse
- 5) relationship
- 6) engine

1 is correct, 2 is incorrect critical distractor/error, 3-6 are incorrect unrelated foils

Example of a control text:

At the Liquor Store

Dr. Stanely Baker xxxxxxxx needed some xxxxxxxx vodka for xxxxxx a party that evening so he went xxxxxx down to the xxxxxx liquor store three xxxxxx blocks away. Just xxxxxxxx outside the xxxxxx store he was xxxxxxxx approached xxxxxx by a young xxxxxxxx girl who xxxxxxxx was his xxxxxxxx brother's age, about 17 xxxxxxxx or 18. The xxxxxxxx girl asked xxxxxxxx him with xxxxxxxx a sweet xxxxxxxx southern accent xxxxxx if he would xxxxxxxx get her a xxxxxxxx fifth of rum xxxxxxxx while xxxxxxxx he was in xxxxxx the store. "I xxxxxxxx don't know" Dr. Baker xxxxxxxx said xxxxxx as he xxxxxxxx thought it xxxxxxxx over. "Oh please xxxxxxxx sir" she xxxxxxxx said xxxxxx as she xxxxxxxx gave him xxxxxx a sweet xxxxxxxx smile. He xxxxxxxx thought xxxxxxxx that he xxxxxxxx might xxxxxxxx as well xxxxxxxx since xxxxxxxx she was xxxxxxxx being so nice. He xxxxxx charged the xxxxxxxx rum and xxxxxxxx vodka xxxxxx and xxxxxxxx walked xxxxxxxx out to the girl. As he was xxxxxxxx handing the xxxxxx bottle over xxxxxxxx to her xxxxxx two men xxxxxxxx came around xxxxxxxx the corner flashing xxxxxx badges xxxxxxxx and not xxxxxx looking too xxxxxxxx happy. Dr. Baker xxxxxxxx felt a lump xxxxxx in his throat.

## Appendix G – Idioms and their Interpretations

### Decomposable Idioms

Pull strings	To exploit personal connections
Spill the beans	To divulge the information
Step on someone's toes	To offend someone
Bury the hatchet	To reconcile/end/settle a disagreement
Draw the line	To establish a limit
Break the ice	To break down a barrier to a social interaction
Add fuel to the flames	To introduce additional provocative factors
Grasping at straws	To depend on something that is useless
Keep tabs on	To retain information on
Pull the plug	To put an end to someone's activities or plans
Take a stand	To oppose or resist someone or something
Jump on the bandwagon	To join a cause
Take care of	To assume responsibility for

### Fixed Idioms

Kick the bucket	To die
Hit the sack	To go to bed
Hit the road	To set out, as on a trip
Raise hell	To cause a serious disturbance
Kill the messenger	To lash out at the bearer of bad news
Hit the hay	To go to bed
Kiss ass	To curry favor



Drop a bomb

To introduce an unpleasant surprise

Make light of

To belittle/ downplay

Lose one's mind

To become insane

Get off one's ass

To become active; leave someone alone

Keep one's cool

To remain composed

Blow one's cool

To become discomposed