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Understanding modified idiomatic expressions;

the 'impossible' just takes a little longer

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Abstract

Language boasts an abundance of prefabricated speech formulae, among which are idiomatic expressions, such as *kick the bucket* or *shoot the breeze*. Idioms are characterised by their lack of compositionality; their intended, figurative meaning (i.e., 'die' and 'have a casual conversation' respectively) is not directly retrievable from the meaning of the phrasal components. Yet these expressions are reported to benefit from faster and/or easier processing, relative to matched non-idiomatic phrases (e.g., *kick the pail*). This 'idiom processing advantage' is partly due to the phrases being conventionalised and familiar, which in turn leads to the formation of lexical representations in the lexicon, or templates in memory. Upon activation, these templates allow for fast retrieval of the figurative meaning (direct route), as opposed to the meaning of novel phrases that needs to be computed on-line (compositional route). It is assumed that the lexicalised status of (some) idioms prohibits the retrieval of the figurative meaning if the phrases undergo modification (e.g., *the breeze was shot*). This could be due to the modified version not matching up to its stored representation, thus making the relevant template inaccessible. This should also affect the idiom processing advantage, since an inability to access an idiom's template would disable the direct retrieval route. This thesis describes four eye-tracking experiments designed to investigate whether idiom templates are flexible enough to allow for idiom modification, while maintaining a processing advantage over compositional language. To address this, Studies 1 and 2 explored whether passivized idioms (*the bucket was kicked*) could be understood figuratively in the presence (Study 1) and absence (Study 2) of a rich context. The results indicated that idioms are

fairly flexible, as passivized idiom forms activated their figurative meaning. However, passivized idioms were processed more slowly than their active forms. Study 3 was a replication of Study 2 with dyslexic readers, as dyslexic readers are believed to find non-literal language challenging. The findings indicated that dyslexic readers have an easier time activating the literal meaning of potentially non-literal strings, but crucially that they are capable of recognising idiomatic strings and activating their figurative meaning, even when the idioms have been passivized. Taken together the results of these three studies indicated that idioms were fairly flexible, as passivized idiom forms activated their figurative meaning in both typically developed and dyslexic readers. Notably, the slower processing of passivized idioms relative to their canonical form in these three studies, could be attributed to the processing costs associated with the passive voice, as it is more complex and less frequent in English. Further, other types of idiom modification are possible and are attested in corpus research. Thus, Study 4 aimed to investigate another type of idiom modification, namely adjectival insertion (e.g., *spill the (spicy (red)) beans*). The findings demonstrated slower processing for both modified and unmodified idioms, when compared to matched literal phrases (*burn the (spicy,(red)) beans*) that were as predictable as the idioms in the context. Importantly, this suggested that the idiom processing advantage might be conflated with predictability, as the idioms in studies are often significantly more predictable than the novel phrases they are compared to. Indeed, the results suggested that accessing idiom templates and activating the figurative meaning might be *more* cognitively demanding and hence potentially more costly than typically assumed. Overall the present findings indicate that idioms

and their templates are flexible enough to accept modifications, without compromising the figurative meaning of the phrase. Nevertheless, the observed cost, and particularly that in Study 4, suggests that idiom templates do not yield an advantage for idioms over control phrases when they are matched for contextual predictability, even if idioms are encountered in their canonical (unmodified) form.

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CHAPTER 1

Introduction

Novelty, or linguistic creativity, is at the heart of language production both from an ideational and a lexico-grammatical perspective. In the first instance, language, as a complex system of rules, provides an endless amount of possible word combinations, which enables language users to express and understand an infinite number of new ideas (Chomsky, 1965). Thus, proficient language users are able to generate and comprehend phrases and sentences that have never been encountered before—provided that they adhere to the syntactic and morphological rules of the given language. However, and perhaps more interestingly, language users are capable, as Wray (2002) says, of producing and understanding "the more challenging kind of novelty" (p. 12). Although Wray here specifically referred to instances of poetic language and speaker errors, the argument put forward in the present thesis is that language users may apply the same processing mechanisms to understand a *novel form* of an otherwise *familiar* phrase.

This thesis examines the on-line comprehension of idiomatic expressions (e.g., *pop the question*, *shoot the breeze*, *kick the bucket*) that have undergone some sort of modification, and as such deviate from their canonical form. The main body consists of four chapters (Chapters 2 – 5), each describing an eye-tracking experiment designed to test how people understand modified idioms. This naturally begs the questions of what constitutes an idiom, what is considered a canonical idiom form, and why this deserves to be studied at all. I begin by addressing the last question.

The creative aspect of language as outlined above, highlights the possibility of producing an indefinite number of linguistic utterances, to suit any number of social interactions and communicative needs. Nevertheless, this "has been considerably overstated" (Wray, 2002, p. 11), as "native speakers do not exercise the creative potential of syntactic rules to anything like their full extent, and […] indeed, if they did so they would not be accepted as exhibiting nativelike control of the language" (Pawley & Syder, 1983, p. 193). That is to say, linguistic discourse comprised exclusively of non-idiomatic, yet perfectly grammatical language, would be considered 'odd' and indicative of 'foreignism' (Pawley & Syder, 1983). People prefer to talk about certain topics (to certain people), or even in certain circumstances in a prescribed way, through prefabricated multi-word units (Coulmas, 1981). These units are believed to be represented as whole chunks in the lexicon or memory and are immediately available to use as required (Wray, 2002, 2004). Such prefabs belong to the broader category called formulaic language (e.g., Ellis, 2008; Pawley & Syder, 1983; Sinclair, 1991), which is so pervasive in every day communication, that it is estimated to make up one third (Foster, 2001) to half of written and spoken discourse (Erman & Warren, 2000). The discrepancy in estimates is due to differences in the corpora studied, as well as to what one considers to be a token of formulaic language. Regardless of the exact number, it is clear that formulaic language is ubiquitous. Crucially, the sheer magnitude of formulaic language in typical discourse suggests that (native) speakers not only need to store and be familiar with hundreds of such sequences (Pawley & Syder, 1983), but also to be able to use them proficiently on a daily basis (Schmitt, 2005). This stresses the importance of carrying out research on

formulaic language, but what makes idioms, per se, particularly interesting?

Idioms, along with other multi-word units whose component words are frequently found in close proximity, including phrasal verbs (*give up*), collocations (*after all*), proverbs (*a stitch in time saves nine*), lexical bundles (*in the hands of*), speech formulae (*good morning*) etc., constitute different types of formulaic language. These sequences are characterised by a tendency of their component words to recur in a particular order and this is fairly fixed regardless of the context, although some phrasal verbs, for example, can be slightly more flexible syntactically (e.g., *turn up the x* vs. *turn the x up*). Although many formulaic sequences, including idioms, are non-literal strings, figurativeness is not a prerequisite of formulaicness (e.g., *good morning*). A case can be made for a phrasal verb like *give up* (meaning 'surrender'), or a collocation such as *in the hands of* (meaning 'in the possession of/under the authority of'), to be considered figurative or idiomatic, since the intended meaning is not technically literal (e.g., being in the possession of something does not mean that the possession is physically in one's hands). Similarly, the intended meaning of a proverb (e.g., *a stich in time saves nine*) is also non-literal ('do not leave something for later if you can do it now'). However, idioms differ because of their communicative function: they describe an experience, event, or concept, like the concept of dying in *kick the bucket* (Schmitt & Carter, 2004), while proverbs, for instance, typically express a common belief or are used in a didactic way. Thus, it is crucial to note from the outset, that throughout this thesis the term 'idiom' is used conservatively to refer to prototypical examples of idiomatic phrases such as *kick the bucket, shoot the breeze, take the bull by the horns*, *throw in the towel* etc., and not to

other potentially non-literal strings such as figurative phrasal verbs, lexical bundles etc.

The most peculiar feature of prototypical idioms is the discrepancy between what the phrases 'say' and what the phrases actually mean, as the figurative meaning of an idiom is not compositional. For example, the meaning 'chat in a leisurely manner' for the idiom *chew the fat,* cannot be computed by taking the phrase apart and sequentially analysing its component words: adding up the separate meanings of *chew*, *the*, and *fat* will not yield the intended meaning. Despite this striking characteristic of idioms, providing a comprehensive and undisputed definition of idioms has proven to be a challenging task and remains to this day somewhat of a grey area, although attempts have been made by various scholars (e.g., Barkema, 1996; Fernando, 1978; Fernando & Flavell, 1981; Moon, 1998). There are a number of reasons that make it difficult to unequivocally define idioms. First, prototypical idioms vary in terms of length, with some idioms being considerably longer (*wrap your head around something*) than others (*hit the ceiling*). They also vary in terms of literal plausibility, with some idioms being ditropic (Van Lancker, Canter, & Terbeek, 1981), meaning that they have a plausible literal as well as a figurative interpretation (e.g., *spill the beans* can mean 'reveal the secret(s)' or 'spill legumes out of a container'), while others are literally-implausible (e.g., *stay the course, trip the light fantastic*). Idioms can also vary in terms of meaning transparency (Cacciari & Glucksberg, 1991), that is, how obvious the metaphorical connection is to the associated figurative meaning; and/or decomposability (Gibbs, 1980; Gibbs & Nayak, 1989; Gibbs, Nayak, & Cutting, 1989), which is how much the component words of an idiom

contribute to the figurative interpretation. While an idiom's meaning is neither fully transparent nor decomposable in isolation (out of context), once its meaning is known, then the connection between the literal and figurative meanings might become more readily apparent. For example, the transparent idiom *saw logs* (meaning 'to snore') can be associated with its figurative meaning by making a metaphoric connection between the sound made when literally sawing logs, to the sound made when one snores (loudly). In contrast, opaque idioms including *kick the bucket* (meaning 'to die') appear not to have, or to have lost their metaphorical motivation. Notably, decomposable idioms, such as *spill the beans*, are said to benefit from a greater contribution of their component parts due to a direct mapping between the idiom components and the figurative meaning. For example, *spill* maps onto 'reveal' and *the beans* maps onto 'the secret(s)'. In contrast, none of the components of the non-decomposable idiom *kick the bucket* map onto the meaning 'die'.

This idiosyncrasy of idiomatic expressions not only creates problems in pursuit of a straightforward idiom definition, but it also has bearing on the way idioms are thought to be represented and processed. An important question in the field, therefore, is whether, or to what extent, idioms are to be conceptualised as phrases, or indeed as whole, lexical units due to their lack (or not clearly evident) compositionality. Models of idiom activation are extensively reviewed in the following chapters, therefore, it suffices here to briefly mention them in order to formulate some working hypotheses with regards to how this relates to idiom modification. Of particular interest to the present thesis is whether modified idioms are permissible and/or how modified idioms are understood by language users. Naturally, strict lexical approaches

(i.e., Lexical Representation Hypothesis (Swinney & Cutler, 1979), Idiom List Hypothesis (Bobrow & Bell, 1973)), advocate that idioms are stored and retrieved holistically (i.e., as whole chunks). Since a modified version of an idiom would not match its stored entry (*the bucket was kicked ≠ kicked the bucket*), the relevant template (*kick the bucket* = 'die') would become unavailable. Alternative approaches (i.e., Configuration Hypothesis (Cacciari & Tabossi, 1988), Superlemma Hypothesis (Sprenger, Levelt, & Kempen, 2006), Multidetermined Model (Libben & Titone, 2008)), maintain that idioms operate as hybrids, partly as lexical units and partly as compositional phrases. In this case, idiom modification should not prohibit access to the relevant template, because these templates can be activated—assuming that idiom modification does not render the phrase unrecognisable and/or that enough component words are present to cause activation to spread to the stored representation.

Crucially, however, compositionality and lexicalisation are believed to occur on a continuum, with some idioms being more compositional (*spill the beans*) and others more lexicalised (*kick the bucket*), and this could determine the ability of idioms to be modified. It has been argued, for instance, that a correlation between decomposability and flexibility dictates that only decomposable idioms are modifiable, whereas non-decomposable idioms are 'frozen' expressions that cannot sustain 'intrusive' modification without compromising their figurative meaning (Gibbs & Nayak, 1989). The word 'intrusive' here refers to instances of internal idiom modification, where the manipulation rearranges the order of the component words (e.g., passive voice; *the bucket was kicked*), or where extra words are inserted into the phrases so

that they tweak or add to the figurative meaning (e.g., *spill the spicy beans* alluding to the revelation of scandalous secrets). This could be contrasted with external modification, such as adverb insertion (e.g., *he suddenly kicked the bucket*), where the modification does not affect the idiom form or the figurative meaning per se, but rather the global interpretation of the phrase ('he suddenly died') (Gibbs & Nayak, 1989; Van de Voort & Vonk, 1995). Further, intrusive modification goes beyond basic grammatical adjustment, such as subject-verb agreement (e.g., *she/he shoot**s** the breeze*) or tense marking (e.g., ***shot** the breeze*), for example, which applies equally well to most idioms. Interestingly though, the mere fact that idioms *are* subject to grammatical agreement indicates a certain, albeit minimal, involvement of syntactic analysis in idiom production: inflection is marked on the verb of the idiom (*kicks/kicked the bucket*) in the same way that inflection is marked on the verb of a literal phrase (*kicks/kicked the ball*). Of course, in literal phrases, meaning is fully compositional: meaning is constructed incrementally as each piece of new information (or new word) is encountered and integrated with what has already preceded (Frazier, 1987; Marslen-Wilson, 1975; Swinney, 1979; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). In addition, each word contributes equally and directly to the intended meaning of the phrase (*kick* + *the* + *ball* = 'kick the ball'), as opposed to the indirect (metaphorical) connection that idioms' components *may* have with the figurative meaning of the phrase.

Compositionality is at the heart of influential models of language processing, such as Chomsky's generative paradigm (Chomsky, 1993, 2014). In this framework, linguistic production is governed by syntactic rules, as

utterances are formed through formal combinatory processes. Syntax and the lexicon are completely separate, and while syntax is the cornerstone of linguistic production, the role of the lexicon is limited to providing memorised words for the syntax to utilise and combine into phrases. Non-compositional strings, such as idioms and other types of formulaic sequences, were marginalised as units belonging to the lexicon and as a result were "unashamedly pushed […] aside and denied their undoubted significance" (Wray, 2002, p. 4). Yet, as mentioned above, language users do not necessarily create utterances from scratch every time they are engaged in a communicative act (Bolinger, 1975; Perkins, 1999), and a great deal of one's ability to communicate effectively in a language necessitates mastering formulaic language (Fillmore, 1979). Therefore, what appears to be more likely in terms of language use and processing, is a dual-system (Wray, 1992), where analytic (syntactic) processing goes hand in hand with holistic processing, the latter being responsible for retrieving formulaic sequences (or 'big words'(Ellis, 1996)) as a whole, directly from the lexicon or memory.

Sinclair (1991) stipulated that language comprehension and production is determined by two frameworks: the *open-choice principle* and the *idiom principle*. Grammatical structures are likened to 'slot-and-filler' models (open-choice principle), where a wide range of choices becomes available to the speaker and the only constraint is that they are grammatically correct. For example, in a typical SVO (Subject-Verb-Object) sentence, virtually any word(s) can fill the slots for S, V, and O respectively. However, there are certain prefabricated phrases that offer considerably fewer choices as some of the 'slots' are fixed (idiom principle) as in *set X on fire* or *set fire to X*. Some

offer no choice whatsoever, such as the collocation *of course* or the idiom *take the bull by the horns*. According to Sinclair, preconstructed phrases constitute single-choices, even if they are comprised of multiple words. This is because they are considered to be one unit or chunk and no other choice is permissible for the given 'slot'. Although in Sinclair's (1991) and Wray's (1992) paradigms syntax and the lexicon are more closely linked and both as seen as important elements of language production and comprehension (compared to Chomsky's approach), formulaic sequences, and idioms in particular, are still considered to be non-freely constructed phrases, or as sequences with an "unexpected level of fixedness" (Wray, 2002, p. 7).

It could be argued that fixedness is what makes a formulaic sequence formulaic; the tendency of the component words to frequently and predictably co-occur in a given pattern makes the sequence familiar and conventionalised to the native speakers of a language (Nunberg, Sag, & Wasow, 1994). Especially for idioms, whose meanings cannot be derived compositionally, familiarity with an idiomatic phrase and by extension with its associated figurative meaning is a prerequisite for the corresponding meaning to become activated. Interestingly, in some cases idiom familiarity might be inadequate and/or less effective in activating the figurative meaning efficiently. For instance, it has been argued that people with learning disabilities find it challenging to understand non-literal language, which extends to formulaic sequences such as idioms (e.g., Hales, 1995). Nevertheless, assuming that an idiom is 'known' by a typical population, does this mean that the phrase ceases to exist as a phrase altogether? In other words, once an idiom becomes (highly) conventionalised and assumes a lexicalized status, does the phrase

automatically become a syntactically 'fixed' phrase, which as such does not undergo syntactic processing and, therefore, cannot accept syntactic modifications? Above we saw that idioms follow regular inflection when it comes to tense and subject-verb agreement (*he kick**ed** the bucket*). While this evidence points to some level of parsing and syntactic processing during idiom production, it is questionable whether more complex syntactic operations are permitted for idioms—or indeed for *all* idioms.

On the other hand, fixedness comes with a benefit, at least for typically developed populations. Indeed, one of the most important reasons *why* people use formulaic sequences is the principle of economy of effort (Becker, 1975; Perkins, 1999): formulaic sequences are so familiar (in their canonical form) that they reduce processing effort by involving a certain level of automaticity in their production and comprehension (Conklin & Schmitt, 2012; Wray, 2002). The use of formulaic sequences, for this reason, aids fluency and comes with a processing advantage: their automatized nature allows speakers to focus their attention on the broader discourse, as opposed to word-level operations, thereby speeding up processing (Nattinger & DeCarrico, 1992). Part of this automatization stems from the very fact that formulaic sequences have stored representations in the lexicon or some kind of templates in memory, that allow for direct retrieval (as opposed to on-line compositional processing). Idioms, in particular, exhibit a processing advantage over non-idiomatic phrases (for an overview see Siyanova-Chanturia & Martinez, 2015). For example, Carrol and Conklin (2017, 2019) in a series of eye-tracking experiments, demonstrated that idioms like *spill the beans* induce shorter and fewer fixations than literal phrases like *spill the chips* and the final words of idioms (*beans*) are more

likely to be skipped than the equivalents in literal phrases. The faster reading time and increased skipping rate are believed to reflect the faster and/or more efficient processing that idioms as conventionalised phrases enjoy, compared to novel phrases which are unconventional and hence do not have stored representations. This 'idiom processing advantage' is supported by a long line of similar findings and across a variety of experimental techniques (Canal, Pesciarelli, Vespignani, Molinaro, & Cacciari, 2015; Carrol & Conklin, 2014b, 2017; Conklin & Schmitt, 2008; Gibbs, 1980; Laurent, Denhières, Passerieux, Iakimova, & Hardy-Baylé, 2006; Siyanova-Chanturia, 2015; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Swinney & Cutler, 1979; Tabossi, Fanari, & Wolf, 2009; Underwood, Schmitt, & Galpin, 2004; Vespignani, Canal, Molinaro, Fonda, & Cacciari, 2010). However, very little is known about what happens to this advantage, as well as to the availability of these templates, when idioms undergo modification.

Research questions

If the aforementioned idiom processing advantage is (even partly) attributable to idioms' formulaic character, which causes templates/ lexical representations to form in the mental lexicon or memory, then an interesting question that arises is how adaptable these templates/ representations are. Based on this, the present work has focused on two main questions:

1. Are idiom templates (and hence the idioms themselves by extension) flexible enough to sustain internal modification without compromising the figurative interpretation of the phrase?
2. Are idiom templates robust, such that an idiom advantage persists when the

phrase undergoes significant internal modification?

Thesis overview

This Chapter serves as a brief prelude to the themes and aims of the thesis. Each experimental chapter is self-contained and includes more focused introductions to the literature relevant to the study being described. A broad overview of the chapters in the thesis is provided in the following paragraphs.

Chapter 2 provides a detailed review of the literature regarding the claims that have been made about the syntactic flexibility of (some) idioms and the disputed correlation between idioms' flexibility and compositionality (or decomposability). The eye-tracking experiment examines whether native-speakers successfully activate the figurative meaning of idioms that have been passivized (e.g., *the beans were spilled/ the bucket was kicked*)—an arguably complex syntactic operation that inverts the subject and object of the clause and causes alterations to the main verb. Idioms and control phrases were inserted in a facilitative context that biased the figurative interpretation of the respective idiom (e.g., 'die' for *the bucket was kicked*). Both active and passivized idioms were compared to matched control phrases (*kicked the apple/the apple was kicked*) whose meaning was incompatible with the global meaning of the sentence ('die'). Importantly, the transparency of idioms—a measure taken to indicate the degree of decomposability of the phrases—was considered as a factor in the analyses of the data. Of note, a slightly modified version of Chapter 2 has been published as an article in *Language & Speech* (Kyriacou, Conklin, & Thompson, 2019).

Chapter 3 describes a follow-up study using a similar experimental

design, investigating whether the figurative meaning of passivized idioms would be activated when passivized idioms were *not* surrounded by a rich context, but instead by a minimal, neutral context. In this chapter, meaning activation of passivized idioms was compared and contrasted with the literature on meaning activation in semantically ambiguous words (i.e., homonyms and polysemes). While at least familiar and/or predictable canonical idioms are found to activate their figurative *and* literal interpretations equally fast (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011), this chapter explored whether modifying an idiom causes an imbalance in their meaning dominance and, specifically, whether it makes the literal meaning more prominent, akin to the dominant (more frequent) meaning of a homonym (e.g., *bank* having the meaning of 'financial institution'). Higher activation of the literal meaning (*the bucket was kicked* = 'the pail was kicked') could interfere with the activation of the figurative meaning, in the same way that the more frequent meaning of a homonym interferes with the activation of the subordinate one (i.e., *bank* having the meaning of 'side of a river').

Chapter 4 examines the processing of passivized idioms by a different population, namely by people with dyslexia. The motivation behind this study was the argument that people with learning disabilities, such as dyslexia, interpret language more literally than their typically developed peers (e.g., Hales, 1995). While empirical findings in support of (or against) this argument are scarce, if true, it could have a major impact on the way people with dyslexia understand idioms, and especially modified ones, since modifications could make the phrases seem less familiar and, thus, more difficult to recognise as idiomatic configurations. Because of the lack of empirical studies in this

domain, the predictions for the eye-tracking experiment described in Chapter 4 were more speculative. Crucially, because the studies in Chapter 3 and 4 were identical, but with different populations of readers, the results allow me to assess similarities, but most importantly potential differences in typically developed and dyslexic readers.

Chapter 5, describes the final eye-tracking experiment that was particularly tailored to address the second question of the thesis; can the idiom processing advantage persist in the face of internal idiom modification? The stimuli sentences contained canonical idioms and idioms with up to two intervening adjectives (*he spilt the spicy (red)beans*) and these were matched with literal, control phrases (*he burnt the (spicy (red)) beans*) that were equally appropriate in their respective contexts. Factors believed to be involved or contributing to the idiom advantage (e.g., frequency, familiarity, and predictability) were considered for both modified and unmodified idiomatic expressions and the reading pattern of the idioms were compared to that of the literal controls.

Finally, Chapter 6 reviews the main findings across the four studies and discusses the overall conclusions that can be drawn from the data as well as their implications. These findings are further discussed in light of what we currently know about the processing of idiomatic phrases and how current theories of idiom representation and processing need to be modified to account for idiom modification.

CHAPTER 2

Passivizability of Idioms: Has the Wrong Tree Been Barked at?

Broadly speaking, *idioms* refer to phrases whose meaning extends beyond what is literally conveyed by their component words, and they are ubiquitous in everyday communication (Erman & Warren, 2000; Glucksberg, 1989; Pollio, 1977). However, the processing of idioms is far from straightforward. On the one hand, idioms defy compositional models of language processing as their figurative meaning is not fully derived from their component parts (Chafe, 1968; Chomsky, 1993; Fernando, 1978; Katz & Postal, 1965; Weinreich, 1969). For instance, the concept *die*, cannot be computed by adding up the individual meanings of *kick*, *the,* and *bucket*. On the other hand, idioms seem to behave like compositional phrases in many ways; they adhere to basic grammatical rules, such as subject and tense agreement (*he kick**ed** the bucket*) (Schmitt, 2005), and some allow complex syntactic manipulations, including passivization (*the beans were spilled*) (Fraser, 1970).

The degree of compositionality of idioms is disputed in the literature. Some research has demonstrated a certain level of compositionality for idiomatic expressions, thus highlighting the involvement of syntactic processing in the activation of the idiomatic meaning (Cacciari & Tabossi, 1988; Cutting & Bock, 1997; Sprenger et al., 2006). However, idioms are not generally thought to have full syntactic flexibility, meaning that they do not undergo complex syntactic operations as freely as literal compositional phrases. Alongside this, idioms are treated as idiosyncratic so that they vary in

the range of syntactic manipulations they can undergo *without* compromising their figurative interpretation. Even structurally identical idioms such as *spill the beans* and *kick the bucket* (V + Det + N) are said to differ in the amount and types of syntactic operations they allow. The former is thought to be passivizable without losing its figurative meaning (*the beans were spilled*) (Cutler, 1982; Fraser, 1970), while the latter has been repeatedly labelled as syntactically frozen and incapable of being passivized without being interpreted literally (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978; Wulff, 2008). However, as will be discussed below, many of the claims are based on offline judgment tasks, which might not reflect how people comprehend idioms during on-line processing. The aim of the current study is to explore whether idioms' passivizability is indeed determined or influenced by their hypothesised degree of syntactic flexibility. I will start by looking at the relevant theories about the syntactic flexibility of idioms.

Some early views saw idioms as syntactic anomalies (Katz, 1973), with lexical approaches asserting that the components of idioms were not analysed, but rather that idioms were stored and retrieved holistically as single lexical units directly from the mental lexicon (Gibbs, 1980; Swinney & Cutler, 1979), or a specified idiom list (Bobrow & Bell, 1973). A consequence of holistic storage was that idiomatic phrases were thought to be syntactically frozen, and the figurative meaning was believed to be attached to a specific form of the idiom (i.e., the canonical form) (McGlone, Glucksberg, & Cacciari, 1994). This also served to explain why idioms were processed more quickly than matched literal phrases: idioms did not require time-consuming syntactic

analyses (Swinney & Cutler, 1979). Many studies have reported faster processing for idioms (*spill the beans*) relative to comparable, compositional phrases (*spill the chips*) (Canal et al., 2015; Carrol & Conklin, 2014b, 2017; Colombo, 2014; Conklin & Schmitt, 2008; Gibbs, 1980; Laurent et al., 2006; Ortony, Schallert, Reynolds, & Antos, 1978; Siyanova-Chanturia, 2015; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Strandburg et al., 1993; Swinney & Cutler, 1979; Tabossi, Fanari, et al., 2009; Underwood et al., 2004; Vespignani et al., 2010). However, this processing advantage may be a by-product of their conventionality, rather than their strictly lexical nature. That is, the tendency of idioms to appear in a certain form, may bring factors to play, such as familiarity, frequency of occurrence, and predictability, to name a few. These factors have been known to influence the processing speed of idioms, as well as other formulaic sequences (see Arnon & Snider, 2010; Burt, 1992; Cacciari, 2014; Cacciari & Tabossi, 1988; Cronk & Schweigert, 1992; Jiang & Nekrasova, 2007; Kim & Kim, 2012; Libben & Titone, 2008; McGlone et al., 1994; Reagan, 1987; Schweigert, 1986; Sosa & MacFarlane, 2002; Tabossi & Zardon, 2014).

Contrary to the predictions of the lexical approaches, syntactically and lexically modified idioms *are* used in their figurative sense, as evidenced by corpus and similar studies (Barlow & Kemmer, 2000; Cacciari & Glucksberg, 1991; Duffley, 2013; Hovhannisyan & Mkrtchyan, 2014; Langlotz, 2006; McGlone et al., 1994; Moon, 1998; Nunberg et al., 1994; Schmitt, 2005). Notably, a Google search by Duffley (2013), revealed instances of extreme idiomatic modifications, including examples like *most of their buckets have been kicked,* where the idiom was both pluralised and passivized. Although one

could argue that such instances are rare and, therefore, not representative of typical idiomatic use, they do challenge the assumption that idiomatic meanings are strictly associated with the canonical form of idioms. Additionally, it seems unlikely that separate entries would be stored for every possible idiomatic variant.

Recent empirical findings call into question lexical theories and demonstrate that syntactic analysis is involved during the processing of idiomatic phrases (Holsinger, 2013; Holsinger & Kaiser, 2013; Peterson, Burgess, Dell, & Eberhard, 2001). Structurally similar idioms can cause blending errors in production (Cutting & Bock, 1997), and are susceptible to syntactic priming effects (Snider & Arnon, 2012). The literal meanings of idiomatic words are sometimes found to be activated during idiomatic comprehension and production (Cacciari & Corradini, 2015; Cacciari & Tabossi, 1988; Sprenger et al., 2006). Collectively these findings challenge the view of idioms as noncompositional, as they show that idioms have internal structure and are subject to the same processing mechanisms as literal phrases. This has prompted a turn towards more compositional and hybrid models of idiomatic language processing.

The Configuration Hypothesis (Cacciari & Tabossi, 1988), posits that idioms are processed compositionally (and hence literally) until the recognition point is reached (referred to as the idiomatic 'key'). The location of the recognition point is influenced by predictability, with an earlier recognition point for highly predictable idioms, as well as a biasing context speeding recognition (Cacciari & Corradini, 2015; Cacciari et al., 2007; Fanari, Cacciari, & Tabossi, 2010; Tabossi, Fanari, & Wolf, 2009). After the recognition point,

the idiomatic meaning is retrieved, which conflicts with the literal interpretation of the individual words in the idiom. Along similar lines, Cutting and Bock (1997), argued that idioms operate on two levels: the lexical level, where idiomatic meanings are stored as concepts, and the syntactic level, where idioms are analysed as phrases. Sprenger et al. (2006), extended this model by introducing an intermediary level, called the Superlemma, whereby idiomatic words (*kick*, *the*, and *bucket*) activate a superlemma (*kick the bucket*), which in turn activates the idiomatic concept (*die*).

These models embrace the (partial) compositionality of idioms, but this has not been accompanied by a belief that idioms are *fully* syntactically adaptable. The Configuration Hypothesis (Cacciari & Tabossi, 1988) predicts that as long as a configuration is recognisable, the idiomatic meaning should be accessed regardless of any syntactic modifications. The Superlemma Theory (Sprenger et al., 2006), although underspecified about how modified idioms are processed,[1] could be used to explain the activation of modified idioms: an idiomatic concept could be activated due to spreading activation from the lemmas to the concept level, despite syntactic alterations. Neither model makes specific claims about potential processing costs because of syntactic modification. Importantly, an underlying assumption is that idioms form a heterogenous group of phrases and specific claims have been made about idioms' ability to take the passive voice. For example, certain idioms, such as *kick the bucket*, are considered particularly resistant to the passive construction (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg,

[1] The Superlemma Theory specifies that some syntactic restrictions may apply in idiom production, but not necessarily in comprehension. This could explain, for example, why the majority of idiomatic production is in the canonical (preferred) form.

1978; Wulff, 2008).

One of the first linguists who attempted to operationalise the syntactic flexibility of idioms was Fraser (1970), with his Frozenness Hierarchy; a scale comprised of six levels of flexibility, ranging from 0 (completely frozen), to 5 (fairly flexible). According to this, an idiom could undergo only as many syntactic operations as the ones formally prescribed by its respective level. The passive voice was allowed for idioms of levels 4 and 5. Therefore, a level 1 idiom (*kick the bucket*) could not be passivized and retain its idiomatic meaning, but a level 4 idiom (*spill the beans*) could. This model was developed based on Fraser's intuitions, and idioms were assigned to the various levels without empirical support for their classification.

An alternative proposal held that the flexibility (and therefore passivizability) of idioms was determined by the syntactic properties of the idioms' literal paraphrases (Newmeyer, 1972). For instance, *kick the bucket* and *chew the fat* could not be passivized because their single-word literal paraphrases, *die* and *chat* respectively, are both intransitive verbs. This proposal was refuted on that grounds that idioms like *give up the ghost* and *throw in the towel* are passivizable, despite having intransitive verbs as literal paraphrases ('die' and 'resign' respectively) (e.g., Nunberg, 1978). Yet other accounts relied on semantic properties of idioms. Abeillé (1995) argued that the ability of (French) idioms to accept the passive voice was determined by the referential autonomy of the subject and object of an idiom; if the subject was also the patient/experiencer, as in *kick the bucket*, where the person who kicks the bucket is the person who dies, passivization was blocked. In contrast, if the subject was independent, as in the case of *spill the beans,* where one can

reveal someone else's secrets, then passivization was permitted. Like Fraser's scale of flexibility, however, this theory has no empirical support. Furthermore, it could be argued that the semantic roles of idioms can be rather fluid. For example, one could imagine a situation where one *spills their own beans* (reveal their own secrets), or wilfully *kick someone else's bucket* (kill them).

An influential semantic account was proposed by Gibbs and Nayak (1989), which was based on Nunberg's (1978) theory of decomposition. According to Gibbs and Nayak, the components of semantically decomposable idioms, like *pop the question*, carry figurative meaning as a result of a direct mapping between their idiomatic and literal meanings. Thus, *pop* maps onto the meaning of *suddenly propose*, and *question* maps onto *marriage*. The figurative meaning of *propose marriage* can be conveyed even if the idiom is passivized (*the question was popped*). Conversely, nondecomposable idioms, such as *kick the bucket,* are nonpassivizable because the individual words are semantically empty; neither *kick* nor *bucket* map onto the figurative meaning *die*. Thus, decomposable idioms are syntactically more flexible, whereas nondecomposable idioms are frozen. While Gibbs and Nayak found that people consistently rated decomposable idioms as more flexible, a study with Italian idioms by Tabossi et al. (2008) did not replicate this finding. An on-line study measuring reaction times to modified idioms (*he let the fat cat out of the bag*), also failed to find an effect of decomposition (Van de Voort & Vonk, 1995). Interestingly, Libben and Titone (2008) found that semantic decomposition only affected offline judgement tasks, where participants were asked to make a conscious decision on the compositionality of idioms, but not online measures, where the focus was on comprehension.

The flexibility of an idiom has also been associated with its degree of transparency, with transparent idioms being more flexible than opaque ones (Cacciari & Glucksberg, 1991; Nunberg et al., 1994). The idiom *spill the beans*, for example, has a transparent metaphorical correspondence between its literal and figurative meanings; one can easily identify an association between spilling beans from a container and revealing secrets. It is important to note that transparency and semantic decomposition are not necessarily overlapping concepts, as a transparent idiom may not be decomposable. For instance, *saw logs* (to snore) is transparent, due to the metaphoric relation between the sound of snoring and the sound of sawing logs, but it is not decomposable as the component words *saw* and *logs* do not map onto *snore*. However, idioms like *kick the bucket*, can be both nondecomposable and opaque, due to an absence of direct mapping as well as a lack of a metaphoric correspondence. Nunberg et al. (1994) hypothesised that in addition to decomposability and transparency, conventionality is an important factor in idiomatic flexibility. He defined conventionality as the possibility of predicting an idiom's figurative meaning in isolation, based solely on the idiom's component words. He claimed, that highly conventionalised, opaque, and nondecomposable idioms like *kick the bucket* and *saw logs* "lose their idiomatic interpretation when they are deformed, as in the passive" (Nunberg et al., 1994, p. 507).

From the above discussion, we see that syntactic flexibility is attributed to some idioms, rather than being a property of idioms in general. A number of theories have attempted to operationalise the flexibility of idioms, and particularly their ability to be passivized, without empirical findings to adequately support any of them. To date, there is no evidence showing that

passivizing idioms, be that flexible or frozen, prohibits their idiomatic interpretation from being activated during on-line language comprehension and especially when idioms are embedded in facilitative context. Findings from a few studies have shown that a facilitative context can speed up the reading of both canonical (Carrol & Conklin, 2017; Siyanova-Chanturia, Conklin, & Schmitt, 2011) and modified idioms (*he didn't spill a single bean*) (Cacciari & Glucksberg, 1991; McGlone et al., 1994), and may increase the acceptability ratings of modified idioms in judgement tasks (Fanari, Cacciari, & Tabossi, 2010; Peterson et al., 2001; Tabossi, Wolf, & Koterle, 2009). Glucksberg (2001) proposed that any syntactic operation should be available for idioms, provided that the component words are preserved and that a plausible communicative intent can justify the manipulation (e.g., using the passive voice to place the focus on the object of the phrase).

The present study uses eye-tracking to explore whether passivized idioms, embedded in idiomatically-biasing contexts, retain their idiomatic interpretation. More specifically, it aims to test (a) whether participants can retrieve the figurative meaning of passivized idioms during sentence comprehension, and (b) whether factors believed to affect idiomatic processing (i.e., familiarity, frequency, and predictability) and syntactic flexibility (i.e., decomposability/transparency) might contribute to this. It was hypothesised that a biasing context would be strong enough to prime the figurative meaning regardless of voice, but naturally, due to the low frequency, familiarity, and predictability of the passivized forms, as opposed to the canonical forms of idioms, it was anticipated that passivized idioms would take longer to process than active ones. Finally, it was expected that decomposability/transparency

would not affect the on-line processing of idiomatic phrases.

Before turning to the study, it is important to define what I mean by idiom. I take idioms to be formulaic sequences, whose meanings are not entirely predictable from the literal meanings of the individual words that constitute them. In particular, I focus on three-word idioms having the structure V+NP. Further, for the sake of clarity, from this point onwards the term transparency will be used as an umbrella term for transparency, decomposability, and conventionality, since these factors overlap to a certain degree and are, therefore, difficult to distinguish in norming studies. More specifically, I take transparency to mean how obvious or guessable the meaning of an idiom is in isolation.

Methodology

Participants

Sixty native speakers of English, all first-year undergraduate students at a British University (Mean age = 18.53, range 18-20; 9 males and 51 females), participated in the eye-tracking study and received course credit for their participation.

Materials

Eighty-four idioms were drawn from the Collins COBUILT Idioms Dictionary (2011). To enable the passive transformation, all idioms were comprised of a transitive verb (V) plus a noun phrase (NP) (see list of materials in Appendix A). A series of norming procedures were followed to account for the (a) frequency, (b) familiarity, (c) transparency, and (d) predictability of the

idioms.

Norming

Ninety-two participants from the same population, but different from those in the eye-tracking study, took part in the norming studies. In four separate questionnaires, participants provided ratings of frequency (n = 16), familiarity (n = 16), and transparency (n = 16) for the idioms. The idioms along with filler phrases were judged on a scale from 1 to 5; 1 always being the most negative pole (least frequent/familiar/transparent) and 5 being the most positive (very frequent/familiar/transparent). The filler items were literal expressions and, in the case of familiarity, other idiomatic expressions accompanied by an incorrect definition (*The straw that broke the camel's back* means to treat animals poorly).

The predictability of both active and passivized idioms was assessed via cloze tests both with and without accompanying context by 44 different participants. For the with-context condition, participants were presented with the stimuli sentences used in the eye-tracking study, leading up to the final idiomatic word which was replaced by a blank, and participants were asked to fill in the blank with the first word that came to mind. There were 4 versions of this test, so that voice (active/passive) was counterbalanced with the context and no-context conditions. Only the scores from the with-context condition were included in the analyses, since the without-context condition almost never had 'correct' completions.

Independent sample *t*-tests were conducted to compare the ratings for idioms and filler items for frequency, familiarity, and transparency, whereas

for predictability a paired-samples *t*-test was used. The descriptive statistics are presented in Table 2.1. Idioms were rated significantly more familiar (M = 4.30, SD = 0.77) than fillers (M = 2.27, SD = 0.82); $t(196) = -18.472$, $p < 0.001$, more frequent (M = 3.36, SD = 0.69) than fillers (M = 2.00, SD = 0.68); $t(156) = -12.27$, $p < 0.001$, as well as more transparent (M = 3.97, SD = 0.68) than fillers (M = 3.34, SD = 1.09); $t(156) = -4.41$, $p < 0.001$. The final words of active idioms in context (nouns) were predicted correctly approximately one third of the time (M = 0.38, SD = 0.33), and they were significantly more predictable than final words of passivized idioms in context (verbs) (M = 0.28, SD = 0.25); $t(83) = 2.44$, $p = 0.04$. Overall, the norming shows that the idioms were familiar, frequent and transparent, but of relatively low predictability.

Table 2.1 - Summary of idiom characteristics.

	Mean	Std. Dev.	Variance
Frequency	3.36	0.69	0.48
Familiarity	4.30	0.77	0.59
Transparency	3.97	0.68	0.46
Active Voice Predictability	0.38	0.33	0.11
Passive Voice Predictability	0.28	0.25	0.06

Main study

All 84 idioms were paired with a control phrase by substituting the final word of the idiom with another noun that matched in frequency and word-length (*kick the apple* for *kick the bucket*). There were overall four conditions in a 2 x 2 design: (1) idiom active, (2) idiom passive, (3) control active, and (4) control passive (see Table 2.2 for an example). All phrases were embedded in a sentential context, intended to bias the figurative meaning of the respective

idiom (e.g., *die* for *kick the bucket*). Thus, the control phrases as in (3) and (4) were *always* incongruent with the meaning of the sentence. For instance, one can kick an apple since apples are potentially kickable objects, but the phrase *kick the apple* is pragmatically anomalous in a context about death. Active idioms (1), on the other hand, were always congruent, since their figurative meaning conveyed the intended meaning of the sentence. Crucially, the focus was on how passivized idioms, as in (2), would be processed. Their contextual congruency should be, therefore, solely dependent upon the phrase retaining or losing its figurative interpretation: if *the bucket was kicked* were to retain the figurative meaning *die*, then the meaning of the phrase would be congruous in the sentence, but if the phrase were to be interpreted literally (*the bucket was literally kicked*), then the (literal) meaning of the phrase would be incongruous, just like the meanings of the active and passive control phrases. Therefore, it was hypothesised that in the former case passivized idioms should be easier to integrate in the context and this should be reflected by a faster processing, while in the latter case no difference in the processing of passivized idioms versus active or passive control phrases would be expected.

Table 2.2 - Example of an idiom in the active and passive voice and its matched controls in the active and passive voice.

No.	Condition	Stimulus Example
1	Idiom Active	Old John seemed to respond well to the new treatment at first, but eventually **he kicked the bucket** and his daughters needed to plan his funeral.
2	Idiom Passive	Old John seemed to respond well to the new treatment at first, but eventually **the bucket was kicked** and his daughters needed to plan his funeral.
3	Control Active	Old John seemed to respond well to the new treatment at first, but eventually **he kicked the apple** and his daughters needed to plan his funeral.
4	Control Passive	Old John seemed to respond well to the new treatment at first, but eventually **the apple was kicked** and his daughters needed to plan his funeral.

The interest areas (IAs) (idiomatic/control phrases) were never placed at the end of a sentence or a line break to avoid wrap-up effects and the programming associated with saccades. The length of the IAs was largely unaffected by the manipulation due to the inclusion of the copular verb *be* and the exclusion of the subject in the passive voice. For example, *he spilled the beans* and *the beans were spilled* both consist of 4 words of comparable length. The overall length of the phrases depended on the tense and aspect used; simple past tense yielded 4-word phrases (146 items), whereas perfect and continuous aspects yielded 5-word phrases (*she had spilled the beans* and *the beans had been spilled*; 22 items). The same was true for the matched control items.

The optional by-phrase of the passive voice was never used for two reasons: a) to control the length of the phrases, and b) to avoid unnatural phrasing. For example, in cases where the idioms included body parts or where the subjects were also the patients, by-phrases sound unnatural (*her lips were buttoned by herself*).

Procedure

The sentences were distributed across four lists using a Latin square design, so that each participant saw each phrase in only one of the four conditions. Care was taken so that the lists were balanced regarding the familiarity, frequency, predictability, and transparency of the idioms. The same 85 filler sentences were used across the lists. These were literal sentences or sentences containing other types of formulaic sequences (binomials, proverbs, etc.). The formulaic sequences in some filler items were also modified in order to distract the participants from the passive voice manipulation (*chips and fish, fed with golden forks, etc.*).

Eye-tracking was carried out with an Eyelink 1000+ desktop-mount eye-tracker (sampling rate 500Hz). Participants were seated in front of a computer monitor and a chin- and head-rest was used to minimise head movement. The eye-tracker was calibrated using a 9-point grid, and re-calibration was performed as necessary.

Each experimental sentence or filler was triple-spaced and displayed one at a time, in black font (Courier New, size 14) on a white background. Items were always preceded by a drift correction. Participants were given oral and written instructions to read the sentences as quickly as possible but for comprehension and to press ENTER to proceed from one item to the next. Random Yes/No comprehension questions were included for filler items to ensure participants' attention. All trials were randomised across participants.

Results

Accuracy on the comprehension questions was high (84%), indicating that the participants had no difficulty with the task. Following visual inspection of the data, one participant was excluded from the analyses due to extreme values across all eye-tracking measures in all conditions. Fixations shorter than 80ms were removed, as was data compromised due to track loss (4.7% together). No further data were removed.

Analyses were carried out on the phrases (whole idiom/control phrase), and the content words (verbs and nouns), to allow for comparisons of the whole phrase and that of its component parts. Analyses of individual words were split by voice, so that the active idiomatic verbs were compared with the active control verbs, the passive idiomatic verbs with the passive control verbs, and so on. I avoided an analysis of phrase-final words across voice, since that would entail a direct comparison of two distinct grammatical classes: nouns in the active and verbs in the passive conditions. Means for the phrases and individual words can be seen in Table 2.3 below.

Table 2.3 - Results for phrases and words in the active and passive voice for the idiom and the control.

		Total Reading Time		*Fixation Count*		*Regression*		*First Pass Reading Time*	
		Mean (ms)	SE	Mean	SE	Mean	SE	Mean (ms)	SE
Phrases									
Active	Idiom	603	22.55	3.39	0.11	0.41	0.03		
	Control	745	28.79	4.23	0.15	0.58	0.03		
Passive	Idiom	657	24.43	3.68	0.12	0.39	0.03		
	Control	794	32.16	4.41	0.17	0.56	0.03		
Words									
Active Voice									
Verb	Idiom	252	7.36	1.47	0.04	0.22	0.02	191	3.62
	Control	292	8.40	1.73	0.04	0.35	0.02	192	3.37
Noun	Idiom	227	4.47	1.29	0.03	0.06	0.01	193	3.27
	Control	264	6.85	1.55	0.04	0.18	0.01	194	3.34
Passive Voice									
Verb	Idiom	238	6.31	1.36	0.03	0.10	0.01	193	3.37
	Control	275	8.00	1.59	0.04	0.11	0.01	198	3.99
Noun	Idiom	247	6.77	1.43	0.04	0.17	0.01	194	3.82
	Control	281	8.71	1.63	0.04	0.30	0.02	196	3.71

For all IAs, I analysed the data drawn from three late eye-tracking measures, namely: total reading time (duration of all fixations including re-fixations), fixation count (the total number of fixations) and regressions (the likelihood of re-fixation into the IA after the eye has moved to the right). For verbs and nouns, I also included an analysis of first pass reading time (duration of all fixations before eyes exited to the left/right), which is an early eye-tracking measure appropriate for the analysis of single words (Carrol & Conklin, 2014a, 2014b; Conklin, Pellicer-Sánchez, & Carrol, 2018).

The data were analyzed using linear mixed effect models with the *lme4* package, version 1.1-15, (Douglas Bates, Maechler, Bolker, & Walker, 2014) in R, version, 3.4.3, (R Core Team, 2018). Idiomaticity and voice were incorporated in the models as fixed effects, each with two levels: idiom vs. control and active vs. passive. The idiom level and active level were each set as the baselines (0). I included frequency, familiarity, transparency, and predictability of idioms as additional fixed effects to check whether idiomaticity or voice would interact with any of them.[2] These predictors were included in models where both idioms and controls were analysed, as wells as in separate models where only idioms were analysed. Trial sequence number and list were also added as fixed effects. By-subject and by-item random slopes and intercepts were included as random effects (Barr, Levy, Scheepers, & Tily, 2013).

Frequency, familiarity, and transparency were all correlated (with all *r*s

[2] The ratings of frequency, familiarity, transparency and predictability were obtained for the idioms in the active voice, as well as predictability for passivized idioms. Thus, the familiarity score obtained for the phrase *he kicked the bucket* was associated with *the bucket was kicked*, *he kicked the apple*, and *the apple was kicked*. This was done to explore whether the familiarity/frequency/predictability/transparency of the active forms would influence the processing of their passivized forms, or their active and passive control equivalents.

> 0.5 and all *p*s < 0.05). To avoid issues of collinearity, I orthogonalized these factors by residualizing. Since transparency was more central to the research question, I first residualised transparency against familiarity and frequency, and then familiarity against frequency. The remaining predictors were centred to avoid having a change in slope that might correlate with a change in intercept. The residualised and centred variables were highly correlated with their original variables (all *rs* > 0.55 and all *ps* < 0.05).

Model components were added in a stepwise manner and following comparisons of the resulting models, only significant covariates were retained. Additive models were initially fitted, and interactions were only included if they significantly improved the model. Different models were fitted for each eye-tracking measure. For the likelihood of regression (a binary variable), logistic linear models were fitted (Jaeger, 2008), while for fixation count a generalised linear model with *poisson* regression was fitted. All durational measures were log-transformed and analysed using linear mixed effects models. The means of the model outcomes and all pairwise comparisons, were calculated using the *emmeans* package (Lenth, 2018).

Phrasal analysis

Table 2.4 presents the model outcomes for all phrase-level measures. When both phrase types were considered, idiomaticity and voice were significant factors, with idiomatic phrases being significantly faster (M = 629.49 ms, SD = 22.95) than control phrases (M = 769. 851 ms, SD = 29.84, *p* <. 001), and active phrases significantly faster (M = 670.74 ms, SD = 24.19) than passive ones (M = 722.49 ms, SD = 26.67, *p* < .001). Trial number was a

significant predictor, with all phrase types being read faster as trial number increased. Frequency was also significant, and it interacted with idiomaticity: as frequency increased, idiomatic phrases were read faster, while control phrases were read more slowly. The separate analysis of idioms only, replicated the findings of the overall phrasal analysis: there was a significant influence of frequency and trial number for active and passivized idioms with increased frequency and trial number leading to a faster reading time.

Table 2.4 - Mixed-effects model estimates for all phrase-level measures.

	Total Reading Time *All Phrases*			Fixation Count *All Phrases*			Regression Likelihood *All Phrases*		
Pred.	*β*	*t*	*SE*	*β*	*z*	*SE*	*β*	*z*	*SE*
Fixed Effects									
(Inter.)	6.50***	150.9	0.04	1.33***	31	0.04	-0.04	-0.12	0.29
Idiomaticity	0.28***	7.74	0.04	0.29***	7.23	0.04	0.71***	9.62	0.07
Voice	0.10**	2.7	0.04	0.08	1.81	0.04			
Freq.	-0.06**	-2.99	0.02	-0.06**	-3.13	0.02	-0.05	-1.05	0.05
Trial no.	-0.00***	-4.8	0	-0.00***	-4.2	0	-0.01***	-8.58	0
Idiom.* Voice	0	0.09	0.05	-0.01	-0.14	0.06			
Idiom.* Freq.	0.05*	2.39	0.02	0.06**	2.86	0.02			
Idiom.* Trial no.	-0.00*	-2.44	0	-0.00*	-1.99	0			
Voice* Freq.	0	0.17	0.02	0.02	0.81	0.02			
Voice* Trial no.	0	-0.36	0	0	0.11	0			
Idiom.* Voice* Freq.	0.01	0.31	0.03	0	-0.17	0.03			
Idiom.* Voice* Trial no.	0	-0.64	0	0	-0.56	0			
Fam.							-0.18*	-2.39	0.07
Trans.							0.21	1.81	0.11

Pred. act.							-0.16***	-3.31	0.05
Random Effects									
σ^2	0.17								
$\tau_{00,item}$	0.02			0.01			0		
$\tau_{00,ppt}$	0.06			0.05			0.89		
ρ_{01}	-0.23			1					

	Active Idioms			*Active Idioms*			*Active Idioms*		
	β	*t*	*SE*	*β*	*z*	*SE*	*β*	*z*	*SE*
Fixed Effects									
(Inter.)	6.50***	151.31	0.04	1.42***	31.04	0.04	-0.17	-0.98	0.18
Idiomaticity									
Voice									
Freq.	-0.06**	-2.99	0.02	-0.04*	-3.05	0.02	-0.06	-0.79	0.08
Trial no.	-0.00***	-4.69	0	-0.00***	-3.89	0	-0.01*	-2.26	0
Random Effects									
σ^2	0.15								
$\tau_{00,item}$	0.02			0.01			0.07		

$\tau_{00,ppt}$	0.06			0.04			0.83		
	Passive Idioms			*Passive Idioms*			*Passive Idioms*		
	β	*t*	*SE*	*β*	*z*	*SE*	*β*	*z*	*SE*
Fixed Effects									
(Inter.)	1.34***	157.78	0.04	1.42***	35	0.04	0.07	0.41	0.17
Idiomaticity									
Voice									
Freq.	-0.06**	-2.92	0.02	-0.04*	-2.3	0.02	-0.21*	-2.52	0.08
Trial no.	-0.00***	-5.61	0	-0.00***	-4.28	0	-0.01***	-3.78	0
Random Effects									
σ^2	0.16								
$\tau_{00,item}$	0.02			0.01			0.24		
$\tau_{00,ppt}$	0.06			0.04			0.6		
Notes									**p<.05**p<.01***p<.001*

The analysis on fixation count also indicated an effect of idiomaticity, with idiomatic phrases eliciting significantly fewer fixations (M = 3.53, SD = 0.11) than control phrases (M = 4.32, SD = 0.15, $p < .001$), regardless of voice type. While active phrases also elicited fewer fixations (M = 3.79, SD = 0.12) than passive ones (M = 4.03, SD = 0.13, $p < .001$), the overall effect of voice was only marginally significant ($p = 0.07$). Trial number was significant with all phrase types eliciting fewer fixations as the experiment progressed. Frequency was also significant, and it significantly interacted with idiomaticity: as frequency increased, idiomatic phrases yielded fewer fixations, while control phrases had more. The idioms-only analysis replicated this pattern.

Idiomaticity was also significant in the analysis of regressions, with idioms being less likely to elicit a regression (M = 0.40, SE = 0.02) than controls (M = 0.57, SE = 0.03; $p = <.001$), but voice was not significant in this measure. There was a significant effect of familiarity and predictability, which affected both idioms and control phrases alike; the more familiar and predictable the canonical (active) idiom was, the less likely it was for regressions to be elicited by both idioms and control phrases. There was also a marginal effect of transparency ($p = 0.07$), by which increased transparency led to fewer regressions for idioms and control phrases. The analysis on idioms highlighted some differences between active and passive idioms. Active idioms were less likely to elicit a regression with increased familiarity, predictability, and trial number, while passive idioms were less likely to do so with increased frequency and trial number. That is, the more frequent the canonical active form of an idiom was, the less likely it was for its passivized form to yield a

regression.

There was no interaction between voice and idiomaticity in any measure, but pairwise comparisons indicated significant contrasts between active idioms, passive idioms, active control phrases, and passive control phrases. As can be seen in Tables 2.3 and 2.5 active idioms were read significantly faster than all other types of phrases, passivized idioms were read faster than both controls phrases, and active control phrases were read faster than passive control phrases. The same pattern was observed in the number of fixations, although in this case there was no significant difference between the control conditions. Active and passive idioms were also significantly less likely to yield a regression than both control phrases, but they did not differ between them. Control phrases also did not differ for this measure. The *p*-values for all pairwise comparisons were adjusted using the Bonferroni correction.

Table 2.5 - Summary of pairwise comparisons between phrases.

	Total reading time			Fixation count			Regression likelihood		
	Ratio	SE	*p*	*Ratio*	*SE*	*p*	*Ratio*	*SE*	*p*
Comparisons									
Idiom active * control active	0.80	0.01	<.001	0.80	0.01	<.001	0.50	0.03	<.001
Idiom active * idiom passive	0.91	0.01	0.001	0.92	0.01	0.001	1.05	0.08	1.00
Idiom active * control passive	0.75	0.01	<.001	0.76	0.01	<.001	0.5	0.06	<.001
Control active * idiom passive	1.13	0.02	<.001	1.14	0.02	<.001	2.08	0.20	<.001
Control active * control passive	0.93	0.01	0.01	0.95	0.02	0.24	1.05	0.08	1.00
Idiom passive * control passive	0.82	0.01	<.001	0.83	0.01	<.001	0.50	0.03	<.001

Lexical analysis

Table 2.6 presents the model outputs for the word-level analyses across measures. Idiomaticity and voice were not significant factors in first pass reading time, so they were removed from the models. Verbs in active phrases (*he* ***kicked*** *the bucket/apple*) were read faster as a function of increased trial number, while nouns in active phrases (*he kicked the* ***bucket/apple***) were read faster as a function of increased frequency (of the respective active idiom), regardless of idiomaticity. Verbs in passive phrases (*the bucket/apple was* ***kicked***) were read faster when an active idiom was predictable (again regardless of idiomaticity), whereas nouns in passive phrases (*the* ***bucket/apple*** *was kicked*) were not influenced by any predictors.

Table 2.6 - Model outputs across measures for word analyses split by voice and idiomaticity.

	First Pass Reading Time			Total Reading Time			Fixation Count			Regression Likelihood		
	Active Phrase			*Active Phrase*			*Active Phrase*			*Active Phrase*		
Pred.	*β*	*t*	*SE*	*β*	*t*	*SE*	*β*	*z*	*SE*	*β*	*z*	*SE*
	Verb			Verb			Verb			Verb		
Fixed Effects												
(Inter.)	5.22 ***	263.74	0.02	5.59 ***	161.62	0.03	0.48 ***	11.31	0.04	-0.88 ***	-5.96	0.14
Idiom.				0.15 ***	6.53	0.02	0.16 ***	4.76	0.03	0.71 ***	6.15	0.11
Trial no.	0.00 *	2.45	0.00	-0.00 **	-3.27	0.00	-0.00 **	-3.21	0.00	-0.01 ***	-5.08	0.06
Freq.												
Pred. act.										-0.24 ***	-3.78	0.06
Pred. pas.												
Idiom.* Freq.												
Idiom.*Trial no.												
Idiom.*Pred. act												
Fam.												
Trans.												

Random Effects

σ2	0.09	0.22	0.00	0.18	
τ00, item	0.00	0.01	0.02	0.40	
τ00, ppt	0.02	0.03		-0.65	
ρ01					

	Noun			Noun			Noun			Noun		
Fixed Effects												
(Inter.)	5.26 ***	342.89	0.02	5.46 ***	156.82	0.03	0.36 ***	8.27	0.04	-2.49 ***	-8.99	0.27
Idiom.				0.22 ***	5.52	0.04	0.18 ***	4.84	0.04	0.00	-0.86	0.00
Trial no.				0.00	-1.28	0.00	-0.00 **	-3.27	0.00	1.28 ***	4.33	0.29
Freq.	-0.02 **	-3.04	0.01	-0.06 ***	-3.56	0.02						
Pred. act.										-0.64 ***	-3.66	0.17
Pred. pas.												
Idiom.* Freq.				0.06 **	-1.28	0.02						
Idiom.*Trial no.				-0.00 *	-2.12	0.00				0.00	-0.52	0.00
Idiom.*Pred. act										-0.46 *	2.54	0.18
Fam.										-0.39	-1.75	0.22
Trans.												

Random Effects

σ2	0.10	0.20	0.00	0.53
τ00, item	0.00	0.01	0.01	0.74
τ00, ppt	0.01	0.02		-0.87
ρ01	1.00	1.00		

	Passive Phrase			*Passive Phrase*			*Passive Phrase*			*Passive Phrase*		
	β	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*
		Verb			Verb			Verb			Verb	
Fixed Effects												
(Inter.)	5.26 ***	313.86	0.02	5.48 ***	279.42	0.04	0.34 ***	6.35	0.05	-1.95 ***	-11.20	0.17
Idiom.				0.27 ***	6.66	0.04	0.29 ***	4.16	0.07			
Trial no.				0.00	-0.49	0.00	0.00	-0.54	0.00	-0.01 **	-2.99	0.00
Freq.												
Pred. act.	-0.02 *	-2.29	0.01									
Pred. pas.												
Idiom.* Freq.												
Idiom.*Trial no.				-0.00 ***	-3.49	0.00	-0.00 *	-2.21	0.00			
Idiom.*Pred. act												

Fam.												
Trans.												
Random Effects												
σ2	0.10			0.19			0.00			0.66		
τ00, item	0.00			0.02			0.01			0.26		
τ00, ppt	0.01			0.02						-0.35		
ρ01												
		Noun			Noun			Noun			Noun	
Fixed Effects												
(Inter.)	5.24 ***	238.05	0.02	5.53 ***	149.93	0.04	0.39 ***	7.40	0.05	-1.10 ***	-7.02	0.16
Idiom.				0.25 ***	5.77	0.04	0.26 ***	3.59	0.07	0.80 ***	6.05	0.13
Trial no.	0.00	1.42	0.00	0.00	-0.96	0.00	0.00	-0.68	0.00	-0.01 ***	-5.73	0.00
Freq.												
Pred. act.				-0.06 **	-2.98	0.02				-0.20 **	-2.84	0.07
Pred. pas.												
Idiom.* Freq.												
Idiom.*Trial no.				-0.00 **	-3.14	0.00	-0.00 *	-1.98	0.00			

Idiom.*Pred. act Fam.				0.03	1.60	0.02						
Trans.												
Random Effects												
σ2	0.10			0.21			0.00			0.29		
τ00, item	0.00			0.01			0.01			0.35		
τ00, ppt	0.02			0.02			-1.00			-0.67		
ρ01												

	Active Idiom			*Active Idiom*			*Active Idiom*			*Active Idiom*		
	β	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*
	Verb			Verb			Verb			Verb		
Fixed Effects												
(Inter.)	5.25 ***	2.33	0.02	5.53 ***	193.25	0.03	0.39 ***	13.62	0.03	-1.01 ***	-5.63	0.18
Idiom.												
Trial no.										-0.01 *	-2.34	0.00
Freq.				-0.04 *	-2.09	0.02	-0.05 *	-2.13	0.03	-0.18 *	-2.08	0.09
Pred. act.												
Pred. pas.	0.02 *	2.33	0.01									

Idiom.* Freq.												
Idiom.*Trial no.												
Idiom.*Pred. act												
Fam.												
Trans.												
Random Effects												
σ2	0.09			0.20			0.00			0.17		
τ00, item	0.00			0.01			0.01			0.40		
τ00, ppt	0.02			0.03								
ρ01												
		Noun			Noun			Noun			Noun	
Fixed Effects												
(Inter.)	5.26 ***	314.68	0.02	5.43 ***	241.03	0.02	0.26 ***	9.13	0.03	-2.91 ***	-14.27	0.20
Idiom.												
Trial no.												
Freq.	-0.03 *	-2.51	0.01	-0.06 ***	-4.27	0.01	-0.06 *	-2.03	0.03	-0.25	-1.64	0.15
Pred. act.										-0.52 **	-2.60	0.20

Pred. pas.												
Idiom.* Freq.												
Idiom.*Trial no.												
Idiom.*Pred. act												
Fam.										-0.51 *	-2.29	0.22
Trans.										0.74	1.88	0.39
Random Effects												
σ2	0.09			0.16			0.00			0.49		
τ00, item	0.00			0.00			0.00			0.72		
τ00, ppt	0.01			0.02								
ρ01												

	Passive Idiom			*Passive Idiom*			*Passive Idiom*			*Passive Idiom*		
	β	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*	*β*	*t*	*SE*
		Verb			Verb			Verb			Verb	
Fixed Effects												
(Inter.)	5.25 ***	220.81	0.02	5.48 ***	219.98	0.02	0.34 ***	6.62	0.05	-2.33 ***	-15.42	0.15
Idiom.												
Trial no.	0.00	0.61	0.00									

Freq.										-0.28 *	-2.15	0.13
Pred. act.												
Pred. pas.				-0.04 *	-2.51	0.02						
Idiom.* Freq.												
Idiom.*Trial no.												
Idiom.*Pred. act												
Fam.												
Trans.												
Random Effects												
σ2	0.09			0.17			0.00			0.56		
τ00, item	0.00			0.01			0.00			0.27		
τ00, ppt	0.01			0.02								
ρ01												
	Noun			Noun			Noun			Noun		
Fixed Effects												
(Inter.)	5.26 ***	270.23	0.02	5.51 ***	210.85	0.03	0.40 ***	7.62	0.05	-1.58 ***	-13.15	0.12
Idiom.												
Trial no.												

Freq.				-0.01	-0.75	0.02		-0.20 *	-2.06	0.10
Pred. act.	-0.03 **	-2.68	0.01	-0.05 *	-2.55	0.02				
Pred. pas.										
Idiom.* Freq.										
Idiom.*Trial no.										
Idiom.*Pred. act										
Fam.										
Trans.										
Random Effects										
σ2	0.10			0.20			0.00	0.24		
τ00, item	0.00			0.01			0.00	0.25		
τ00, ppt	0.02			0.02						
ρ01										
Notes										**p<.05**p<.01***p<.001*

The separate analysis on idiomatic words only, showed that the verbs in active idioms (*he **kicked** the bucket*) were read faster when the predictability of their passive forms increased. Though seemingly counterintuitive, it must be remembered that the predictability of the passive idioms was based on the predictability of the verb (*kicked*), as this was the final word elicited by the cloze task (*the bucket was* ____). Thus, the more predictable the idiomatic verb (in the passive form), the faster it was read in the active form. The nouns in active idioms (*bucket*) were affected by frequency; the more frequent the idiom was, the faster its noun was read, while the nouns in passive idioms were affected by the predictability of active idioms. Again, this is not surprising since the predictability of the active idioms was measured by the predictability of their noun (*bucket*), and therefore, the more predictable the idiomatic noun, the faster that noun was read when encountered in the passivized form.

The output for total reading time demonstrates that idiomaticity was highly significant; nouns and verbs in both active and passive conditions, were read significantly faster when they were parts of idiomatic phrases as opposed to control phrases. There was a significant speed up from increased trial number for active phrase verbs, but there was only an interaction between idiomaticity and trial number for the remaining conditions indicating that this effect only affected the verbs and nouns in control phrases, as opposed to in idioms. Frequency was significant, and it interacted with idiomaticity: idiomatic nouns in active idioms (*bucket*) were read significantly faster than the control nouns in active phrases (*apple*) as a function of the frequency of the respective (active) idioms. Nouns in passive phrases, on the other hand, benefitted from increased predictability: the more predictable the noun of an

active idiom, the faster its respective noun was read in the passive phrases, regardless of idiomaticity. There was no interaction between predictability and idiomaticity.

When examining the total reading time for idiomatic verbs and nouns only, a facilitative effect of frequency was found, which extended to both verbs and nouns of active idioms. There was also a facilitative effect of predictability on the nouns and verbs of passive idioms; passive idiomatic verbs were faster when there was increased predictability of the passive idiom (the final verb), and nouns were faster when there was increased predictability of the active idiom (the final noun).

Analysis on fixation count indicated a strong effect of idiomaticity for verbs and nouns in active and passive phrases; verbs and nouns elicited fewer fixations when they were part of idioms versus control phrases. Verbs and nouns in active phrases elicited fewer fixations as trial number increased, regardless of idiomaticity. However, only the verbs and nouns in passive control phrases exhibited this pattern; verbs and nouns in passive idioms were not affected by trial number. The idioms-only analysis demonstrated an effect of phrase frequency for both verbs and nouns in active idioms: the verbs and nouns of more frequent idioms yielded fewer fixations. No effects were noted for verbs or nouns in passive idioms for fixation count.

Finally, the regression analysis indicated an effect of idiomaticity for verbs and nouns of active phrases, whereby verbs and nouns found in idioms were significantly less likely to yield a regression, than the equivalents in controls. This also held for the nouns of passive phrases, but not for the verbs of passive phrases. There was an overall effect of trial number with verbs and

nouns in active and passive phrases eliciting fewer regression as the trial number increased. The nouns and verbs in active and passive phrases were also facilitated by the predictability of the idiomatic nouns (in the active voice). There was also an interaction between idiomaticity and predictability for the nouns of active phrases, with nouns of active idioms being significantly more likely to yield a regression than nouns of active controls. There was no interaction between idiomaticity and predictability for the verbs of active phrases, suggesting that idiomatic and control verbs (*kicked*) did not differ in this respect.

When only idioms were considered, there was an effect of phrasal frequency for verbs in active idioms, as well as for verbs and nouns in passive idioms. The more frequent the (active) idiom was, the less likely it was for a regression to occur to the respective words. Nouns of active idioms, on the other hand, were influenced by familiarity and predictability. The more familiar and predictable the (active) idiom was, the less likely it was for a regression to occur on the noun of the active idiom.

Discussion

The present study examined two main questions. First, it was explored whether passivized idioms, inserted in idiomatically-biasing contexts, activate their idiomatic meaning during on-line reading comprehension, or whether they are reduced to compositional strings that as such are not idiomatic and therefore do *not* make sense in the context. Second, the study also aimed to test whether familiarity, frequency, transparency, and predictability influence the processing of passivized idioms. To this end, eye movement patterns to active

(canonical) and passivized idioms were compared against those of active and passive control phrases.

I start by considering the first question. We see that the total reading time for the whole phrase demonstrated an effect of both voice and idiomaticity. Active phrases were read significantly faster than passive ones and idiomatic phrases were read significantly faster than control ones. Active and idiomatic phrases also elicited significantly fewer fixations than passive and control phrases respectively, but only idiomatic phrases were significantly less likely to yield a regression. Unsurprisingly, active idioms (*he kicked the bucket*) were the fastest and elicited the fewest fixations. Crucially, passivized idioms (*the bucket was kicked*) were read faster and elicited fewer fixations than both active and passive control phrases (*he kicked the apple*/ *the apple was kicked*). Passive control phrases were also slower to read than active control phrases, but they did not differ in the number of fixations. Active and passive idioms alike were significantly less likely to elicit a regression compared to active and passive control phrases.

At the word-level (*kick* and *bucket/apple*), idiomaticity did not modulate the first pass reading time of either the verbs or nouns, but it significantly influenced total reading time, fixation count, and regressions in most conditions. More specifically, verbs and nouns in idiomatic phrases were read faster and elicited fewer regressions than verbs and nouns in control phrases, regardless of voice. Idiomatic verbs in passive voice and idiomatic nouns in both voices were also less likely to yield a regression compared to control verbs and nouns respectively.

The overall findings from both phrase- and word-level analyses, show

that passivized idioms and their component words had an advantage over active and passive controls and their respective components. This suggests that passivized idioms did retain their figurative meaning: the fact that they were faster to process (as evidenced by fewer and shorter fixations) indicates an easier integration in the context, that also required less reanalysis (as evidenced by the reduced likelihood of regression) in comparison to controls. Therefore, it appears that the faster processing observed for passivized idioms (and their component words) can *only* be attributed to the idiomatic meaning being activated which rendered the phrases contextually congruous. If passivized idioms were understood (only) literally, then their literal meaning would have been just as incongruous as the meaning of both control phrases and hence no difference should have been noted in their processing.

In general though, the findings demonstrate a processing cost associated with the passive construction, which affected idiomatic and control phrases alike. Literature on the processing of the passive voice often ascribes a delaying effect to the violation of the agent-first bias, as the passive subject is the experiencer or patient and not the agent (Kamide, Scheepers, & Altmann, 2003; Knoeferle, 2007; Knoeferle, Crocker, Scheepers, & Pickering, 2005; Mack, Meltzer-Asscher, Barbieri, & Thompson, 2013; Meyer, Mack, & Thompson, 2012). In the current study, the longer processing time could have also been due to the passive construction being more infrequent than the active in English (Hopper & Thompson, 1980; Williams & Colomb, 1990), as well as to the relative novelty of the passivized idioms and contextual incongruency of the passive controls respectively.

The advantage observed for active idioms (*kick the bucket*) versus

control phrases, (*kick the apple*) aligns with previous findings showing that idioms are processed faster than equivalent, nonidiomatic phrases (Carrol & Conklin, 2014b, 2017; Gibbs, 1980; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Swinney & Cutler, 1979; Underwood et al., 2004; Wolter & Yamashita, 2015), although of course in the present study the active idioms were always congruous in the context, while the active control phrases were not. Nevertheless, research shows that idioms are processed faster than literal phrases, even when both phrase types are plausible in their respective contexts (Conklin & Schmitt, 2008).

The most important finding was that passivized idioms were not contextually inappropriate. It should be stressed that while it is argued that idioms can be passivized *without* losing their figurative meaning, the possibility that their literal interpretation is also activated, at least at some point during comprehension, cannot be rejected. After all, passivized idioms were slower to process than active ones and although this could have been caused by the unfamiliarity of the passivized forms, or the lower frequency of the passive voice in general, it could also reflect an obligatory activation, processing, and subsequent suppression of the literal meaning. This is particularly likely for idioms that have a literal and figurative interpretation (*kick the bucket*), compared to those that can only be interpreted figuratively (*stay the course*). The current study was not designed to test this question and is explored in the study of Chapter 3.

I will now consider the second question regarding the involvement of familiarity, frequency, transparency, and predictability on the processing of idioms. These factors were included in models where both idioms and controls

were analysed, as well as in models where active idioms and passive idioms were analysed separately. In the former case, all of the conditions were assigned the frequency, familiarity, transparency, and predictability values of their respective (active) idioms. This was done to assess whether any of the factors associated with the active and, thus the canonical form of the idioms, influenced the processing of the other conditions. However, because these values are in fact only related to the idioms separate analyses on the idioms (active and passive forms) were carried out.

Idiom frequency was a significant predictor in total reading time and fixation count across all phrases in all analyses. The more frequent an (active) idiom, the faster reading time and fewer fixations were noted for both its active and passive form. Interestingly, the reverse effect was true for controls. That is, the more frequent an (active) idiom was, the reading time slowed down and fixations increased for both active and passive forms of the control phrase. This pattern was also observed in the reading time of active idiomatic nouns (*bucket*) versus active control nouns (*apple*). Furthermore, increased phrase frequency led to faster total reading times and to fewer fixations to both nouns and verbs of active idioms, to fewer regressions to verbs of active idioms, as well as to fewer regressions to nouns and verbs of passive idioms. Passivized forms of frequent idioms were also less likely to elicit a regression.

Frequency is a "fundamental shaper of a lexical system always dynamically responsive to experience" (Monsell, 1991, p. 150). This should be true for individual words and sequences of words like idioms, which is in agreement with usage- and exemplar-based models of language processing (Abbot-Smith & Tomasello, 2006; Bybee, 1985, 1995, 1998, 2006; Goldberg,

1995, 2006; Tomasello, 2003). Thus, the findings lend support to the view, that the frequency with which idioms are encountered influences their processing—both that of their active and passive forms. Interestingly, increased frequency slows the processing of controls. It might be that in a biasing context, higher idiom frequency increases the activation of the idiom itself, making the control more challenging for the processing system when it appears. That is, a stronger expectation is built, resulting in greater processing effort when the expectation is not met.

Crucially, the frequency of an idiom is almost exclusively from its active form, but it was found that the passive form of these idioms demonstrates a significant processing advantage due to the active form's frequency. A few possibilities arise from this finding. First, it appears that the frequency of an idiom is not strictly associated with its canonical form and, therefore, encountering its components (in any order) is enough to activate the idiom and its figurative meaning. Second, it is possible that because of the biasing context there was already some activation of the idiom, thus when the component words were encountered (regardless of their order) the idiom and its meaning were quickly activated. Thus, an important question for future research is the role of context in the activation of a figurative meaning for passivized idioms. Third, because an idiom's components (*bucket* and *kick*) are frequently encountered in close proximity, it might be these co-occurrence probabilities that speed up processing. Again, additional research would be needed to explore this possibility.

Transparency did not influence any measures in any condition, although there was a marginal effect on the likelihood of regression in the phrase

analysis, with less transparent phrases being more likely to elicit a regression. This appears to contradict the claim that opaque/nondecomposable idioms (*kick the bucket*) are syntactically frozen and nonpassivizable (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978; Wulff, 2008). If they were frozen, we should see an effect of transparency, such that opaque idioms should have an increased processing cost, either in terms of more fixations and regressions or longer fixation times. Two explanations may account for the current pattern of results. First, idioms were rated as highly transparent and there was not a lot of variability amongst the items. Second, the term transparency has been used to describe a number of phenomena in the literature: metaphoric transparency, semantic decompositionality, and conventionality. The use of transparency here is most closely aligned with semantic decompositionality, as the ratings asked participants to evaluate how easy they thought it would be to guess the meaning of a phrase if they had never encountered it before (*kick the bucket* means to die). It may be that explicitly manipulating metaphoric transparency or conventionality would yield different results. However, findings from a relevant study suggest otherwise. In their study, Van de Voort and Vonk (1995) included metaphoric motivation (of transparency) and component mapping (of semantic decomposition) as separate predictors, but they found no effect of either in a lexical decision task. Moreover, it has been recently found that judgments of transparency and decomposability are largely influenced by the degree of familiarity with an idiom (Carrol, Littlemore, & Dowens, 2018), thus making it harder to dissociate these factors and their potential effects on idiom processing.

Both familiarity and predictability demonstrated some interesting effects. The more familiar and predictable the active form of an idiom, the less likely it was for there to be regressions in any condition: active and passive idioms, as well as the active and passive control phrases. Similar to the discussion of frequency, because of the biasing context, some activation of the idiom was likely even when the phrase turned out to be nonidiomatic. Encountering any of the component words, for example the word *kicked* in the control condition, could have activated the idiom further. The more familiar or predictable the idiom, the greater its activation, which will lead to fewer and shorter fixations.

On word-level and in the idioms-only models, a facilitative effect of predictability was noted for regressions to nouns of active idioms. When all phrases were considered, the predictability of the passive verbs seemed to speed up their total reading time, but the predictability of the idiomatic noun (of active idioms) minimised regressions to nouns of active and passive phrases *regardless* of idiomaticity (*bucket/apple*). As before, there was no interaction between predictability and idiomaticity. While I cannot definitively explain this, it is possible that less reanalysis was needed for the appropriate meaning of predictable idiomatic nouns (*bucket*) to be integrated and, equally, less reanalysis was needed for the inappropriate meaning of the respective control nouns (*apple*) to be discarded—potentially because the idiomatic meaning was activated.

In addition, the processing of the two control conditions may have varied. That is, active controls may have led to activation of the idiom upon encountering the verb (*kick*)—especially since the prior context favoured the

idiom. Activation of the idiom then had to be supressed upon encountering the anomalous word (*apple*). In contrast, passive controls induced longer processing times, not because they led to activation of the idiom, but because reinterpretation was necessary in order to make sense of the phrase. While this explanation is plausible, the fact that the noun of the passive controls (*the* ***bucket*** *was kicked*) benefited from predictability suggests *some* activation of the figurative meaning even in the passive control condition. Therefore the need to suppress the idiomatic meaning even in this case seems likely. However, participants were not explicitly asked how they initially or eventually interpreted the control phrases in the given context, or whether they simply rejected them as meaningless.

All of the findings seem to point to the fact that the figurative meaning of idioms is retrieved even in the passive voice, as the manipulation did not render idioms contextually implausible. Notably, the analysis of transparency seems to demonstrate that passivization is possible even for opaque idioms. Thus, the present findings contradict theories assuming variability in the syntactic behaviour of idioms based on factors like transparency (Abeillé, 1995; Fraser, 1970; Newmeyer, 1972; Nunberg et al., 1994), as well as the tenets of lexical approaches, which claim that any kind of syntactic manipulation will result to loss of idiomaticity.

In fact, a processing advantage seemed to extend not only to active and passivized idiom phrases, but also to their individual components. This underscores both the compositional and unitary nature of idiomatic expressions and it suggests that idioms as a whole and their components separately carry figurative load (or meaning). This fits in well with hybrid models of idiom

representation. The Configuration Hypothesis (Cacciari & Tabossi, 1988), for instance, predicts a literal-compositional analysis, until enough input has been gathered so as to render the phrase a recognisable, idiomatic configuration, but certain idiomatic words (the 'keys') are more important to this than others. The position of the key is crucial, as it determines the predictability of an idiom and hence the speed of its recognition. The cloze tasks showed that the final word of the idioms was not particularly predicable in isolation (actives = 0.95% completion; passives = 0.64%), or in context (actives = 38% completion; passives = 28%), indicating that the idioms were largely unpredictable ('late-key') and hence the final words were necessary for the idiomatic configuration to be 'unlocked' and the figurative meaning to be accessed. This could explain why no facilitation was noted for final idiomatic nouns of active idioms in first pass reading (*kicked the* ***bucket***), in contrast to similar previous studies where an effect of idiomaticity was found in such early measures (e.g., Carrol & Conklin, 2017).

Notably, the differences found between idioms and controls emerge in late-measures and therefore may not reflect differences in idiomatic *access* per se, but rather differences in the effort required for *reanalysis*, in which case the data would not be well suited to test current models of idiom access (i.e., Configuration Hypothesis and Superlemma Theory). Passivized idioms may require a certain level of reanalysis due to their (unfamiliar) syntactic frame and both control phrases would need reanalysis in the search for an appropriate interpretation in the context. However, the fact that we do not see a facilitation for final idiomatic words in active idioms (*kick the* ***bucket***), suggests that there was no priming for the second element of the phrase (*bucket*) despite the

availability of the first one (*kick*) and the biasing context. This suggests that the figurative meaning of active idioms was not immediately *accessed*, but retrieved via *reanalyses*.

In light of this, I considered the possibility of the figurative meaning (of active idioms) being accessed at a slight delay, due to the low predictability of the items. As per the Configuration Hypothesis (Cacciari & Tabossi, 1988), access to unpredictable idioms' figurative meaning occurs some time after the phrase offset (around 300ms) and following the initial processing of the final idiomatic word. Therefore I decided to run a *post-hoc* analysis looking for potential spillover effects; the processing of a word (*n*) during first pass reading may sometimes carry over to the next one (*n*+1) (Conklin et al., 2018). Two separate models were built using the same predictors as in the main analyses and spillover was set as the dependent variable (i.e., the duration of the first fixation made on *n*+1 after the eye has left word *n* in first pass). This was done to check for spillover effects, as a function of idiomaticity, from the final words in active phrases (*apple/bucket*) and final words of passive phrases (*kicked*) onto *n*+1 (the word *and* in this case). Interestingly, the final idiomatic words in active phrases (*kicked the* ***bucket***) led to a significantly shorter fixation of *n*+1, in comparison to final words in control phrases (*kicked the* ***apple***) ($\beta = 0.08$, $t = 2.21$, SE = 0.03; $p = 0.02$), but no difference in spillover effects was noted for the final words of passivized idioms versus controls (*the apple/bucket was* ***kicked***) ($\beta = 0.01$, $t = -1.24$, SE = 0.03; $p = 0.71$). Therefore, although an effect of idiomaticity was not visible during first pass reading time, spillover effects suggest that the figurative meaning of active idioms was accessed *shortly* after the final word had been encountered—and therefore it

was not just constructed through effortful reanalyses. The fact that a similar effect was not found for passivized idioms further suggests that some reanalysis took place in this case, as the figurative meaning was not accessed at the same time or in the same way. This finding lends further support to the Configuration Hypothesis (Cacciari & Tabossi, 1988), as it provides evidence in favour of the final words of unpredictable idioms acting as the 'key(s)' of the configurations and suggests that the literal meaning of the phrases was initially accessed (during first pass reading time, before the idiom was recognised), while the figurative meaning became available a few milliseconds after that (i.e., after the eye had moved from the final idiomatic element and landed on the following word *n*+1). More carefully controlled research designed specifically to address this question about the timing of retrieval of the idiomatic meaning relative to the idiomatic key is needed.

Importantly, the current models are underspecified with regards to how idiom modification influences processing. More specifically, models need to explain: the impact of slowed idiom access due to modification; the presumably slower processing due to the competing literal meaning; and resolution of the competition between the two meanings. The Configuration Hypothesis assumes that the order of an idiom's components does not matter as long as the phrase remains a recognisable configuration. However, it does not make any predictions about whether a processing cost is implicated by modifying the canonical form of the configuration. Similarly, the Superlemma Theory does not specify how syntactic modification affects spreading activation in idiom comprehension. Thus, in both models the idiomatic meaning should (eventually) be retrieved, but the time course of the retrieval as

well as the processing effort associated with the (delayed) competition needs to be considered.

These findings demonstrate that the idiomatic meaning of passivized idioms is retrieved, but leaves open important questions for future research and indicate where models need further elaboration. Do the lexical items (*bucket* and *kick*) trigger idiomatic activation regardless of their order, although when the noun precedes the verb (i.e., in the passive) activation is slowed? While the present data do not definitively answer this, they indicate that the former is important; the occurrence of the lexical items of an idiom in close proximity contributes to idiom activation. This would explain why passivized idioms benefitted from the frequency, familiarity, and predictability (to a lesser extent) of the active forms.

The current findings also appear to be in line with the multidetermined model of idiom processing (Libben & Titone, 2008; Titone & Connine, 1999; Titone & Libben, 2014). According to this, several sources of information are utilised in different time frames when processing an idiomatic expression. For example, a cross-modal priming task reported in Titone and Libben (2014), demonstrated that literal implausibility facilitated idiomatic processing before the phrase offset, higher familiarity (defined as the subjective frequency of encounter rather than how familiar the meaning of an idiom was) facilitated idiomatic processing at the phrase offset, while decomposability facilitated the processing of idioms following the phrase offset. In the present study, a similar strong effect of frequency was observed in reading time and fixation count, which reflect initial lexical retrieval and subsequent meaning integration in the context (Conklin et al., 2018), while predictability affected regressions

suggesting that once integrated, the idiomatic meaning needed less reanalysis. However, a strong effect of decomposability was not found in any measure.

In sum, this study has provided evidence that idioms are in fact rather flexible, even when their meaning is not transparent, and permit complex reconfiguration such as the passive voice. More precisely, idioms can be passivized without losing their figurative meaning and despite varying in their familiarity, frequency, predictability, and transparency – although some of these factors appear to contribute to how quickly the figurative meaning becomes available. The present findings provide on-line processing evidence that supports those of corpus- and internet-search studies demonstrating the existence of a wide variety of idiomatic variants (e.g., Barlow & Kemmer, 2000; Duffley, 2013; Moon, 1998).

CHAPTER 3

Meaning activation and ambiguity resolution in modified idioms: evidence from eye-tracking

Idiomatic phrases (e.g., *spill the beans* meaning 'reveal a secret') pose particular challenges to the processing system. First, as discussed in previous Chapters, it is difficult to infer the figurative meaning of idioms from their component words (*spill*, *the*, and *beans*). Adding to this complexity is the fact that some idioms are also ambiguous—they have a plausible literal interpretation in addition to their figurative one. For example, *spill the beans* can refer to a situation where beans are literally spilled out of a container. In contrast, it is not possible to literally *shoot the breeze* or *play (something) by ear*. Ambiguous idioms, much like ambiguous words, would be subject to ambiguity resolution processes.

Most of what we know about meaning activation in idioms is based on findings from idioms presented in their canonical form. Little is known about which meaning of an (ambiguous) idiom is likely to become activated first, if the idiom is encountered in a modified version. This is probably due to a prevalent—yet largely unsubstantiated—belief that (at least some) idioms are fixed and cannot accept extensive reconfiguration without losing their figurative meaning (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978; Wulff, 2008). Studies looking at actual idiom use, for example in corpora, have demonstrated that this is not the case (e.g., Duffley, 2013; Hovhannisyan & Mkrtchyan, 2014; Moon, 1998; Schmitt, 2005). In a Google search, Duffley (2013) found instances of considerable

idiomatic modification, including examples like *most of their buckets have been kicked,* where the idiom was both pluralised and passivized. Further, the eye-tracking study described in Chapter 2 provided evidence that the figurative meaning of putatively fixed idioms is activated in a facilitative context during on-line comprehension, even in the passive form. Passivized idioms had fewer and shorter fixations than matched controls (*the bucket/apple was kicked*), but a processing cost was observed for passivized idioms compared to their active forms (*he kicked the bucket*), as passivized idioms elicited significantly more and longer fixations. In addition, active idioms induced a smaller spillover effect (*he kicked the bucket and ...*) than their control phrases (*he kicked the apple and ...*), but no difference was found between passivized idioms (*the bucket was kicked and...*) and their respective controls (*the apple was kicked and...*), suggesting that active (canonical) idioms have earlier access to their figurative meaning than passivized idioms.

As the figurative meaning was always biased in the context, the fast processing of the canonical idioms would suggest that either both the figurative and literal meanings were activated to the same degree, or that the figurative meaning was dominant and as such received little competition from the subordinate literal interpretation. The slower processing of the passivized idioms, on the other hand, might suggest that activation of the figurative meaning was difficult due to the need to supress the more dominant literal interpretation, which would imply that modifying an idiom causes a shift in its meaning dominance. Importantly, however, the literal meaning of (both active and passivized) idioms in the study of Chapter 2 was not congruous in any condition. Therefore, this study could not address whether the longer reading

times and more frequent refixations in passivized idioms indeed reflected the need to suppress the (dominant) literal meaning in favour of the contextually-appropriate (figurative) one. This raises interesting questions about meaning activation, dominance, and ambiguity resolution in modified 'fixed' phrases, as well as the extent to which the figurative meaning of modified idioms becomes activated when it is *not* strongly biased by a preceding context. The current eye-tracking study explores these questions.

Meaning activation in ambiguous words

Ambiguous idioms share some common properties with ambiguous words, in the sense that they too have more than one plausible meaning. As such, they involve disambiguation processes in order for the appropriate meaning to be selected and activated in a given context. Extensive literature, which goes beyond the scope of the present thesis, has addressed the issue of meaning activation and representation of ambiguous words (for a recent review see Eddington & Tokowicz, 2015). For the current purposes, it suffices to review some of the main findings.

Ambiguous words are typically subcategorised into homonyms and polysemes based on the relatedness of their meanings. Homonyms have distinct meanings that only share the same word-form 'by accident' (Weinreich, 1964): for example *bank* referring to the 'financial institution' or the 'side of a river'. The different meanings of homonyms can vary in how frequent they are: if all meanings are equally frequent, homonyms are considered to be balanced, but if one meaning is more dominant (e.g., 'financial institution' meaning of *bank*), they are considered to be unbalanced

(or biased). A polyseme, such as *church*, has multiple related meanings, in this case the 'building' and the 'religious organization'. The meanings of polysemes, conventionally referred to as senses, are not entirely discrete but instead one sense is more appropriate than another in a given context (Weinreich, 1964).

Earlier research focusing on the time course of meaning activation and selection in ambiguous words has demonstrated that the presence of a biasing context (as well as the relative strength of the context) interacts with meaning frequency and influences initial lexical access (e.g., Duffy, Kambe, & Rayner, 2001; David S Gorfein, 1989; Hogaboam & Perfetti, 1975; Martin, Vu, Kellas, & Metcalf, 1999; Onifer & Swinney, 1981; Simpson, 1981, 1984; Vu, Kellas, & Paul, 1998). Balanced homonyms have been found to slow reading in a neutral context, probably reflecting the additional processing effort required to immediately select the appropriate meaning, as the distinct meanings could lead to completely different interpretations. Unbalanced homonyms have been found to favour their dominant (most frequent) meaning (Duffy, Morris, & Rayner, 1988) while activation of their subordinate (less frequent) meaning comes at a processing cost (subordinate bias effect), even if preceding context biases its activation (Rayner, Pacht, & Duffy, 1994). Thus, the dominant meaning of a biased homonym is more readily committed to, and is difficult, if not impossible, to fully suppress. Although polysemes could also have a dominant (frequent) sense, leading to comparable effects in activation, the effect of frequency has not been equally well examined for polysemous words (Eddington & Tokowicz, 2015). Generally though, polysemes are believed to activate a core or underspecified meaning, which is shared by all the senses of

the word. Selection of the most appropriate sense can be stalled until further disambiguating information becomes available (Frazier & Rayner, 1990; Pickering & Frisson, 2001); (for counterevidence see Foraker & Murphy (2012) and Klein and Murphy (2002)).

The majority of the evidence to date suggests that homonyms and polysemes are processed differently when compared to both unambiguous words and to each other (e.g., Armstrong & Plaut, 2011, 2008; Brown, 2008; Klepousniotou, 2002). For example, in a series of lexical decision experiments, Klepousniotou and Baum (2007) found an 'ambiguity advantage' for polysemes, such that polysemes produced faster reaction times than frequency-matched unambiguous words. No processing advantage was noted for balanced or unbalanced homonyms and the advantage for polysemes was attributed to a 'sense-relatedness effect', as the various senses are somehow connected, causing no competition during activation. Homonyms, on the other hand, exhibit "slower reaction times in both sentential and isolation possibly because their multiple unrelated meanings are competing, thus slowing down the activation process" (Klepousniotou, Pike, Steinhauer, & Gracco, 2012, p. 13). These findings further imply that homonyms and polysemes might be represented differently in the lexicon, with the multiple meanings of homonyms occupying different entries, while the multiple senses of polysemes are stored together under a single entry.

Meaning activation in canonical idioms.

Ambiguous idioms are different from homonyms and polysemes, as the ambiguity extends across multiple words. However, the relationship between

idioms' meanings varies across idioms, as it does across types of lexical ambiguity. For example, the literal and figurative meanings of idioms such as *kick the bucket* ('boot the pail' and 'die' respectively) are distinct like the two unrelated meanings of a homonym. In addition, one idiom interpretation could become more dominant, although as we shall see, meaning dominance in idioms depends on factors beyond the mere frequencies of the respective meanings. This includes familiarity with the figurative meaning, predictability, literal plausibility, and transparency among others. On the other hand, an idiom like *spill the beans* could be thought to be more like a polyseme, whose senses are somehow connected. Here the relation is metaphoric: *beans* could be a representation of *secrets* and the act of spilling them could allude to the secrets' revelation[3].

A robust literature reports a fast processing for idioms (*spill the beans* = 'reveal a secret') compared to novel phrases (*spill the chips*), suggesting a faster activation of the figurative meaning relative to the literal meaning of novel phrases (e.g., Carrol & Conklin, 2014b, 2017, 2019; Carrol, Conklin, & Gyllstad, 2016; Conklin & Carrol, 2019; Conklin & Schmitt, 2008, 2012; Siyanova-Chanturia & Martinez, 2015; Vespignani et al., 2010), hence denoting an 'idiom advantage' similar to the 'ambiguity advantage' found for polysemes over unambiguous words. Such findings have been occasionally used as evidence of ambiguity resolution and meaning dominance in idioms

[3] Interestingly, certain polysemes are classified as metaphoric if one of its senses is figuratively related to the literal sense(s) of the word, like *eye* referring to the 'hole in a needle' as opposed to 'the organ of the body' (Apresjan, 1974). Metaphoric polysemes are thought to be closer to homonymy than to typical polyseme (Klepousniotou et al., 2012), especially when the sense relatedness between literal and figurative senses is not straightforward, as it was in the example given. This resembles meaning relatedness in opaque and/or non-decomposable idioms, where the connection between the literal and figurative meaning is less obvious.

(although ‘dominance’ here is not related to frequency). For example, Swinney and Cutler (1979) argued that if ambiguous idioms (*kick the bucket*) yield faster reaction times than matched literal phrases (*lift the bucket*), this is because the figurative meaning is dominant and accessed first, despite both meanings competing in parallel: if the literal meaning was accessed first, or at the same time, then the processing time of idioms should not differ from that of literal-control phrases. Based on this, the authors also argued that the figurative meaning of an idiom bypasses compositional analyses and is stored as a separate entry in the mental lexicon (Lexical Representation Hypothesis), much like the distinct meanings of homonyms are believed to be.

However, this type of evidence is circumstantial as the activation of the literal meaning is not *directly* contrasted with the figurative (*spill the beans* = ‘reveal a secret’ vs. ‘spill legumes out of a container’) and, therefore, literal consideration cannot be excluded. In fact, in a subsequent experiment Swinney (1981) found that target words related to the figurative meaning of ambiguous idioms (*die* for *kick the bucket*) were not primed after an encounter with the first component word of the idiom (*kick*), suggesting that the figurative meaning was not considered in parallel from the phrase onset as previously assumed. Further, following the phrase offset (i.e., after *bucket*), *only* the figurative targets were primed, suggesting that the literal meaning ‘takes a back seat’ once an idiom has been encountered in full.

Similar observations have been made for unambiguous idioms that do not have a plausible literal interpretation (*be in seventh heaven*), indicating that the literal meaning of idioms is obligatorily active to some degree. Cacciari and Tabossi (1988) found that target words related to the literal meaning of

unambiguous idioms (*saint*) were primed before the phrases were recognised as configurations, while figurative targets (*happy*) were primed after their recognition point (referred to as the idiom 'key' in the Configuration Hypothesis). Predictable ('early-key') idioms are recognised sooner and consequently activate their figurative meaning faster (at the expense of their literal one), while unpredictable idioms ('late-key') only activate their figurative meaning a few seconds (around 300ms) following the phrase offset (Cacciari & Corradini, 2015; Cacciari, Padovani, & Corradini, 2007; Molinaro, Vespignani, Canal, Fonda, & Cacciari, 2008; Tabossi, Fanari, et al., 2009; Titone & Connine, 1994; Vespignani et al., 2010). These findings suggest that the literal meaning of an idiom (in isolation) is the dominant one until the phrase reaches its recognition point. Following recognition, the figurative meaning can be retrieved directly, potentially shifting the meaning dominance towards the figurative interpretation of the phrase. Similar priming effects have been noted in idiom production, lending support to spreading activation models such as the Superlemma Theory (Sprenger et al., 2006), according to which, activation (in idiom comprehension) would spread from the idiomatic elements (simple lemmas), to the idiom (superlemma), and finally to the relevant concept (figurative meaning).[4]

In addition to predictability (where the idiom's key occurs), other factors might make the figurative meaning more salient in idioms (Giora, 1997, 2003; Siyanova-Chanturia, 2015; Siyanova-Chanturia & Martinez, 2015). These include the frequency of the overall phrase, familiarity with the

[4] The Superlemma Theory (Sprenger et al., 2006) was formulated as an idiom production theory (bottom-up) with the possibility of it also explaining idiom comprehension as outlined above (top-down).

figurative meaning, transparency (how guessable or relatable the figurative meaning is with the phrase elements in isolation), and literal plausibility. The figurative meaning of highly frequent and familiar idioms might be faster to activate and likewise both opaque and literally-implausible idioms might activate their figurative meaning faster, as the lack of transparency and of a plausible literal interpretation respectively, prioritise the figurative meaning. The Multidetermined Model of idiom processing (Libben & Titone, 2008; Titone & Connine, 1999; Titone & Libben, 2014), proposes that such factors affect idiom processing at different time frames, as multiple sources of information become available asynchronously. For instance, in a cross-modal priming task, Titone and Libben (2014) observed that target words related to the figurative meaning of literally-implausible idioms (*prepared* for *be armed to the teeth*) were primed before the phrase offset. After the phrase offset, target words benefited from increased idiom familiarity, while 1000ms following the phrase offset an effect of decomposability was found, with target words of non-decomposable idioms receiving a higher degree of priming. Unfortunately, however, this study did not use literal targets for comparison and therefore we cannot draw conclusions about which meaning was more highly activated during each stage of processing.

The role of context in meaning disambiguation

Context can interact with meaning frequency in ambiguous words. For example, when an ambiguous word is preceded by neutral context, the most frequent meaning is faster to retrieve (or all meanings are equally fast if ambiguous words are balanced). If, however, ambiguous words are preceded

by disambiguating context, this might aid the selection of the contextually appropriate meaning, although as was mentioned before, a biasing context cannot always suppress the dominant interpretation of an unbalanced homonym (Duffy et al., 1988). Similarly, context can be crucial in determining meaning activation in idioms.

While the findings described above suggest an almost compulsory activation of the literal and figurative meaning in isolation (at least after the idiom has been recognised) conflicting evidence from a self-paced reading task proposed that a biasing context is necessary for the activation of the figurative meaning during on-line comprehension. Using garden-path sentences where the ending contradicted the figurative meaning of the idiom (e.g., […] *he kicked/kick the bucket* <u>*that was on the kitchen floor*</u>), Colombo (2014) observed that the reading of the post-idiom region only increased when the idiom was preceded by a figuratively-biasing context rather than a neutral context (e.g., *The rich old man was very ill, and his inheritor was hoping that* vs. *It looked like the man was going to* […]). This led to the conclusion that the idiomatic meaning had only been activated when the context biased its activation. However, Colombo's results do not necessarily exclude idiomatic activation in the neutral context as well, since both meanings could have been equally activated, thus facilitating whichever interpretation the completion supported. Indeed, this seems very likely as the majority of the items used in this experiment were specifically selected to have an *equally* frequent figurative and literal meaning (i.e., they were 'balanced').

In another self-paced reading task, Cacciari and Corradini (2015) examined the reading time of ambiguous idioms and post-idiom

disambiguating regions in story contexts which favoured either a literal or an idiomatic conclusion. Idioms were divided on the basis of their predictability (early-or late-key), but all had a dominant figurative interpretation. In the idiom region, they found that predictable idioms were read faster than unpredictable ones, while in the post-idiom disambiguating region there was an interaction between sense (literal vs. figurative) and idiom predictability. Idiomatic continuations were read faster than literal ones when preceded by predictable idioms, but literal continuations were read faster than idiomatic ones when preceded by unpredictable idioms. Although idiomatic continuations were read slightly faster when preceded by predictable versus unpredictable idioms, the difference was not statistically significant, suggesting idiomatic access in both cases. As the authors admit, the design of this experiment "did not have a baseline condition that would have allowed [them] to decide if idiom activation speeded up the reading of idiom-resolving continuations or conversely literal activation slowed down the reading of idiom-resolving continuations" (Cacciari & Corradini, 2015, p. 804). In other words, there was no control condition in the manipulation that would have allowed for this comparison. However, the fact that literal continuations of predictable idioms induced a cost, indicates a commitment to the dominant figurative interpretation of the phrase, akin to what has been found for the dominant meanings of homonyms (subordinate effect bias). Of note, the effect in this case was observed in the disambiguating region, as opposed to the homonym literature where effects are observed in the ambiguous word itself.

Several eye-tracking studies, which are particularly relevant to the current experiment, have also focused on meaning activation of ambiguous

idioms in context. First, Titone and Connine (1999) examined the effect of contextual bias on the reading times of ambiguous (but highly frequent) idioms that varied in their degree of decomposability. Disambiguating context was manipulated so that it either preceded or followed the idioms in question. The researchers found that decomposable idioms were read equally fast regardless of whether biasing context preceded or followed them and regardless of whether they were intended literally or figuratively. Non-decomposable idioms, on the other hand, were read significantly more slowly in both senses when they were preceded, rather than followed by disambiguating context. It was argued, therefore, that because non-decomposable idioms have distinct idiomatic and literal meanings, integration of the appropriate meaning takes longer. It could be further argued, therefore, that non-decomposable idioms behave more like homonyms, which slow processing because of their contrasting and competing interpretations, while decomposable idioms behave more like polysemes, whose senses are related and as such do not compete. Conversely, decomposable idioms have more related meanings which facilitate both interpretations at no extra cost. Analyses of the disambiguating regions revealed an insignificant trend whereby idiomatically biased regions were faster to read than literally biased regions. However, this effect was driven by differences in item properties (i.e., length), highlighting the importance of having carefully controlled regions of interest.

Siyanova-Chanturia, Conklin and Schmitt (2011) explored meaning activation in ambiguous idioms embedded in story contexts. The stories were designed to promote the figurative or literal meaning of idioms (*at the end of the day* meaning ‘in the evening’ or ‘eventually’) prior to the presentation of

the phrases. Stories containing literal control phrases (*at the end of the war*) were included for comparison. All idioms were highly familiar and predictable, half were decomposable and half non-decomposable. Analyses carried out in the idiom region demonstrated that native speakers processed idioms in *both* senses equally fast, and *both* were read significantly faster than control phrases, as evidenced by significantly fewer and shorter fixations. No effects of decomposability were reported and unlike Cacciari and Corradini's (2015) finding, predictable idioms did not appear to favour their figurative interpretation over their literal one. Of course, in Cacciari and Corradini (2015) the effect was observed in the disambiguating region (not in the idiom itself) and the context followed rather than preceded the idioms. These differences could account for the discrepancies. More interestingly, though, Siyanova-Chanturia et al.'s (2011) findings may cast some light upon the way ambiguity is resolved in idioms relative to ambiguous words. Specifically, the fact that both idiom senses exerted an advantage over matched control phrases resembles the processing advantage found for polysemes—but not for balanced or unbalanced homonyms—over unambiguous words. If the latter is attributed to a 'sense-relatedness effect' (Klepousniotou & Baum, 2007), this would imply that the seemingly contrasting meanings of idioms are *not* that contrasting after all. In fact, idiom senses could be sharing a core or underspecified meaning that aids sense selection without competition, just like multiple senses of polysemes. If, on the other hand, idiom meanings were competing for activation in the same way that two (equally-frequent) meanings of a balanced homonym would be, we would still expect no cost on whichever interpretation ended up being selected (i.e., *at the end of the day* used literally

vs. figuratively), but crucially, we would expect a *slower* processing for the idiom (*at the end of the day*) relative to the control phrase (*at the end of the war*); in line to what has been argued about competition in balanced homonyms versus unambiguous words, where the delaying effect would reflect the extra processing time needed to resolve ambiguity and select the contextually-appropriate meaning.

More recently, an eye-tracking experiment by Milburn and Warren (2019) explored the effect of meaning dominance and meaning relatedness of familiar idioms on their meaning activation during on-line reading comprehension. A disambiguating sentence (*Peter often panics about small things/ Peter is an expert on parallel bars*.), preceded the idiom sentence (*Sometimes he loses his grip.*), and this was in turn followed by a meaning-neutral sentence (*But he always recovers*.). Meaning dominance was determined by asking participants what percentage of the time they expected each idiom to be used in either sense, while meaning relatedness was similarly determined by asking participants to rate on a scale from 1-7 how related the literal and figurative meanings of idioms were (resembling the construct of transparency/ decomposability in other idiom studies). They found that idioms with a dominant figurative interpretation and idioms with a higher meaning relatedness were read faster than idioms with balanced meanings and idioms with less related meanings respectively. Importantly though, neither of these factors contributed to how the literal versus the figurative meaning of the same idiom was processed, as there was no significant difference between the two. Further, the researchers found that idioms with a high meaning dominance as well as a high meaning relatedness were *slower* to process than idioms with a

low meaning dominance but with a high meaning relatedness. Stronger meaning dominance is a characteristic feature of homonyms, which led the authors to argue that meaning bias can override meaning relatedness, resulting in such idioms being processed more like homonyms than polysemes. A lower meaning bias but still a high relatedness, on the other hand, might result in idioms being more akin to balanced polysemes. Finally, literally-dominant and/or unfamiliar idioms were not included in the study and therefore relevant comparisons cannot be made.

Lastly, Titone et al. (2019) noted that prior to meaning disambiguation, an advantage for idioms (*have a lark*) versus control phrases (*see a lark*) was conferred to both senses of the phrase (i.e., literal and figurative), but differences emerged in the disambiguating region that followed the idioms as a function of idiom familiarity and decomposability. Specifically, a disambiguating region favouring the literal meaning of idioms was read more *slowly* when the idioms in question were rated as highly familiar, which was interpreted as a commitment to the more dominant (i.e., figurative) meaning of the phrase. However, increased decomposability (resembling Milburn and Warren's (2019) high meaning relatedness) was found to override the effect of familiarity by eliminating the advantage of the figurative meaning, as figurative continuations were slower to read. This was attributed to the fact that decomposable idioms "interfered with the ability to access the figurative meaning of an idiom by fostering the viability of its literal interpretation" (Titone et al., 2019, p. 22), and this was interpreted as evidence of increased competition between the two meanings. However, this finding could also be interpreted as decomposable idioms being more 'balanced' in their meanings,

since the figurative meaning did not actually suffer in comparison to the literal. Instead, both meanings were equally active, thus facilitating both the literal and figurative continuations. It is also worth mentioning that the disambiguating regions in this study were problematic: they were only matched for length, but appeared to have varied considerably in terms of language complexity and/or overall frequency of the component words. Moreover, some of the items, including *have a lark*, were not strictly speaking idioms. *Lark* is in fact a homonymous word having the meaning of 'bird' or 'something done for fun', thus the word alone (and not the phrase as a whole) was the source of ambiguity. Therefore, item-specific properties may have been confounded in the reported effects.

Notably, familiarity has produced some conflicting results. On the one hand, it has been associated with an equally easy integration of both the literal and figurative meaning of an idiom (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011), yet, it was also found to yield a cost for the literal interpretation of the phrase (Titone et al., 2019). This difference is likely due to different constructs assumed under the same term. In Siyanova-Chanturia et al., (2011) and Milburn and Warren (2019) familiarity was defined as familiarity with the idioms' figurative meaning, whereas in Titone et al., (2019) familiarity was defined as the subjective frequency of the given idioms. Corpus findings suggest that idioms are more frequently used in their figurative sense (Moon, 1998), potentially influencing subjective frequency ratings as well. Hence, it would not be surprising that increased 'familiarity' in this case facilitated the figurative meaning of idioms: idioms rated as more frequent, were likely more frequent in their figurative sense—just like the most

frequent meaning of unbalanced homonyms. Conversely, the figurative meaning of an idiom can be highly familiar, but not necessarily the most frequent, or it can be highly frequent, but if it is unfamiliar to a speaker then it is unlikely to be the dominant one irrespective of its frequency.

Overall, the findings reviewed in this section suggest that meaning activation in ambiguous but canonical idioms—both in context and in isolation—is subject to multiple factors. In addition to frequency, meaning activation may depend on (a) predictability, (b) decomposability, and (c) familiarity. Predictable and non-decomposable idioms might prioritise their figurative meaning (figuratively-dominant), whereas unpredictable and decomposable idioms might prioritise their literal meaning (literally-dominant). However, familiarity could potentially mask these effects, since studies in which predictable, figuratively-dominant and balanced idioms, as well as idioms with low and high meaning relatedness, were found to facilitate *both* their literal and figurative interpretations (e.g., Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011), and the common denominator appears to be increased familiarity with the figurative meaning of the phrase. Importantly though, in the aforementioned studies familiar idioms were *preceded* by facilitative context, as opposed to the remaining studies where idioms were *followed* by facilitative context. Thus, the ease of processing may have been driven by contextual bias and not familiarity per se.

The finding that both senses of ambiguous familiar idioms are significantly faster to read than unambiguous matched control phrases (Siyanova-Chanturia, Conklin, & Schmitt, 2011), might indicate that (at least familiar) idioms behave like polysemes whose senses are not competing for

activation and where commitment to one sense is stalled until further disambiguation. The above findings also suggest that the configuration of words (i.e., idiom component words) imparts some of the processing advantage observed for (familiar) idioms in general, which is then conferred to both senses: figurative and literal (Siyanova-Chanturia, Conklin, & Schmitt, 2011; Titone et al., 2019). Important questions remain about how meaning dominance might be influenced as a result of changes in the idiomatic configuration (i.e., modifying the idiom), particularly in a context that does not support either the literal or figurative interpretation prior to the presentation of the phrase.

Meaning activation in modified idioms

As we saw in Chapter 2, modified idioms appear to retain their figurative interpretation in biasing contexts. For instance, it was found that in a context about death, the passivized idiom *the bucket was kicked* exerted a processing advantage over its matched control phrase *the apple was kicked.* However, passivized idioms were also slower to process than their active forms (*kicked the bucket*), suggesting that a processing cost might be associated with idiom modification. Notably, this cost could reflect a shift in the meaning 'balance' of an idiom, whereby the literal meaning is *preferred*, thus inducing a cost when it turns out to be incompatible with subsequent context and needs to be suppressed.

Although current models of idiom processing can account for the flexibility of idioms to a certain degree, they make no explicit claims about potential costs or shifts in meaning dominance as a result. The Configuration

Hypothesis (Cacciari & Tabossi, 1988), for example, holds that a modified idiom can activate its figurative interpretation, as long as the modification does not render the phrase unrecognisable; the idiom 'key', upon which the recognition of the phrase depends, does not necessarily coincide with one (or more) particular word(s) in the idiom, nor is it necessarily fixed across varied contexts (Cacciari & Tabossi, 1988). Similar predictions could be made by the Superlemma Theory (Sprenger et al., 2006), although this model is underspecified in terms of idiomatic modification in both comprehension and production. The activation of all of the individual lemmas making up an idiom (*the, bucket, was, kicked*) might be enough to push the superlemma (*kick the bucket*) to its activation threshold and activate the figurative meaning (*die*) at the conceptual level.

Despite this, idioms are not typically compositional and activation of the figurative meaning *is* subject to activation of pre-stored lexical representations or templates (e.g., Molinaro & Carreiras, 2010; Siyanova-Chanturia, Conklin, Caffarra, Kaan, & Van Heuven, 2017; Vespignani et al., 2010): an idiom is recognised once a successful match is established between what is being encountered (*kick the…*) and with what is already known and stored in the lexicon/memory (*kick the bucket* means 'die'). Activating the figurative meaning of a modified idiom (*the bucket was kicked* meaning 'died') should also involve template-matching operations so that a connection between the phrase and a potential figurative meaning is established. However, since a modified idiom might not be a 'perfect match' for its template, as opposed to the canonical form of the idiom, this could hinder the recognition of the phrase, causing the literal meaning to have priority.

Usage- and Exemplar-Based models of language processing propose that frequently occurring items have stronger representations in memory and are faster to process (e.g., Bybee, 1985, 1998, 2006; Goldberg, 1995; Tomasello, 2003). Thus, more familiar, frequent, and predictable idioms might hold stronger representations resulting in a faster retrieval of their figurative meaning. In the study of Chapter 2 it was found that increased frequency and to a lesser degree increased familiarity and predictability of the canonical idioms benefitted their processing and interestingly they also benefitted the processing of their passivized forms in the same way: frequency speeded (total) reading time, while familiarity and predictability reduced the probability for a regression. No notable effects were found for transparency, except a marginal effect on regression likelihood, with more transparent idioms being less likely to elicit a regression. As canonical and passivized idioms were always intended figuratively, the study was not designed to test whether these factors would also facilitate the processing of the literal meaning as well, or conversely, if they would hinder its activation. These findings support the Multidetermined Model (Libben & Titone, 2008; Titone & Connine, 1999), although this model too is underspecified regarding the effects of idiom modification on comprehension. It is likely, however, that factors implicated in the processing of canonical idioms, might also affect the processing of modified versions of them.

Provided that these factors indeed influenced the processing of the passive forms of idioms in the *same way* as the canonical forms, it could be argued that the norming ratings gathered for the canonical idioms were fairly representative of the passivized idioms as well. In addition, it could also be

argued that these factors may affect meaning activation in passivized idioms, in the same way that they do in canonical idioms. In the previous section we saw that decomposable and unpredictable idioms in their canonical form show a preference towards the literal meaning (Cacciari & Corradini, 2015; Titone & Connine, 1999; Titone et al., 2019), while familiar canonical idioms seem to benefit the activation of both their meanings, even if they are predictable and regardless of meaning relatedness/decomposability or meaning dominance (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011). Therefore, decomposable (or transparent) and unpredictable passivized idioms may also bias their literal meaning, while the passivized forms of familiar idioms might equally benefit both interpretations.

Alternatively, it could be argued that modified idioms automatically become *less* familiar due to the modification, which distorts the familiar-looking string. This could delay the recognition of the phrase by hindering the activation of the idiom's template or representation and as such modified versions of even familiar idioms might prioritise their literal interpretation. Consequently, much like the most frequent meaning of biased homonyms, if the literal interpretation of the idiom is viable in the context it would be processed very quickly. In contrast, if the figurative meaning turns out to be preferred in the context, this interpretation could elicit subordinate bias effect, like the less frequent meaning of a biased homonym. This would be mean that the figurative meaning would be accompanied by increased competition from the dominant literal interpretation and as a result it would be significantly slower to process, denoting a processing cost associated with suppressing the dominant interpretation of the phrase.

As we have seen, context may influence meaning activation in canonical idioms and it might even interact with predictability and decomposability, as it does with frequency for ambiguous words. However, the figurative meaning of canonical idioms can be activated in isolation, conditional upon the phrase being recognised as a configuration. Crucially, for modified idioms a biasing context might be an essential *prerequisite* for the figurative meaning to become activated. Modified idioms, such as *he didn't spill a single bean* (meaning 'he did not reveal any secrets'), were found to be read faster (McGlone et al., 1994) and rated as more acceptable in judgment tasks (Tabossi et al., 2009) when embedded in a facilitative than in a neutral context. In Chapter 2, it was also found that the figurative meaning of passivized idioms could be activated in a biasing context during on-line processing. However, it is possible that the context 'forced' a figurative interpretation for the passivized idioms, potentially adding to (or even causing) their slower processing. That is, if *the bucket was kicked* only activated its literal meaning and a figurative interpretation was consciously retrieved once the literal interpretation was deemed incongruent in the context, this would explain why further analyses were generated: the longer and more frequent refixations would reflect the extra time needed to 'find' a plausible (figurative) interpretation. If the figurative meaning fails to become activated altogether without considerable contextual support, this would have implications for idiom processing theories, such as the Configuration Hypothesis (Cacciari & Tabossi, 1988) and Superlemma Theory (Sprenger et al., 2006), as it would suggest that a cooccurrence of idiomatic elements in a noncanonical order is not enough to unlock the configuration, or spread the activation to the idiom's

superlemma, despite all the words/lemmas (including idiom 'keys') being available.

Overall, current models do not explicitly address potential effects of idiom modification on processing, but in Chapter 2 it was found that passivized idioms were consistently processed more slowly than their active counterparts—although less so when canonical idioms were rated as highly familiar, frequent, and predictable. The observed processing cost could have been due to the unfamiliarity and low frequency of the passivized idiom forms, which means that the phrases were recognized more slowly (template-matching) and as a result their figurative meaning was activated later than when they appeared in their canonical form. Alternatively, it could simply be a by-product of the passive construction, which is usually slower to process than the active (Kamide et al., 2003; Knoeferle, 2007; Knoeferle et al., 2005; Mack et al., 2013; Meyer et al., 2012); the slower processing might reflect difficulties in the analysis of the syntax, rather than difficulties in the retrieval of the figurative meaning per se. Importantly, the processing cost might reflect a shift in the meaning dominance of passivized idioms, with the literal meaning becoming more highly activated and having to be rejected in the given context. Since the literal meaning was always contextually anomalous, the study in Chapter 2 did not allow for a more nuanced understanding of the activation of the literal versus the figurative meaning of passivized idioms and it is hence the focus of the current study.

The study

Meaning activation in modified idioms should be dependent upon the

phrases being recognised as idiomatic—through successful matching operations to pre-stored templates (i.e., a superlemma). Assuming that modified idioms are suboptimal for template matching, this could promote a compositional analysis for the phrases and prioritise the literal interpretation as a result, especially in a neutral context. Therefore, the figurative meaning might become less salient and as such more difficult to process, as opposed to canonical idioms where both meanings appear to be processed with comparable ease (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011). Moreover, if activation of the figurative meaning is observed for modified idioms in the absence of contextual bias, this would strongly suggest that idiomatic elements alone, even appearing in an unfamiliar order, lead to at least some activation of the idiom. Moreover, previous studies differ in their selection of regions of interest. Some have focused on the idiom region alone while others have focused on both the idiom region and disambiguating regions. However, disambiguating regions consisted of more than one word, making it difficult to effectively control for overall language complexity, potentially causing misleading effects.

The current study explores meaning activation for passivized idioms in contexts that are neutral until the idiom (*kick the bucket*), but are later disambiguated with a target word that is associated with the literal meaning (*water*), the figurative meaning (*body*), or alternatively is semantically unrelated to either meaning (*time*). Importantly, except for the target word, the remaining context was the same across all conditions. If one of the two meanings of a passivized idiom has greater activation and/or less competition from the other, then the respective target word should be easier to process. This

would be reflected by a faster reading (i.e., shorter and fewer fixations) for the target word. In contrast, significantly more and longer fixations would be expected for the target word, if the meaning associated with it has less activation and/or there is greater competition from the alternative meaning. Assuming that both meanings are activated and competition is not too great (as in canonical idioms), both literal and figurative target words should be processed equally fast and faster than control target words. Given the absence of a preceding disambiguating context, there should be no initial difference in the processing of the passivized idioms across the conditions. Differences are likely to emerge later on, when encountering the target words. For instance, encountering a target word that does not correspond to a (highly) activated meaning should increase the likelihood for a regression into the idiomatic phrase, thus affecting later measures such as regressions and/or total reading time.

Methodology

Participants

Forty-five native speakers of British English took part in the eye-tracking experiment (mean age = 20.02, SD = 3.28, 37 females and 8 males). Participants received payment or course credit for their participation.

Materials

Forty-five idioms were selected from the Collins COBUILT Idioms Dictionary (2011), many of which appeared in Chapter 2. All idioms were chosen to allow for an equally plausible figurative and literal interpretation

(e.g., *kick the bucket, spill the beans,* etc.). The idioms consisted of a verb plus a noun phrase (V + NP) to enable use in the passive voice. One idiom (*rock the boat*) was removed from analyses due to an error in the design of the experiment, thus leaving forty-four idioms in total.

Stimuli

Table 3.1 provides examples of the stimuli (for all experimental items see Appendix B). Idioms were embedded at the beginning of sentences, but did not start a sentence, and a neutral context preceded them. They were presented in their passive form without an agent by-phrase. The intended meaning of each idiom (literal or idiomatic) was disambiguated later in the sentence by a word (which I refer to as the *target word*). The target word was manipulated to fit each of the three experimental conditions: (a) idiomatic, (b) literal, and (c) control. For instance, *body* was the figurative target word of the idiom *kick the bucket* as it associates with the concept of death, while *water* was the literal target word since buckets are often filled with water.

Control target words were chosen to be anomalous (*time* for *kick the bucket*) for two reasons. First, this served as a baseline against which the activation of the figurative meaning of passivized idioms could be checked. That is, if the figurative meaning failed to become activated, then we would expect comparable processing for idiomatic target words (a) and control target words (c), as both would be anomalous and difficult to integrate into the sentence: if *the bucket was kicked* does not activate the concept *die*, then *body* would make no more sense than *time*. Second, the control condition provided a baseline of potential processing costs. For example, if passivized idioms do

activate their figurative meaning but only *after* having activated and subsequently supressed their literal meaning, we would expect slower processing of the idiomatic target word (a) compared to the literal one (b), but we should still expect a faster processing for the idiomatic target word (b) compared to the control one (c). If, on the other hand, both the idiomatic and literal meanings of an idiom are equally easy to activate, then we would expect no difference between idiomatic (a) and literal target words (b), and both should be processed more quickly than control target words (c).

Table 3.1 - Example stimuli used for the idioms kick the bucket, tie the knot, and clear the air, as well as their target words across conditions: (a) idiomatic, (b) literal, and (c) control. The idiom and target words are underlined in the examples below but were not demarcated in any way for participants.

1	Kick the bucket	a	When the bucket was kicked, she got rid of the body with the help of her devoted housekeeper.
		b	When the bucket was kicked, she got rid of the water with the help of her devoted housekeeper.
		c	When the bucket was kicked, she got rid of the time with the help of her devoted housekeeper.
2	Tie the knot	a	Once the knot was tied, he felt confident that his wife would not go anywhere.
		b	Once the knot was tied, he felt confident that his boat would not go anywhere.
		c	Once the knot was tied, he felt confident that his idea would not go anywhere.
3	Clear the air	a	When the air was cleared, they were finally able to reconcile and everything went back to normal.
		b	When the air was cleared, they were finally able to breathe and everything went back to normal.

c When the air was cleared, they were finally able to jump and everything went back to normal.

Care was taken so that a target word[5] never occurred at a line break, avoiding fixation contamination due to the programming and execution of saccades (Conklin et al., 2018). All stimuli sentences were of a comparable length and target words were placed approximately in the middle or towards the end of each sentence. Context length starting from the first character following the idiomatic phrase and leading up to the final character before the target word (*she got rid of the* in Table 3.1's example sentence 1) ranged between 3 and 47 characters including spaces (M = 29,86, SD = 10.05).

Norming

The idioms underwent a series of norming procedures to account for factors known to influence idiom processing. Sixty-two participants from the same population but different from those in the eye-tracking study were asked to rate the idioms in terms of frequency (*n*=16), familiarity (*n*=16), and transparency (*n*=30).[6] Table 3.2 presents the relevant descriptive statistics. Each factor was measured in a separate questionnaire using a scale from 1

[5] Most of the target words (27/44) completed the clause in which they were embedded. For instance, upon encountering *body* and *water* in (1) the clause *she got rid of the x* is completed. In contrast, *wife* and *boat* in (2) are the subjects of a secondary clause whose meaning is not completed until the end of the sentence has been reached. This could potentially influence how fast the meaning of a phrase is activated, since the completion of a clause by a target word could also resolve meaning disambiguation more readily. For this reason I explored this as a factor when analysing the eye-tracking data, but found no significant modulation in any measure investigated.

[6] These ratings were obtained for the idioms in their active (and hence canonical) form in order to explore this as a potential predictor contributing or affecting the processing of their passivized versions.

(never heard or used the phrase/ very unsure about the figurative meaning of the phrase/ very easy to guess the meaning of the phrase) to 5 (very frequently heard or used the phrase/ very sure about the figurative meaning of the phrase/ very difficult to guess the meaning). Frequency was, therefore, defined as how often a given idiom is encountered, familiarity as how familiar one is with the figurative meaning of an idiom (a dictionary definition was provided for this), and transparency was defined as how easy it is to guess the meaning of an idiom in isolation, based on its component words alone. As familiarity can affect judgements of transparency (Carrol et al., 2018), definitions of idioms were not provided in the transparency questionnaire and participants were instructed to select 5 if they were unaware that a given phrase had an idiomatic meaning and/or were unable to guess the figurative meaning based solely on the idiomatic elements. Literal phrases and idiomatic phrases with an incorrect definition were included in the frequency and familiarity questionnaires respectively as fillers. Idioms were rated as significantly more frequent and more familiar than fillers (p <0.001). No fillers were included in the transparency questionnaire since participants were informed beforehand that all the phrases had an idiomatic interpretation. Overall, the idioms used in the present study were rated as fairly frequent, highly familiar and (surprisingly) rather transparent, potentially mirroring the high familiarity with the items.

Table 3.2 – Descriptive statistics for the idioms and the semantic association strength between idiomatic verbs and nouns with their respective target words. Frequency, familiarity, and transparency were measured on a scale from 1-5. Transitional probability is reported below as a percentage. Semantic association strengths were extracted from the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 2004), calculated here as number of instances plus 1.

	Mean	SD
Idiom Characteristics		
Frequency	3.40	0.72
Familiarity	4.30	0.65
Transparency	2.69	0.60
Transitional Probability	0.53	1.94
Semantic Associations		
Idiom Verb – Idiomatic target word	1.00	0.00
Idiom Verb – Literal target word	1.01	0.04
Idiom Verb – Control target word	1.00	0.00
Idiom Noun – Idiomatic target word	1.00	0.00
Idiom Noun – Literal target word	1.05	0.13
Idiom Noun – Control target word	1.00	0.00

Notes: Frequency, familiarity and transparency ratings were collected for the canonical form of idioms, while the transitional probability is reported as the probability of the final word in passivized idioms.

In the study for Chapter 2 the predictability of the final words of active and passivized idioms (*he kicked the _ / the bucket was _*) was measured in a series of cloze tests, which showed almost complete unpredictability in the absence of context and the provision of biasing context did not improve predictability. This was likely due to the short length of the idioms in question (Fanari et al., 2010). Given that in the present study idioms were presented without facilitative context and were of the same length and type (and most of them were the same items as in Chapter 2), no cloze tests were carried out. Instead, the transitional probability was used to evaluate predictability. The predictability of the final word was calculated as the frequency of the whole phrase (*the bucket was kicked*) divided by the first three elements of the phrase (*the bucket was*) and then multiplied by 100 to yield a percentage (McDonald

& Shillcock, 2003a, 2003b). The frequency values were extracted from the BNC (Davies, 2004) as instances per million words. In line with the low predictability reported in Chapter 2, the final words of passivized idioms (*kicked*) exhibited a very low transitional probability, which is not surprising considering that predictability and transitional probability are often correlated. Indeed, almost all the final words of idioms yielded a transitional probability of 0, and therefore transitional probability was not included in the models when analysing the data.

Using the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 2004), the association strength of the content words in the idioms and the disambiguating target words was assessed: association of *bucket* and *kick* with *body* (figurative target word), *water* (literal target word), and *time* (control word) respectively. The association strength between the idioms' content words and idiomatic and control target words were mostly 0, whereas for the literal target words there were occasionally some strong associations (e.g., the noun *air* from *clear the air* was highly associated with its literal target word *breathe*). Because of this, association strengths were calculated as the original value plus 1 to avoid having 0 values in the database and were then log-transformed to reduce the skewness of the distribution. An ANOVA test confirmed that Condition was significant for both idiomatic nouns (*bucket*) [$F(2, 1602) = 77.10$, $p < .001$] and verbs (*kicked*) [$F(2, 1602) = 29.84$; $p < .001$. Pairwise comparisons showed that literal target words had significantly stronger association strength with idiomatic nouns as well as verbs compared to both idiomatic and control target words ($p < .001$). No difference was found between idiomatic and control target words ($ps > 0.9$).

Idiomatic and literal target words were matched for frequency ($p = 0.9$) and word length ($p = 0.67$), but control target words were deliberately chosen to be more frequent and significantly shorter (all ps < 0.05) (see Table 3.3). This would ensure that any adverse processing observed for the control target words in the eye-tracking experiment could be attributable to their contextual incongruency and not to other, unrelated factors. To this end, I also conducted a lexical decision task using all of the target words along with an equal amount of pseudowords that matched the target words in length. Twenty native speakers of British English (age = 19.45, SD = 1.02; 1 male, 19 females) took part in the experiment and were asked to decide whether each string of letters was a real English word or not by pressing a corresponding key on the keyboard. The experiment was designed using PsychoPy (Peirce, 2007) and words were presented randomly one-by-one in the middle of the screen, in white Arial font over a black background. The whole procedure lasted for approximately 5 minutes. Response times shorter than 350ms and longer than 2000ms were removed from the analysis, leading to a data loss of 3.65%, out of which 1.55% were target words. Target words elicited a significantly faster response time (M = 620ms, SD = 220) than pseudowords (M = 780ms, SD = 304); $t(5085) = 21.55$, $p < 0.005$), but crucially no significant effect of Condition (idiomatic, literal, control) was found for the response time of target words [$F(2, 2596) = 0.212$; $p = 0.80$] (for means see Table 3).

Table 3.3 – Descriptive statistics of target words including response times from the lexical decision task.

	Frequency			*Word Length*		*Response Time (ms)*	
Target word Type	N	Mean	SD	Mean	SD	Mean	SE
Idiomatic	44	65.08	62.38	6.48	2.42	616.67	7.43
Literal	44	51.39	67.24	6.11	2.05	619.73	7.29
Control	44	186.20	235.10	4.30	1.41	623.57	7.77

Notes: Frequency values were extracted from the BNC and reported above as instances per million words. Word Length was calculated as number of characters.

Procedure

Three experimental lists were created using a Latin square design so that each participant encountered a target phrase in only one of the three conditions (idiomatic, literal, or control). To distract participants from the purpose of the study and especially the semantic incongruency of the control items, 45 filler sentences of a similar syntax were created, some of these were semantically plausible, and some were not (**When the soup was ruined, everyone wanted to go out for trees instead*.). The same filler sentences were used across lists.

An Eyelink 1000+ desktop-mount tracker was used to track and record eye-movements during reading with a minimum sampling rate of 500Hz. To minimize head movement during reading a forehead-and-chin rest was used. Participants were seated facing a computer monitor and a 9-point calibration was performed at the beginning of the experiment and whenever necessary thereafter. Participants were asked to read each sentence as quickly as possible but for comprehension, and to press ENTER after they finished reading a sentence to proceed to the next one. Around half of the filler sentences were

followed by an easy yes or no comprehension question to ensure participants' attention to the content of the sentences. The presentation of the stimuli was randomized per participant and each sentence was preceded by a drift correction. Sentences were triple-spaced and presented in black font (Courier New, size 14) on a white background. The whole task lasted about 20 minutes.

Results

Participants' accuracy on the comprehension questions was high (93%), indicating that they had understood the task and the sentences. The analyses of the eye-tracking data was focused on four different areas of interest: 1) the idiomatic phrase as a whole (*the bucket was kicked*), 2) the noun of the idiomatic phrase (*bucket*), 3) the final word (verb) of the idiomatic phrase (*kicked*), and 4) the disambiguating target word (*body/water/time*). Of note, the term 'idiomatic phrase' is used throughout in the remaining section to refer to the ambiguous passivized phrases (*the bucket was kicked*), regardless of whether the phrase was meant figuratively or literally. When referring to a particular sense of the phrase, then the respective meaning is specified.

For all interest areas three late eye-tracking measures were considered, namely: total reading time (the sum of all fixation durations including those of refixations), number of fixations, and likelihood of regression (after the eye has moved forward in the sentence). Early eye-tracking measures might not be appropriate for analyses beyond the word level (Carrol & Conklin, 2014a; Conklin et al., 2018), therefore measures such as first fixation duration, first pass reading time (the sum of all fixations made during first pass reading but before the eye moves forward in the sentence), and skipping (the likelihood of

a word to be skipped) were explored for the idioms' nouns and verbs, and the target words, but not the idiom as a whole. Spillover (i.e., the duration of the first fixation made on the word immediately following a region of interest (*n*+1)) was also considered: the word immediately following the idiom region and the target word. The means for these interest areas are presented in Table 3.4.

Table 3.4 – Mean values for all interest areas in all conditions. Skipping and Regression values are given as a probability between 0-1, Fixations as number of instances and First Fixation Duration, First Pass Reading Time, Total Reading Time and Spillover are given in milliseconds.

Cond.	**Skipping**			
	Noun	Final Word	Target word	
Idiomatic	0.33	0.16	0.07	
Literal	0.34	0.15	0.05	
Control	0.32	0.16	0.13	

	Fixations			
	Noun	Final Word	Target word	Whole Idiom
Idiomatic	1.64	1.59	1.45	4.29
Literal	1.57	1.52	1.39	4.17
Control	1.63	1.64	1.59	4.36

	First Fixation Duration			
	Noun	Final Word	Target word	
Idiomatic	175	186	187	
Literal	174	180	188	
Control	172	188	190	

	Regression In			
	Noun	Final Word	Target word	Whole Idiom
Idiomatic	0.47	0.13	0.14	0.73
Literal	0.42	0.11	0.11	0.70
Control	0.43	0.15	0.34	0.74

	First Pass Reading Time			
	Noun	Final Word	Target word	
Idiomatic	185	203	203	
Literal	185	196	200	
Control	184	205	201	

	Spillover	
	Final Word	Target word
Idiomatic	169	184
Literal	175	189
Control	170	189

	Total Reading Time			
	Noun	Final Word	Target word	Whole Idiom
Idiomatic	263	267	242	749
Literal	254	250	235	716
Control	257	278	292	755

The data were analysed using linear mixed effects models with the *lme4* package (version 1.1-20; (D Bates, Mächler, Bolker, & Walker, 2015)) in R (version 3.5.2; R Core Team, 2018). Condition was set as a fixed factor with three levels, each corresponding to one of the experimental conditions: idiomatic, literal, and control. The idiomatic condition was set as the baseline. By-subject and by-item random slopes and intercepts were initially fitted as random effects (Barr et al., 2013), but were incrementally reduced to intercepts only, due to model convergence issues. Occasionally by-item intercepts needed to be dropped altogether due to singular fits, but by-participant intercepts were always included in the models. To test for any list effects, experimental list was included as factor in the analyses. Word association strengths (for nouns and verbs) were also included as predictors in the whole idiom and target word analyses. For the target word analyses alone, I also explored target word frequency (log-transformed) as well as length.

Idiom frequency, familiarity, and transparency (but not transitional probability) were set as predictors in separate models for the whole phrase analyses (as these factors best apply to idioms as a whole) and for the target words in order to see whether they would affect their processing. Frequency, familiarity, and transparency were correlated with rs > 0.50 and the Kappa value was estimated at 30.39, suggesting problematic multicollinearity (Baayen, 2008). To reduce this, the variables were centred and then frequency was residualised against familiarity and then transparency against familiarity. The residualised and centred variables were highly correlated with their original variables (all rs > 0.65; all ps < 0.005) and the Kappa value dropped to 1 suggesting that multicollinearity had been effectively reduced.

Fixations shorter than 80ms were incorporated into the largest nearest fixation for a distance up to 0.5 degrees, or were removed from the data when they fell outside of this. Following a visual inspection of the data a few extreme observations were discarded. These procedures resulted to an overall data loss of 0.35% in the whole phrase dataset, 0.40% in final words, 0.35% in idiomatic nouns, and 0.25% in target words. Furthermore, 16.4% of the idiomatic nouns (*bucket*) were skipped during first pass reading and not later fixated by a regression (118 observations in idiomatic condition, 109 in literal, and 98 in control condition). Similarly, 9.9% of the final words in the idiom (*kicked*) were skipped (68 in idiomatic, 61 in literal, and 67 in control condition), and 18.6 % of the target words (122 in idiomatic, 115 in literal, and 133 in control condition).

Model components were added one-by-one and only significant covariates were retained following a comparison of the resulting models. Additive models were fitted initially, and interactions were included only if they significantly improved a model's fit. For durational measures (reading times), data were log-transformed and analysed using linear mixed effects modelling. Binary measures (regression likelihood and skipping) were analysed using logistic linear models (Jaeger, 2008) and number of fixations (a count measure) was analysed using generalised linear modelling with *poisson* regression. Pairwise comparisons were conducted using the *emmeans* package (Lenth, 2018). For the sake of brevity, only the outputs of models where Condition emerged as a significant factor are reported here (Tables 3.5 and 3.6) and the remaining models are presented in Appendix D.

Table 3.5 - Model Outputs where Condition was a significant factor

	Total Reading Time											
	Whole Idiom				*Final Word*				*Target word*			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*
(Inter.)	6.62	0.05	137.84	**<0.001**	5.59	0.04	148.64	**<0.001**	5.3	0.06	83.06	**<0.001**
Literal	-0.05	0.02	-2.14	**0.033**	-0.06	0.03	-2.28	**0.023**	-0.03	0.03	-1.06	0.288
Control	0.01	0.02	0.41	0.679	0.04	0.03	1.46	0.145	0.19	0.03	5.59	**<0.001**
Target word Length									0.03	0.01	4.18	**<0.001**
Random Effects												
σ^2	0.15				0.23				0.20			
$\tau_{00\ PPT}$	0.08				0.04				0.04			
$\tau_{00\ ITEM}$	0.01				0.00				0.01			
Observations	1973				1776				1605			

	Regression				Skipping			
	Target word				*Target word*			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*
(Inter.)	-1.80	0.18	-9.79	**<0.001**	-0.77	0.41	-1.85	0.064

Literal	-0.21	0.18	-1.21	0.225	-0.29	0.25	-1.16	0.247
Control	1.17	0.16	7.53	**<0.001**	0.7	0.23	3.08	**0.002**
Target word Length					-0.31	0.07	-4.73	**<0.001**
Random Effects								
σ^2	3.29				3.29			
$\tau_{00\ PPT}$	0.56				0.28			
$\tau_{00\ ITEM}$	0.27				0.02			
Observations	1605				1605			

Table 3.6 - Model outputs including idiom frequency, familiarity, transparency, and transitional probability as predictors. Only factors that reached significance are included in the final models below.

	Whole Idioms								*Target words*							
	Total Reading				**Regression**				**Fixations**				**Total Reading Time**			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*z*	*p*	*β*	*SE*	*z*	*p*	*β*	*SE*	*t*	*p*
(Inter.)	6.62	0.05	140.84	**<0.001**	1	0.22	4.64	**<0.001**	1.45	0.04	36.42	**<0.001**	5.32	0.06	83.65	**<0.001**
Literal	-0.02	0.02	-2.14	**0.03**									-0.03	0.03	-1.17	0.24
Control	0.01	0.02	0.41	0.68									0.18	0.03	5.5	**<0.001**
Target Word Length													0.03	0.01	3.95	**<0.001**
Freq.	-0.03	0.03	-2.6	**0.01**	-0.2	0.1	-2.65	**0.008**					0.09	0.08	1.13	0.261
Fam.	-0.02	0.02	-2.54	**0.02**					-0.0	0.02	-2.53	**0.011**	-0.06	0.06	-1.09	0.276
Cond.Literal*Freq													-0.04	0.04	-1.55	0.122
Cond.Control*Freq													-0.05	0.05	-1.27	0.206
Cond.Literal*Fam													0.09	0.03	3.26	**0.001**

Cond.Control*Fam				0.09	0.03	2.77 **0.006**
Target WordLength*F Target WordLength*F				-0.01	0.01	-1.64 0.102 0.00 0.01 -0.12 0.908
Random Effects						
σ^2	0.15	3.29	0.21		0.2	
$\tau_{00\ PPT}$	0.08	1.83	0.06		0.04	
$\tau_{00\ ITEM}$	0.01	0.06	0.01		0.01	
Obs.	1973	1973	1973		1605	

Idiom

Condition was not significant in any analyses of the idioms' nouns (*bucket*), most analyses of the final words (*kicked*) except for total reading time, or in any non-durational measures of the whole phrase (i.e., regression likelihood and fixation count). However, for the literal condition there was a significant difference in the total reading time for whole phrases (*the bucket was kicked*) and the final words (*kicked*), whereby idioms and their final words were read faster when the idiomatic phrase in question was intended literally. Pairwise comparisons confirmed that these areas of interest yielded significantly shorter reading times in the literal condition compared to both the idiomatic and control condition (all *p*s <0.03), but there was no difference between the idiomatic and control condition in any measure (all *p*s > 0.1). Further, there was no effect of list or word association in any measure.

Target word

Condition did not affect first fixation duration or first pass reading time for target words, but there was a significant effect for skipping in the control condition, such that the control target words (*time*) were more likely to be skipped than target words in the other two conditions. Pairwise comparisons confirmed that control target words were significantly more likely to be skipped than literal and idiomatic target words (all *p*s < 0.002), but there was no difference between the skipping of idiomatic and literal target words ($p = 0.24$). This is discussed further in the Discussion. There was a significant effect of target word length, whereby the shorter the target word, the more likely it was for it to be skipped, but there was no interaction with Condition.

Control target words elicited significantly longer total reading times compared to the other two conditions (ps < 0.001), but there was no difference between idiomatic and literal target words (p = 0.28). Target word length had a similar effect as in the skipping rate: the shorter the target word, the faster it was read but there was no interaction with Condition. Control target words were also significantly more likely to elicit a regression than the other two conditions (ps < 0.001), but again idiomatic and literal target words did not differ (p = 0.22). Neither list nor association strength modulated any measures.

Additional Idiom Factors

The model outputs where idiom frequency, familiarity, and transparency were included are reported in Table 3.6. Idiom frequency and familiarity significantly modulated the total reading time of the whole phrase: with increased frequency and familiarity, the reading of the corresponding idiomatic phrase speeded up. Increased frequency (of the idiom) also reduced the likelihood for a regression into the idiomatic phrase and the number of fixations. Interestingly, familiarity interacted with the processing of the target words (see Figure 3.1 below). Idiomatic target words (*body*) were read significantly faster as familiarity with the relevant idiom increased, while literal target words (water) were read significantly more slowly. Control target words were also read significantly more slowly (than both idiomatic and literal target words) as familiarity increased, although idiomatic target words were read more slowly than control target words when idioms were less familiar. Transparency did not modulate any measures and no interaction was found between Condition and any other factor.

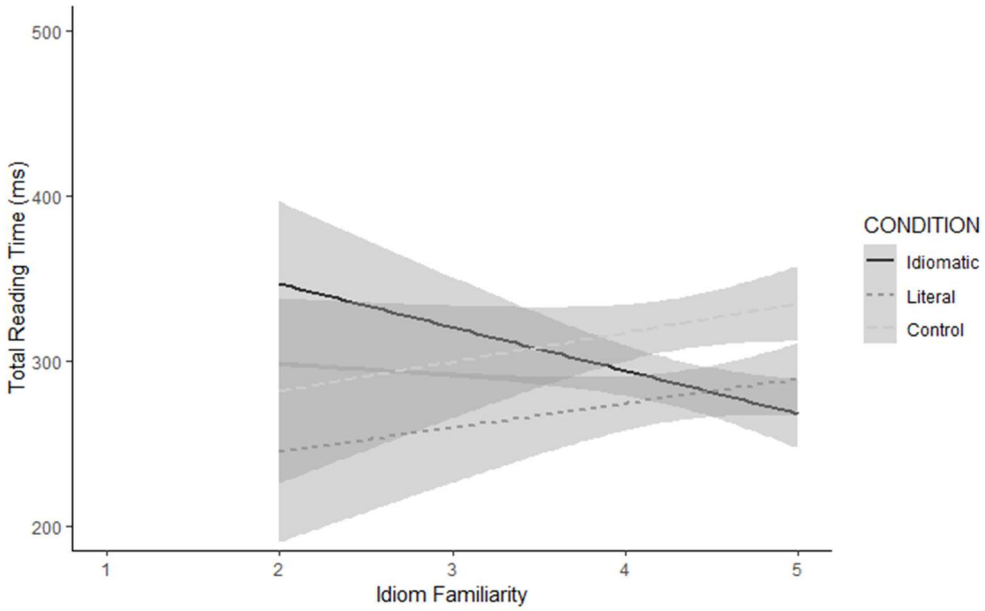


Figure 3.1-Effect of idiom familiarity ratings (1 = unfamiliar, 5 = very familiar) on the total reading time of the target words in the idiomatic, literal, and control condition

Discussion

The present study investigated potential differences in the activation of the literal versus the figurative meaning of ambiguous passivized idioms (*the bucket was kicked* meaning 'the pail was kicked' or 'died') inserted in identical sentences that differed only by one word—the target word—which either related to the figurative (*body*) or literal (*water*) meaning of the phrase, or was unrelated to both (*time*). Except for the target words, the context was neutral to avoid meaning bias. Eye-movement data were gathered for the target word region and idiom region (whole phrase and elements separately), and were then compared across Condition: figurative, literal, and control. Additional factors including the frequency, familiarity, and transparency of the idioms, as well as target word length, frequency and association strength between the target words and the idiomatic elements were also considered.

Passivized idioms (*the bucket was kicked*) and their final words (*kicked*)

elicited a significantly shorter total reading time in the literal condition (*the bucket was kicked* = 'the pail was kicked'), but they did not differ in the figurative versus the control condition. As anticipated, there was no difference in the processing of the idiom content words in early measures. Both nouns (*bucket*) and final words (*kicked*) yielded comparable first fixation duration and first pass reading time. This makes sense, since passivized idioms occurred at the beginning of sentences and were not preceded by a biasing context, therefore participants had no way of knowing the intended meaning. A different pattern was observed for target words. Control target words (*time*) elicited significantly longer fixations (in total reading time) and were significantly more likely to elicit a regression[7] than both figurative and literal target words, but there was no difference between the processing of the figurative (*body*) and literal (*water*) target words in any measure.

Condition did not affect early measures (i.e., first fixation duration, first pass reading time, or spillover) in any interest area, except in terms of the skipping of target words, where control target words were significantly more likely to be skipped. This is not surprising given that control target words were significantly shorter and more frequent than both figurative and literal target words, thus likely benefitting more from parafoveal processing (Conklin et al., 2018; Hyönä, 2011; Rayner, 2009). There was also a significant effect of target word length on the total reading time and skipping of target words, but there

[7] For target words I also examined regression-out likelihood. This would refer to the likelihood of regression from the target word region during first pass reading (*body/water/time*) prior to leaving the region in a forward direction, to an *earlier* point in the sentence, although not necessarily back into the idiomatic phrase (*the bucket was kicked*). Condition was not significant in this model ($\beta_{Literal}$ = -0.22, SE = 0.16, z = -1.32/ $\beta_{Control}$ = -0,09, SE = 0.16, z = -0.55) and therefore I only report regression-in likelihood (for both idiomatic phrases and target words).

was no interaction with Condition. The longer the target word was, the longer fixation it elicited and the less likely it was to be skipped. The effect of word length on processing is well documented in the eye-tracking literature (Conklin et al., 2018; Hyönä, 2011; Rayner, 2009) and therefore will not be considered further. Literal target words had significantly stronger associations with idiomatic elements, but association strength was not significant in any model (for target words or idioms). Finally, both frequency and familiarity (but not transparency) facilitated the processing of both passivized idioms and their target words, although they affected different measures. This is discussed in more detail later on.

The present findings will be considered in light of the initial hypotheses regarding meaning activation in modified idioms: if ambiguous passivized idioms activate both their meanings, then both meanings should be equally easy to process, mirroring findings from canonical idioms such as those reported by Siyanova-Chanturia et al. (2011) and Milburn and Warren (2019), where idioms were processed equally efficiently in both their figurative and literal sense. If one meaning is dominant (likely the literal meaning because idioms were passivized), then we should observe a facilitation for the respective meaning and potentially a disadvantage for the alternative (i.e., figurative meaning). Alternatively, if one meaning (likely the figurative) does not become activated at all, then the respective target word should be processed exactly in the same way as the control (anomalous) target word. Notably, in the aforementioned idiom studies (and studies on ambiguous words) the idioms were the locus of disambiguation processes, since a biasing context preceded them which forced meaning selection to occur within the idiom region.

Conversely, in the present study passivized idioms were the source of ambiguity, but disambiguation processes likely happened in the target word region which appeared several characters after the idioms.

Interestingly, the results from the target word analyses demonstrated a comparable availability of *both* meanings of passivized idioms (*the bucket was kicked* = 'kick the pail' or 'died'), resembling the findings from canonical idioms (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011)—although again, the effect here is *not* manifested in the idiom, but in the disambiguating (target word) region. Specifically, both literal (*water*) and figurative (*body*) target words were processed equally efficiently and both demonstrated a consistent advantage over contextually inappropriate controls (*time*). However, the present results also demonstrated that the total reading times for passivized idioms and their final words were significantly shorter in the literal condition, despite an equal (and high) likelihood for a regression into the idiom region across conditions.[8] This indicates that while the idiomatic phrases (and their final words) needed reanalysis, this was easier in the literal condition, perhaps due to stronger activation of the literal meaning. Taken together, the data from the two regions of interest (idiom and target word) appear to point in different directions: one that favours the literal interpretation of passivized idioms (idiom region) and another that shows no particular preference for either meaning (target word region). This begs the question of

[8] Although I did not originally intend to look at first pass reading time for the whole phrase (*the bucket was kicked*), I decided to examine this *post-hoc* in order to ensure that the effect in total reading time was driven by regressive refixations. This would exclude the possibility that one condition (e.g., the literal) was read faster the first-time round, which would be counterintuitive and indicative of problematic stimuli since participants would not know how a phrase was intended at that point. The model confirmed that there was no effect of Condition on first pass reading time ($\beta_{Literal}$ = -0.01, SE = 0.01, t = -1.08/ $\beta_{Control}$ = 0,00, SE = 0.01, t = 0.39).

how these seemingly contrasting findings can be interpreted.

A plausible explanation for the 'literal advantage' in the idiom region could be that the literal meaning was more easily *integrated* in the context, despite both meanings exhibiting the same degree of activation in the target word region. Evidence from single-word processing demonstrate that word recognition and integration are distinctive operations (e.g., Clifton Jr, Staub, & Clifton, 2011; Clifton Jr, Staub, & Rayner, 2007). Therefore, the present data could be illustrating two separate stages involved in idiom comprehension: first, the recognition of the idiom and activation of its meaning(s) (target word region) and, second, the integration of that meaning in the wider context (idiom region in late measures). The fact that the literal advantage occurs as a result of regressions/refixations to the idiom region—and not because of faster first pass reading times—further supports that the effect reflects integration processes.

An easier integration of the literal meaning relative to the figurative one could be due to the low predictability of the items. The passivized idioms were unpredictable (had a 'late key'), as indicated by the null transitional probability of the idioms' final words and, therefore, the Configuration Hypothesis would predict that the figurative meaning became available some time after the phrase offset (around 300ms), while the literal interpretation became available first. As the target words did not occur *immediately* after the idiomatic phrases, with intervening context averaging over 30 characters—although context was occasionally as short as to only include 3 intervening characters—this could have given ample time for the figurative meaning to 'catch up'. Nevertheless, if the literal meaning remained highly active throughout, this could have facilitated its integration in the context. Interestingly, similar findings have

been reported in Cacciari and Corradini (2015) where unpredictable idioms were found to speed up the reading of (post-idiom) literal continuations. This was interpreted as the literal continuations enhancing the already fully activated literal meaning of the phrase, whereas "the figurative meaning of unpredictable idiom strings had less time to consolidate and could not integrate in the sentential meaning" (Cacciari & Corradini, 2015, p. 805). Notably, the literal advantage in the present study was observable in the idiom region and not in the disambiguating region (i.e., target words), while in Cacciari and Corradini (2015) the opposite held. This could be due to different experimental techniques, as Cacciari and Corradini (2015) used a self-paced reading task where participants would be unable to regress into the idiom region, and hence differences in meaning integration emerged in the post-idiom disambiguating region. Importantly, current models of idiom processing are underspecified in terms of meaning integration, as they focus on idiom *activation* in the absence of context.

In terms of integration, it would also appear that the figurative meaning was not easier to integrate than the meaning of the control target word, since idiomatic phrases in the figurative condition did not exhibit an overt processing advantage in the idiom region over those in the control (anomalous) condition. However, the pattern of results suggest that the meaning of the figurative target word was successfully integrated with the idiom region following a rereading of the phrase. In contrast, the meaning of the control target word was not, which generated attempts to integrate its meaning with subsequent context (i.e., words appearing to the right of control target words). As the meaning of controls also failed to integrate in later context, this resulted in more

regressions back into the control target words, whereas regressions back into idiomatic and literal target words were equally and significantly less likely.

Another possibility is that the literal advantage reflects differences in item characteristics and specifically idiom familiarity. As was mentioned in the introduction, the common denominator in studies that found no difference in the idiom region was perhaps high familiarity with the items (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011). While most of the present items were also rated as highly familiar (in their canonical form), some of them were not. Crucially, there was a significant interaction between familiarity and target word condition in the total reading time, such that idiomatic target words were read significantly faster and literal target words significantly more slowly in highly familiar idioms, while literal target words were read significantly faster than figurative ones in less familiar idioms. Naturally, familiarity with an idiom and its figurative meaning is a prerequisite for the figurative meaning to become activated; if one is unaware that a phrase can be idiomatic and/or is unfamiliar with the associated figurative meaning, a pure compositional analysis can only yield (and benefit) the literal understanding of the phrase. Based on this, it was further hypothesized that the literal advantage in the idiom region may have been driven by the less familiar idioms. To explore this, a post hoc analysis was conducted with familiar idioms only (familiarity ratings >=4). Interestingly, in this model the literal condition was no longer reliable (β_{Literal} = -0.04, SE = 0.02, t = -1.62), demonstrating no advantage for the literal sense once the less familiar idioms were eliminated from the dataset. Unfortunately, it was impossible to compare this finding with a model containing unfamiliar idioms only, as this involved very few

observations which greatly reduced power and inflated Type II error.

While the source of the literal advantage in the idiom region may be unclear, the findings from the target word region unanimously indicate comparable availability of both meanings of passivized idioms. Crucially, however, familiarity with the figurative meaning (of the canonical form of idioms) seems to determine which meaning will be activated first in passivized versions, in the same way that it might determine meaning activation in canonical idioms (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011). Increased familiarity slowed down the reading time of literal target words and speeded up the reading time of figurative target words. However, another post hoc analysis including only the target words of familiar idioms (familiarity ratings >=4) demonstrated that literal target words of familiar idioms were *not* slower to process than figurative target words of the same idioms (β_{Literal} = -0.01, SE = 0.03, t = 0.34; p = 0.73). In contrast, literal target words of less familiar idioms appeared to be much slower to read than the figurative target words of the same idioms, though again, it was impossible to test whether these differences were significant for the same reasons as above (i.e., low statistical power).

Notably, the finding that passive forms of familiar idioms facilitated both their figurative and literal meanings is in contrast with Titone et al.'s (2019) finding that increased idiom familiarity disadvantaged the literal interpretations (of canonical idioms). However, in Titone et al. (2019), familiarity was defined as the subjective frequency of occurrence of idiomatic expressions, whereas in the present study it was defined as the subjective familiarity with the figurative meaning of an idiom, and hence they are

different constructs. In relation to this, it is also possible that Cacciari and Corradini's (2015) finding that unpredictable (canonical) idioms facilitate their literal interpretation is also due to differences in familiarity with the figurative meaning. Although the figurative meaning of all selected idioms was 'known' (ensured by asking participants to provide a paraphrase for each idiom), the *degree* of familiarity with the figurative meaning may have still differed among items, since in the rating questionnaire familiarity was again measured in terms of frequency of occurrence (as in Titone & Connine, 2019). Therefore, it is possible that meaning familiarity differed within idioms, with unpredictable idioms being more likely to have a less familiar figurative meaning, thus facilitating their literal interpretation.

Overall, it appears that when an idiom is 'known' there is no cost associated with meaning selection even if the idiom is modified. This could be interpreted as the modified idioms being processed either like balanced homonyms, where competition exists but does not disadvantage either meaning, or like polysemes where no competition arises among different senses. The system seems to be able to activate and hold onto both plausible interpretations, which facilitates whichever meaning of the phrase ends up being supported by the context. In contrast, there is evidence of increased competition between the literal and figurative meanings of less familiar idioms, with the literal meaning being dominant and the figurative meaning assuming a subordinate role, much like the most and least frequent meaning of an unbalanced homonym. Specifically, Figure 3.1 showed that when idioms were less familiar, not only were the figurative target words slower to process in comparison to the literal target words, but also in comparison to the control

target words. Though again, it was impossible to determine whether these differences were statistically significant, this observation has potentially important ramifications. First, the slower processing of the figurative relative to the literal target words suggests that the literal interpretation was indeed more dominant. Second, the slower processing of the figurative relative to the control target words implies that the figurative meaning *was* considered as a plausible interpretation and entered into competition with the literal one. However, since the figurative meaning was the subordinate interpretation, it experienced greater competition from the dominant literal meaning of the phrase and was suppressed as a result. In contrast, the control target word was not as disadvantaged as the figurative, because it had no relation to the idiom or the context, and was therefore an unlikely candidate for meaning competition. Thus, in the case of unfamiliar idioms that do not appear in their canonical form, it appears that the idiomatic meaning becomes less prominent.

A question that arises at this point, is why the figurative meaning of less familiar idioms would compete for activation, since by definition, people would be unfamiliar with the figurative meaning of the respective idioms. Notably though, even the least familiar idioms received a rating of 2 (fairly unfamiliar), and not of 1 (completely unfamiliar), which indicates *some* (but clearly not enough) familiarity with the relevant figurative meaning. Had unfamiliar idioms been completely unknown to participants, we would expect identical processing between the figurative and control target words, as both meanings would be obviously 'wrong' in the context.

As opposed to Siyanova-Chanturia et al., (2011) where the matched control phrases (*at the end of the war*) were contextually congruous, the control

target words (*time* for *kick the bucket*) were not: passivized phrases were kept constant across conditions (*the bucket was kicked*) and therefore it was impossible to include a contextually-plausible control target word that did not relate to either meaning of the phrase. Consequently, although the findings demonstrate a faster processing for the literal and figurative target words relative to the control target words, it cannot be determined whether the activation of these meanings would be slower or faster relative to meaning activation of a matched unambiguous phrase (e.g., *the ball was kicked*). A slower activation would be indicative of competition between the two meanings of a passivized idiom, in the same way that two equally frequent meanings of balanced homonyms compete and slow down processing, whereas a faster activation would suggest that both meanings of a passivized idiom are considered more like related senses of polysemes ('sense-relatedness effect' described by Klepousniotou et al. (2007)). The current study, however, was not designed to delineate this level of specificity and is an avenue for future research.

Further, assuming that modified idioms are matched against pre-stored templates in memory or representations in the lexicon, upon which the retrieval of their figurative meaning depends, the present findings suggest that template-matching operations happen relatively quickly even for modified idioms. The figurative meaning appeared to have equivalent activation to the literal one in a short period of time (i.e., by the time the target words were encountered). More central to the research question, it appears that activation of the figurative meaning *does* occur when idioms are passivized, even in the absence of a preceding biasing context, although the literal meaning of (unfamiliar) idioms

appears to receive more activation and/or might be easier to integrate.

The findings from the target word region support models such as the Configuration Hypothesis (Cacciari & Tabossi, 1988) and Superlemma Theory (Sprenger et al., 2006), which predict idiom activation based on the cooccurrence of idiomatic words regardless of order, and highlight the partly compositional nature of idioms. Importantly though, current models are specifically formulated to predict idiom *activation* (in the absence of context) and cannot be used to explain or predict how the figurative meaning might be *integrated* as part of wider discourse. Consequently, they cannot account for the 'literal advantage' observed here in the idiom region.

The present findings also imply that potential processing costs associated with idiom modification, such as the disadvantage observed for passivized versus active idioms in Chapter 2, cannot be attributed to extensive reanalyses imposed by contextual bias, but may be partially attributed to an inhibitory effect caused by the more dominant literal meaning when unfamiliar idioms are concerned. For passivized versions of familiar idioms, on the other hand, it appears that the figurative meaning experiences some activation, with or without contextual support, or at least that it manages to 'catch-up' with the literal meaning of the phrase rather quickly. Lastly, it is likely that some processing cost may be associated with the passive voice per se, as it is a more complex syntactic operation, though this should apply equally to all conditions in this case.

Similar to the findings reported in Chapter 2, some effects of idiom frequency and familiarity were found on the processing of passivized idioms. High familiarity and frequency of an idiom (in its active form) led to a decrease

in the total reading time of the respective passivized form and reduced the number of fixations in the idiom region. Transparency did not modulate any measures, in line with the findings of Chapter 2, likely because all of the items were rated as highly transparent. Overall, the findings lend support to the Multidetermined Model (Libben & Titone, 2008; Titone & Connine, 1999) where such factors are believed to influence idiom processing and further add that these factors are influential in modified versions of idioms.

Collectively, the findings from previous studies and the ones from the present eye-tracking study seem to indicate that there is weak, or no competition between the two meanings of ambiguous idioms, which appears to extend to modified idioms, even in the absence of rich context. At the same time, it appears that competition between the two meanings of less familiar and modified idioms becomes stronger, with the figurative meaning being supressed and inducing a cost when it is required in the given context. Therefore, it could be argued that semantic selection in familiar idioms (both canonical and modified) could be likened to the simultaneous processing of multiple senses of polysemes, where a commitment to one particular sense might be withheld until encountering further disambiguating evidence, or alternatively, to balanced homonyms, where meaning selection is slower (relative to unambiguous words), but selection does not induce a cost for either meaning. In contrast less familiar (but not completely unknown) idiomatic expressions bear a resemblance to biased homonyms, which tend to have a dominant sense that inhibits the subordinate one. In addition, an issue that deserves further investigation is how to potentially disentangle idiom activation from meaning integration in discourse, in light of current models of idiom

processing. Finally, the findings provide evidence in support of a more flexible processing system, whereby a mere encounter with potentially idiomatic words leads to activation of the relevant figurative meaning, even without strong contextual support—but provided that the relevant meaning is familiar to a speaker.

CHAPTER 4

The processing of modified ambiguous idioms by readers with dyslexia

Evidence demonstrates that people do not *typically* have difficulties in processing either the figurative or literal meaning of ambiguous but familiar idioms (Milburn & Warren, 2019). In fact, findings show that both meanings are processed equally fast (*at the end of the day* = 'eventually' and 'in the evening'), and both are faster to process than the meaning of novel phrases (*at the end of the war*) (Siyanova-Chanturia, Conklin, & Schmitt, 2011). It appears, therefore, that 'knowing' an idiomatic phrase benefits not only the retrieval of the figurative meaning, but somehow the processing of its literal interpretation as well.

In Chapter 3, we saw that this facilitation may extend to modified versions of familiar idioms since passivized idioms facilitated the processing of post-idiom disambiguating words (i.e., target words) that related to the figurative and literal meaning of the phrases (e.g., *body* and *water* for *the bucket was kicked*). Notably, however, an advantage was observed in the idiom region in terms of faster total reading time, when the phrases were intended literally (*the bucket was kicked* = 'the pail was kicked'). It was hypothesised that the literal meaning of passivized idioms was perhaps easier to integrate because it was activated first and remained active throughout. The phrases were unpredictable or 'late-key', and according to the Configuration Hypothesis (Cacciari & Tabossi, 1988) this would mean that the figurative meaning became activated some milliseconds *after* the phrase offset and following a full activation of the literal meaning. Indeed, the figurative

meaning of familiar[9] modified idioms appeared to become available just a few characters further down the sentence and was fully active by the time the target word region was entered.

While it seems that typical readers compensate quickly (at least for familiar idioms), it remains to be seen whether the figurative meaning of such phrases could prove particularly challenging for certain groups who are believed to struggle with non-literal language. People with dyslexia (DYS), and other disabilities that may affect learning (e.g., autism spectrum disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD) etc.), are said to have a reduced pragmatic competence (Cooke, 2001; Griffiths, 2007) and an overall tendency to take language too literally (Hales, 1995). Assuming that typically developed readers (TDRs) *first* active the literal meaning of passivized idioms *and* show a facilitation in terms of meaning integration—although they are able to recover the figurative meaning (of familiar idioms) in a short time (Chapter 3)—dyslectic readers (DYSRs) might fail to retrieve the figurative meaning altogether. If they are indeed prone to understanding language literally, then the literal interpretation might be activated first and remain the *only* interpretation available, thus leading to processing problems when the literal meaning turns out to be incompatible with subsequent context.

Unfortunately, very few studies have investigated the way people with DYS process idioms and current models of idiom processing were not

[9] Familiarity was judged on the canonical form of idioms (e.g., *kick the bucket*). However, the studies in Chapters 2 and 3 demonstrated an identical effect of familiarity (and other factors) on the processing of both canonical and modified forms of idioms (*the bucket was kicked*). Therefore, although a passivized idiom would never be 'familiar' in the technical sense of the word, since passivized idioms are infrequent in language use and hence rather unfamiliar, 'familiar passivized/modified idioms' is adopted here as a contracted way to refer to 'the passive/modified forms of familiar idioms'.

developed taking into consideration learning disabilities (LD), making it difficult to formulate strong predictions. There are, however, some findings from similar groups and particularly from children with broadly specified LD that might help cast some light onto this, albeit in an indirect way. The eye-tracking experiment described in this Chapter, aimed to gather some initial evidence from on-line reading comprehension in order to explore whether DYSRs will be able to activate the figurative meaning of modified (passivized) ambiguous idioms, or whether they will only activate the literal meaning of the phrase.

Meaning activation by TDRs

Idioms are more frequently used in their figurative sense (Moon, 1998) and are known to be processed faster than comparable non-figurative expressions (e.g., Canal, Pesciarelli, Vespignani, Molinaro, & Cacciari, 2015; Carrol & Conklin, 2017, 2019; Carrol, Conklin, & Gyllstad, 2014; Colombo, 2014; Conklin & Carrol, 2019; Conklin & Schmitt, 2008, 2012; Laurent, Denhières, Passerieux, Iakimova, & Hardy-Baylé, 2006; Siyanova-Chanturia, 2015; Siyanova-Chanturia et al., 2011; Tabossi, Fanari, & Wolf, 2009; Underwood, Schmitt, & Galpin, 2004; Vespignani, Canal, Molinaro, Fonda, & Cacciari, 2010). That is not to say, however, that this processing advantage is exclusively associated with the figurative meaning of the phrase, since the literal meaning appears to enjoy a similar processing ease, at least when the phrases in question are familiar and preceded by disambiguating context (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011).

The results of the previous study (Chapter 3) demonstrated that familiar

passivized idioms activate both plausible interpretations (*the bucket was kicked* = 'died' and 'the pail was kicked') even in the absence of a preceding biasing context. This was evidenced by the comparable processing of literal and figurative target words appearing after the idioms (*body* and *water* respectively). However, the passivized forms of *less* familiar idioms demonstrated a preference for their literal meaning, as the reading time of the figurative target words suffered relative to that of the literal target words. This implied that the literal meaning of less familiar idioms might become dominant and the figurative one subordinate, and as such it is suppressed and/or receives greater competition from the literal interpretation. Despite this, the passivized idioms were recognised as idiomatic phrases even when they were less familiar. This was demonstrated by the fact that the figurative target words for less familiar idioms were processed more *slowly* than the irrelevant, control target words. This was taken as evidence of increased competition between the figurative and literal meaning of the phrase (thus indicating activation of the figurative meaning), whereas in contrast, the meaning of the control target word was easily dismissed, as it was contextually anomalous and hence it did not compete for activation. This further indicated that (both familiar and less familiar) passivized idioms were successfully matched with their stored templates or representations in memory, enabling the retrieval of the figurative meaning.

Interestingly, a significantly faster total reading time was observed for passivized idioms and their final words in the literal condition, but as this effect was driven by regressive refixations, it was hypothesized that the facilitation occurred during integration processes. As mentioned above, this facilitation

may have emerged due to the literal meaning becoming activated first. Nevertheless, the figurative meaning of familiar passivized idioms managed to 'catch up' and was as equally active as the literal one in the target word region, a few characters after the phrases. This further suggested that typical readers were able to recover the figurative meaning (of familiar idioms) relatively fast and once both meanings were active, the processing system retained both their activation, thus, facilitating whichever sense of the idiom was favoured by the target word. This suggested that canonical and modified versions of familiar idioms might be processed like polysemes or balanced homonyms, where sense or meaning selection respectively does not come at a cost (at least for the alternative interpretation).

At the same time, neurological findings show that idioms cause a stronger and more widespread activation in the brain (e.g., Boulenger, Hauk, & Pulvermüller, 2008; Boulenger, Shtyrov, & Pulvermüller, 2012; Lauro, Tettamanti, Cappa, & Papagno, 2007; Mashal, Faust, Hendler, & Jung-Beeman, 2008; Zempleni, Haverkort, Renken, & Stowe, 2007) contesting the idea that meaning activation in idioms is undemanding to the processing system. Therefore, despite the faster processing that idioms (in both senses) seem to enjoy in comparison to novel phrases, people whose language processing is impaired because of brain damage or LD might find them particularly challenging.

Idiom processing by DYSRs

People with specific LD and other disorders that can affect learning, such as ASD, are believed to demonstrate difficulties in understanding non-

literal language (Mashal & Kasirer, 2012), including humour (Ozonoff & Miller, 1996), metaphor and irony (Happé, 1993, 1995) and idioms (Kerbel & Grunwell, 1998; Qualls, Lantz, Pietrzyk, Blood, & Hammer, 2004). For example, children with LD have been found to underperform at verbal and visual metaphor tasks: in multiple-choice questions eliciting the most plausible meaning of metaphoric expressions (e.g., *eat up a storm*) embedded in context (with and without pictorial aids), children with LD were significantly more likely to select a literal response than TD children (Friemoth & Kamhi, 1990). Children with semantic-pragmatic difficulties (including Asperger syndrome and high-functioning ASD) had significantly greater difficulty in acting out the meaning of contextually-embedded idioms on a play set and in giving verbal definitions of idioms compared to TD children (Kerbel & Grunwell, 1998). Qualls et al. (2004), similarly observed that preadolescents with language-based LD were less likely to select the contextually-appropriate figurative interpretation of idioms in a multiple-choice task relative to TD peers (e.g., selecting 'be annoying or troublesome' for *go against the grain*), despite the idioms being presented in short biasing stories. Further, explicit idiom comprehension tasks, whereby children were asked to select the 'correct' interpretation of literally-plausible idioms (e.g., *he got cold feet* means: a) 'he lost courage' (figurative), b) 'the temperature of his feet got lower' (literal), c) 'he got a present' (irrelevant distractor)) demonstrated that children with LD and ASD tended to opt for the literal meanings, suggesting that they understood fewer idiomatic expressions than TD children, while no significant difference was noted between ASD and LD children (Mashal & Kasirer, 2011, 2012).

Clearly, as illustrated in the brief literature review above, most of the research to date has been based on children, and the term LD has been used loosely to refer to any kind of learning disability. Dyslexia (DYS) is the most common type of specific LD, affecting up to 12% of the English-speaking population and it sadly remains largely immune to remedial treatments, therefore it continues into adulthood (Kasirer & Mashal, 2017). DYS is characterised by less accurate and/or disfluent word recognition, poor spelling skills, and reduced decoding abilities, which are mainly—but not unanimously—attributed to a phonological deficit (Lyon, Shaywitz, & Shaywitz, 2003). DYS has also been associated with restricted working memory (Smith-Spark & Fisk, 2007), but not with non-verbal intelligence since people with DYS perform similarly to TD peers at general cognition tasks (Eden, Olulade, Evans, Krafnick, & Alkire, 2016).

Dyslexia can manifest in various forms and therefore it is imperative to clarify that DYS here refers to developmental dyslexia, as opposed to acquired DYS which is often the result of brain damage (Nijakowska, 2010). Developmental DYS is a specific learning difficulty that affects children from the early stages of learning how to read and spell (Critchley & Critchley, 1978), and has been associated with difficulties in naming, spoken language, and memory (see Brunswick, 2012). Some of the signs of potential dyslexia include disfluent and inaccurate reading and spelling skills, word omission, easy distraction during reading and writing, struggling with textual comprehension, and problems with retaining verbal information. For some people with DYS, difficulties have also been noted in texts that follow a certain sequence, such as poems, as well as the pronunciation of polysyllabic words.

Often, there is a marked disparity between the spoken and written work of people with DYS.

Dyslexia-specific studies have demonstrated that DYS children display a lack of cohesion in their thoughts as they tend to introduce new topics at unnatural points in conversations (Riddick, Farmer, & Sterling, 1997). Similarly, Cooke (2001) observed that people with DYS underperformed on pragmatic problems, such as understanding idioms, jokes, as well as discerning subtle pragmatic intent. In an exploratory study, Griffiths (2007) administered Bryan's (1995) Right-Hemisphere Language Battery (RHLB) test to people with and without DYS and found that the DYS group struggled to derive inferential information from a text and made considerably more errors in identifying the correct punchline for a joke, compared to the control group. Unlike children with DYS, however, adults and adolescents with DYS can understand conventional metaphors in off-line tasks (e.g., multiple-choice questionnaires) (Griffiths, 2007; Kasirer & Mashal, 2017), indicating that people with DYS are capable of abstract thinking, such as mapping traits from a source to a target domain in metaphors, and/or that they develop compensatory skills.

Recently, Saban-Bezalel et al. (2018) conducted a lexical decision task using a divided visual field paradigm to test meaning activation of (Hebrew) idioms in people with and without DYS. Target words associated with either the literal (*pail*) or figurative meaning (*die*) of idioms (*kick the bucket*) were presented to either the left visual field (Right Hemisphere, RH) or the right visual field (Left Hemisphere, LH) of participants. People with DYS and their TD peers did not differ in reaction times in any condition, but the DYS group

showed a RH advantage in terms of accuracy and hemispheric processing. That is, people with DYS were significantly more accurate in their responses if a literal target was presented in the left visual field (RH) and they also demonstrated overall higher activation of the RH, as opposed to a more bilateral hemispheric processing of the control group. Of note, idioms were presented in isolation (out of context), as is often the case with lexical decision tasks. However, this might take some pressure off of working memory and leave more resources available to processing the phrases, potentially explaining why no differences were noted in reaction times for the dyslexic versus the control group, especially since participants with DYS had longer presentation times to compensate for their slower reading. Indeed, the limited pragmatic awareness has been linked with working memory constraints, delayed processing, and lower skill automatization (Griffiths, 2007). More specifically, the reduced ability to automatize language processing, as a result of a more laborious grapheme-to-phoneme mapping, leaves fewer resources available in the working memory to allocate to higher-level processing, including the processing of non-literal language.

Crucially, idioms in real life are embedded in context, whether that is written or spoken. With particular reference to written language, the combined demands for lower-level processing (e.g., grapheme-phoneme correspondence, word recognition etc.) and higher-level processing (e.g., syntactic analysis, figurative meaning comprehension etc.) during reading might overload the already restricted working memory of DYSRs, contributing to a weakened ability to recognise and process idioms efficiently. In addition, a limited working memory might make it more difficult for DYSRs to simultaneously

entertain multiple interpretations, such as the two plausible meanings of an ambiguous idiom. Therefore, while TDRs appear to maintain activation of both meanings of familiar passivized idioms (Chapter 3), DYSRs might be unable to do so. Interestingly, in a recent study it was found that increased working memory capacity, as well as increased verbal intelligence and inhibitory control correlated positively with on-line idiom comprehension (Cacciari, Corradini, & Ferlazzo, 2018). This further implies that DYSRs might be at a disadvantage when processing idioms, because of their poorer working memory and verbal intelligence, and maybe because of a poorer inhibitory control too, which may not effectively filter out irrelevant meanings.

In fact, deficient inhibitory processes have been noted in children with LD. Lorsbach and colleagues (1996) used sentences with highly constraining final words (e.g., *jelly* in 'We made a sandwich with peanut butter and …'), and replaced some of them with less probable target words (*bananas*). The target words (*bananas*) were subsequently elicited in a memory (sentence completion) task. As opposed to TD children, children with LD tended to complete the sentences with the disconfirmed noun (*jelly*), demonstrating greater difficulty in inhibiting activation of irrelevant (yet highly predictable) information, as well as in sustaining activation of relevant (but less predictable) information (*bananas*). Similar research conducted on highly skilful and less skilful readers (though not readers with LD), has shown that less skilful readers experience difficulty in suppressing the contextually-irrelevant meaning of an ambiguous word (Gernsbacher, 1990, 1993; Gernsbacher & Faust, 1991; Gernsbacher, Varner, & Faust, 1990). For example, Gernsbacher and Faust (1990), asked adult participants to judge whether a target word presented after

a phrase was relevant to the meaning of phrase or not. Some phrases contained ambiguous words as in *he dug with the spade* where *spade* could have the meaning of 'one of the four suits of playing cards' (irrelevant) or 'shovel' (relevant). While both skilful and less skilful readers could not help responding 'yes' to the irrelevant target *ace* when that was presented right after the phrase, skilful readers were able to supress it following a short time interval. In contrast, less skilful readers exhibited no improvement in their ability to suppress the irrelevant meaning even after that, contributing to their problematic textual comprehension. DYSRs are indeed characterised by less skilful reading abilities, which could mean that they too might have problems suppressing contextually-irrelevant meanings, such as the literal meaning of an ambiguous idiom when the figurative one is actually intended, and vice versa. However, if DYSRs also prefer the literal meaning of idioms by default, although they can still retrieve the figurative meaning somehow, deficient inhibition would be visible only when the literal meaning turns out to be dispreferred in the context. In other words, DYSRs might be unable to suppress the irrelevant literal meaning of the phrase in favour of the figurative one.

Overall, the above findings provide indirect evidence supporting the idea that DYSRs might have problems understanding idioms. This could be due to (a) an impaired pragmatic competence which prohibits activation of a non-literal meaning, (b) a poorer working memory which makes access to a figurative meaning as well as the simultaneous contemplation of multiple interpretations difficult, and/or (c) an inability to inhibit irrelevant meanings, such as the literal meaning when an utterance is intended figuratively. Alternatively, it is possible that a combination of these factors exists or that

these factors are somehow interrelated. Importantly, there is hardly any empirical evidence demonstrating *how* people with DYS process idioms, and specifically whether the figurative meaning would be available, albeit slower to activate, or completely irretrievable. As opposed to the explicit off-line measures (i.e., comprehension tasks) prevalent in most previous studies, and to the lexical decision task of Saban-Bezalel et al. (2018) where idioms were presented out of context, this eye-tracking experiment allowed for an investigation of how adults with DYS deal with idioms embedded in discourse, during on-line reading, thus resembling more closely real-life demands. Notably, problems in accessing the figurative meaning and/or inhibiting the irrelevant (literal) meaning of an idiom would go above and beyond the typical reading problems associated with DYS. Therefore, while an overall slower reading would be expected for DYSRs, difficulties arising as a direct result of idiom comprehension should manifest in the way the literal versus the figurative meaning is processed.

The study

This exploratory study aimed to test how DYSRs would process the meaning of modified ambiguous idioms compared to the TDRs employed in the previous study. To this end, the experiment of Chapter 3 was replicated with DYSRs. Passivized idioms (*the bucket was kicked*) were embedded in neutral sentences without prior context and the intended meaning was clarified by a single word—the target word—which appeared after the phrases and was associated either with the figurative meaning of the phrase (*body*), the literal meaning (*water*), or was irrelevant to both (*time*). Passivized phrases (*the*

bucket was kicked) remained the same across conditions. The results of the previous chapter illustrated that both the figuratively- and literally-related target words (*body/water*) of passivized forms of familiar idioms were equally fast to process by TDRs and both were faster to process than the control target words (*time*). Less familiar idioms, on the other hand, prioritised their literal interpretation and the figurative meaning appeared to suffer. It was also suggested that the literal meaning was easier to integrate into the context, perhaps due to faster and/or greater initial activation. Importantly though, the figurative meaning of familiar passivized idioms was retrieved in due course and was as highly active as the literal one in the target word region. Once both interpretations were active, the processing system maintained their activation, facilitating the processing of both relevant target words (i.e., literal and figurative).

It was anticipated that DYSRs would be significantly slower than TDRs, but crucially, it was hypothesised that DYSRs might exhibit a different reading pattern for idioms and target words which goes beyond their slower reading speed. That is, if DYSRs *cannot* activate the figurative meaning of passivized idioms (*the bucket was kicked* = 'died'), then the figurative (*body*) and control (*time*) target words should be processed significantly more slowly than the literal target words (*water*). Further, figurative and control target words should not differ from one another, indicating that the figurative meaning was not considered as a plausible interpretation and as such did not compete for activation. Instead, if the figurative meaning *can* be accessed, but only after the literal meaning turns out to be incompatible in the context, then the figurative target word (*body*) should be slower to process than the literal

target word (*water*), but still faster than the control (*time*). This would also indicate reduced inhibition processes, whereby the irrelevant meaning is difficult to suppress, and a poorer ability to entertain more than one meaning simultaneously. Alternatively, if DYSRs can access and maintain both meanings of (familiar) passivized idioms just like TDRs, we would expect that the processing of the literal (*water*) and figurative (*body*) target words would be identical as in TDRs, although naturally slower. With regards to the idiom region (*the bucket was kicked*) we might expect to see an even greater effect for the literal condition, assuming that DYSRs will have a preference for the literal meaning of the phrase ('the pail was kicked').

Methodology

Participants

The experimental group consisted of 36 participants (mean age = 20.8, SD = 3.12, 26 females, 10 males) formally diagnosed with developmental DYS by an educational psychologist. As a control group I used the data from the 45 participants (mean age = 20.02, SD = 3.28, 37 females and 8 males) collected for the study in Chapter 3. These were TDRs who had not reported having learning disability, or any other reading impairment. Both DYSRs and TDRs were (high-functioning) native speakers of British English and received either university course credit or payment for their participation.

Phonological decoding skills and general cognition

To ensure that the DYSRs and TDRs were representative of their respective groups I administered three sub-tests of the Rapid Automatized

Naming task (RAN) (Denckla & Rudel, 1976), a tool that can screen for DYS in children and adults (see Jones, Snowling, & Moll, 2016). These tests measure naming speed for highly familiar stimuli across a variety of categories: letters, digits, colours, items, or combinations of these. Each sub-test contains the same 5 items (i.e., 5 letters/digits etc.) that are repeated on a 10 x 5 matrix. Participants are asked to read the stimuli aloud as fast as possible using a left to right and down orientation, as they would normally read a piece of text. Naming speed is believed to indicate the level of automatization of low-level lexical processes (such as grapheme-to-phoneme mapping for example) and as such it correlates with reading fluency and discriminates between proficient and less proficient readers: faster naming times predict more fluent reading and vice versa. People with DYS tend to exhibit slower naming speeds compared to people without learning disabilities, particularly in the letter- and digit-subtests (e.g., Bowers & Swanson, 1991; Bruck, 1990; S. Griffiths & Frith, 2002). Thus, both of these sub-tests were used, as well as the one combining these two types of stimuli (2Set). As can be seen from Table 4.1, DYSRs did significantly less well in all three sub-tests of the RAN test compared to the TDRs. To further ensure that group differences would not be due to unrelated cognitive differences, the Raven's Advanced Progressive Matrices Short Form test (APM-III) (Raven, 2010) was administered, as a measure of non-verbal intelligence. The full test consists of 23 pattern completion tasks and takes approximately 40 minutes to complete. In order to ensure that participants could finish all of the tasks (including eye-tracking) within an hour, participants were given 20 minutes to attempt the first 15 items of the booklet. The mean scores (Table 4.1) indicated no differences in non-

verbal intelligence between the groups.

Table 4.1-Performance on phonological and intelligence tasks administered to TDRs and DYSRs. The mean scores for the three sub-tests of the RAN test are reported as time in seconds, whereas the scores for the APM-III are reported as the averaged sum of correct responses out of 15.

	Mean (SD)		*p*	*t*	df
	TDSs	DYSRs			
RAN-Digits	21 (4.8)	15.41 (2.4)	0.03	-5.423	79
RAN-Letters	20.57 (5)	15.76 (2.8)	0.004	-6.733	79
RAN-2Set	23.46 (5.7)	16.74 (2.3)	0.003	-7.201	79
APM-III	9.58 (2.9)	8.84 (2.6)	0.415	-1.181	79

Materials, Design, and Procedures

The same materials, experimental design, and procedures from the previous study (Chapter 3) were employed for the current eye-tracking experiment. For convenience, some stimuli examples are reproduced below (Table 4.2). As before, 45 ambiguous idioms were presented in their passive form (*the bucket was kicked*) in a neutral context to avoid meaning bias. Each sentence contained one disambiguating word, the target word, which either related to the figurative meaning of the phrase (*body*), the literal meaning (*water*), or was unrelated to both (*time*). Participants were asked to read the sentences for comprehension and to answer YES/NO questions on some of the filler items, while their eye-movements were tracked by an EyeLink 1000+ desktop mount eye tracker. Norming data on the frequency, familiarity, transparency, and transitional probability of the idioms were collected, as well as semantic association strengths between the target words and the respective nouns and verbs of idioms (for details see Table 3.2 Chapter 3).

Table 4.2 - Example stimuli used for the idioms kick the bucket, tie the knot, and clear the air, across conditions: (a) idiomatic, (b) literal, and (c) control. The idioms and their target words are underlined.

1	Kick the bucket	a	When the bucket was kicked, she got rid of the body with the help of her devoted housekeeper.
		b	When the bucket was kicked, she got rid of the water with the help of her devoted housekeeper.
		c	When the bucket was kicked, she got rid of the time with the help of her devoted housekeeper.
2	Tie the knot	a	Once the knot was tied, he felt confident that his wife would not go anywhere.
		b	Once the knot was tied, he felt confident that his boat would not go anywhere.
		c	Once the knot was tied, he felt confident that his idea would not go anywhere.
3	Clear the air	a	When the air was cleared, they were finally able to reconcile and everything went back to normal.
		b	When the air was cleared, they were finally able to breathe and everything went back to normal.
		c	When the air was cleared, they were finally able to jump and everything went back to normal.

Results

The dyslexic group scored equally well on the comprehension task, with both the DYSRs and TDRs reaching 93% correct responses, confirming that DYSRs had no problem with the task and that their overall comprehension was not impaired relative to TDRs. To aid comparisons between the two groups, I focused the analyses on the same areas of interest and analysed the

data in exactly the same way as in the previous Chapter. Therefore, I examined the total reading time for the whole idiom (*the bucket was kicked*) and the first fixation duration, first pass reading time, total reading time, and skipping rate for the target word (*body/water/time*), idiom noun (*bucket*) and idiom verb (*kick*) respectively. Regression likelihood and number of fixations were explored for all interest areas. Idiom verbs (which were the final words of the phrases) and target words were also examined for spillover effects on n+1. Experimental list was included in the models to ensure no list effects. The means of these analyses are present in Table 4.3.

Table 4.3-Mean values across interest areas for typically developed readers (TDRs) and readers with dyslexia (DYSRs). All durational measures are reported in milliseconds, regression and skipping likelihood as probability between 0-1, and fixation count as instances.

		Group TDRs	DYSRs	Group TDRs	DYSRs	Group TDRs	DYSRs
		Mean *First fixation duration (ms)*		Mean *First pass reading time (ms)*		Mean *Total reading time (ms)*	
Condition	Idiom noun	174 (2.71)	185 (4.64)	185 (3.35)	206 (8.30)	257 (9.91)	366 (43 22)
	Idiomatic	176 (3.25)	182 (4.91)	186 (4.09)	201 (8.48)	263 (11.20)	361 (43.20)
	Literal	174 (3.21)	185 (4.99)	186 (4.08)	209 (8.85)	254 (10.80)	358 (42.80)
	Control	172 (3.15)	188 (5.06)	184 (4.02)	208 (8.80)	256 (10.90)	377 (45. 10)
		First fixation duration (ms)		*First pass reading time (ms)*		*Total reading time (ms)*	
Condition	Idiom verb	184 (3.36)	200 (8.47)	200 (4.91)	227 (18.51)	261 (11.10)	348 (43.90)
	Idiomatic	186 (3.91)	198 (8.70)	201 (5.59)	224 (18.55)	261 (11.20)	347 (44.90)
	Literal	180 (3.78)	203 (8.89)	194 (5.39)	232 (19.17)	247 (10.50)	348 (43.09)
	Control	188 (3.96)	198 (8.68)	204 (5.68)	225 (18.57)	275 (11.70)	379 (47.08)
		First fixation duration (ms)		*First pass reading time (ms)*		*Total reading time (ms)*	
Condition	Target word	188 (3.46)	201 (4.01)	201 (4.42)	222 (5.20)	255 (9.89)	329 (13.73)
	Idiomatic	187 (3.98)	208 (4.77)	202 (5.17)	232 (6.28)	240 (10.20)	321 (14.57)
	Literal	188 (3.99)	196 (4.52)	200 (5.11)	219 (5.97)	234 (9.86)	287 (13.06)
	Control	190 (4.07)	199 (4.58)	201 (5.16)	215 (5.84)	294 (12.77)	385 (17.91)
		Regression Likelihood		*Fixation count*		*Skipping*	
Condition	Idiom noun	0.43 (0.03)	0.52 (0.05)	1.62 (0.05)	2.16 (0.07)	0.19 (0.02)	0.18 (0.04)
	Idiomatic	0.46 (0.04)	0.54 (0.05)	1.66 (0.07)	2.16 (0.09)	0.18 (0.02)	0.16 (0.04)

	Literal	0.41 (0.04)	0.48 (0.05)	1.59 (0.06)	2.13 (0.09)	0.19 (0.02)	0.16 (0.04)
	Control	0.42 (0.04)	0.53 (0.05)	1.64 (0.06)	2.23 (0.09)	0.19 (0.02)	0.21 (0.05)

		Regression Likelihood		*Fixation count*		*Skipping*	
	Idiom verb	0.13 (0.01)	0.18 (0.03)	1.56 (0.05)	2.04 (0.07)	0.06 (0.1)	0.07 (0.03)
Condition	Idiomatic	0.13 (0.01)	0.15 (0.03)	1.55 (0.06)	1.98 (0.08)	0.06 (0.01)	0.08 (0.04)
	Literal	0.11 (0.01)	0.19 (0.04)	1.49 (0.06)	1.96 (0.08)	0.05 (0.01)	0.08 (0.04)
	Control	0.15 (0.02)	0.20 (0.04)	1.62 (0.06)	2.18 (0.09)	0.06 (0.01)	0.06 (0.03)

		Regression Likelihood		*Fixation count*		*Skipping*	
	Target word	0.19 (0.02)	0.25 (0.02)	1.45 (0.05)	1.81 (0.07)	0.10 (0.01)	0.08 (0.01)
Condition	Idiomatic	0.14 (0.02)	0.21 (0.02)	1.43 (0.06)	1.74 (0.08)	0.06 (0.01)	0.05 (0.01)
	Literal	0.12 (0.01)	0.18 (0.01	1.37 (0.06)	1.61 (0.08)	0.05 (0.01)	0.05 (0.01)
	Control	0.34 (0.03)	0.38 (0.04)	1.57 (0.07)	2.09 (0.10)	0.20 (0.02)	0.15 (0.02)

		Spillover (ms)	
	Idiom verb	172 (3.67)	200 (5.70)
Condition	Idiomatic	170 (5.47)	206 (7.57)
	Literal	175 (5.75)	198 (6.89)
	Control	170 (5.35)	198 (7.08)

		Spillover (ms)	
	Target word		
Condition	Idiomatic	184 (5.87)	204 (6.66)
	Literal	189 (6.12)	206 (6.80)
	Control	188 (6.28)	203 (6.70)

		Total reading time (ms)		*Regression Likelihood*		*Fixation count*	
Condition	Idiom	740 (33.8)	1182 (59.4)	0.73 (0.01)	0.86 (0.02)	4.27 (0.17)	6.38 (0.29)
	Idiomatic	749 (35.4)	1154 (60.2)	0.73 (0.04)	0.86 (0.02)	4.29 (0.19)	6.25 (0.29)
	Literal	716 (33.9)	1138 (59.4)	0.70 (0.04)	0.84 (0.03)	4.17 (0.18)	6.10 (0.29)
	Control	755 (35.8)	1258 (65.6)	0.75 (0.04)	0.87 (0.02)	4.35 (0.19)	6.78 (0.32)

As in Chapter 3, data were analysed using mixed effects models with the *lme4* package version 1.1-20; (D Bates et al., 2015) in R (version 3.5.2; R Core Team, 2018), while pairwise comparisons and means were calculated using the *emmeans* package (Lenth, 2018). As before, Condition was set as a three-level fixed factor, with the idiomatic condition being the baseline. Group (DYSRs vs. TDRs) was set as a two-level fixed factor, with TDRs being the baseline. Items and participants were set as random factors, but only the by-items and by-participant intercepts were included in the models due to convergence issues. In line with the data analysis in Chapter 3, idiom frequency, familiarity, and transparency were included as predictors in separate models for idioms and target word analyses, while for target words separate effects of target word length and frequency were included. The semantic association strength between target words and idioms' verbs and nouns was also explored in both idiom and target word analyses. Idiom frequency and transparency were residualised and familiarity was centred in the same fashion as in the previous Chapter. Model components were added in a stepwise manner and were kept only if they improved the model's fit.

Fixations shorter than 80ms were embedded into the largest nearest fixation for a distance up to 0.5 degrees, or were removed from the data when distance exceeded this threshold. This, in combination to occasional track loss led to an overall data loss of 2.71%. No outliers were removed from the idiom or idiom content words datasets and only a couple of extreme values were removed from the target word dataset (0.12%). Twenty-four per cent of words were skipped during first pass reading and not later fixated by a regression (116 idiom nouns: 40 in the idiomatic, 44 in the literal, and 32 in the control

condition; 117 idiom verbs: 39 in the idiomatic, 43 in the literal and 35 in the control condition; and 157 target words: 41 in the idiomatic, 58 in the literal and 58 in the control condition).

While it was expected that overall DYSRs would be slower readers based on previous eye-tracking findings reporting longer fixations, shorter saccades, more fixations, and more regressions for people with DYS compared to TDRs (for further discussion see Rayner, 1998; Rayner, Juhasz, & Pollatsek, 2005), the focus here was to test how each group would read the specified areas of interest as a function of Condition. For this reason, I only report models where *both* Group and Condition were significant and/or where there was a significant interaction between the two. The outputs of the relevant models are presented in Table 4.4. Any remaining models are included in Appendix E.

Table 4.4-Model outputs for dyslexic (DYSRs) versus typically developed readers (TDRs)

IDIOMS								
	Total reading time				Fixation count			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*z*	*p*
(Inter.)	6.6	0.05	142.98	**<0.001**	1.44	0.04	33.58	**<0.001**
DYSRs	0.47	0.06	7.51	**<0.001**	0.4	0.06	6.94	**<0.001**
Literal	-0.03	0.02	-1.95	0.051	-0.03	0.02	-1.48	0.14
Control	0.04	0.02	2.65	**0.008**	0.05	0.02	2.91	**0.004**
Random Effects								
σ^2	0.16				0.18			
τ_{00}	0.07_{PPT}				0.06_{PPT}			
	0.01_{ITEM}				0.01_{ITEM}			
N	81_{PPT}				81_{PPT}			

	44_{ITEM}				44_{ITEM}			
Observ.	3557				3557			

IDIOM VERBS

	Total reading time				Fixation count			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*z*	*p*
(Inter.)	5.55	0.04	135.72	**<0.001**	0.43	0.04	11.13	**<0.001**
DYSRs	0.32	0.13	2.42	**0.022**	0.27	0.05	5.39	**<0.001**
Literal	-0.03	0.02	-1.35	0.177	-0.03	0.03	-0.78	0.437
Control	0.07	0.02	2.96	**0.003**	0.07	0.03	2.16	**0.031**
Random Effects								
σ^2	0.27				0.48			
τ_{00}	0.05_{PPT}				0.04_{PPT}			

	0.01 ITEM	0.00 ITEM
N	81 PPT	81 PPT
	44 ITEM	44 ITEM
Observ.	3163	3163

TARGET WORDS

	First fixation duration				Total reading time				Regression likelihood				Fixation count			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*	*β*	*SE*	*z*	*p*	*β*	*SE*	*z*	*p*
(Inter.)	5.23	0.02	247.3	**<0.001**	5.27	0.06	86.46	**<0.001**	-1.72	0.16	-10.84	**<0.001**	0.07	0.08	0.94	0.348
DYSRs	0.11	0.03	3.83	**<0.001**	0.25	0.05	5.3	**<0.001**	0.35	0.18	1.97	**0.048**	0.22	0.05	4.42	**<0.001**
Literal	0.01	0.02	0.34	0.736	-0.06	0.02	-2.94	**0.003**	-0.19	0.12	-1.6	0.11	-0.05	0.04	-1.28	0.2
Control	0.02	0.02	0.97	0.334	0.19	0.03	7.19	**<0.001**	1.01	0.11	9.42	**<0.001**	0.24	0.04	5.78	**<0.001**

Dys* Literal	-0.07	0.03	-2.46	**0.014**								
Dys* Control	-0.07	0.03	-2.41	**0.016**								
Target word length					0.04	0.01	5.58	**<0.001**			0.04	0.01	4.24	**<0.001**
Random Effects												
σ^2	0.09				0.24				3.29		0.48	
τ_{00}	0.01 $_{PPT}$				0.04 $_{PPT}$				0.47 $_{PPT}$		0.03 $_{PPT}$	
	0.00 $_{ITEM}$				0.02 $_{ITEM}$				0.25 $_{ITEM}$		0.01 $_{ITEM}$	
N	81 $_{PPT}$				81 $_{PPT}$				81 $_{PPT}$		81 $_{PPT}$	
	44 $_{ITEM}$				44 $_{ITEM}$				44 $_{ITEM}$		44 $_{ITEM}$	

Observ.	3030	3030	3030	3030

Idiom and idiom content words

Group and Condition together did not reach significance in any analyses of the idiom noun (*bucket*), although Group alone did modulate most of the measures, indicating a more effortful processing for DYSRs versus TDRs (Appendix E). Both Group and Condition significantly modulated the total reading time and number of fixations in idiom verbs (*kicked*)—which were also the final words of the phrases—and by extension in the idioms as a whole (*the bucket was kicked*). Dyslexic readers read idioms and their final words significantly more slowly and produced significantly more fixations than TDRs, but both groups produced longer and more fixations in the control condition, in both interest areas. There was no significant interaction between Group and Condition in either measure, although the interaction approached significance in the total reading time of idioms ($p = 0.059$).

In Chapter 3, a significant facilitation was noted for the total reading times of both idioms and their final words (verbs) in the literal condition. Here, the literal condition did not significantly differ from any other condition in idiom verbs and was only marginally significant in the idiom region ($p = 0.051$). To test for more fine-grained differences pairwise comparisons were conducted for the total reading time of idioms. These indicated that TDRs indeed read the passivized idioms faster in the literal condition compared to the idiomatic ($p = 0.03$) and control condition ($p = 0.01$). DYSRs showed no difference between the idiomatic and literal condition ($p = 0.54$), although idioms in both the literal and idiomatic condition were read significantly faster than (the same) idioms in the control condition (both ps < 0.001). The same trend was observed in idiom verbs, although pairwise comparisons failed to

reach significance. Experimental list was not significant in any models.

Target words

Both Group and Condition reached significance in all of the analyses of the target words, with the exception of first pass reading time.[10] Interestingly, there was a significant interaction between Group and Condition in the first fixation duration, whereby DYSRs tended to fixate the idiomatic target word (*body*) for significantly longer compared to both the literal (*water*) and control target word (*time*). In contrast, TDRs did not exhibit a significant difference in their first fixation duration as a function of Condition. Pairwise comparisons confirmed these findings and further added that although idiomatic target words induced longer first fixations than both literal and control target words (ps < 0.01) in DYSRs, literal and control target words did not differ (p = 0.5).

The analysis of the total reading time of target words indicated main effects of Group, Condition, and Word Length, but there was no significant interaction between Group and Condition. DYSRs read (all) target words significantly more slowly than TDRs. The main effect of the literal condition suggested that literal target words were read significantly faster overall. Pairwise comparisons, however, revealed that *only* DYSRs read literal target words faster than both control and idiomatic target words (ps < 0.001); TDRs only read literal target words faster than *control* target words (p < 0.001) but *not* faster than idiomatic target words (p = 0.4). Control target words induced significantly longer total reading times and pairwise comparisons confirmed that both groups read control target words significantly more slowly in

[10] Both factors were significant initially, but once Target word Length was inserted in the model, Condition was no longer significant.

comparison to both literal and idiomatic target words (all *p*s < 0.001). The length of the target words (in characters) was also significant in this model: the longer the target word, the longer its total reading time was.

Control target words were significantly more likely to elicit a regression and elicited significantly more fixations than both idiomatic and literal target words in both groups. Pairwise comparisons confirmed this and further showed that idiomatic and literal target words did not differ in terms of regression likelihood and fixation count in either DYSRs or TDRs, (*p*s > 0.05). Target word length also affected the number of fixations, with longer target words inducing significantly more fixations in both groups. Finally, there was no effect of semantic association strength, target word frequency, or experimental list in any of the models for target words.

Idiom factors

Frequency, familiarity, and transparency were included in separate models to see if they further influenced any of the idiom and target word analyses. As in the previous chapter, transitional probability was excluded from the models due to it consisting almost entirely of 0 values. The model outputs where any of these factors significantly modulated the outcome are presented in Table 4.5. In models where both Group and Condition were significant, familiarity alone modulated the total reading time and the number of fixations in idioms, with more familiar idioms yielding significantly shorter and fewer fixations regardless of Condition or Group.

Table 4.5-Model outputs for dyslexic and typically developed readers, including idiom factors (familiarity, frequency, and transparency) that reached significance

IDIOMS

	Total reading time				Fixation count			
Pred.	*β*	*SE*	*t*	*p*	*β*	*SE*	*z*	*p*
(Inter.)	6.6	0.05	144.72	**<0.001**	1.44	0.04	33.94	**<0.001**
DYSRs	0.47	0.06	7.51	**<0.001**	0.4	0.06	6.94	**<0.001**
Literal	-0.03	0.02	-1.95	0.051	-0.03	0.02	-1.47	0.143
Control	0.04	0.02	2.65	**0.008**	0.05	0.02	2.91	**0.004**
Fam.	-0.05	0.02	-2.67	**0.011**	-0.04	0.02	-2.63	**0.008**
Random Effects								
σ^2	0.16				0.18			
τ_{00}	0.07 $_{PPT}$				0.06 $_{PPT}$			
	0.01 $_{ITEM}$				0.01 $_{ITEM}$			
N	81 $_{PPT}$				81 $_{PPT}$			
	44 $_{ITEM}$				44 $_{ITEM}$			
Observ.	3557				3557			

TARGET WORDS

	Total reading time			
Pred.	*β*	*SE*	*t*	*p*
(Inter.)	5.28	0.06	86.06	**<0.001**
DYSRs	0.25	0.05	5.3	**<0.001**
Literal	-0.07	0.02	-3.07	**0.002**

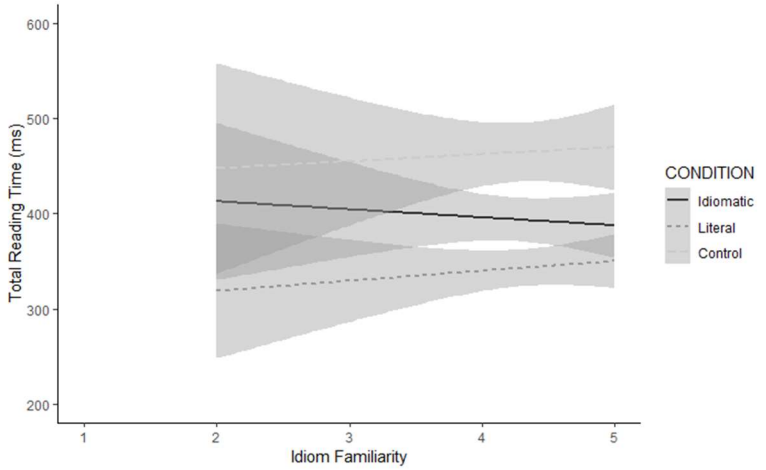
Control	0.19	0.03	7.12	**<0.001**
Target word length	0.04	0.01	5.39	**<0.001**
Fam.	-0.09	0.05	-1.78	0.076
DYSRs*Fam.	0	0.02	0.04	0.967
Lit.*Fam.	0.06	0.02	2.67	**0.008**
Contr.*Fam.	0.08	0.02	3.1	**0.002**
Target word length*Fam.	0.01	0.01	1.14	0.254
Random Effects				
σ^2	0.24			
$\tau_{00\ PPT}$	0.04			
$\tau_{00\ ITEM}$	0.02			
N_{PPT}	81			
N_{ITEM}	44			
Observ.	3030			

Familiarity interacted with Condition in the total reading time of target words but it did not interact with Group, exhibiting a similar pattern to the one observed in the previous chapter (Figure 4.1): increased idiom familiarity speeded the total reading time of idiomatic target words and slowed the reading time of both literal and control target words although this was less pronounced for DYSRs. A separate model including only highly familiar idioms (Familiarity >= 4) showed that literal target words were *not* significantly slower *or* faster to process than idiomatic target words ($\beta_{Literal}$ = -0.03, SE = 0.02, t = -1.25; p = 0.20), while control target words were significantly slower to read ($\beta_{Control}$ = 0.24, SE = 0.03, t = 7.34; p < 0.001). This aligned with the

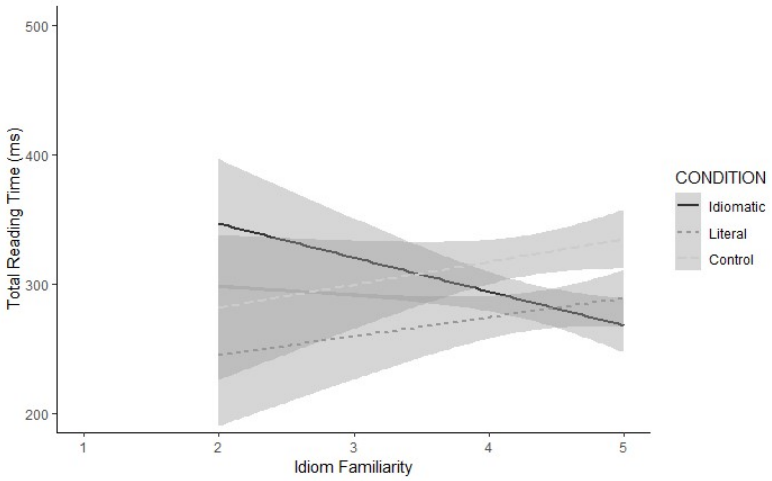
findings of the previous Chapter. Although familiarity did not interact with Group, I ran a separate model for DYSRs with highly familiar idioms, to see whether the effect was driven by both groups or whether it was driven mainly by the TDRs. Interestingly, this model indicated that even for highly familiar idioms, DYSRs were significantly faster to read the literal than the figurative target words ($\beta_{Literal}$ = -0.038 SE = 0.04, t = -2.04; p = 0.04), but the figurative target words were also significantly faster to read than the control target words ($\beta_{Control}$= 0.24, SE = 0.05, t = 4.92.25; $p < 0.001$). In contrast, unfamiliar idioms in both groups seemed to facilitate their literal target words at the expense of the figurative ones, but interestingly, the control target words in DYSRs were always slower than the figurative target words, whereas the control target words in TDRs were faster than figurative target words for less familiar idioms, potentially indicating defective suppression mechanisms for DYSRs. Unfortunately, as a result of a limited number of observations for unfamiliar idioms, there was not enough power to run additional analyses for unfamiliar idioms and therefore it was impossible to test whether the differences between idiomatic and control target words in either group was statistically significant.

Figure 4.1-Effect of Familiarity on the total reading time of Target words in DYSRs (a) and TDRs (b)

(a)



(b)



Discussion

The aim of this study was to explore how readers with DYS (DYSRs) would process the figurative versus the literal interpretation of modified and semantically ambiguous idioms and whether their reading pattern would differ from that of typically developed readers (TDRs). In the study in Chapter 3, it was found that the literal meaning of passivized idioms (*the bucket was kicked* = 'the pail was kicked') was integrated more easily in the context, but TDRs were able to quickly activate the figurative interpretation when the idioms were familiar (*the bucket was kicked* = 'died'), since the figurative target words (*body*) produced identical processing as the literal ones (*water*). For less familiar idioms, on the other hand, the literal meaning dominated over the figurative, as the literal target words were faster to process than the figurative ones. The present results demonstrated significant differences in the way DYSRs processed the same phrases. While no differences were found in the idiom region between the literal and figurative condition, the findings from the target word region showed that DYSRs *preferred* the literal interpretation of the phrases. The literal target words (*water*) were overall significantly faster to process than both the figurative (*body*) and control target words (*time*), resembling the way TDRs processed the less familiar passivized idioms. Importantly though, DYSRs did activate the figurative meaning since figurative target words elicited a shorter total reading time than the control target words. However, compared to the literal meaning, the figurative meaning was costly to the processing system.

Circumstantial evidence, not necessarily derived from studies on adults with DYS, suggested that this population might be inclined to interpret

language too literally because of a reduced pragmatic competence, an inability to simultaneously hold multiple meanings in the working memory, limited resources available to the processing of non-literal language, and/or an inability to effectively inhibit contextually-irrelevant meanings. Considering these, two possibilities arose. First, DYSRs would be completely incapable of activating the figurative meaning of a passivized idiom, or second, the figurative meaning could become available, but at a significant delay relative to the literal meaning of the phrase.

TDRs processed both idiomatic (*body*) and literal target words (*water*) equally fast and both enjoyed a faster reading time, fewer fixations, and a decreased probability for a regression relative to control target words (*time*). It was concluded, therefore, that by the time the target word region was reached, both meanings of modified ambiguous idioms were available and there was no competition between the two: both interpretations remained active, facilitating whichever sense was then favoured by the target word. A significant interaction between idiom familiarity and target word condition in the total reading time, confirmed that the two plausible meanings did not compete when idioms were familiar, but they did so when idioms were less familiar. In the latter case, a longer processing time was observed for the figurative compared to the literal (and control) target words, indicating that the literal meaning of less familiar and modified idioms was more highly activated.

Although DYSRs produced significantly more fixations and were significantly more likely to regress into the target word region in comparison to TDRs, the two groups did not differ with regards to how many times they (re)fixated the figurative versus the literal target words. That is, regression

likelihood and fixation count in both groups only increased significantly for the control target words, while literal and idiomatic target words did not differ between them. This suggested that less (re)analysis was required for the two plausible interpretations of the phrases, by both groups. However, DYSRs exhibited some crucial differences in the processing of the target words in the total reading time and first fixation duration. In the former instance, literal target words elicited significantly faster total reading times compared to both idiomatic and control target words. Importantly, a separate analysis revealed that DYSRs had a preference towards the literal meaning of the phrases of not only when idioms were less familiar, but also when they were highly familiar. It could be argued, therefore, that the literal interpretation is indeed dominant for DYSRs, in line with the argument that people with learning disabilities, including dyslexia, lack a certain pragmatic awareness and tend to understand language too literally (Cooke, 2001; Griffiths, 2007; Hales, 1995).

Notably, the current finding are in contrast to that of Saban-Bezalel et al.'s (2018), who found no difference between TDRs and DYSRs in reaction times to target words associated to either the literal (*pail*) or figurative meaning of idioms (*die*). However, as was argued before, this might reflect differences in task demands, as idioms in that study were presented in isolation, where in the present study, idioms were embedded in context. Here, the lower- and higher-level demands of on-line discourse processing, including word recognition, syntactic processing, meaning integration etc., could have overloaded the working memory capacity and interfered with the DYSRs' ability to activate the figurative meaning. Nevertheless, the present findings are somewhat in line with Saban-Bezalel et al. (2018), in the sense that DYSRs

were able to activate the figurative meaning of passivized idioms, implying that activation of non-literal interpretations was not impaired. This was demonstrated by the fact that the figurative target words were read significantly *faster* than the control target words, suggesting that DYRs had retrieved the relevant meaning, although at a delay relative to the literal one.

Further evidence in support of this emerged from the analysis of the first fixation duration of target words and more specifically by the interaction between Condition and DYSRs. DYSRs produced significantly longer first fixations for figurative target words, but no modulation was observed for TDRs in the same measure. First fixation duration is believed to reflect early stages of processing, such as word recognition (Conklin et al., 2018), but may be indicative of initial meaning activation in this case as literal and figurative target words were matched for length and frequency and, therefore, differences cannot be attributed to variability in word properties. Instead, the present finding suggests that DYSRs realised early on (i.e., from the first fixation) that the figurative target words offered a plausible interpretation in the context, but the activation of this interpretation was for some reason problematic. Literal and control target words, on the other hand, yielded shorter first fixations and did not differ between them. The literal target words were easy to process probably because they were readily unified with the dominant literal interpretation of the phrase, while the control target words, were probably just as easily discarded as anomalous, especially since these were significantly shorter and more frequent, thus speeding up their identification as incongruous in the context. This naturally begs the question of why the figurative target words would induce such long first fixation durations.

Two possible explanations may account for this. First, the figurative meaning was not initially activated in the idiom region and therefore the inflated first fixation duration in the target word region reflects a post hoc idiom identification and activation of the figurative meaning. Second, it is possible that the figurative meaning did receive some initial activation in the idiom region, but was suppressed in favour of the literal interpretation, or the literal meaning was not effectively inhibited in the target word region despite its contextual irrelevance. This would be in line with the argument that DYSRs have deficient inhibitory mechanisms, but also with the claim that working memory constraints prevent DYSRs from holding multiple interpretations in memory, thus leading to a premature commitment to the literal sense.

The undifferentiated first fixation duration for TDRs further implies that TDRs process (at least familiar) modified idioms more like balanced homonyms or polysemes where meaning selection does not come at a cost for the alternative interpretation—although like balanced homonyms, passivized idioms could be more costly compared to non-idiomatic passive phrases (e.g., *the ball was kicked*). DYSRs, on the other hand, exhibit sings of committing to the literal meaning of both familiar and less familiar passivized idioms which yields a considerable cost when this meaning is disconfirmed by later context. It could be argued, therefore, that DYSRs are more inclined to treat modified idioms like biased homonyms that have a dominant interpretation (literal) and selection of the subordinate meaning (the figurative) creates subordinate bias effect (i.e., processing cost). Unfortunately, as no studies to date have systematically examined how DYSRs process homonyms and polysemes, it is impossible draw comparisons with the present findings, although this seems

like a good avenue for future research.

Idioms and their final words in the control condition elicited significantly more and longer fixations from both DYSRs and TDRs, and the analyses including idiom familiarity, frequency, and transparency did not reveal any differences between the two groups. The literal advantage observed by TDRs in the previous Chapter only approached significance in the general model, but was still significant in pairwise comparisons. This was taken to reflect an easier integration of the literal, as opposed to the figurative meaning, possibly because the literal meaning was activated first: the passivized phrases were unpredictable as idiomatic configurations, which meant that the figurative meaning became available *after* the phrase offset, whereas the literal meaning was immediately available *at* the phrase offset (Configuration Hypothesis (Cacciari & Tabossi, 1988)). DYSRs, on the other hand, read the passivized phrases and their final words in both the idiomatic and literal condition at the same rate and produced a comparable number of fixations, suggesting that neither meaning was more or less difficult than the other for DYSRs to integrate. However, this does not mean that DYSRs were more efficient at integrating meaning, but rather that they were more inclined to integrate a meaning as soon as evidence of ambiguity emerged. For example, upon first fixating the target word, DYSRs strived to assign an appropriate meaning right away—and when this meaning turned out to be figurative, fixations increase indicating problematic integration. It could be argued, therefore, that DYSRs adopted a less 'risky' reading behaviour (see Leinenger & Rayner, 2017), by which they did not delay committing to a particular meaning until all the available information was (re)considered. It is true that in the present study, no

further disambiguating information was offered after the target words, but participants were not made explicitly aware of this. Rapid meaning selection could be an implicit compensatory strategy employed by DYSRs, as this would allow them to reduce the amount of information kept in the working memory, which would in turn free up resources for the processing of upcoming text. TDRs, on the other hand, might adopt a 'riskier' reading behaviour, in the sense that they actively entertain all plausible interpretations simultaneously and only attempt to unify the best one after all available information has been evaluated or reanalysed via regressions, or in this case, by revisiting the idiom region.

Overall, the results of Study 3 confirm that DYSRs have an easier time processing the literal meaning of potentially non-literal strings, but crucially they are not incapable of recognising idiomatic strings, even when these have sustained considerable modification (i.e., passive form). This was demonstrated by the fact that the figurative meaning was eventually activated, relative to the anomalous meaning of the control target words, despite the significant cost associated with it. This study aimed to provide initial evidence as to how DYSRs process modified idioms during on-line language comprehension. However, considering the multiple plausible sources for the problematic activation of the figurative meaning, it is imperative that future work delves into more detail in order to understand what constitutes the actual cause of this. This will not only help us have a more comprehensive understanding of DYS as a learning condition, but it might also provide an avenue for potential remedies.

CHAPTER 5

The Idiom Advantage Turned to Dust:

An Eye-Tracking Investigation

As we have seen, language has a wealth of prefabricated 'formulaic language' (e.g., idioms, binomials, collocations). These are recurring word combinations with a stereotypical form that is not thought to be constructed with each use, have a conventionalized meaning, and are highly familiar to a speech community (Van Lancker Sidtis, 2004, 2012). Therefore, formulaic language is available with 'no assembly required'. Idioms, for instance, are known for their tendency to appear in a fixed (canonical) form (*weather the storm*) and for having a conventionalised meaning ('overcome a difficulty'). However, as evidenced in corpus studies reviewed earlier (eg., Barlow & Kemmer, 2000; Duffley, 2013; Moon, 1998) and in the empirical findings of the previous three studies of this thesis, idioms are subject to creative adaptations by language users.

The (relatively) fixed nature of formulaic language in general, and idioms in particular, can be contrasted with novel language, which refers to 'nonrecurrent combinations that do not show any significant degree of cohesion or fixedness' (Carrol et al., 2016, p. 405). As a result, formulaic language involves a certain level of automaticity and reduces processing effort (Perkins, 1999). Unsurprisingly, therefore, idioms and other types of formulaic language demonstrate a processing advantage over matched novel language, both in terms of speed and accuracy in comprehension (for an overview see Siyanova-Chanturia, 2013) and production (e.g., Arnon & Priva, 2013, 2014).

For instance, idioms (*weather the storm*) are often found to be processed faster than comparable, nonidiomatic phrases (*avoid the storm*) (e.g., Arnon & Snider, 2010; Carrol & Conklin, 2014b, 2017; Carrol, Conklin, & Gyllstad, 2014; Conklin & Schmitt, 2008).

Though so far the focus has been on the passive construction, which rearranges the order of the idiom component words, other types of modification are certainly possible. For instance, adjectives can be used to 'add' something to the figurative meaning, as in *he was wrinkling his fastidious nose* and *he weathered a renewed storm* (Moon, 1998); *fastidious* provides further insight into the subject's character (i.e., that the subject is particularly scrupulous), and *renewed* suggests that the *storm* (or difficulty) had occurred and been dealt with in the past, or alternatively that a new difficulty has arisen following a previous one. While the previous studies primarily aimed to address meaning activation in modified idioms, the findings also suggested that the idiom processing advantage might not survive modifications, as passivized idioms came at a cost. However as this may have been due to the passive voice and not the modification per se, the present study looked at idiom modification under a different light. Specifically, it aimed to test whether adjectival modification (*weather the renewed storm*) could have any bearing on idioms' processing advantage compared to both matched non-idiomatic phrases, as well as the canonical form of the idiom.

The idiom advantage

Idioms are not compositional phrases, as their figurative meaning cannot be computed from the component words; the separate meanings of

weather, *the*, and *storm*, for example, does not yield the meaning 'overcome a difficulty'. Despite their opacity, some early empirical findings indicated that idioms were faster to process than comparable literal phrases (Gibbs, 1980; Swinney & Cutler, 1979). The processing of an idiomatic phrase had been likened to the processing of single words, in the sense that the figurative meaning was retrieved directly from the lexicon, without on-line computation (Gibbs, 1980; Swinney & Cutler, 1979). Hence, since lexical retrieval is faster than on-line computation, this accounted for the idiom advantage. Another theory proposed that idioms were initially processed compositionally, just like typical phrases, and only certain idioms (decomposable) were faster to process than literal phrases (Gibbs & Nayak, 1989; Gibbs, Nayak, & Cutting, 1989).

While both of these views have some merit, empirical findings ultimately showed that idioms are not merely stored and processed as 'single units', as syntactic analyses are not disabled during idiom comprehension and the literal meaning of idioms is available, depending, among other things, on the predictability of the phrase (see Cacciari & Tabossi, 1988; Holsinger, 2013; Holsinger & Kaiser, 2013; Peterson et al., 2001; Snider & Arnon, 2012; Sprenger et al., 2006). Further, idioms' (on-line) processing speed does not appear to be determined by decomposability, as many idioms were found to elicit faster processing than matched non-idiomatic phrases regardless of their degree of decomposability (Carrol & Conklin, 2014b, 2017; Libben & Titone, 2008; Tabossi et al., 2008; Van de Voort & Vonk, 1995).

Nevertheless, idioms do need to hold lexical representations or some sort of templates in memory, that activate the figurative meaning and compensate for its non-compositionality. In line with Gibbs' (1980) and

Swinney and Cutler's (1979) hypothesis, these lexical representations/templates may indeed allow for a faster processing of idioms once activated, leading to an 'idiom advantage'. Numerous studies have reported faster processing for idioms, at least by native speakers, and regardless of whether idioms were used in their figurative or literal sense. This has been demonstrated by faster response times in lexical decision tasks (Carrol & Conklin, 2014b; Ortony et al., 1978; Rommers, Dijkstra, & Bastiaansen, 2013; Swinney & Cutler, 1979; Tabossi, Fanari, et al., 2009), shorter reading times in self-paced reading tasks (Colombo, 2014; Conklin & Schmitt, 2008; Gibbs, 1980), shorter reading times, fewer regressions, and increased skipping rates (for final idiomatic words) in eye-tracking studies (Carrol & Conklin, 2017; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Underwood et al., 2004), and more recently, by a reduced N400 and increased P300 amplitudes in ERP studies (Laurent et al., 2006; Strandburg et al., 1993; Vespignani et al., 2010).

The source of this idiom advantage overlaps with several concepts discussed in previous Chapters. The conventionality of idioms, caused by their tendency to appear in a fixed form, makes them considerably more frequent, more familiar, and more predictable than novel phrases. Usage- and Exemplar-Based models of language processing (Abbot-Smith & Tomasello, 2006; Bybee, 1985, 1998, 2006; Bybee & Beckner, 2010; Croft, 2001; Goldberg, 1995, 2006; Langacker, 1987; Pierrehumbert, 2001; Tomasello, 2003), advocate that frequently occurring items have stronger representations in memory and are faster to process as a result. This is confirmed by research on other types of multi-word units, such as binomials (*bride and groom*)

(Siyanova-Chanturia, Conklin, & Van Heuven, 2011; Siyanova & Schmitt, 2008), phrasal verbs (*give in*) (Kim & Kim, 2012), collocations (*heavy rain*) (Wolter & Gyllstad, 2011, 2013), and lexical bundles (*in the middle of the*) (Arnon & Priva, 2013; Arnon & Snider, 2010; Durrant & Doherty, 2010; Tremblay, Derwing, Libben, & Westbury, 2011), which are more frequent than matched, non-formulaic strings. While idioms are less frequent than other formulaic strings (Moon, 1998), they are particularly salient and fewer encounters may be needed for them to become conventionalised (Siyanova-Chanturia & Martinez, 2015). In fact, saliency might underpin the idiom advantage rather than frequency per se, as an inverse effect of frequency has also been noted for idioms; infrequent verbs occurring in idioms (*twiddle* in *twiddle one's thumbs*) are more predictive of their idiomatic uses than other more frequent verbs (*hit* in *hit the road*), and idioms containing such words may be processed faster as a result (Libben & Titone, 2008).

In addition to their salience, idioms are also more familiar phrases in comparison to novel ones, although even within idioms familiarity can vary, with more familiar idioms enjoying faster processing than less familiar ones (Cronk & Schweigert, 1992; Libben & Titone, 2008; Schweigert, 1986; Tabossi, Wolf, et al., 2009; Van Lancker Sidtis, 2012). Furthermore, idioms are more predictable than novel phrases. For example, an English native speaker encountering the fragment *take the bull by the _*, would predict *horns* as a probable continuation, thus making both *horns* and the overall phrase predictable. The effect of predictability in language processing is particularly pronounced in ERP studies, where a predictable word is believed to cause a reduction of the N400 amplitude (Hagoort, Hald, Bastiaansen, & Petersson,

2004; Kutas & Hillyard, 1980, 1984; Van Petten & Kutas, 1990). Relevant studies on idioms, have found a similar modulation especially with final words of predictable idioms (*horns*) (Laurent et al., 2006; Strandburg et al., 1993; Vespignani et al., 2010). Moreover, it has been found that predictable idioms amplify the P300 component (Vespignani et al., 2010), which is thought to reflect expectancy confirmation (Verleger, 1988)—though the contrary view has also been expressed (see Donchin, 1981; Donchin & Coles, 1988; Donchin & Fabiani, 1991). It has been therefore suggested, that the P300 effect in idioms reflects a template matching confirmation, whereby what is being read or heard (*take the bull by the* -), is matched against what is already known and stored as a representation/template in the memory *(take the bull by the horns*).

Interestingly, Canal et al. (2017) have recently compared ERP effects of predictable (Italian) idioms used figuratively (*close one eye* meaning 'to overlook') and literally (*close one eye* meaning 'close one eye'), and of control literal phrases with a comparable predictability of the final word (*get a punch in one eye*). No difference in the N400 component was observed for the final word (eye) across the three conditions, but instead a frontal positivity (PNP) emerged for idioms when used figuratively, as opposed to idioms used literally and literal control phrases. In addition, only the literal conditions elicited an increase in the middle gamma frequency band. These findings implied that the figurative interpretation of the idiom required sentence revision mechanisms (evidenced by the PNP effect) and that the literal meaning of idiomatic words is not carried out—at least not after the idiom is recognised (as evidenced by the lack of middle gamma frequency).

The speed at which an idiom is processed in comparison to a literal

phrase may be also determined by how fast the idiom is recognised. Cacciari and Tabossi (1988) found faster reaction times to targets related to the figurative meaning of idioms (*happy* for *be in seventh heaven*) than to targets related to the literal meaning (*saint*) *only* when idiom completions were predictable and hence were recognised faster. For idioms having unpredictable completions, response times to literal targets (*saint*) were faster, reflecting the delayed recognition of the idiomatic phrase. To account for their findings, the researchers proposed the Configuration Hypothesis, according to which idioms are processed literally until their recognition point is reached ('idiomatic key'), after which, their figurative meaning is retrieved. Many studies have corroborated this view, however, only when looking at idioms out of context (Cacciari & Corradini, 2015; Cacciari et al., 2007; Tabossi et al., 2005; Titone & Connine, 1994). A facilitative or biasing context has been found to increase the predictability of idiom completions (i.e., move the key forward in the idiom), resulting in a yet faster recognition of the phrases and faster retrieval of the figurative meaning (Fanari et al., 2010).

Context can increase the speed with which an idiom will be processed, by biasing towards its figurative or literal interpretation and/or by increasing its predictability (i.e., anticipating *spill the beans* in a context about the revelation of secrets) (Cacciari & Glucksberg, 1991; Colombo, 2014; Fanari et al., 2010; Hillert & Swinney, 2001; Tabossi, Wolf, et al., 2009; Titone & Connine, 1999). In addition, context has been found to improve the acceptability judgement scores of modified idioms (Peterson et al., 2001; Tabossi, Wolf, et al., 2009), and to speed up their processing time as well. For example, McGlone et al. (1994), observed that both *he didn't spill the beans* and the

modified *he didn't spill a single bean* were read faster in biasing than in neutral context.

As mentioned in Chapter 2, the need to unify this idiom advantage with the fact that idioms are also analysed syntactically, has promoted a move towards a hybrid representation of idioms (Cacciari & Tabossi, 1988; Cutting & Bock, 1997; Sprenger et al., 2006), whereby idioms are viewed as both lexicalised units and partly compositional phrases. The Configuration Hypothesis (Cacciari & Tabossi, 1988), assumes that once an idiom is recognised, access to its lexical representation becomes available, but until that point the individual words are activated. The faster the idiom is recognised (or predicted), the faster its representation is retrieved. The Superlemma Theory (Sprenger et al., 2006) assumes that activation of the figurative meaning depends upon the activation spreading from the component words or lemmas (*spill, the, beans*), to a superlemma (*spill the beans*), and from the superlemma to the concept ('reveal a secret'). Access to the lexical representation of the idiom occurs when the superlemma reaches its activation threshold. However, not all words may equally contribute to the activation of the configuration or superlemma. For example, in *twiddle one's thumbs* the low frequency of the verb *twiddle* makes the idiomatic phrase particularly predictive (Libben & Titone, 2008). Therefore, this idiom should be recognized more quickly than an idiom that needs multiple words to be activated. In both of these theories, the speed by which the key is reached or the superlemma is activated, determines the processing speed of the overall idiom. In cases where the key is at the offset of the idiom or all of the component words are needed to activate the superlemma, the advantage of idioms over compositional phrases would be

diminished or even disappear.

A potential shortcoming with the above theories is that they do not consider other factors that have been demonstrated to be important in the idiom processing literature, such as familiarity and frequency. The Multidetermined Model of idiom processing, outlined by Libben and Titone (2008), and Titone and Connine (1999), posits that multiple factors influence the speed of idiomatic processing, though not necessarily to the same degree, or at the same time frame (Libben & Titone, 2008; Titone & Libben, 2014). For example, in a series of experiments, Libben & Titone (2008) found that familiarity and frequency, to some extent, were associated with better idiomatic comprehension in on-line measures, while other factors such as decomposability were only found facilitative in overt judgment tasks. Provided that such factors are particularly prominent in idioms, as opposed to novel phrases, we would expect at least some of them to add to the idiom advantage.

Idiomatic modification and its effects on the idiom advantage

The idiom advantage is associated with the canonical form of an idiom (*spill the beans*), as this form becomes conventionalised through usage and exposure. Despite this, language users do deviate from the conventional form, making creative adaptations. For instance, *spill the spicy beans* could be interpreted as an attempt to provide information about the nature of the *secrets* that are exposed (i.e., that the secrets are scandalous). While adjectival insertion, as well as other types of modifications, are found in corpus and related studies (Barlow & Kemmer, 2000; Cacciari & Glucksberg, 1991; Duffley, 2013; Hovhannisyan & Mkrtchyan, 2014; Langlotz, 2006; McGlone

et al., 1994; Moon, 1998; Nunberg et al., 1994; Schmitt, 2005), little is known about how they are processed, and especially whether they too have an idiom advantage.

Although the theories discussed in the previous section do not make specific claims with regards to adjectival insertion, hybrid approaches are overall more flexible with regards to idiomatic modification. That is, they predict that idioms will be understood figuratively provided that they are still recognizable idiomatic configurations (Cacciari & Tabossi, 1988), or equally that activation can spread from the lemmas to the conceptual level (Cutting & Bock, 1997; Sprenger et al., 2006), but do not predict whether modification will somehow affect the idiom advantage. It is also worth mentioning that the Superlemma Theory posits that superlemmas can place restrictions on the flexibility of the idioms. For example, the researchers argued that *hit the icy road* is not permissible by the superlemma of *hit the road*, although it is not immediately evident why. One could imagine a scenario where *hit the icy road* could be used, to refer to a journey under cold weather conditions.

The purpose of the current study is not to demonstrate that adjectivally-modified idioms are understood figuratively, as this is implied by the existence of such examples in corpora, but rather to see whether adjectivally-modified idioms benefit from the widely-established idiom advantage. Certainly, adding an adjective into an idiomatic expression, as in *spill the spicy beans*, not only requires that the original idiom be recognised, but also that accurate interpretation be made for *spicy*, so that it can be interpreted within the phrase and the wider context. The predictions of the theories in this case are less straightforward, but certain predictions can be made. If (as per the

Configuration Hypothesis) the recognition point of a modified idiom occurs before the modification, we *might* expect the modified form to retain some or all of its processing benefit. For example, if *spill the beans* is recognised after *spill the*, then *spill the spicy beans* should also be recognised after *spill the*[11]. In other words, the configuration in both cases would be 'unlocked' at the offset of *spill the*. This should make the idiom entry available, and thus confer a benefit to both the modified and unmodified forms, although the occurrence of the word *spicy* might attenuate or inhibit this benefit, because there is no longer a strict 'match' to the unlocked configuration. In contrast, if *spill the beans* is unlocked after encountering *beans* (i.e., *beans* is the key), then adding *spicy* will increase the amount of time needed to reach the 'key', thus delaying idiom recognition. Consequently, any idiom advantage is expected to be reduced or lost. Similar predictions could be made by the Superlemma Theory. If the lemmas *spill the* are enough to activate the idiom superlemma, then they should be enough to do so in the case of *spill the spicy beans*. If *spill*, *the,* and *beans* are all needed to activate the superlemma, then inserting an intervening word will slow the activation of the superlemma.

According to the Multidetermined Model (Libben & Titone, 2008; Titone & Libben, 2014) various factors might influence the processing speed of adjectivally-modified idioms, just as they influence that of canonical forms. Contrasting possibilities arise from this. On the one hand, it might be that more frequent or familiar (or predictable) idioms are processed faster than comparable literal phrases even with the insertion of adjectives: the idiom is

[11] This assumes that there is no parafoveal preview of the word after *spill the*. While parafoveal preview would be expected to influence processing, for the sake of laying out the predictions of the model I do not take this into consideration.

recognized quickly and the modification is rapidly integrated into the understanding of it. On the other hand, the opposite could be observed: because of the high familiarity or predictability of the idiomatic phrase in its canonical form, expectations about which and how idiom components should appear might slow activation of the idiom and its figurative meaning since these expectations would not be met in the modified version.

The effect of adjectival insertion on the processing (speed) of idioms has not been explored using eye-tracking, but there are some existing findings from behavioural studies suggesting that the idiom advantage might *not* survive the manipulation. In a self-paced reading task, McGlone et al. (1994), observed that when inserted in a rich context, modified idioms with extra words (*he didn't spill a single bean)* were read at the same rate as their literal paraphrases (*he didn't say a single word*), but both phrase types were read considerably more slowly than the original idioms (*he didn't spill the beans*). This would suggest that the idiom advantage does not survive the addition of extra words (when compared to a literal control). However, this study explored other types of idiom manipulations as well (e.g., word replacement), making it difficult to draw clear conclusions about adjective modification per se, since different manipulations could have different effects on processing.

Van de Voort and Vonk (1995), measured reaction times to final words of adjectivally-modified idioms, for instance the word *bag* in *he let the fat cat out of the bag* and compared this to the same words in their original forms (*he let the cat out of the bag*), as well as to control phrases with a different final word (e.g., *closet* in *he let the fat cat out of the closet*). All phrases were embedded in short, neutral contexts that did not favour either the idiomatic, or

the literal interpretation. Reaction times to final words of modified idioms were significantly slower than both original idioms and control phrases. While this was not interpreted as evidence of loss of idiomaticity (i.e., loss of the figurative meaning), the researchers argued that intervening adjectives might delay the activation of the idiomatic meaning or even change the idiom's retrieval route. In any case, these findings from an overt response time task, suggest that the idiomatic processing advantage does not survive the addition of internal adjectives.

Some recent empirical studies on different types of formulaic sequences, however, contrast with the aforementioned behavioural findings and seem to be pointing to a different conclusion. Molinaro et al. (2013), combined a self-paced reading task with EEG to compare the processing of (frequent) modified and unmodified complex prepositions (*in the capable hands of* versus *in the hands of*). A longer reading time was observed for the noun (*hands*) and the second preposition (*of*) in the modified condition, reflecting the extra time needed to integrate the additional information, but also a significantly smaller N400 amplitude was noted for the nouns (*hand*s) in the modified condition, suggesting an easier integration and hence a processing advantage for the modified prepositions. The authors argued that the insertion of the congruous adjectives may have in fact increased the cloze probability of the noun, as they restricted the range of possible phrase continuations. Vilkaitė (2016), in an eye-tracking study, compared the reading patterns of adjacent versus nonadjacent collocations (*provide information/ provide (some of the) information*) to matched controls (*compare (some of the) information*). The items were inserted in a minimal context to keep all nouns (*information*) equally unpredictable, but

the transitional probabilities of the adjacent collocations (i.e., how likely the word is to appear after another in a corpus) were naturally higher. That is, the word *information,* for instance, was more likely to occur after *provide* than after *provide some of the*. The results demonstrated not only an advantage for adjacent collocations over controls, but also for nonadjacent ones over their matched controls. This was evidenced by a faster reading time for both types of collocations and their final words in all (late) eye-tracking measures. This was taken as an indication that the processing advantage conferred by the canonical form of collocations, survived the insertion of (up to three) intervening words. While idioms, modified complex prepositions, and collocations are different types of formulaic language, they do share a common fundamental property: they are all recurrent word combinations. Therefore, one could argue that a benefit for adjectivally-modified idioms could also be found, if tested with similar methodological tools.

In sum, we know that language users use language creatively. Early, behavioural response tasks indicate that this type of creative language may disrupt the processing advantage conferred to canonical idiom forms. More recent research using eye-tracking and EEG suggests that a formulaic language advantage might survive the insertion of adjectives. Therefore, two diverging hypotheses can be formulated regarding the present study. If the idiom advantage extends beyond the canonical form, we would expect to find fewer fixations and/or shorter reading times for phrases such as *spill the spicy beans* compared to control phrases such as *burn the spicy beans* even when one or two adjectives are inserted (*spill/burn the spicy, red beans*). Conversely, if the advantage is *only* conferred to the canonical form, there should be no

difference between adjectivally-modified idioms and their respective controls. In either case, it was expected that a processing advantage would be found for canonical idioms versus matched controls, in line with the literature. Finally, given the prominence of various factors in relation to idiom processing, it seemed interesting to also explore whether frequency, familiarity, (contextual) predictability, and transitional probability of idioms have any bearing on the magnitude of the idiom advantage.

Methodology

Participants

Ninety native speakers of English (mean age = 22 years, SD = 5.5; 18 males, 72 females) took part in the eye-tracking experiment. Participants received either course credit or £5 for their participation.

Materials

Ninety idioms, comprised of a verb, determiner, and noun (*spill the beans*, *touch a nerve*, *pull one's leg*), were selected from the Collins COBUILT Idioms Dictionary (Sinclair, 2011). The complete stimuli containing the idioms and control phrases can be seen in Appendix C. Sixteen different English native speakers (mean age = 19, SD = 1.14; 2 males, 14 females) rated how familiar they were with the meaning of the idioms, on a scale from 1 to 5. Filler items consisting of literal phrases and formulaic phrases with a wrong definition, were included in the questionnaire to ensure that participants used the full scale. The descriptive statistics of the phrases are presented in Table 5.1.

Table 5.1 - Descriptive statistics of the idioms and the matched literal items with frequency measures and transitional probability based on values from the BNC, familiarity of the meaning based on a 5-point rating scale (1 = not at all familiar, 5 = highly familiar), predictability from cloze task

	Mean (SD)	
	Idioms	Literal Phrases
Verb Length	5.59 (1.69)	6.22 (1.78)
Verb Frequency	138. 80 (466.74)	152.76 (452.59)
Familiarity	4.26 (0.81)	-
Frequency	0.32 (0.31)	0.15 (0.51)
Transitional Probability	9.56 (13.16)	3.01 (9.24)
Predictability	0.40 (0.33)	0.31 (0.34)

All 90 idioms were paired with a control, literal phrase (hereafter referred to as literal phrase) by substituting the verb of the idiom (*burn the beans* for *spill the beans*). The verbs were matched for frequency ($t(8098) = 1.26$, $p = 0.17$), but they were significantly longer in characters in literal phrases than in idioms ($t(8098) = 16.37$, $p < 0.001$). Both of these factors were considered as variables in the analysis.

The frequencies of idiomatic and literal phrases were extracted from the BNC (Davies, 2004), as instances per million words, and idioms were found to be consistently more frequent than literal phrases ($t(8098) = -17.06$, $p < 0.001$). The transitional probability of the final words, which were kept constant across phrase type (*beans*), was calculated by dividing the overall frequency of the phrase (*spill/burn the beans*), by the frequency of the bigram (*spill/ burn the*) and multiplying by 100 to yield a percentage (McDonald & Shillcock, 2003a). Final words had a significantly higher transitional probability in idioms than in literal phrases ($t(8098) = -25.93$, $p < 0.001$).

The idiom-literal pairs (N = 180) were then embedded in sentences,

designed to bias the idiomatic meaning of the idiom, or the literal meaning of the literal phrase respectively. To estimate the contextual predictability of the phrases (without intervening adjectives), a cloze test was created and administered to a different set of 16 participants (mean age = 18.5, SD = 0.75; 2 males, 14 females). There were two counterbalanced lists, so that each participant only saw the phrase in one of the two conditions (idiomatic or literal). Participants were presented with the experimental sentences leading up to the final word of the phrases (*bean*), which was replaced by a blank, and participants were asked to fill in the blank with the first word that came to mind. Final words were predicted correctly 40% of the time in idioms, and 32% of the time in controls and this difference was statistically significant ($t(8098) = -11.23$, $p < 0.001$).

To check if there was a difference in the predictability of *predictable* idioms versus *predictable* literal phrases, I repeated the analysis on a subset of data excluding items with a zero cloze probability. Interestingly, when both phrase types had a cloze probability above 0, there was no significant difference between idioms (M = 0.51, SE = 0.005) and literal phrases (M = 0.50, SE = 0.006); $t(5758) = -1.05$, $p = 0.29$. I then divided the items into two further predictability bins (low- and high-cloze probability), to check for fine-grained differences. In low-cloze probability (probability > 0 but < 0.50), there was no difference between idioms (M = 0.22, SE = 0.002) and literal phrases (M = 0.22, SE = 0.002); $t(2608) = 0.07$, $p = 0.9$, but in high-cloze probability (probability >= 0.50), literal phrases were surprisingly more predictable (M = 0.75, SE = 0.005) than idioms (M = 0.73, SE = 0.004); $t(3148) = 2.99$, $p = 0.003$.

To test the effect of adjectival insertion on the idiom advantage, I designed a 2 x 3 experiment, where phrase type (idiom versus literal) interacted with the number of intervening adjectives (0, 1, or 2). I included both a 1- and 2-adjective condition to see whether an idiom advantage survived this type of modification, as well as whether it decreased with increasing intervening words. The no-adjective condition served as a baseline. Therefore, there were six conditions in total (Table 5.2): (1) idiom without adjectives, (2) idiom with 1 adjective, (3) idiom with 2 adjectives, (4) literal phrase without adjectives, (5) literal phrase with 1 adjective, and (6) literal phrase with 2 adjectives.

Table 5.2 – Example of sentences for the idioms and matched literal phrases with 0, 1, or 2 intervening adjectives.

Cond.	Sentence
Idiom	
1	Oscar had always been terrible at keeping secrets, so *he eventually* **spilt the beans** *when he* was asked about his friend's ongoing affair.
2	Oscar had always been terrible at keeping secrets, so *he eventually* **spilt the spicy beans** *when he* was asked about his friend's ongoing affair.
3	Oscar had always been terrible at keeping secrets, so *he eventually* **spilt the spicy, red beans** *when he* was asked about his friend's ongoing affair.
Literal	
4	Oscar wanted to cook a homemade Mexican dish, but *he eventually* **burnt the beans *when he*** forgot to turn off the hob, so he ended up ordering pizza.
5	Oscar wanted to cook a homemade Mexican dish, but *he eventually* **burnt the spicy beans** *when he* forgot to turn off the hob, so he ended up ordering pizza.
6	Oscar wanted to cook a homemade Mexican dish, but *he eventually* **burnt the spicy, red beans** *when he* forgot to turn off the hob, so he ended up ordering pizza.

The same adjectives were used in both phrase types to control for semantic complexity, frequency, and word length. As I wanted to keep the phrases congruous in their respective contexts, I selected adjectives that would

be plausible in both scenarios. For instance, I opted for *spicy* and *red* in the example in Table 5.2. In the idiomatic context, *spicy* could be interpreted as *scandalous*, while the red colour is often associated with passion and danger, thus alluding to the illegitimate love affair described in the sentence. In the literal context, both *spicy* and *red* sound plausible, since this type of food is often found in Mexican dishes. In some instances the adjectives were more generic to fit both contexts (e.g., *big*, *small* etc.). The two words immediately preceding and following the phrases of interest (*he eventually* and *when he* in the example) were kept constant across a matched set of items, except in one instance (*pick/examine one's brain*), where only one preceding word (as well as the two following ones) were the same across conditions.

Procedure

The sentences were counterbalanced across six lists using a Latin square design, such that each participant saw a phrase of interest in only one of the six conditions. Care was taken so that the areas of interest (including the phrases as well as the preceding and following words) did not occur over a line break to avoid contamination from saccade programming (Conklin et al., 2018). In addition, each list contained (the same) 90 filler sentences, that were of a similar structure to the experimental ones. The fillers were either literal sentences or they contained other types of formulaic sequences (e.g., binomials, proverbs etc.) with adjectives inserted in some of them, so that the experimental items would not stand out.

An Eyelink 1000+ desktop-mount eye-tracker with a sampling rate of 500 Hz was used. Participants were seated in front of a computer monitor and a

chin- and head-rest was used to minimise head movement. The eye-tracker was calibrated using a 9-point grid, and re-calibration was performed when necessary. The sentences were triple-line spaced, in black font (Courier New, size 14) on a white background, and were displayed in the middle of the screen, one at a time. Drift correction was performed before the presentation of each trial. Participants were asked to read the sentences as quickly as possible but for comprehension and to press ENTER to proceed from one item to the next. Forty per cent of the filler items were followed by a Yes/No comprehension question to ensure participants' attention. The order of the presentation of the sentences was randomized by participant.

Results

The overall accuracy on the comprehension questions was high (92%), indicating that the participants were engaged with the task. Fixations shorter than 80 ms were either incorporated to the largest nearest fixation (for a distance up to 0.5 degrees) or removed from the data. This led to a loss of 0.06% of the data, while an additional 0.09% of the data were compromised due to track loss. No further data were discarded.

As per Carrol and Conklin's (2014a) suggestions, analyses were performed on a phrasal level (*spill/burn the (spicy, (red)) beans*) to accommodate the multi-word nature of the idioms, as well as to produce results comparable to similar studies (Carrol & Conklin, 2017; Siyanova-Chanturia, Conklin, & Schmitt, 2011). Separate analyses on final words (*beans*) were also carried out, since final words often have greater skipping rates and/or shorter fixations in idioms (Carrol & Conklin, 2017).

For both phrase- and word-level analyses I examined three late measures: total reading time (the duration of all fixations including those of re-fixations),[12] fixation count (the total number of fixations), and regressions (the likelihood of re-fixation into the phrase/final word, after the eye had moved to the right). For final words, I also examined first pass reading time (an early measure including the duration of all fixations before eyes exited to the left/right), and skipping (the likelihood of the word to be skipped) (Carrol & Conklin, 2014a; Conklin et al., 2018). The means for the phrases and final words, for each measure, are presented in Table 5.3.

Table 5.3 - Mean phrase- and word-level measures for idioms and literal phrases with 0, 1 or 2 adjectives. Duration measures are reported in milliseconds, count measures in number of instances, and both skipping, and regression measures are reported as probability with values in brackets indicating the standard error.

	Means (SE)				
	Skipping	*First Pass Reading Time*	*Total Reading*	*Fixation Count*	*Regression*
Whole Phrase					
Literal Phrase			668 (19.31)	3.50 (0.09)	0.30 (0.01)
Idiom			710 (23.62)	3.76 (0.11)	0.38 (0.02)
Literal 0 Adj.			459 (13.60)	2.47 (0.07)	0.24 (0.01)
Idiom 0 Adj.			488 (16.53)	2.65 (0.08)	0.28 (0.02)
Literal 1 Adj.			690 (20.42)	3.60 (0.09)	0.32 (0.02)

[12] The model for total reading time for whole phrases was also carried out with adjusted reading time to account for phrasal length, and thus for the addition of extra adjectives. Total reading time was divided by the number of characters of the phrases (including spaces) to produce an 'adjusted' total reading time per segment. The results and patterns of this model were the same as with the non-adjusted total reading time, so the results of the latter model are reported instead.

Idiom 1 Adj.			734 (24.82)	3.86 (0.12)	0.40 (0.02)
Literal 2 Adj.			941 (27.86)	4.79 (0.13)	0.36 (0.02)
Idiom 2 Adj.			1001 (33.86)	5.14 (0.15)	0.49 (0.02)
Final Word					
Literal Phrase	0.28 (0.02)	213 (3.01)	232 (4.41)	1.24 (0.02)	0.07 (0.00)
Idiom	0.26 (0.01)	214 (3.29)	241 (4.80)	1.28 (0.02)	0.09 (0.00)
Literal 0 Adj.	0.27 (0.02)	210 (3.24)	228 (4.63)	1.21 (0.03)	0.07 (0.00)
Idiom 0 Adj.	0.25 (0.01)	211 (3.51)	236 (5.02)	1.26 (0.03)	0.09 (0.00)
Literal 1 Adj.	0.30 (0.02)	212 (3.28)	233 (4.76)	1.24 (0.03)	0.08 (0.00)
Idiom 1 Adj.	0.28 (0.02)	213 (3.54)	242 (5.15)	1.29 (0.03)	0.10 (0.01)
Literal 2 Adj.	0.28 (0.02)	216 (3.33)	236 (4.80)	1.25 (0.03)	0.06 (0.00)
Idiom 2 Adj.	0.25 (0.01)	217 (3.60)	244 (5.19)	1.30 (0.03)	0.08 (0.00)

The data were analysed with linear mixed-effects models using the *lme4* package, version 1.1-17 (Douglas Bates et al., 2014) in R, version 3.5.1 (R Core Team, 2018). Phrase type and adjective condition were incorporated in the models as fixed effects. Phrase type was a two-level factor (idiomatic phrase and literal phrase) while adjective condition had three levels (0 adjectives, 1 adjective, and 2 adjectives). By-participant and by-item random slopes and intercepts were included as random effects (Barr et al., 2013), but only the by-subject and by-item intercept and slope for phrase type was included in the models; the by-subject and by-item intercept and slope for the adjective condition was dropped as the models failed to converge.

Phrase frequency, transitional probability, predictability (also referred to as cloze probability), verb frequency, verb length, and trial sequence were incorporated as additional predictors. Familiarity was included in separate models, since the familiarity scores only applied to idioms. Transitional and cloze probability, as well as frequency and familiarity, can be highly correlated factors. However, all correlations were low to mild (all rs $> \pm 0.33$), and after centering the variables, the Kappa value was estimated at 1.71, confirming that there was no problematic multicollinearity (Baayen, 2008). It is likely that transitional and cloze probability were not correlated due to the relatively high predictability of the literal phrases, in comparison to their low transitional probability. Usually these factors correlate for idioms, as they are conventionalised and tend to have both a high cloze and a high transitional probability. For this reason, I also checked for a correlation in idioms only, but again no correlation was found between transitional and cloze probability (r = 0.36) likely because of the strong context which increased the cloze probability

relative to the transitional probability. The correlation between familiarity and frequency for idioms only was still low ($r = 0.14$).

Model components were added in a stepwise manner, and following model comparisons, only significant covariates were retained. Additive models were initially fitted, and interactions were included only if they significantly improved the model's fit. Durational measures (i.e., total/first pass reading time) were log transformed and calculated using linear mixed-effects models. Count measures (i.e., fixation count) were analysed using a generalised linear model with a *poisson* regression, and binary measures (i.e., likelihood for regression and skipping) were analysed with logistic linear models (Jaeger, 2008). Model means and pairwise comparisons were estimated using the *emmeans* package (Lenth, 2018). Table 5.4 presents the model outputs of the phrasal and final-word analyses.

Table 5.4 - Model outputs for all eye-tracking measures for idioms and matched literal phrases with 0,1, or 2 adjectives split by phrase- and word-level

Phrase Analyses

	Total Reading Time				Fixation Count				Regression			
Pred.	β	SE	t	p	β	SE	z	p	β	SE	z	p
(Inter.)	6.22	0.03	203.3	**<0.001**	1.01	0.03	35.09	**<0.001**	-0.81	0.1	-7.99	**<0.001**
Phrase Type	0.06	0.02	3.16	**0.002**	0.07	0.02	3.85	**<0.001**	0.36	0.07	4.9	**<0.001**
Adj. (1 adj.)	0.41	0.01	38.14	**<0.001**	0.37	0.02	22.2	**<0.001**	0.45	0.07	6.36	**<0.001**
Adj. (2 adj.)	0.72	0.01	67.25	**<0.001**	0.66	0.02	38.39	**<0.001**	0.72	0.07	10.36	**<0.001**
Freq.	-0.01	0.01	-1.44	0.15								
Trial Seq.	0	0	-11.39	**<0.001**	0	0	-10.44	**<0.001**	0	0	-8.76	**<0.001**
Pred.	-0.04	0.01	-3.84	**<0.001**	-0.04	0.01	-4.02	**<0.001**	-0.13	0.03	-3.62	**<0.001**
Verb Length	0.04	0.01	4.14	**<0.001**	0.03	0.01	3.36	**0.001**				
Verb Freq.	-0.02	0.01	-1.88	0.06	-0.01	0.01	-1.45	0.148				
Random Effects												
σ^2	0.15				1				3.29			
τ_{00}	0.06 $_{PPT}$				0.04 $_{PPT}$				0.41 $_{PPT}$			
	0.01 $_{ITEM}$				0.01 $_{ITEM}$				0.12 $_{ITEM}$			
ρ_{01}	0.63 $_{PPT}$				1.00 $_{PPT}$				-0.05 $_{PPT}$			
	-0.54 $_{ITEM}$				-0.60 $_{ITEM}$				-0.81 $_{ITEM}$			
Observations	8087				8087				8087			

Final Word Analyses

	First Pass Reading Time	Total Reading Time	Fixation Count

Pred.	β	SE	t	p	β	SE	t	p	β	SE	z	p
(Inter.)	5.35	0.02	347.81	**<0.001**	5.46	0.02	245.92	**<0.001**	0.24	0.03	7.65	**<0.001**
Phrase Type	0	0.01	0.41	0.679	0.03	0.01	2.5	**0.012**	0.04	0.02	1.67	0.095
Adj. (1 adj.)	0.01	0.01	0.73	0.465	0.02	0.01	1.85	0.064	0.02	0.03	0.82	0.414
Adj. (2 adj.)	0.02	0.01	2.27	**0.023**	0.03	0.01	2.64	**0.008**	0.04	0.03	1.27	0.204
Freq.												
Trial Seq.					0	0	-2.9	**0.004**	0	0	-2.26	**0.024**
Trans. Prob.	-0.02	0.01	-2.43	**0.015**	0	0.01	-0.31	0.754				
Pred.	-0.02	0.01	-2.9	**0.004**	-0.05	0.01	-5.56	**<0.001**	-0.04	0.01	-3.4	**0.001**
Random Effects												
σ^2	0.12				0.16				1			
τ_{00}	0.01 $_{PPT}$				0.02 $_{PPT}$				0.01 $_{PPT}$			
	0.00 $_{ITEM}$				0.01 $_{ITEM}$				0.00 $_{ITEM}$			
ρ_{01}	1.00 $_{PPT}$				0.74 $_{PPT}$				1.00 $_{PPT}$			
	-0.30 $_{ITEM}$				-0.51 $_{ITEM}$				-1.00 $_{ITEM}$			
Observations	6062				6062				6062			

	Regression				Skipping			
Pred.	β	SE	z	p	β	SE	z	p
(Inter.)	-2.35	0.14	-16.3	**<0.001**	-1.13	0.11	-9.94	**<0.001**
Phrase Type	0.28	0.11	2.64	**0.008**	-0.11	0.06	-1.89	0.06
Adj. (1 adj.)	0.13	0.11	1.2	0.23	0.17	0.06	2.74	**0.006**
Adj. (2 adj.)	-0.12	0.11	-1.08	0.279	-0.04	0.04	-0.58	0.564
Freq.								

Trial Seq.	0	0	-2.48	**0.013**	0	0	-3.61	**<0.001**
Trans. Prob. Pred.	-0.18	0.06	-2.99	**0.003**				
Random Effects								
σ^2	3.29				3.29			
τ_{00}	0.36 $_{PPT}$				0.34 $_{PPT}$			
	0.29 $_{ITEM}$				0.40 $_{ITEM}$			
ρ_{01}	-1.00 $_{PPT}$				-0.39 $_{PPT}$			
	-0.30 $_{ITEM}$				-0.03 $_{ITEM}$			
Observations	6062				8100			

Phrase type significantly modulated total reading time, number of fixations, and the likelihood for regression to whole phrases, as well as total reading time and regressions in final words but not first pass reading time, number of fixations or skipping. Literal phrases and their final words were read faster, yielded fewer fixations, and were less likely to elicit a regression, in comparison to idiomatic phrases and their respective final words. The adjectival conditions affected all the measures in the whole-phrase analyses, whereby each additional adjective led to longer total reading times, more fixations, and more regressions. In the final words, both first and total reading time increased as a function of adjectival insertion, but *only* when there were two intervening adjectives.

Predictability (cloze probability) significantly affected all of the measures for the whole phrases, and in final words, except for skipping. In general, increased predictability led to shorter and fewer fixations, as well as to fewer regressions, regardless of phrase type or how many adjectives were inserted into the phrase. On the other hand, higher transitional probability only facilitated the first pass reading time of final words. Verb length modulated the total reading time and number of fixations in whole phrases; the longer the verb, there were more and longer fixations. Finally, trial sequence had a significant effect on most measures (expect first pass reading time in final words), such that as the experiment progressed there were fewer fixations and regressions as well as shorter fixations. Phrase frequency did not significantly modulate any of the measures.

There was no significant interaction between phrase type and adjectival condition (or any other predictor), in any measure. However, pairwise

comparisons at the phrasal-level significantly differed from each other in total reading time (all *p*s < 0.02) and fixation count (*p*s < 0.01). Pairwise comparisons were also significant in regressions (*p*s < 0.001), except between idiomatic and literal phrases without adjectives ($p = 0.7$).

At the word-level, no significant pairwise comparisons were noted for any measure, but there was an interesting finding in the skipping analysis. Twenty-five per cent of the final words (1077 in literal and 961 in idiomatic phrases) were skipped and not later fixated via a regression. The final words in literal phrases tended to be more likely to be skipped than final idiomatic words, but the effect was only marginally significant ($p = 0.06$). Interestingly, the final words of phrases were significantly more likely to be skipped when there was 1 adjective inserted into the phrase ($M_{1\ adjective} = 0.29$, SE = 0.02), than zero adjectives ($M_{no\ adjective} = 0.26$, SE = 0.01; $p = 0.01$), but there was no difference between no adjective and 2 adjectives or 1 adjective and 2 adjectives ($M_{2\ adjectives} = 0.27$, SE = 0.01; $p = 0.83$ and $p = 0.07$ respectively).

Familiarity

When only idioms were considered, familiarity emerged as a significant factor in all measures in phrase-level analyses (all *p*s < 0.03) (for full model outputs see Appendix F); the more familiar the idiom was, the fewer and shorter the fixations, and the fewer regressions were observed. This processing benefit held regardless of whether, or how many, adjectives were inserted into the idiom, but there was no interaction between familiarity and adjectival condition. Interestingly, while phrase frequency did not modulate the models when both idioms and literal phrases were examined, it did reach significance

in the idioms-only model, whereby the more frequent the idiom, the shorter its reading time.

Predictability

To explore the influence of predictability further, I divided the whole-phrase dataset in three subsets to include: (a) unpredictable items (cloze probability = 0), (b) somewhat predictable items (cloze probability > 0 but < 0.50), and (c) highly predictable items (cloze probability >= 0.50).

I then reran the previous models. The means are presented in Table 5.5 and the model outputs in Table 5.6. In both unpredictable and highly predictable phrases, phrase type was not significant in total reading time, or number of fixations, although there was a tendency for the literal phrases to be read faster and to elicit fewer fixations. Idioms were significantly more likely to yield a regression than literal phrases in both conditions, but pairwise comparisons reached significance only for the unpredictable phrases (*p*s < 0.01). For the somewhat predictable phrases, the results followed the same pattern as the main results: literal phrases were read significantly faster, elicited significantly fewer fixations, and were significantly less likely to yield a regression in comparison to idioms. Pairwise comparisons did not reach significance in total reading time, but they did in the number of fixations (*p*s <0.02) and approached significance in the likelihood for regression ($p = 0.07$).

Table 5.5 – Mean phase measures for idioms and literal phrases with 0,1, or 2 adjectives, divided by high and low predictability. Total reading time is reported in milliseconds, fixation count in number of instances, and regression is reported as a probability, with values in brackets indicating the standard error.

	Unpredictable Phrases			*Slightly Predictable Phrases*		
Whole Phrase	**Total Reading Time**	**Fixation Count**	**Regression**	**Total Reading Time**	**Fixation Count**	**Regression**
Literal	730 (24.51)	3.82 (0.12)	**0.33 (0.02)**	**643 (23.55)**	**3.38 (0.10)**	**0.29 (0.02)**
Idiom	742 (34.48)	3.85 (0.16)	**0.46 (0.02)**	**705 (29.28)**	**3.77 (0.13)**	**0.37 (0.02)**
Literal 0 Adj.	506 (18.01)	2.70 (0.10)	**0.25 (0.02)**	441 (16.89)	**2.39 (0.08)**	**0.21 (0.02)**
Idiom 0 Adj.	514 (24.68)	2.72 (0.12)	**0.36 (0.03)**	484 (20.81)	**2.67 (0.10)**	**0.28 (0.02)**
Literal 1 Adj.	747 (26.57)	3.92 (0.13)	**0.35 (0.02)**	675 (25.83)	**3.54 (0.12)**	**0.31 (0.03)**
Idiom 1 Adj.	759 (36.39)	3.95 (0.17)	**0.48 (0.03)**	740 (31.82)	**3.95 (0.14)**	**0.41 (0.03)**
Literal 2 Adj.	1028 (36.55)	5.25 (0.17)	**0.41 (0.02)**	893 (34.16)	**4.55 (0.15)**	**0.35 (0.03)**
Idiom 2 Adj.	1044 (50.06)	5.30 (0.22)	**0.54 (0.03)**	979 (42.09)	**5.05 (0.18)**	**0.45 (0.03)**

	Highly Predictable Phrases			*Highly Predictable Idioms Vs Unpredictable Literal Phrases*		
Whole Phrase	**Total Reading Time**	**Fixation Count**	**Regression**	**Total Reading Time**	**Fixation Count**	**Regression**
Literal						
Idiom	661 (24.09)	3.48 (0.11)	**0.30 (0.02)**	**710 (22.74)**	**3.75 (0.12)**	0.33 (0.02)
	675 (24.74)	3.55 (0.11)	**0.35 (0.02)**	**666 (26.12)**	**3.43 (0.11)**	0.32 (0.02)
Literal 0 Adj.						
Idiom 0 Adj.	451 (17.01)	2.46 (0.08)	0.22 (0.02)	484 (16.35)	2.61 (0.09)	0.24 (0.02)
Literal 1 Adj.	461 (17. 46)	2.51 (0.09)	0.26 (0.02)	454 (18.49)	2.39 (0.09)	0.23 (0.02)
Idiom 1 Adj.	679 (25.59)	3.56 (0.12)	0.30 (0.02)	727 (24.51)	3.86 (0.13)	0.34 (0.02)

Literal 2 Adj.	694 (26.27	3.63 (0.12)	0.35 (0.02)	681 (27.72)	3.52 (0.12)	0.33 (0.02)
Idiom 2 Adj.	942 (35.50)	4.83 (0.16)	0.38 (0.02)	1017 (34.37)	5.25 (0.17)	0.43 (0.02)
	963 (36.46)	4.93 (0.16)	0.44 (0.02)	953 (38.69)	4.79 (0.17)	0.42 (0.02)

Significant Interactions are shown in bold ($p < 0.05$)

Table 5.6 – Model outputs for all eye-tracking measures for idioms and matched literal phrases with 0,1, or 2 adjectives divided by high and low predictability.

	Unpredictable Phrases											
	Total Reading Time				**Fixation Count**				**Regression**			
Pred.	β	SE	t	p	β	SE	z	p	β	SE	z	p
(Inter.)	6.31	0.04	167.67	**<0.001**	1.09	0.04	26.42	**<0.001**	-0.75	0.14	-5.52	**<0.001**
Phrase Type	0.02	0.04	0.38	0.701	0.01	0.04	0.21	0.834	0.53	0.11	4.95	**<0.001**
Adj. (1 Adj.)	0.39	0.02	19.25	**<0.001**	0.37	0.03	13.34	**<0.001**	0.46	0.11	4.13	**<0.001**
Adj. (2 Adj.)	0.71	0.02	35.02	**<0.001**	0.66	0.03	25.06	**<0.001**	0.73	0.11	6.55	**<0.001**
Trans. Prob.	0.05	0.02	2.93	**0.003**	0.07	0.02	4.27	**<0.001**				
Verb Length	0.04	0.02	2.71	**0.007**					-0.14	0.05	-2.8	**0.005**
Trial Seq.	0	0	-5.38	**<0.001**	0	0	-5.21	**<0.001**	0	0	-3.92	**<0.001**
Random Effects												
σ^2	0.16				1				3.29			
τ_{00}	0.06 $_{PPT}$				0.05 $_{PPT}$				0.31 $_{PPT}$			
	0.01 $_{ITEM}$				0.01 $_{ITEM}$				0.05 $_{ITEM}$			
ρ_{01}	1.00 $_{PPT}$				1.00 $_{PPT}$				0.66 $_{PPT}$			
	-0.88 $_{ITEM}$				-0.96 $_{ITEM}$				-1.00 $_{ITEM}$			
Observations	2335				2335				2335			

	Somewhat Predictable Phrases											
	Total Reading Time				**Fixation Count**				**Regression**			
Pred.	β	SE	t	p	β	SE	z	p	β	SE	z	p

(Inter.)	6.17	0.04	154.63	**<0.001**	0.98	0.04	24.25	**<0.001**	-0.94	0.16	-5.72	**<0.001**
Phrase Type	0.09	0.04	2.43	**0.015**	0.11	0.03	3.13	**0.002**	0.4	0.14	2.79	**0.005**
Adj. (1 Adj.)	0.42	0.02	22.11	**<0.001**	0.39	0.03	14.38	**<0.001**	0.57	0.11	5.21	**<0.001**
Adj. (2 Adj.)	0.7	0.02	36.42	**<0.001**	0.64	0.03	24.55	**<0.001**	0.73	0.11	6.76	**<0.001**
Trans. Prob.												
Verb Length	0.05	0.02	3.01	**0.003**	0.04	0.02	2.55	**0.011**				
Trial Seq.	0	0	-5.57	**<0.001**	0	0	-5.65	**<0.001**	0	0	-4.85	**<0.001**
Random Effects												
σ^2	0.16				1				3.29			
τ_{00}	0.07 $_{PPT}$				0.04 $_{PPT}$				0.57 $_{PPT}$			
	0.01 $_{ITEM}$				0.01 $_{ITEM}$				0.17 $_{ITEM}$			
ρ_{01}	-0.10 $_{PPT}$				1.00 $_{PPT}$				-1.00 $_{PPT}$			
	-0.53 $_{ITEM}$				-0.62 $_{ITEM}$				-0.56 $_{ITEM}$			
Observations	2608				2608				2608			

	Highly Predictable Phrases											
	Total Reading Time				**Fixation Count**				**Regression**			
Pred.	β	SE	t	p	β	SE	z	p	β	SE	z	p
(Inter.)	6.21	0.04	160.88	**<0.001**	1.01	0.04	25.45	**<0.001**	-0.8	0.13	-5.96	**<0.001**
Phrase Type	0.02	0.03	0.69	0.49	0.02	0.03	0.66	0.511	0.23	0.11	2.1	**0.036**
Adj. (1 Adj.)	0.41	0.02	24.76	**<0.001**	0.37	0.03	14.63	**<0.001**	0.42	0.1	4.25	**<0.001**
Adj. (2 Adj.)	0.74	0.02	44.55	**<0.001**	0.67	0.02	28.35	**<0.001**	0.79	0.1	8.07	**<0.001**
Pred.	-0.05	0.02	-3.04	**0.002**					-0.13	0.05	-2.69	**0.007**
Verb Length	0.04	0.02	2.53	**0.012**								
Trial Seq.	0	0	-8.18	**<0.001**	0	0	-6.65	**<0.001**	0	0	-6.42	**<0.001**

Trans. Prob.			
Random Effects			
σ^2	0.14	1	3.29
τ_{00}	0.06 $_{PPT}$	0.04 $_{PPT}$	0.36 $_{PPT}$
	0.02 $_{ITEM}$	0.01 $_{ITEM}$	0.07 $_{ITEM}$
ρ_{01}	0.42 $_{PPT}$	1.00 $_{PPT}$	0.14 $_{PPT}$
	-0.62 $_{ITEM}$	-0.56 $_{ITEM}$	-0.94 $_{ITEM}$
Observations	3144	3144	3144

	Highly Predictable Idioms Versus Nonpredictable Literal Phrases											
	Total Reading Time				**Fixation Count**				**Regression**			
Pred.	β	SE	t	p	β	SE	z	p	β	SE	z	p
(Inter.)	6.27	0.04	176.08	**<0.001**	1.05	0.04	25.33	**<0.001**	-0.8	0.14	-5.83	**<0.001**
Phrase Type	-0.06	0.03	-2.36	**0.018**	-0.09	0.03	-2.69	**0.007**	-0.05	0.1	-0.44	0.657
Adj. (1 Adj.)	0.41	0.02	22	**<0.001**	0.39	0.03	13.98	**<0.001**	0.49	0.11	4.38	**<0.001**
Adj. (2 Adj.)	0.74	0.02	39.81	**<0.001**	0.7	0.03	26.18	**<0.001**	0.89	0.11	8.09	**<0.001**
Pred. Verb Length	0.03	0.02	2.15	**0.031**					-0.18	0.05	-3.28	**0.001**
Trial Seq.	0	0	-6.56	**<0.001**	0	0	-4.8	**<0.001**	0	0	-4.48	**<0.001**
Trans. Prob.					0.03	0.02	2.19	**0.028**				
Random Effects												
σ^2	0.14				1				3.29			

τ_{00}	0.06 $_{PPT}$	0.05 $_{PPT}$	0.36 $_{PPT}$
	0.01 $_{ITEM}$	0.01 $_{ITEM}$	0.05 $_{ITEM}$
ρ_{01}	0.47 $_{PPT}$	1.00 $_{PPT}$	1.00 $_{PPT}$
	1.00 $_{ITEM}$	-0.93 $_{ITEM}$	-1.00 $_{ITEM}$
Observations	2561	2561	2561

Because in the highly predictable category literal phrases were significantly more predictable than idioms, which was not the case for the unpredictable and slightly predictable categories, I created another dataset where I included only highly predictable idioms (cloze predictability > 0.70) and unpredictable literal phrases (cloze predictability = 0), so that idioms would be significantly more predictable. Phrase type was significant in total reading time and fixation count, but not in regressions. Notably, the idioms were read significantly faster and elicited significantly fewer fixations than literal phrases, but no difference was noted in the likelihood for regression.

Discussion

The broader literature on idioms demonstrates a robust advantage for idioms compared to matched literal phrases (Canal et al., 2015; Carrol & Conklin, 2014b, 2017; Colombo, 2014; Conklin & Schmitt, 2008; Gibbs, 1980; Laurent et al., 2006; Ortony et al., 1978; Siyanova-Chanturia, 2015; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Strandburg et al., 1993; Swinney & Cutler, 1979; Tabossi, Fanari, et al., 2009; Underwood et al., 2004; Vespignani et al., 2010). The present study aimed to explore whether this idiom advantage persists when idioms are used creatively, and specifically when idioms are modified with intervening adjectives. To this end, an eye-tracking study was designed to compare the reading pattern of idioms to that of matched literal phrases, with and without adjectives.

Based on previous findings, it was anticipated that canonical idioms (*spill the beans*) would be significantly faster to process than matched literal phrases (*burn the beans*). Surprisingly, however, the results indicated the

opposite; literal phrases demonstrated a consistent processing advantage over idioms, as evidenced by significantly shorter and fewer fixations, as well as a smaller likelihood of regressions. A similar pattern was observed in the word-level analyses for the final words of literal phrases, except for the first pass reading time, and number of fixations—where no difference was found as a function of phrase type.

There were less clear predictions about whether an idiom advantage would survive the addition of intervening adjectives. Consistent with the observations for the unmodified phrases, literal phrases with one and two adjectives (*burn the spicy (red) beans*) were processed more efficiently than idioms with one and two adjectives respectively (*spill the spicy (red) beans*). This was again reflected in all late eye-tracking measures, in both phrase- and word-level analyses. Less surprisingly, the addition of each adjective led to an increase in the fixations and fixations times across measures (and for both phrase types), reflecting the extra time needed to process the additional information. In line with previous research (e.g., Cacciari & Corradini, 2015; Cacciari et al., 2007; Tabossi et al., 2005; Titone & Connine, 1994), increased predictability led to more efficient processing, but crucially this was not only evident in idioms, but also in literal phrases.

The present findings on the modified idioms are in line with McGlone et al. (1994), and Van de Voort and Vonk (1995), where an increase in processing time was observed as a function of adjectival insertion. Also, like Molinaro et al. (2013), a longer reading time was noted in the modified conditions, but in contrast with their finding of a smaller N400 amplitude for nouns in modified prepositions (*in the capable hands of*), no evidence of

facilitation was observed here for the idiomatic phrases or their final words. Interestingly, it was found that final words were more likely to be skipped following the insertion of one adjective, than with two or zero adjectives, which is in line with Molinaro et al.'s argument that the insertion of a congruous adjective could increase the cloze probability of the following noun (by restricting the range of possible phrase continuations). However, this applied to literal phrases as well as to idioms, therefore it does not speak of an idiom advantage per se. These findings are also in contrast with Vilkaitė's (2016), where an advantage was noted for nonadjacent collocations *(provide some of the information*) versus comparable non-collocations (*compare some of the information*).

The failure to find an advantage for unmodified idioms in their canonical form clearly contrasts with the findings reported in the literature across tasks and methodologies. Consequently, the items and experimental design were inspected more closely, to explore whether this might account for the diverging results. Idiomatic phrases here were familiar, similar to previous studies (e.g., Carrol & Conklin, 2014b, 2017; Rommers, Dijkstra, & Bastiaansen, 2013; Siyanova-Chanturia, Conklin, & Schmitt, 2011), and when familiarity was included in the analyses, it was found to benefit the processing of idioms with and without adjectives. There is, therefore, no reason to believe that these results are due to low familiarity with the items. Frequency and transitional probability cannot account for the findings either, since the idiomatic phrases were significantly more frequent and had a significantly higher transitional probability than the literal phrases. Moreover, the literal phrases had a processing advantage despite containing significantly longer

verbs, with length known to slow reading (Rayner, 2009).

Predictability, on the other hand, could potentially explain the findings. In the main analyses, where all phrases were included, idioms were significantly more predictable (40%) than literal phrases (32%), which in theory should have contributed to an idiom advantage. A closer look at the items revealed that literal phrases were significantly more predictable when cloze probability was above, or equal to 0.50—but no difference was noted in the predictability of idioms and literal phrases in the remaining items. One could argue, therefore, that this may have tipped the results in favour of the literal phrases. However, separate analyses indicated that literal phrases exhibited an advantage, not only when they were more predictable than idioms, but also when predictability was balanced between the conditions. In other words, when idioms and literal phrases were equally predictable (or equally unpredictable), literal phrases were still processed more efficiently.

This was clearly manifested in the analyses for somewhat predictable phrases, where all comparisons were significant across measures. In unpredictable phrases, only regressions reached significance, though this was most likely due to low statistical power, as these analyses were carried out on smaller subsets of the data (and particularly small in the case of unpredictable phrases). Furthermore, the fact that we see a significant disadvantage for idioms, albeit only in the likelihood for regressions in this case, implies that idioms were more difficult to process and to integrate in the context, since they needed to be reanalysed more often than their matched literal phrases.

A few major methodological differences were identified between this study and previous ones that might help to explain the findings. Some of the

earliest studies on idioms did not overtly explore predictability as a factor (e.g., McGlone et al., 1994; Swinney & Cutler, 1979), but since only familiar idioms were selected, it would be safe to assume that idioms (*kick the bucket*) were more predictable than their matched controls (*lift the bucket*). In more recent studies, where predictability has been explored, it was predominantly done so for idioms during pre-tests, so that only highly predictable idioms (with cloze completion rates often higher than 75%) would be included in the materials (Carrol & Conklin, 2014b, 2017; Conklin & Schmitt, 2008; McGlone et al., 1994; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Sprenger et al., 2006; Underwood et al., 2004). The predictability of the control phrases, on the other hand, was by-and-large not measured or compared (with the exception of a few studies that I discuss below). This suggests that the idiom advantage often reported in the literature, might have been an artefact of unbalanced predictability between the idioms and matched literal items.

To test this hypothesis on the present items, I carried out an additional analysis comparing the processing of highly predictable idioms (with cloze probability >= 0.70) to that of unpredictable literal phrases (with cloze probability = 0), thus mimicking the experimental conditions in previous studies. Interestingly, the results in this case aligned with past research; idioms exhibited a significantly shorter reading time and fewer fixations—though no difference was noted in the likelihood for regression. This advantage seemed to extend to modified idioms (*spill the spicy (red) beans*), versus modified literal phrases (*burn the spicy (red) beans*), but none of the pairwise comparisons reached significance, which could be a matter of reduced statistical power. Nevertheless, this finding reinforces the previous argument, that the advantage

often attributed to idioms could be in fact attributed to skewed predictability and highlights the significance of considering the predictability of the literal items in idiom studies.

Predictability of the literal/control items has only been considered in three studies in the literature: Tabossi, Fanari, and Wolf (2009), Rommers et al. (2013), and Canal et al. (2017). In a *post-hoc* analysis, Tabossi et al. (2009), found that (unsurprisingly) the idioms in their study were significantly more predictable than their matched controls and contemplated whether this unbalanced predictability may have caused the shorter response times for idioms. However, when predictability was accounted for, the researchers still observed an idiom advantage, while when familiarity was accounted for, they did not find a difference between idioms and matched controls. The authors concluded that familiarity might be the determining factor and not predictability. While this might be true when idioms are processed out of context (as in Tabossi et al. (2009)) since idioms will always be more familiar than novel expressions, with rich contexts the predictability of the literal phrases can be 'boosted', thus making them more 'equal' to idioms. The present findings show that when context makes a literal phrase predictable (or as predictable as an idiom), then the idiom advantage disappears, even though idioms were still significantly more familiar.

Rommers et al. (2013) measured reaction times to final words of (Dutch) idioms and literal phrases (e.g., *he walked against the <u>lamp</u>* meaning *he got caught* versus *he screwed the new light bulb into the <u>lamp</u>*), and found that the words were responded to faster when they were in idioms than in literal sentences, despite the target words having comparable cloze probability.

Rommers et al. do not provide a full list of the materials they used, but from the single example given, it may be that the literal target elicited a longer reaction time because readers needed to integrate meaning across nine words, while in the figurative condition the meaning of the phrase was across five words (almost half the amount). This, in combination with the fact that the stimuli were presented word-by-word for 300 ms, with a 300 ms blank screen after each word, could have made the integration of the literal targets more difficult, due to the larger amount of information that needed to be held in memory. Moreover, the unbalanced amount of information preceding the literal target, could have induced greater spillover effects onto the target word. Conversely, in the present study, idioms and literal phrases were not only largely balanced in terms of cloze probability, but the phrases themselves, as well as the regions immediately preceding and following them, were more carefully matched, thus minimising spillover effects into the regions of interest. Therefore, other things being equal, it still appears that the so-called idiom advantage might be nothing more but a by-product of often unbalanced predictability (or unbalanced stimuli design).

These findings align with Canal et al.'s (2017), where in contrast to previous EEG studies, the researchers compared the processing of idioms (used figuratively and literally) with that of *equally* predictable literal phrases. The researchers did not observe the typical reduction of the N400 amplitude (or an increase of the P300 component) usually reported for idioms over matched phrases (e.g., Laurent et al., 2006; Strandburg et al., 1993; Vespignani et al., 2010). Since the N400 component is thought to reflect (among other things) the predictability of a given stimulus, it makes sense that there was no difference

between phrases with comparable cloze probability, be that idiomatic or not. These findings, therefore, also imply that there might be no 'idiom advantage' when predictability is carefully accounted for.

Overall, the findings of the current study pose a challenge for the 'idiom advantage' as a notion, as well as to current theories of idiomatic language processing. Hybrid approaches hold that an idiom advantage emerges when idioms are recognised as figurative expressions, and access to their lexical representation (or template) becomes available (Cacciari & Tabossi, 1988; Cutting & Bock, 1997; Sprenger et al., 2006). Nonidiomatic phrases, on the other hand, are obligatorily subjected to compositional analysis, which is more time-consuming. The Configuration Hypothesis (Cacciari & Tabossi, 1988) explicitly refers to an idiomatic 'key'—the point at which the figurative meaning of an idiom becomes available. A cloze task provides a good indication of where the key occurs, with high cloze probability indicating that an idiom is recognisable at a particular point (i.e., before the string offset). Predictability was indeed significant in all the eye-tracking measures I examined, but it did not interact with idiomaticity. More predictable idioms were recognised faster than less predictable ones, but were *not* faster than equally predictable literal phrases (that would nevertheless undergo full on-line computation). This is seemingly in contrast to the prediction that idioms, which are equally predictable to novel phrases, should be faster because they bypass compositional processing.

The Multidetermined Model (Libben & Titone, 2008; Titone & Libben, 2014) would also have problems accounting for the current findings. If the idiom advantage is driven by various factors such as familiarity, frequency

etc.—as the model proposes—then the idioms should have been processed faster than the matched literal phrases. The results show that (both modified and unmodified) idioms were processed more slowly despite having a significantly higher familiarity, frequency, and transitional probability. However, the Multidetermined Model allows for factors to be prioritised relative to each other. By changing the weightings of the constraints, it should be possible to account for the current data. Notably, these changes would severely diminish the importance of the variables thought to underpin the idiom advantage.

Generally, none of the current theories on idiom processing seems to fit the present findings; however, the Multidetermined Model has the capacity to do so. The fact that a consistent advantage was found for literal phrases, except when looking at highly predictable idioms versus unpredictable literal phrases, implies that the idiom advantage may have been confounded with an advantage for highly predictable language. This seems very likely considering that only highly predictable idioms (versus unpredictable controls) were generally used in previous studies. The effect of prediction on language processing is an unquestionable phenomenon, with a vast literature demonstrating faster processing for highly predicted compared to less predicted language (for an excellent, recent review see Kuperberg & Jaeger, 2016).

An interesting question arises about why idioms were not processed with the *same* ease as literal phrases, at least when they were just as predictable and contextually plausible (and especially when other factors clearly favoured the idioms, e.g., shorter verb length). The answer to this might lie at the very heart of idioms' nature. Idioms are opaque phrases, potentially ambiguous, and

whose intended figurative meaning does not match the literal meaning conveyed by their component parts. At the same time, neurological findings show that idioms cause a stronger and more widespread activation in the brain (e.g., Boulenger, Hauk, & Pulvermüller, 2008; Boulenger, Shtyrov, & Pulvermüller, 2012; Lauro, Tettamanti, Cappa, & Papagno, 2007; Mashal, Faust, Hendler, & Jung-Beeman, 2008; Zempleni, Haverkort, Renken, & Stowe, 2007), contesting the idea that meaning activation in idioms is undemanding to the processing system.

It could be argued that the insertion of adjectives might have promoted a more compositional reading—at least in the modified condition—and/or that the adjectives in the idioms were metaphorical in nature, which made them more difficult to process. For example, understanding the adjectives in *spill the spicy, red beans* requires more complex inferencing so that a semantic association between *spicy*, *red*, and *secrets* can be established. This is not the case for the same adjectives in the literal condition (*burn the spicy, red beans*), where *spicy* and *red* are just (literal) properties of *beans*. However, while both of these arguments could explain why no advantage was found for the modified idioms, they cannot account for the fact that unmodified idioms were processed more slowly than matched, literal phrases.

Finally, because the processing of a region of interest can sometimes carry over to the next one (Conklin et al., 2018), I ran a *post-hoc* analysis to test for any spillover effects as a function of phrase type. It was hypothesised that an idiom advantage might be discovered on the first (n+1), or second word (n+2) immediately following the idiomatic/literal phrases. Recall that n+1 and n+2 were the same across conditions, and therefore the properties of these

words were kept constant. No significant effect of phrase type was found on the n+1 ($\beta = 0.04$, $t = 0.96$, SE = 0.01; $p = 0.33$), or n+2 ($\beta = 0.005$, $t = 0.29$, SE = 0.01; $p = 0.80$).

Thus, to conclude, the present study set out to explore whether creative uses of idioms would benefit from the same idiom advantage that is often reported for idioms in the literature. Particularly, I focused on the insertion of one and two adjectives, as in *he spilt/burned the spicy red beans*. No advantage for adjectivally-modified idioms was found, but surprisingly no advantage was found for unmodified idioms over matched, literal phrases either. The literal phrases, and their final words, had an advantage over idioms across all measures. Notably, compared to previous studies, the predictability of the idiomatic and literal phrases was more carefully controlled, and so were the regions preceding and following the phrases. Crucially, literal phrases were processed faster than idioms when their predictability was matched, whereas an 'idiom advantage' was *only* discovered when highly-predictable idioms were compared to unpredictable controls. This was despite other factors, such as frequency and familiarity, favouring the idioms.

The present findings call into question the existence of an 'idiom processing advantage', in the sense that there is something special about idioms per se. Rather, they suggest that what often grants idioms a processing advantage is the fact that they are significantly more predictable in comparison to matched control phrases. Importantly, when predictability was balanced between idioms and matched controls, idioms were processed *more slowly* than literal phrases. This not only refutes the existence of an idiom advantage, but actually speaks of an idiom 'disadvantage'. While these findings conflict with

the wider idiom literature, they align with the recent ERP findings on idiom processing (Canal et al., 2017). Finally, the current findings raise important questions about the nature and the processing of idioms, which will require further research.

CHAPTER 6

Conclusions: what does it all mean?

This thesis has presented four eye-tracking experiments designed to test how native speakers understand idioms encountered in a noncanonical form. Idioms are phrases that have a conventionalized meaning within a linguistic community and hence become familiar to speakers in a particular form: e.g., *shoot the breeze*, *kick the bucket*. Native speakers are able to activate the figurative meaning very quickly once they hear or read such phrases in their expected form and in fact, idioms in their canonical form, and particularly the more familiar and/or predictable ones, are processed faster than matched literal phrases, yielding a so-called 'idiom processing advantage' (Canal et al., 2015; Carrol & Conklin, 2014b, 2017; Conklin & Schmitt, 2008; Gibbs, 1980; Laurent et al., 2006; Siyanova-Chanturia, 2015; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Swinney & Cutler, 1979; Tabossi, Fanari, et al., 2009; Underwood et al., 2004; Vespignani et al., 2010). Part of this processing advantage is ascribed to the conventionalized status of the phrases, which not only increases their familiarity and predictability, but also leads to the formation of lexical representations in the lexicon, or templates in memory, serving (more or less) as mental dictionary entries for the figurative meaning. The two main issues addressed in this thesis are: first, the extent to which these representations or templates are exclusively attached to the conventional, canonical form of the idiom; and, second, whether these templates retain the idiom advantage in the event of idiom modification.

Current models of idiom processing were primarily developed to

account for idioms' speeded processing. Loosely put, the Configuration Hypothesis (Cacciari & Tabossi, 1988) sees predictability as the main source of the advantage, as this dictates how early the phrase will be recognised as a configuration (idiom 'key'). Similarly, the Superlemma Hypothesis (Sprenger et al., 2006) stipulates that idioms will be processed faster if fewer component words are needed for the phrases to be recognised and for their superlemmas to become activated. The Multidetermined Model (Libben & Titone, 2008), on the other hand, maintains that multiple factors (including predictability, frequency, familiarity, and decomposability) interplay and affect idiom processing, potentially even at different processing stages. Though these models are—or have the potential to be—more open towards idiom modification relative to earlier models (i.e., Lexical Representation Hypothesis (Swinney, 1979), Idiom List Hypothesis (Bobrow & Bell, 1973)), there was little or no empirical support demonstrating how and if idiom modification affects the understanding and/or the processing speed of the phrases during on-line language comprehension. With regards to the comprehension of modified idioms, scholars have specifically claimed that some idioms, including *kick the bucket* and *shoot the breeze*, are so conventionalized that they have become syntactically fixed, inflexible, or frozen expressions, such that the phrases are understood literally when modified (i.e., *the bucket was kicked ≠ died*) (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978; Wulff, 2008), though this had never been substantiated by empirical findings.

The main findings

Study 1 (Chapter 2), used eye-tracking to examine whether the passive forms of putatively flexible and inflexible idioms retained or lost their figurative meaning in a context that biased their figurative interpretation (e.g., 'die' for *kick the bucket*). Active and passivized idioms (*he kicked the bucket/the bucket was kicked*) were matched with contextually incongruous active and passive control phrases *(he kicked the apple/the apple was kicked*). Active idioms served as a baseline to demonstrate the typical idiom advantage. It was hypothesised that if passivized idioms *retained* their figurative meaning (*the bucket was kicked = died*), then they should be processed more efficiently than the control phrases, since their figurative meaning would make the phrase contextually congruent and hence easier to process. If, on the other hand, passivized idioms *lost* their figurative interpretation (*the bucket was kicked = the pail was kicked*), then their meaning should be just as incongruous as those of both control phrases, in which case no differences should be noted in the processing of the passivized idioms versus the control phrases. The results demonstrated a processing advantage for passivized idioms—both those that were classified as flexible and inflexible by linguists. Specifically, passivized idioms yielded fewer and shorter fixations and refixations, as well as fewer regressions than control phrases. However, idioms in the passive form induced longer reading times than the same phrases in their canonical form (i.e., active voice). Together these findings demonstrated that passivizing an idiom does *not* result in the phrase being understood only literally, but the modification takes a toll on processing speed.

Study 2 (Chapter 3), investigated whether the processing cost observed

for passivized idioms in Study 1 was due to interference from the literal meaning of the phrases (*the bucket was kicked* = 'the pail was kicked'), and also whether the figurative meaning of passivized idioms would be activated if not biased by the context. To achieve this, literally plausible passivized idioms (*the bucket was kicked*) were inserted in neutral sentences that did not favour a particular interpretation. The context following the phrases remained constant, with the exception of a disambiguating target word, that either related to the figurative meaning (*body*), to the literal meaning (*water*), or was semantically irrelevant (*time*). A faster processing of the literal target (*water*) would indicate that the literal meaning was activated first, which could interfere with the activation of the figurative meaning and create a subordinate bias effect, akin to what is typically observed in the processing of unbalanced homonyms (*bank*) where obligatory activation of the dominant meaning ('financial institution') interferes with the activation of the subordinate one ('side of river') and leads to a processing cost when the latter is intended. Eye-movement patterns showed that both literal and figurative targets of familiar[13] passivized idioms were read faster and elicited fewer regressions than control targets. Importantly reading patterns for figurative and literal targets did not differ, suggesting that both interpretations were available. Conversely, for less familiar passivized idioms, literal targets were read faster, indicating that reduced familiarity can lead to a primarily literal understanding of the phrase. This finding suggested that the processing cost in the previous study was unlikely due to an interference from the literal meaning, particular because the

[13] Note that, as in Chapter 3, the term 'familiar passivized idioms' is used to indicate 'passivized forms of familiar idioms', since passive idioms are infrequent in typical language use and are not, therefore, familiar in this form.

biasing context in Study 1 should have boosted activation of the figurative meaning. Notably, the general cost associated with the passive voice was not eliminated. The second main finding of Study 2 was that passivized idioms (idiom region) attracted shorter regressive fixations in the literal condition, potentially indicating that the literal meaning had become activated first and/or was more easily integrated in the otherwise neutral context.

Because dyslexic people have been shown to have reduced pragmatic competence (Cooke, 2001; C. Griffiths, 2007), less efficient inhibitory control (Gernsbacher & Faust, 1991; Lorsbach et al., 1996), potentially making the suppression of contextually irrelevant meanings challenging, and a limited working memory capacity (Smith-Spark & Fisk, 2007), that may be unable to concurrently entertain multiple interpretations and/or allocate more resources to the processing of ambiguous language, idioms might be challenging for them. Thus, Study 3 (Chapter 4) replicated Study 2 with participants who have dyslexia (DYS). Although the typically developed readers (TDRs) of Study 2 demonstrated a facilitation for the literal meaning of the phrases (idiom region), the figurative meaning of familiar passivized idioms was activated by the time the target word region was reached. It was hypothesised, therefore, that readers with DYS (DYSRs) might have a greater difficulty in activating the figurative meaning. In Study 3, the eye-movement patterns of DYSRs were compared to those of TDRs. DYSRs read the literal targets (*water*) faster than the figurative targets (*body*), regardless of how familiar the passivized phrases were, clearly demonstrating a preference for the literal meaning. However, the figurative targets (*body*) were faster to process than the irrelevant control targets (*time*), suggesting that the figurative meaning was activated and

integrated eventually. Overall, the results showed that DYSRs do retrieve the figurative meaning of modified idioms, but activation is slower and costly. This was evident early on during processing, as figurative targets elicited a longer first fixation duration in comparison to both types of target words. In contrast to TDRs, DYSRs did not exhibit any differences in their reading of the idiom region.

Study 4 (Chapter 5) again addressed whether the idiom advantage survives modification. As mentioned at the beginning of the Chapter, a plethora of studies have demonstrated that idioms in their canonical form (*spill the beans*) are processed faster than matched literal phrases (*spill the chips*), owing to their conventionality, and by extension, to their frequency, familiarity, predictability, and lexicalised status. Considering the processing cost of passivized idioms observed in Study 1, which could be attributed to the passive construction being more cognitively demanding (Study 2), in Study 4, a different modification was utilised. In this eye-tracking experiment extra adjectives were inserted into the idiom so that the modification maintained the active syntax of the idiom, but 'disrupted' the canonical form by distancing the idiom component words (e.g., *spilled the (spicy (red)) beans*). The reading pattern for idioms without adjectives (canonical form) and idioms with up to two intervening adjectives, was compared to that of matched, literal phrases (e.g., *burned the (spicy (red)) beans*). Both phrase types were embedded in sentential contexts that biased their respective meaning. It was anticipated that canonical idioms would exhibit the typical advantage compared to their matched literal phrases and that this advantage might survive the addition of adjectives. Surprisingly, the results demonstrated no advantage for idioms over

literal phrases, whether they were modified or not. Idioms were *only* faster to process when they were highly predictable relative to literal phrases that were unpredictable in their context. The findings suggested that idioms might actually be *more* difficult to process than literal control phrases when the control phrases are just as predictable in a context as the idioms themselves.

Evidence against idiom 'frozenness'

As we saw in Chapter 1, some prominent models of language processing hold that linguistic production and comprehension is governed by syntax (e.g., Chomsky, 1965; Katz, 1973), and idioms as atypically non-compositional strings were the exception that proved the rule. Idioms, along with other types of formulaic or pre-constructed sequences offer 'single-choices', as Sinclair (1991) put it. Thus, they are fairly 'fixed' and predictable with regards to which words they allow to occupy their 'slots' (Sinclair, 1991), as well as how and where these words should occur: for example, English native speakers prefer *bride and groom* over *groom and bride*, despite the phrases referents' meaning being essentially the same thing. Along the same lines, a greater degree of fixedness has been claimed for idioms in terms of word choice as well as word order. For instance, people say *spill the beans*, not *drop the beans* or *spill the lentils* when figuratively referring to the (accidental) revelation of secrets, but the order in which the component words of some idioms appear (*kick the bucket*) is not merely a matter of preference, but arguably, of necessity, with a reversal of the component words being said to lead to a loss of the figurative meaning (*the bucket was kicked* ≠ 'die') (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978;

Wulff, 2008).

In contrast, literal phrases are flexible and fully compositional: their component words 'carry' the meaning of the phrase and, therefore, manipulating those words (e.g., via passivization) does not affect the meaning of the individual words, nor that of the overall phrase. Thus, passivizing a literal phrase (*they ate the cake* to *the cake was eaten (by them)*) makes it syntactically more complex, but semantically, the same message is conveyed, although in the passive form, the focus falls on the patient rather than the agent of the event. The component words of idioms, on the other hand, do not carry the figurative meaning in the same way, as idioms are not compositional (*kick* + *the* + *bucket* ≠ 'die'), and it has been argued that the figurative meaning is instead attached to the phrase as a whole (*kick-the-bucket* = 'die'). Consequently, idioms are thought to be syntactically fixed, with *some* being completely frozen and as such unable to undergo complex syntactic alterations without losing their figurative meaning (Fraser, 1970; Gibbs & Nayak, 1989; Langlotz, 2006; Makkai, 2011; Nunberg, 1978; Wulff, 2008): the passivized form *the bucket was kicked* would be solely understood literally, as 'the pail was kicked'. As was discussed in Chapter 2, a number of different theories were formulated to operationalise the idiosyncrasy of idioms with respect to their fixedness and flexibility (e.g., Abeillé, 1995; Fraser, 1970; Newmeyer, 1972). For the most part, these were developed based on what Wray describes as "armchair intuition" (2002, p. 13), in other words, without empirical validation. One theory that was supported by some empirical findings, and which became rather influential, was the Decomposition Hypothesis (Gibbs & Nayak, 1989; Gibbs, Nayak, Bolton, & Keppel, 1989). According to this

theory, the flexibility of idioms depends on the decomposability of the phrases, that is, how much the component words of an idiom contribute to the figurative meaning. Indeed, Gibbs and colleagues found that native speakers rated decomposable idioms as more flexible than non-decomposable ones in judgement tasks. However, this decomposability effect, failed to be replicated in other studies (Tabossi et al., 2008), and was not found to influence on-line idiom processing (Libben & Titone, 2008).

Though fixedness is undoubtedly what makes an idiom conventional and familiar within a linguistic community, the current findings suggest that once conventionalized, these phrases can be refashioned and still retain their figurative meaning. The findings of Studies 1, 2, and even 3, demonstrated that idioms preserve their figurative interpretation when significantly reconfigured (i.e., passivized), regardless of how transparent their meaning. Here, transparency ratings were used here as a metric of idiom compositionality (or decomposability). Study 3, in particular, showed that even DYSRs, who had an easier time processing the literal-compositional meaning of the phrases, were (eventually) able to retrieve the figurative meaning. Importantly, transparency did not affect or determine the level of flexibility of an idiom in any of the studies reported in this thesis: passivized idioms (*the bucket was kicked*), be they transparent or opaque, yielded overall fewer and shorter (re)fixations than matched control phrases (*kicked the apple/the apple was kicked*: Study 1). Fewer and shorter (re)fixations were noted for the figurative than control target words appearing after passivized idioms (e.g., *body* vs. *time* for *the bucket was kicked*) for TDRs (Study 2), as well as DYSRs (Study 3).

Thus, taken together the data in this thesis call into question the notion

that some idioms are 'frozen' or markedly idiosyncratic in their flexibility, although idioms certainly have a preferred (canonical) form. However, the canonical form cannot be thought to be set in stone, as people can understand novel and/or creative adaptations of idioms used figuratively during on-line comprehension. As such, the canonical form of an idiom is not its *fixed* form, but is rather its *default* form. Crucially, the present findings complement evidence from studies on corpora and real language use, which have demonstrated that idioms are manipulated by language users with the intent to be playful or creative (e.g., Barlow & Kemmer, 2000; Duffley, 2013; Hovhannisyan & Mkrtchyan, 2014; Moon, 1998), and they further illustrate that idioms are subject to more extensive syntactic operations than what many models either assumed or stated. That is, idioms do not merely accept simple grammatical changes, such as tense agreement (*he kick**ed** the bucket*), but also more complex operations including the passive construction, establishing their (somewhat) compositional nature.

The role of the parts

If the component words of an idiom can be moved around and the figurative meaning is still available, it follows that the component words play a role in meaning activation. But how can this be reconciled with the fact that idioms are not compositional (*kick* + *the* + *bucket* ≠ 'die')? One way of doing this, is by assuming that the accumulation of activation from encountering an idiom's component words in proximity, form the basis of an idiomatic configuration (Cacciari & Tabossi, 1988), or a superlemma (Sprenger et al., 2006). These configurations of words or superlemmas enable the retrieval of

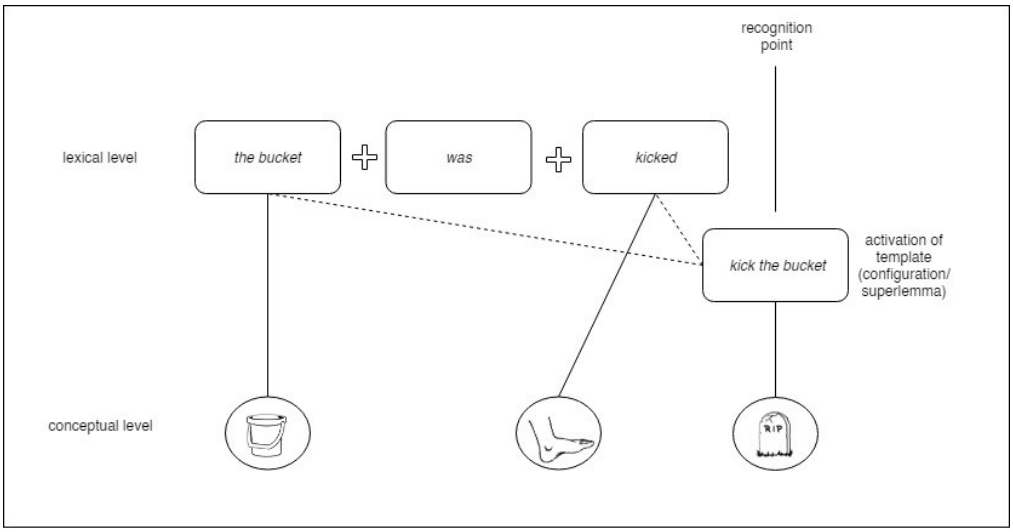


Figure 6.1 – Graphic illustration of how the meaning of the passivized idiom the bucket was kicked would become activated. Continuous lines represent stronger activation/connection, whereas dotted lines represent a weaker activation/connection. The configuration/superlemma represents the template or stored representation of the idiom and although the idiom was written here in its canonical form kick the bucket, idioms' templates might be more generic and less rigid in terms of form, thus allowing for figurative interpretations of noncanonical idiom forms.

the figurative meaning once activated.

Figure 6.1, presents activation when the words of a modified idiom are encountered. Here, *bucket*, being the first idiom component to be encountered in the passive form, is likely to lead to a stronger activation of the literal meaning 'pail' (continuous line), than the configuration/superlemma *kick the bucket* (hence the dotted line). This is because the passive form of the idiom is uncommon in language use, making the phrase considerably less frequent, and potentially the word *bucket* a weaker predictor of the respective superlemma/configuration than the same *bucket* in the canonical, active form. However, the weak activation of the configuration/superlemma becomes stronger as the remaining idiom words are encountered (i.e., *was kicked* in this example). Once the components have been encountered, the phrase is recognised and the figurative meaning can be accessed. In other words, the

component words lead to the activation of the figurative meaning, just not in the traditional way: instead of each word adding a piece of information incrementally, the presence of all of the words in close proximity (or some of the words if idioms are highly predictable) activate the stored representation or template of the idiom, which in turn leads to idiomatic activation. Therefore, readjusting the position of these words, while still maintaining their close proximity, can render an idiomatic interpretation.

It is important to note that the Superlemma Theory (Sprenger et al., 2006) does not make clear predictions about the effects of idiom modification on activation of the superlemma and it further states that syntactic alternations *can* be blocked by the superlemmas of inflexible idioms. The present findings suggest that the simple lemmas (idiom's component words) of even inflexible idioms activate the relevant superlemmas in a facilitative context (Study 1), although not to the same extent when idioms are modified, unfamiliar, and inserted in a minimal context (Study 2). Crucially, the findings do *not* indicate that a superlemma blocks the activation of the figurative meaning, but rather that the phrases were not familiar enough and/or the context was not facilitative enough to cause (fast) activation of the respective figurative interpretation.

The current findings are in line with the predictions of the Configuration Hypothesis (Cacciari & Tabossi, 1988), which assumes that the figurative meaning of an idiom will be accessed once the phrase is recognised, regardless of word order and as long as the phrase remains recognisable, meaning, as long as the key(s) are still present. Notably, the key(s) are not necessarily fixed across all contexts: for example *bucket* might be the key of *kick the bucket* but not necessarily of *the bucket was kicked*. The theory states

that the figurative meaning of unpredictable idioms (i.e., idioms whose key coincides with the last word of the phrase) will activate a few milliseconds following the phrase offset (e.g., after *bucket* in *kick the bucket*). Indeed the fact that active idioms in Study 1 caused a spillover effect on $n + 1$, implies that the figurative meaning was activated soon after word n (*bucket*) was read. Both the active and passivized idioms used in Studies 1-3 were unpredictable (late-key) in the presence and absence of context, suggesting that both forms had a similar activation point, that is, the final word of the idiom (*bucket* in the active and *kicked* in the passive). Yet idioms in their passive form needed longer reading and rereading time relative to their canonical form, indicating that the modification itself significantly slowed down activation. Neither the Configuration Hypothesis, nor any other model has made any claims regarding processing costs associated with idiom modification, but as the findings of Study 2 suggest, the slower processing time of passivized idioms may be an artefact of the syntactic construction, as passive voice is more complex. This would mean that the processing cost may not be due to the fact that idioms were modified, but specifically because they were passivized.

The role of external factors

Prior familiarity with an idiom and its idiomatic interpretation is needed for the stored representation/template to be accessed. Unsurprisingly, in Study 2 it was found that activation of the figurative meaning was more challenging when the phrases were passivized versions of *less* familiar idioms. Perhaps less familiar idioms have weaker templates or weaker connections between the component words and their templates and as such cannot swiftly activate the

figurative meaning, especially when the phrases are modified (as in Figure 6.1). In contrast, the templates of highly familiar idioms appear to have stronger representations that more rapidly activate the figurative (as well as the literal) meaning of the phrase, despite the unfamiliar syntactic form in which the idiomatic phrases were found.

Interestingly, when passivized idioms were inserted in a biasing context, as in Study 1, it was frequency and not familiarity that speeded up processing. The idioms used in both Studies 1 and 2 were rated mostly as familiar with only a small proportion rated as less familiar, although still with a rating of 2 or above (on a scale where 1 = completely unfamiliar), indicating that those idioms were not completely unknown to the native-speaker participants. Therefore, the figuratively-biasing context in Study 1, which preceded the idioms, could have facilitated the activation of the figurative meaning of the less familiar phrases. For example, a scenario about an old man being sick could have aided the activation of the meaning 'die' before participants even encountered the phrase *kicked the bucket/the bucket was kicked*. Assuming that the context indeed aided the activation of the correct interpretation before the idiom was presented, it is not surprising that frequency was then the only factor influencing processing speed: more frequent idioms led to a faster activation, in line with Usage- and Exemplar-Based models of language processing, advocating that more frequent linguistic items are processed faster than less frequent ones (Abbot-Smith & Tomasello, 2006; Bybee, 1985, 1995, 1998, 2006; Goldberg, 1995, 2006; Tomasello, 2003).

Familiarity, frequency, predictability, and transparency ratings were gathered for the canonical form of idioms across all studies. These ratings

demonstrated a relationship between idioms in their canonical form (Study 1), but *also* the same idioms in their passivized version (Studies 1 and 2)—with the exception of transparency which did not modulate reading patterns for either form in any study. This suggests that these factors are not strictly associated with a particular form of the idiom, and the fact that they may facilitate idioms in a non-canonical form suggests that in terms of representation, idiom templates might be rather generic, so that any combination (in terms of order) of idiom component words can lead to an activation of the template, although component words of more frequent/familiar/predictable idioms will result in faster and/or greater activation. This is in line with the Multidetermined Model (Libben & Titone, 2008; Titone & Connine, 1999), which assumes that factors such as the above affect the processing speed of idioms, though the model does not specify whether modified versions of idioms would benefit equally.

Idiom modification influences processing

The collective findings of the studies demonstrate that idioms are flexible, but that modification reduces the processing benefit conferred by an idiom. Study 1 showed that passivized idioms (*the bucket was kicked*) were faster to read than control phrases (*the apple was kicked/kicked the apple*), but slower to read than their active forms (*kicked the bucket*). It was hypothesized that this could indicate interference from the literal meaning of the phrase (i.e., *the bucket was kicked* = 'the pail was kicked'). To address this, Study 2 embedded passivized idioms in neutral contexts and a post-idiom target word (*body/water*) disambiguated the intended meaning of the phrase. A facilitation

and/or easier processing of the literal, as opposed to the figurative, target would suggest that the literal meaning was indeed more prominent and potentially causing interference with the activation of the figurative meaning. The findings of Study 2, however, demonstrated that this delay could not be attributed to interference from the literal meaning, since even in the absence of a biasing context, the figurative meaning was retrieved quickly. The provision of a rich context prior to the passivized idioms in Study 1 would have 'primed' the figurative sense, making it likely that the processing cost observed in Study 1 reflected the novelty of the idiom passivized forms and/or the lower frequency of the passive construction (Hopper & Thompson, 1980; Williams & Colombo, 1990).

Study 2 also showed that passivized versions of familiar ambiguous idioms facilitated the activation of both their literal and figurative senses, mirroring findings from studies on canonical idioms (Milburn & Warren, 2019; Siyanova-Chanturia, Conklin, & Schmitt, 2011). More specifically, it was found that target words appearing after the passivized idioms and relating to one of the two plausible meanings of the phrase (*body* and *water* for *the bucket was kicked*) were (re)read at the same speed. Thus, it was concluded that once both meanings were activated (literal and figurative), both meanings remained available downstream in the sentence. Meaning activation was likened to the way equally frequent meanings of balanced homonyms are processed, or alternatively, the way different but related senses of polysemes are understood, whereby in both cases the selected interpretation does not come at a cost for the processing system (e.g., Duffy et al., 2001; Klepousniotou et al., 2012). Notably, passivized idioms intended literally (*the bucket was kicked* = 'the pail

was kicked') elicited the shortest regressive fixations (though regressions were not necessarily launched from the target words). This suggested that perhaps the literal meaning was more highly activated and/or more easily integrated than the figurative one. However, because the disambiguating target words occurred a number of characters (letters) after the passivized idioms and considering that the idioms were unpredictable as configurations in the context, a faster initial activation of the literal meaning was highly likely. This could have eased the *integration* of the relevant meaning in the context (see also Cacciari & Corradini, 2015). As discussed in Chapter 3, current models of idiom processing were developed to explain how an idiom's meaning becomes activated, and *not* how this meaning might be integrated as part of a wider context, which would be an interesting avenue for future research. This raises important questions regarding the integration of the figurative meaning; as far as the findings of Study 2 are concerned, it could be argued that the passive manipulation caused an initial imbalance in meaning dominance by prioritising the literal meaning. The equilibrium was restored rapidly for familiar idioms, such that the figurative meaning quickly reached an equivalent level of activation, while, for less familiar idioms, the literal meaning remained the most highly active one.

When repeating Study 2 with DYRs (Study 3), it became clear that activating the figurative meaning of *both* familiar and less familiar passivized idioms was more challenging for this population. As opposed to TDRs, DYSRs read the literal target words (*water*) faster than the figurative (*body*) and control targets (*time*), indicating a preference for the literal meaning of the phrases. Based on findings in the wider literature, it was suggested that DYSRs might

be less efficient in suppressing the contextually-irrelevant meaning of the phrases (Gernsbacher & Faust, 1991; Lorsbach et al., 1996), in concurrently entertaining multiple interpretations and/or in allocating sufficient resources to the processing of the figurative meaning due to a limited working memory capacity (Smith-Spark & Fisk, 2007). Although more fine-tuned research will be needed to determine exactly why non-literal meanings are more difficult to understand by DYSRs, the findings of Study 3 do not support the idea that DYSRs have (severely) reduced pragmatic competence: DYSRs were able to activate the figurative interpretation, albeit more slowly than TDRs.

When discussing the findings of Study 3, it was mentioned that DYSRs may have been *committed* to the literal interpretation of the phrases, potentially as a subconscious way of minimizing the workload in working memory. Future research could investigate whether a prior context biasing a figurative interpretation of (both canonical and modified) idioms would encourage DYSRs to commit to the figurative meaning. Also measures of working memory should be included, for both DYSRs and TDRs, to establish its role in maintaining multiple meanings of idioms during sentence processing. This would clarify whether the literal meaning is by default more highly activated in DYSRs, or whether it was more probable here, because idioms were presented in minimal contexts and were modified (and hence unfamiliar in this form).

The idiom advantage, predictability, and idiom modification

Having established that idioms can be understood figuratively when significantly modified (i.e., passivized as in Studies 1-3), the focus turned to whether idiom modification might affect the processing speed of the phrases,

and specifically whether this can affect the 'idiom processing advantage' that is often associated with the canonical form of idioms (e.g., *spill the beans* over *spill the chips*). It was mentioned earlier that at least part of this advantage stems from the lexicalised status of idioms, which involves representations or templates in memory. These templates are activated once an idiom is recognised, and the sooner a phrase is recognised, the faster a template is activated, leading to a processing advantage for idioms relative to matched literal phrases that have to be computed word-by-word on-line.

In Study 1, we saw that passivized idioms were slower to process than their active forms, even though both forms were equally unpredictable in the context (late-key) and should have a similar recognition point (i.e., after the phrase offset). This finding suggests that the processing advantage may not survive modification. However, the passive construction itself may have been the (main) cause of this processing cost, since it is more complex and less frequent than the active voice. Some recent studies on other types of formulaic sequences have in fact shown that a processing advantage can survive the addition of extra words. For example, the modified collocation *provide some of the information* was read faster than its matched non-collocation *compare some of the information* (Vilkaitė, 2016), while a reduced N400 was also observed for the noun (*hand*) of modified versus unmodified complex prepositions (*in the (capable) hands of*) (Molinaro et al., 2013). To explore whether a similar pattern would be observed for idioms, Study 4 used a similar modification. To this end adjectives were inserted into the phrase so that idiom words would occur in their expected syntactic order, but would be disrupted by the insertion of the extra words, as in *he spilled the spicy (red) beans*. In contrast to the

previous findings (i.e., Molinaro et al., 2013; Vilkaitė, 2016), the results of the eye-tracking experiment in Study 4 did not indicate a processing advantage for idioms in either their canonical (*spilled the beans*) or modified form (*spilled the spicy (red) beans*) compared to the literal control phrases (*burn the (spicy (red)) beans*). In fact, both types of idioms were read more slowly and yielded more regressions than their matched control phrases, indicating that they were more difficult to process.

Clearly, these results appeared to 'go against the grain' considering the vast literature reporting faster processing for canonical idioms versus matched non-idiomatic phrases. As discussed in Chapter 5, a potentially significant difference was identified between the stimuli of Study 4, and those of the majority of the literature. That is, in Study 4, the *control* phrases were not only plausible in their respective contexts, but were also (highly) predictable in them, as evidenced by the 'correct' responses in the cloze tasks. On some occasions, the final word of the control phrases was even more predictable than that of the idioms. Crucially, when control phrases and idioms were matched for their contextual predictability—while idioms were still significantly more familiar, frequent, and with a higher transitional probability—the literal, control phrases were processed faster than the idioms. Most previous studies did not measure or match the contextual predictability of control phrases, or alternatively they used idioms and controls out of context, where idioms are naturally bound to be more predictable as they are conventionalised phrases.

The findings of Study 4 did, however, line up with a recent EEG study. Canal et al. (2017) found that the final words of predictable idioms and equally predictable control phrases did not differ in their modulation of the N400

effect. However, idioms induced a frontal positivity (PNP) (when used in their figurative sense) indicating that they required sentence revision mechanisms. This suggests that idioms require more processing effort than literal phrases, though this only becomes evident when idioms are compared to equally predictable literal phrases. The PNP effect in Canal et al., (2017) might align with the longer reading and rereading times, as well as the increased likelihood for regressions observed in Study 4. Essentially, this would mean that the idiom advantage has been conflated with an advantage for predictable (idioms) versus unpredictable (control) phrases, and as such might not be quite as representative of actual idiom comprehension. A processing cost for idiomatic phrases would not be that surprising considering the nature of these phrases; they do not 'mean' what they 'say' and neurolinguistic studies demonstrate that idioms are associated with stronger and more widespread activation in the brain (e.g., Boulenger, Hauk, & Pulvermüller, 2008; Boulenger, Shtyrov, & Pulvermüller, 2012; Lauro, Tettamanti, Cappa, & Papagno, 2007; Mashal, Faust, Hendler, & Jung-Beeman, 2008; Zempleni, Haverkort, Renken, & Stowe, 2007).

More research is needed in order to draw definitive conclusions as to whether the idiom advantage is 'real', or whether the advantage that has been observed thus far is really just an advantage conferred to any predictable language, and/or whether the idiom advantage is in fact an artefact of unbalanced experimental materials. A good place to start would be to replicate Study 4 without the use of extra adjectives while also manipulating the stimuli further so that predictability is more carefully controlled. This would allow us to see whether the insertion of the adjectives had (inadvertently) encouraged a

stricter compositional reading, of not only the modified idioms, but also of their canonical forms, potentially delaying the activation of the canonical idioms and, as a result, giving an advantage to the literal phrases.

With regards to the modified idioms specifically, the appropriateness of the injected adjectives was not assessed empirically. Although the adjectives were carefully chosen to fit both the idioms and their control phrases in their respective contexts, they may have suited one interpretation of the phrase more than the other. Because idiom modification is fairly rare, this may have disadvantaged the modified idioms (*spill the spicy (red) beans*) relative to their matched literal phrases (*burn the spicy (red) beans*). This would not, of course, explain why unmodified idioms were also slower to read than their matched controls, unless, as stated in the previous paragraph, the manipulation caused an overall stricter compositional reading of the phrases.

Limitations and future directions

In Study 1 we saw that passivized idioms were slower to process than their active forms, but so were passivized control phrases (*the apple was kicked*) compared to their active forms (*kick the apple*). Although this study was designed to test meaning activation of modified idioms, a follow-up study should investigate whether passivized idioms would be slower or faster to process relative to *contextually plausible* passive control phrases. Similar processing in this case would further clarify if the passive voice was indeed the main driver of the processing cost of passivized idioms. Conversely, if passivized idioms were slower to process, then this would signal that some additional idiom-specific factors (apart from voice) contributed to the cost.

With regards to Study 2 and 3, where the focus was heavily on which meaning would be activated first, it would be ideal to run an additional norming study measuring idioms' meaning dominance in their canonical form. For example, participants could be asked to rate how likely it is for an idiomatic phrase to be encountered figuratively versus idiomatically. This would add another dimension to the analysis and would allow for more direct comparisons with findings from the lexical ambiguity literature, where words have meanings that are more frequent, less frequent or have similar frequencies. Another norming study would also be beneficial for Study 4, one judging the appropriateness of the injected adjectives. This could help with the interpretation of the results: were the literal phrases (*burned the spicy (red) beans*) read faster because the adjectives were more suitable for the literal interpretation as opposed to the figurative one?

Considering the findings of Study 4, as well as those of Canal et al., (2017), it is imperative that future research explores the role of predictability and potentially disentangles it from the 'idiom processing advantage'. More importantly, future research should address the issue of whether or not idioms actually yield a processing disadvantage, as they are more cognitively demanding, and the extent to which this disadvantage has been masked by the often unbalanced experimental design (with regards to contextual predictability). Moreover, another avenue for future research, would be to examine how a figurative meaning becomes integrated in a biasing versus neutral context and when this occurs either before or after the idiom. Together research like this would also help to develop current models of idiom processing, originally accounting for the activation of the figurative meaning.

Overall conclusions

Taken together, the findings in this thesis indicate that the figurative meaning of idioms is not solely associated with the canonical form, but perhaps with the idioms' component words occurring in close proximity. This allows for the configuration to be recognised and the figurative meaning to become activated when the component words appear in an unexpected form or order. The findings further indicate that idioms (and their templates/representations) are far more flexible than many scholars have given them credit for: reconfiguration did *not* halt the activation of the figurative meaning. Thus, both typically developed readers, as well as those with dyslexia, were able to activate the figurative meaning of modified idioms—although this was more laborious in the latter case. The speed of activation in typically developed readers depended on familiarity with the figurative meaning when surrounding context was minimal, or on the frequency of the phrase when prior context was facilitative, although there was some cost for modified idioms relative to unmodified ones. Of particular interest, canonical idioms *also* appeared to incur a processing cost when compared to literal phrases matched for contextual predictability.

In sum, the thesis supports the view of language use as a creative process, whereby users are not restricted to simple reproduction of linguitic material, but they also recreate, or refashion it in new contexts (Swann & Maybin, 2007). After all, language use can be, and is, used creatively to convey humour and finer nuances of meaning, and formulaic expressions in particular are often the locus of language play and creativity, since one needs to be able to recognise what is 'normal' (the canonical form of an idiom), in order to fully

appreciate any playful or creative deviation from the norm, such as the use of an idiomatic variant (Carter, 2015; Carter & McCarthy, 2004; Crystal, 2001). The research presented in this thesis demonstrates that the figurative meaning of idioms is not lost when they are modified. However, the pervasive finding of an idiom advantage needs to be further explored to determine whether it is simply due to the predictabilty of the formulation and akin to other predictable language, or whether some of the advantage is conferred by the configuration itself.

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APPENDICES

Appendix A

Experimental lists - Study 1

No.	LIST 1
1	Alan always thought he was a very mediocre piano player, but at the recital the show was stolen and all the agents wanted to sign a contract with him.
2	Alex was trying for months to avoid bankruptcy while keeping all his staff, so a footpath was walked for a while but luckily things got better in the end.
3	Although Gary hated being on that strict diet for a year, he lost 4 stone because he stayed the course and he was very proud of himself afterwards.
4	Although Jim’s health seemed to deteriorate over the last couple of weeks, he turned the horse and he amazed everyone with his recovery.
5	Although Maggie's father is technically the official head of the business, the strings are pulled without consulting him unless it is necessary.
6	Amy was sick of her flatmate's pranks and decided to prank her back so that the bet could be settled once and for all.
7	Anastasia usually wears casual clothes, so when she arrived in a maxi dress a vase was made at the gala and she got all the attention.
8	Andrew spent a rough couple of months settling into the new country, but eventually his key was found and he got used to living abroad.
9	As soon as Ron informed his boss that he had met his sale targets, he moved the billboards and Ron did not get the bonus he was expecting.
10	Barney asked for a company car right after negotiating a good pay rise, so his chair was pushed and his boss fired him for being greedy.
11	Becca's parents didn't want her to study abroad, but by talking to them calmly the table was prepared so when she finally left they were happy for her.
12	Bob bought a Ferrari soon after becoming an accountant, so people thought that he had lined his curtains as he could not afford it on his salary alone.
13	Brian’s wife is sensitive about her weight, so when he suggested her to go on a diet he twisted the knife and she got really upset with him.
14	Bruce bragged about being a just officer, but when his son was caught stealing, he bent the rules so that he wouldn’t have to go to jail.
15	Buddy felt overwhelmed with work after his promotion, but by working hard the grade was made in the end despite the rough start.
16	Caroline had been dreaming of opening a boutique, so when a shop was let, she took the tram and her business is now blooming.
17	Carter threatened to fire anyone who would not go to work on the bank holiday, so he flexed his muscles effectively and all the staff went to work as normal.

Cecile could no longer afford designer shoes when her husband got fired,
18 so the chill was felt and their marriage began to crumble.
Chris is generally a rude person, but when he offended a police officer he
19 crossed the room and the officer arrested him.
Collin finally realised that his reckless behaviour was harming his family,
20 so his fence was mended the moment he got out of jail.
Dad got fired last January, and Mum’s salary was the only source of
income, so we tightened our belts for a few months until Dad could find a
21 new job.
Debbie didn't really feel like clubbing with her friends last night, but her
22 hair was twisted and she ended up joining them anyway.
Despite Eleanor’s fury when a guest spilled red wine on her wedding
23 dress, her house was kept and acted as if nothing had happened.
Edward won the Nobel Prize by developing a revolutionary drug, and so
24 he made his dinner in the scientific world.
Ellie’s cousin overheard her critical comment about him, so she realised
25 that a stapler had been dropped and she apologised to him afterwards.
Emma had to become stricter when her students started acting up, so she
26 cracked the whip until she was able to regain full control of the classroom.
Fred copied some classified documents, but by putting them back quickly
27 he covered his tracks and no one ever found out about it.
George knows everything about phones, so when his sister wanted to buy
28 one, she picked his brains for hours in order to choose the best one.
Gina aimed to run her own restaurant one day, so by working at a local
diner she cut her teeth and within a couple of years she gained all the
29 necessary experience.
Gina had been putting off some home repairs, but the roof started leaking,
30 so she bit the biscuit and she decided to hire a repairman.
Harold couldn't deal with the memories of his late wife when he was
sober, so the bottle was hit every night and he ended up having a drinking
31 problem.
Harrison needed his candidate to win the elections, so with that scheme he
32 tipped the bottle in his candidate's favour.
Harry observed the procedure being carried out by his supervisors many
times, so he learnt the ropes and they finally trusted him to do it on his
33 own.
Inspector Smith found the police informant dead in his own house, so he
smelled a flower and he called the homicide department to investigate the
34 cause of death.
Jack and Linda had a big fight over money, but they truly love each other
35 so they buried the thistle for the sake of their relationship.
Jackie was left in charge when her boss went away on a business trip, so
36 she held the fort for a month and she actually did an amazing job.
Jake caught his little brother wearing his leather jacket without asking, so
37 he blew a feather and he started yelling at him.
Jess comes from a family of doctors, so by applying for a fine arts degree
38 she broke the lamp and her parents were very disappointed.
Jessica asked to work from home, but her manager did not like the idea, so
her nails were clipped by telling her she needed to be in the office every
39 day.

Jill had been working on her essay non-stop for weeks, but she felt like the surface was barely scratched, so she decided to get an extension for the
40 deadline.
Joey put up with his boss's whims but when he was asked to do her
41 laundry, the picture was drawn as this was not part of his job.
Julia saw her husband spilling sugar on the floor right after she had
42 mopped, so the tree was hit and she scolded him for being careless.
Justin got scared of driving after a serious car accident, but his job depended on it, so the card was turned and he managed to put that horrible
43 incident behind him.
Keira turned down that amazing job offer without thinking it through, so
44 the boat was missed but she did not really realise that until it was too late.
Kim made more car sales in a week than her colleagues did in a month, so
45 she set the pace for the whole department and she received a large bonus.
Laura spent her salary on a new, silky dress for her cousin's wedding, so
46 she broke the bank and she was forced to ask her parents for a loan.
Lia and Vicky had a lot of catching up to do, so when they finally met up
47 they chewed the fat for hours over a warm cup of coffee.
Lilly was a successful director, but her last movies were awful so people say her phone has been lost and there have been rumours that she is
48 retiring.
Lisa's staff started leaving work early, so by introducing a clock card
49 machine she stemmed the flower and now everyone leaves at 5pm sharp.
Lois's new bakery was not paying off, so by closing it down and reselling it she cut her losses for good, but she was feeling depressed afterwards
50 because she truly loved that shop.
Loren couldn't tell her superior what she really thought of his design, so
51 her lips were buttoned in order to avoid a confrontation with him.
Lorenzo was the first one in his village to have obtained a bachelor's
52 degree, so he flew the jet proudly and everyone admired him.
Lucy was already upset with her husband, so when he forgot their date the
53 flames were fanned and Lucy was absolutely furious with him.
Maria spent endless hours on the beach every day when she visited Crete,
54 so the ball was caught and all her friends were very jealous of her tan.
Mark wanted to officialise his relationship with Judith after five years, so
55 the balloon was popped during their romantic getaway to Paris last month.
Max is really bad at keeping secrets, so when Jane told him about her illness the beans were spilled during the family dinner and Jane got angry
56 with him.
Michael never cared for his uncle, but at the prospect of inheriting his house his tune was changed dramatically and now he calls him on the
57 phone every day.
Mike broke up with Beth hastily because he was angry, but then he realised the fence had been jumped and he decided to give her a chance to
58 explain.
Mike used to be against marriage, so when he proposed to Jane, she
59 thought her leg was being pulled and as a result she started laughing.
Natalie seemed to have all the necessary experience, so the HR director
60 thought that she fit the bill and he offered her a permanent position.

Neal didn’t mean to upset his mum but by mentioning his brother’s
61 accident a nerve was touched and she started crying inconsolably.
Neil avoids taking responsibility for anything that happens during his watch, and he always passes the buck to his subordinates so they can take
62 the blame for him.
Nick motivated his employees by giving them a significant pay rise, so the pump was primed successfully and the company's sales increased
63 considerably in the following months.
Officer Ron, set up a wide range of bait houses in the targeted area so he
64 turned the boxes on burglars who got locked inside.
Old John seemed to respond well to the new treatment at first, but eventually he kicked the apple and his daughters needed to plan his
65 funeral.
Oscar wanted to increase business, so by implementing cash incentives he
66 greased the pots and new customers started showing interest.
Peter sensed that Sally was extremely nervous during their first date, so the ice was broken by telling her an embarrassing but funny story about
67 himself.
Sally was excited about moving in with him, but he is so untidy that later
68 on the cost was being counted as she had to clean up after him all the time.
Sam needed that promotion, but after sabotaging his colleagues he realised
69 that he had sold his bike and he was suffering from guilt afterwards.
Sarah was devastated when her exhibition received awful reviews, so she
70 licked her stamps in private and she was considering giving up painting.
Stan knew that his mum was right to be so upset when he failed the test,
71 so he faced the music and he promised her not to do that again.
Ted was planning to steal from his dad’s company, and with his accountant’s help the books were cooked carefully so that no one would
72 notice the falsified documents.
Teresa was careless and showed up half an hour late for the big interview,
73 so she cooked her goose and she did not get the job because of that.
Tess tried to convince her reckless sister to study for her final exams, but
74 her breath was wasted as her sister continued to party anyway.
Thomas was feeling irritable and everything seemed to be bothering him,
75 so he picked a fight with his girlfriend for no reason.
Tina was seen by a psychiatrist and his initial evaluation confirmed that she had lost her pins to the point that she could not separate reality and
76 imagination.
Tom didn't want his subordinates to do all the hard work on their own, so
77 his weight was pulled for the project and he was respected for it.
Tom works for a conservative company so when he suggested new
78 methods the boat was rocked and his superiors were not happy about this.
Tony didn't want his wife to be imprisoned for the crime she had committed, so the rap was taken and he was charged with a ten-year
79 sentence as a result.
Tony spent more time on excessive partying than he did on his studies, so the glass was dropped on his final exams and he had to resit all of them in
80 September.

81	Vicky didn’t like boardroom politics but all her colleagues were ruthless, so the film was played anyway and she became the company’s first female CEO.
82	When Holly reached for her phone to see the time, she realised how late it was, so she hit the deck immediately and she rushed to work.
83	When Ian had a work accident, his boss tried to avoid compensating him but his corner was fought and he received a comprehensive package.
84	Will has been working with this specialised medical equipment for years, so he knows the jokes and his colleagues come to him when they face problems.

No.	LIST 2
1	Alan always thought he was a very mediocre piano player, but at the recital he stole the car and all the agents wanted to sign a contract with him.
2	Alex was trying for months to avoid bankruptcy while keeping all his staff, so he walked a tightrope for a while but luckily things got better in the end.
3	Although Gary hated being on that strict diet for a year, he lost 4 stone because the course was stayed and he was very proud of himself afterwards.
4	Although Jim’s health seemed to deteriorate over the last couple of weeks, the horse was turned and he amazed everyone with his recovery.
5	Although Maggie's father is technically the official head of the business, she pulls the curtains without consulting him unless it is necessary.
6	Amy was sick of her flatmate's pranks and decided to prank her back so that she could settle the score once and for all.
7	Anastasia usually wears casual clothes, so when she arrived in a maxi dress she made a splash at the gala and she got all the attention.
8	Andrew spent a rough couple of months settling into the new country, but eventually he found his feet and he got used to living abroad.
9	As soon as Ron informed his boss that he had met his sale targets, the billboards were moved and Ron did not get the bonus he was expecting.
10	Barney asked for a company car right after negotiating a good pay rise, so he pushed his luck and his boss fired him for being greedy.
11	Becca's parents didn't want her to study abroad, but by talking to them calmly she prepared the ground so when she finally left they were happy for her.
12	Bob bought a Ferrari soon after becoming an accountant, so people thought that his curtains had been lined as he could not afford it on his salary alone.
13	Brian’s wife is sensitive about her weight, so when he suggested her to go on a diet the knife was twisted and she got really upset with him.
14	Bruce bragged about being a just officer, but when his son was caught stealing, the rules were bent so that he wouldn’t have to go to jail.
15	Buddy felt overwhelmed with work after his promotion, but by working hard he made the soup in the end despite the rough start.

Caroline had been dreaming of opening a boutique, so when a shop was
16 let, the tram was taken and her business is now blooming.
Carter threatened to fire anyone who would not go to work on the bank holiday, so his muscles were flexed effectively and all the staff went to
17 work as normal.
Cecile could no longer afford designer shoes when her husband got fired,
18 so she felt the pinch and their marriage began to crumble.
Chris is generally a rude person, but when he offended a police officer the
19 room was crossed and the officer arrested him.
Collin finally realised that his reckless behaviour was harming his family,
20 so he mended his ways the moment he got out of jail.
Dad got fired last January, and Mum's salary was the only source of income, so our belts were tightened for a few months until Dad could find
21 a new job.
Debbie didn't really feel like clubbing with her friends last night, but they
22 twisted her arm and she ended up joining them anyway.
Despite Eleanor's fury when a guest spilled red wine on her wedding
23 dress, she kept her head and acted as if nothing had happened.
Edward won the Nobel Prize by developing a revolutionary drug, and so
24 his dinner was made in the scientific world.
Ellie's cousin overheard her critical comment about him, so she realised
25 that she had dropped a clanger and she apologised to him afterwards.
Emma had to become stricter when her students started acting up, so the whip was cracked until she was able to regain full control of the
26 classroom.
Fred copied some classified documents, but by putting them back quickly
27 his tracks were covered and no one ever found out about it.
George knows everything about phones, so when his sister wanted to buy
28 one, his brains were picked for hours in order to choose the best one.
Gina aimed to run her own restaurant one day, so by working at a local diner her teeth were cut and within a couple of years she gained all the
29 necessary experience.
Gina had been putting off some home repairs, but the roof started leaking,
30 so the biscuit was bitten and she decided to hire a repairman.
Harold couldn't deal with the memories of his late wife when he was sober, so he hit the desk every night and he ended up having a drinking
31 problem.
Harrison needed his candidate to win the elections, so with that scheme
32 the bottle was tipped in his candidate's favour.
Harry observed the procedure being carried out by his supervisors many times, so the ropes were learnt and they finally trusted him to do it on his
33 own.
Inspector Smith found the police informant dead in his own house, so a flower was smelled and he called the homicide department to investigate
34 the cause of death.
Jack and Linda had a big fight over money, but they truly love each other
35 so the thistle was buried for the sake of their relationship.
Jackie was left in charge when her boss went away on a business trip, so
36 the fort was held for a month and she actually did an amazing job.

Jake caught his little brother wearing his leather jacket without asking, so
37 a feather was blown and he started yelling at him.
Jess comes from a family of doctors, so by applying for a fine arts degree
38 the lamp was broken and her parents were very disappointed.
Jessica asked to work from home, but her manager did not like the idea, so
he clipped her wings by telling her she needed to be in the office every
39 day.
Jill had been working on her essay non-stop for weeks, but she felt like
she barely scratched the wall so she decided to get an extension for the
40 deadline.
Joey put up with his boss's whims but when he was asked to do her
41 laundry, he drew the line as this was not part of his job.
Julia saw her husband spilling sugar on the floor right after she had
42 mopped, so she hit the roof and she scolded him for being careless.
Justin got scared of driving after a serious car accident, but his job
depended on it, so he turned the page and he managed to put that horrible
43 incident behind him.
Keira turned down that amazing job offer without thinking it through, so
44 she missed the bus but she did not really realise that until it was too late.
Kim made more car sales in a week than her colleagues did in a month, so
45 the pace was set for the whole department and she received a large bonus.
Laura spent her salary on a new, silky dress for her cousin's wedding, so
46 the bank was broken and she was forced to ask her parents for a loan.
Lia and Vicky had a lot of catching up to do, so when they finally met up
47 the fat was chewed for hours over a warm cup of coffee.
Lilly was a successful director, but her last movies were awful so people
48 say she has lost her edge and there have been rumours that she is retiring.
Lisa's staff started leaving work early, so by introducing a clock card
49 machine the flower was stemmed and now everyone leaves at 5pm sharp.
Lois's new bakery was not paying off, so by closing it down and reselling
it her losses were cut for good, but she was feeling depressed afterwards
50 because she truly loved that shop.
Loren couldn't tell her superior what she really thought of his design, so
51 she buttoned her sleeves in order to avoid a confrontation with him.
Lorenzo was the first one in his village to have obtained a bachelor's
52 degree, so the jet was flown proudly and everyone admired him.
Lucy was already upset with her husband, so when he forgot their date he
53 fanned the soup and Lucy was absolutely furious with him.
Maria spent endless hours on the beach every day when she visited Crete,
54 so she caught the sun and all her friends were very jealous of her tan.
Mark wanted to officialise his relationship with Judith after five years, so
55 he popped the question during their romantic getaway to Paris last month.
Max is really bad at keeping secrets, so when Jane told him about her
illness he spilled the juice during the family dinner and Jane got angry
56 with him.
Michael never cared for his uncle, but at the prospect of inheriting his
house he changed his shirt dramatically and now he calls him on the
57 phone every day.

Mike broke up with Beth hastily because he was angry, but then he realised he had jumped the gun and he decided to give her a chance to
58 explain.
Mike used to be against marriage, so when he proposed to Jane, she
59 thought he was pulling her ear and as a result she started laughing.
Natalie seemed to have all the necessary experience, so the HR director
60 thought that the bill was fit and he offered her a permanent position.
Neal didn’t mean to upset his mum but by mentioning his brother’s
61 accident he touched a rabbit and she started crying inconsolably.
Neil avoids taking responsibility for anything that happens during his watch, and the buck is always passed to his subordinates so they can take
62 the blame for him.
Nick motivated his employees by giving them a significant pay rise, so he primed the pole successfully and the company's sales increased
63 considerably in the following months.
Officer Ron, set up a wide range of bait houses in the targeted area so the
64 boxes were turned on burglars who got locked inside.
Old John seemed to respond well to the new treatment at first, but eventually the apple was kicked and his daughters needed to plan his
65 funeral.
Oscar wanted to increase business, so by implementing cash incentives the
66 pots were greased and new customers started showing interest.
Peter sensed that Sally was extremely nervous during their first date, so he broke the cup by telling her an embarrassing but funny story about
67 himself.
Sally was excited about moving in with him, but he is so untidy that later
68 on she was counting the data as she had to clean up after him all the time.
Sam needed that promotion, but after sabotaging his colleagues he realised
69 that his bike had been sold and he was suffering from guilt afterwards.
Sarah was devastated when her exhibition received awful reviews, so her
70 stamps were licked in private and she was considering giving up painting.
Stan knew that his mum was right to be so upset when he failed the test,
71 so the music was faced and he promised her not to do that again.
Ted was planning to steal from his dad’s company, and with his accountant’s help he cooked the fish carefully so that no one would notice
72 the falsified documents.
Teresa was careless and showed up half an hour late for the big interview,
73 so her goose was cooked and she did not get the job because of that.
Tess tried to convince her reckless sister to study for her final exams, but
74 she wasted her fuel as her sister continued to party anyway.
Thomas was feeling irritable and everything seemed to be bothering him,
75 so a fight was picked with his girlfriend for no reason.
Tina was seen by a psychiatrist and his initial evaluation confirmed that her pins had been lost to the point that she could not separate reality and
76 imagination.
Tom didn't want his subordinates to do all the hard work on their own, so
77 he pulled his hair for the project and he was respected for it.
Tom works for a conservative company so when he suggested new
78 methods he rocked the chair and his superiors were not happy about this.

Tony didn't want his wife to be imprisoned for the crime she had committed, so he took the ferry and he was charged with a ten-year
79 sentence as a result.
Tony spent more time on excessive partying than he did on his studies, so he dropped the ball on his final exams and he had to resit all of them in
80 September.
Vicky didn’t like boardroom politics but all her colleagues were ruthless, so she played the game anyway and she became the company’s first
81 female CEO.
When Holly reached for her phone to see the time, she realised how late it
82 was, so the deck was hit immediately and she rushed to work.
When Ian had a work accident, his boss tried to avoid compensating him
83 but he fought his age and he received a comprehensive package.
Will has been working with this specialised medical equipment for years, so the jokes are known and his colleagues come to him when they face
84 problems.

No. LIST 3
Alan always thought he was a very mediocre piano player, but at the recital the car was stolen and all the agents wanted to sign a contract with
1 him.
Alex was trying for months to avoid bankruptcy while keeping all his staff, so a tightrope was walked for a while but luckily things got better in
2 the end.
Although Gary hated being on that strict diet for a year, he lost 4 stone
3 because he stayed the night and he was very proud of himself afterwards.
Although Jim’s health seemed to deteriorate over the last couple of weeks,
4 he turned the corner and he amazed everyone with his recovery.
Although Maggie's father is technically the official head of the business,
5 the curtains are pulled without consulting him unless it is necessary.
Amy was sick of her flatmate's pranks and decided to prank her back so
6 that the score could be settled once and for all.
Anastasia usually wears casual clothes, so when she arrived in a maxi
7 dress a splash was made at the gala and she got all the attention.
Andrew spent a rough couple of months settling into the new country, but
8 eventually his feet were found and he got used to living abroad.
As soon as Ron informed his boss that he had met his sale targets, he
9 moved the goalposts and Ron did not get the bonus he was expecting.
Barney asked for a company car right after negotiating a good pay rise, so
10 his luck was pushed and his boss fired him for being greedy.
Becca's parents didn't want her to study abroad, but by talking to them calmly the ground was prepared so when she finally left they were happy
11 for her.
Bob bought a Ferrari soon after becoming an accountant, so people thought that he had lined his pockets as he could not afford it on his salary
12 alone.
Brian’s wife is sensitive about her weight, so when he suggested her to go
13 on a diet he twisted the switch and she got really upset with him.

Bruce bragged about being a just officer, but when his son was caught
14 stealing, he bent the board so that he wouldn’t have to go to jail.
Buddy felt overwhelmed with work after his promotion, but by working
15 hard the soup was made in the end despite the rough start.
Caroline had been dreaming of opening a boutique, so when a shop was
16 let, she took the plunge and her business is now blooming.
Carter threatened to fire anyone who would not go to work on the bank holiday, so he flexed his legs effectively and all the staff went to work as
17 normal.
Cecile could no longer afford designer shoes when her husband got fired,
18 so the pinch was felt and their marriage began to crumble.
Chris is generally a rude person, but when he offended a police officer he
19 crossed the line and the officer arrested him.
Collin finally realised that his reckless behaviour was harming his family,
20 so his ways were mended the moment he got out of jail.
Dad got fired last January, and Mum’s salary was the only source of income, so we tightened our muscles for a few months until Dad could
21 find a new job.
Debbie didn't really feel like clubbing with her friends last night, but her
22 arm was twisted and she ended up joining them anyway.
Despite Eleanor’s fury when a guest spilled red wine on her wedding
23 dress, her head was kept and acted as if nothing had happened.
Edward won the Nobel Prize by developing a revolutionary drug, and so
24 he made his mark in the scientific world.
Ellie’s cousin overheard her critical comment about him, so she realised
25 that a clanger had been dropped and she apologised to him afterwards.
Emma had to become stricter when her students started acting up, so she cracked the china until she was able to regain full control of the
26 classroom.
Fred copied some classified documents, but by putting them back quickly
27 he covered his ears and no one ever found out about it.
George knows everything about phones, so when his sister wanted to buy
28 one, she picked his roses for hours in order to choose the best one.
Gina aimed to run her own restaurant one day, so by working at a local diner she cut her fingers and within a couple of years she gained all the
29 necessary experience.
Gina had been putting off some home repairs, but the roof started leaking,
30 so she bit the bullet and she decided to hire a repairman.
Harold couldn't deal with the memories of his late wife when he was sober, so the desk was hit every night and he ended up having a drinking
31 problem.
Harrison needed his candidate to win the elections, so with that scheme he
32 tipped the balance in his candidate's favour.
Harry observed the procedure being carried out by his supervisors many times, so he learnt the lyrics and they finally trusted him to do it on his
33 own.
Inspector Smith found the police informant dead in his own house, so he smelled a rat and he called the homicide department to investigate the
34 cause of death.

Jack and Linda had a big fight over money, but they truly love each other
35 so they buried the hatchet for the sake of their relationship.
Jackie was left in charge when her boss went away on a business trip, so
36 she held the spoon for a month and she actually did an amazing job.
Jake caught his little brother wearing his leather jacket without asking, so
37 he blew a fuse and he started yelling at him.
Jess comes from a family of doctors, so by applying for a fine arts degree
38 she broke the mould and her parents were very disappointed.
Jessica asked to work from home, but her manager did not like the idea, so
her wings were clipped by telling her she needed to be in the office every
39 day.
Jill had been working on her essay non-stop for weeks, but she felt like
the wall was barely scratched, so she decided to get an extension for the
40 deadline.
Joey put up with his boss's whims but when he was asked to do her
41 laundry, the line was drawn as this was not part of his job.
Julia saw her husband spilling sugar on the floor right after she had
42 mopped, so the roof was hit and she scolded him for being careless.
Justin got scared of driving after a serious car accident, but his job
depended on it, so the page was turned and he managed to put that
43 horrible incident behind him.
Keira turned down that amazing job offer without thinking it through, so
44 the bus was missed but she did not really realise that until it was too late.
Kim made more car sales in a week than her colleagues did in a month, so
45 she set the clock for the whole department and she received a large bonus.
Laura spent her salary on a new, silky dress for her cousin's wedding, so
46 she broke the glass and she was forced to ask her parents for a loan.
Lia and Vicky had a lot of catching up to do, so when they finally met up
47 they chewed the ice for hours over a warm cup of coffee.
Lilly was a successful director, but her last movies were awful so people
say her edge has been lost and there have been rumours that she is
48 retiring.
Lisa's staff started leaving work early, so by introducing a clock card
49 machine she stemmed the tide and now everyone leaves at 5pm sharp.
Lois's new bakery was not paying off, so by closing it down and reselling
it she cut her fruit for good, but she was feeling depressed afterwards
50 because she truly loved that shop.
Loren couldn't tell her superior what she really thought of his design, so
51 her sleeves were buttoned in order to avoid a confrontation with him.
Lorenzo was the first one in his village to have obtained a bachelor's
52 degree, so he flew the flag proudly and everyone admired him.
Lucy was already upset with her husband, so when he forgot their date the
53 soup was fanned and Lucy was absolutely furious with him.
Maria spent endless hours on the beach every day when she visited Crete,
54 so the sun was caught and all her friends were very jealous of her tan.
Mark wanted to officialise his relationship with Judith after five years, so
the question was popped during their romantic getaway to Paris last
55 month.

Max is really bad at keeping secrets, so when Jane told him about her illness the juice was spilled during the family dinner and Jane got angry
56 with him.
Michael never cared for his uncle, but at the prospect of inheriting his house his shirt was changed dramatically and now he calls him on the
57 phone every day.
Mike broke up with Beth hastily because he was angry, but then he realised the gun had been jumped and he decided to give her a chance to
58 explain.
Mike used to be against marriage, so when he proposed to Jane, she
59 thought her ear was being pulled and as a result she started laughing.
Natalie seemed to have all the necessary experience, so the HR director
60 thought that she fit the dress and he offered her a permanent position.
Neal didn't mean to upset his mum but by mentioning his brother's
61 accident a rabbit was touched and she started crying inconsolably.
Neil avoids taking responsibility for anything that happens during his watch, and he <u>always</u> passes the tart to his subordinates so they can take
62 the blame for him.
Nick motivated his employees by giving them a significant pay rise, so the pole was primed successfully and the company's sales increased
63 considerably in the following months.
Officer Ron, set up a wide range of bait houses in the targeted area so he
64 turned the tables on burglars who got locked inside.
Old John seemed to respond well to the new treatment at first, but eventually he kicked the bucket and his daughters needed to plan his
65 funeral.
Oscar wanted to increase business, so by implementing cash incentives he
66 greased the wheels and new customers started showing interest.
Peter sensed that Sally was extremely nervous during their first date, so the cup was broken by telling her an embarrassing but funny story about
67 himself.
Sally was excited about moving in with him, but he is so untidy that later on the data were being counted as she had to clean up after him all the
68 time.
Sam needed that promotion, but after sabotaging his colleagues he realised that he had sold his soul and he was suffering from guilt
69 afterwards.
Sarah was devastated when her exhibition received awful reviews, so she
70 licked her wounds in private and she was considering giving up painting.
Stan knew that his mum was right to be so upset when he failed the test,
71 so he faced the sea and he promised her not to do that again.
Ted was planning to steal from his dad's company, and with his accountant's help the fish were cooked carefully so that no one would
72 notice the falsified documents.
Teresa was careless and showed up half an hour late for the big interview,
73 so she cooked her roast and she did not get the job because of that.
Tess tried to convince her reckless sister to study for her final exams, but
74 her fuel was wasted as her sister continued to party anyway.
Thomas was feeling irritable and everything seemed to be bothering him,
75 so he picked a card with his girlfriend for no reason.

Tina was seen by a psychiatrist and his initial evaluation confirmed that she had lost her marbles to the point that she could not separate reality and
76 imagination.
Tom didn't want his subordinates to do all the hard work on their own, so
77 his hair was pulled for the project and he was respected for it.
Tom works for a conservative company so when he suggested new
78 methods the chair was rocked and his superiors were not happy about this.
Tony didn't want his wife to be imprisoned for the crime she had committed, so the ferry was taken and he was charged with a ten-year
79 sentence as a result.
Tony spent more time on excessive partying than he did on his studies, so the ball was dropped on his final exams and he had to resit all of them in
80 September.
Vicky didn’t like boardroom politics but all her colleagues were ruthless, so the game was played anyway and she became the company’s first
81 female CEO.
When Holly reached for her phone to see the time, she realised how late it
82 was, so she hit the pan immediately and she rushed to work.
When Ian had a work accident, his boss tried to avoid compensating him
83 but his age was fought and he received a comprehensive package.
Will has been working with this specialised medical equipment for years, so he knows the ropes and his colleagues come to him when they face
84 problems.

No. LIST 4

Alan always thought he was a very mediocre piano player, but at the recital he stole the show and all the agents wanted to sign a contract with
1 him.
Alex was trying for months to avoid bankruptcy while keeping all his staff, so he walked a footpath for a while but luckily things got better in
2 the end.
Although Gary hated being on that strict diet for a year, he lost 4 stone
3 because the night was stayed and he was very proud of himself afterwards.
Although Jim’s health seemed to deteriorate over the last couple of weeks,
4 the corner was turned and he amazed everyone with his recovery.
Although Maggie's father is technically the official head of the business,
5 she pulls the strings without consulting him unless it is necessary.
Amy was sick of her flatmate's pranks and decided to prank her back so
6 that she could settle the bet once and for all.
Anastasia usually wears casual clothes, so when she arrived in a maxi
7 dress she made a vase at the gala and she got all the attention.
Andrew spent a rough couple of months settling into the new country, but
8 eventually he found his key and he got used to living abroad.
As soon as Ron informed his boss that he had met his sale targets, the
9 goalposts were moved and Ron did not get the bonus he was expecting.
Barney asked for a company car right after negotiating a good pay rise, so
10 he pushed his chair and his boss fired him for being greedy.

Becca's parents didn't want her to study abroad, but by talking to them calmly she prepared the table so when she finally left they were happy for her.

Bob bought a Ferrari soon after becoming an accountant, so people thought that his pockets had been lined as he could not afford it on his salary alone.

Brian’s wife is sensitive about her weight, so when he suggested her to go on a diet the switch was twisted and she got really upset with him.

Bruce bragged about being a just officer, but when his son was caught stealing, the board was bent so that he wouldn’t have to go to jail.

Buddy felt overwhelmed with work after his promotion, but by working hard he made the grade in the end despite the rough start.

Caroline had been dreaming of opening a boutique, so when a shop was let, the plunge was taken and her business is now blooming.

Carter threatened to fire anyone who would not go to work on the bank holiday, so his legs were flexed effectively and all the staff went to work as normal.

Cecile could no longer afford designer shoes when her husband got fired, so she felt the chill and their marriage began to crumble.

Chris is generally a rude person, but when he offended a police officer the line was crossed and the officer arrested him.

Collin finally realised that his reckless behaviour was harming his family, so he mended his fence the moment he got out of jail.

Dad got fired last January, and Mum’s salary was the only source of income, so our muscles were tightened for a few months until Dad could find a new job.

Debbie didn't really feel like clubbing with her friends last night, but they twisted her hair and she ended up joining them anyway.

Despite Eleanor’s fury when a guest spilled red wine on her wedding dress, she kept her house and acted as if nothing had happened.

Edward won the Nobel Prize by developing a revolutionary drug, and so his mark was made in the scientific world.

Ellie’s cousin overheard her critical comment about him, so she realised that she had dropped a stapler and she apologised to him afterwards.

Emma had to become stricter when her students started acting up, so the china was cracked until she was able to regain full control of the classroom.

Fred copied some classified documents, but by putting them back quickly his ears were covered and no one ever found out about it.

George knows everything about phones, so when his sister wanted to buy one, his roses were picked for hours in order to choose the best one.

Gina aimed to run her own restaurant one day, so by working at a local diner her fingers were cut and within a couple of years she gained all the necessary experience.

Gina had been putting off some home repairs, but the roof started leaking, so the bullet was bitten and she decided to hire a repairman.

Harold couldn't deal with the memories of his late wife when he was sober, so he hit the bottle every night and he ended up having a drinking problem.

Harrison needed his candidate to win the elections, so with that scheme
32 the balance was tipped in his candidate's favour.
Harry observed the procedure being carried out by his supervisors many times, so the lyrics were learnt and they finally trusted him to do it on his
33 own.
Inspector Smith found the police informant dead in his own house, so a rat was smelled and he called the homicide department to investigate the
34 cause of death.
Jack and Linda had a big fight over money, but they truly love each other
35 so the hatchet was buried for the sake of their relationship.
Jackie was left in charge when her boss went away on a business trip, so
36 the spoon was held for a month and she actually did an amazing job.
Jake caught his little brother wearing his leather jacket without asking, so
37 a fuse was blown and he started yelling at him.
Jess comes from a family of doctors, so by applying for a fine arts degree
38 the mould was broken and her parents were very disappointed.
Jessica asked to work from home, but her manager did not like the idea, so
39 he clipped her nails by telling her she needed to be in the office every day.
Jill had been working on her essay non-stop for weeks, but she felt like she barely scratched the surface, so she decided to get an extension for the
40 deadline.
Joey put up with his boss’s whims but when he was asked to do her
41 laundry, he drew the picture as this was not part of his job.
Julia saw her husband spilling sugar on the floor right after she had
42 mopped, so she hit the tree and she scolded him for being careless.
Justin got scared of driving after a serious car accident, but his job depended on it, so he turned the card and he managed to put that horrible
43 incident behind him.
Keira turned down that amazing job offer without thinking it through, so
44 she missed the boat but she did not really realise that until it was too late.
Kim made more car sales in a week than her colleagues did in a month, so
45 the clock was set for the whole department and she received a large bonus.
Laura spent her salary on a new, silky dress for her cousin's wedding, so
46 the glass was broken and she was forced to ask her parents for a loan.
Lia and Vicky had a lot of catching up to do, so when they finally met up
47 the ice was chewed for hours over a warm cup of coffee.
Lilly was a successful director, but her last movies were awful so people
48 say she has lost her phone and there have been rumours that she is retiring.
Lisa’s staff started leaving work early, so by introducing a clock card
49 machine the tide was stemmed and now everyone leaves at 5pm sharp.
Lois’s new bakery was not paying off, so by closing it down and reselling it her fruit were cut for good, but she was feeling depressed afterwards
50 because she truly loved that shop.
Loren couldn't tell her superior what she really thought of his design, so
51 she buttoned her lips in order to avoid a confrontation with him.
Lorenzo was the first one in his village to have obtained a bachelor's
52 degree, so the flag was flown proudly and everyone admired him.
Lucy was already upset with her husband, so when he forgot their date he
53 fanned the flames and Lucy was absolutely furious with him.

Maria spent endless hours on the beach every day when she visited Crete,
54 so she caught the ball and all her friends were very jealous of her tan.
Mark wanted to officialise his relationship with Judith after five years, so
55 he popped the balloon during their romantic getaway to Paris last month.
Max is really bad at keeping secrets, so when Jane told him about her illness he spilled the beans during the family dinner and Jane got angry
56 with him.
Michael never cared for his uncle, but at the prospect of inheriting his house he changed his tune dramatically and now he calls him on the phone
57 every day.
Mike broke up with Beth hastily because he was angry, but then he realised he had jumped the fence and he decided to give her a chance to
58 explain.
Mike used to be against marriage, so when he proposed to Jane, she
59 thought he was pulling her leg and as a result she started laughing.
Natalie seemed to have all the necessary experience, so the HR director
60 thought that the dress was fit and he offered her a permanent position.
Neal didn't mean to upset his mum but by mentioning his brother's
61 accident he touched a nerve and she started crying inconsolably.
Neil avoids taking responsibility for anything that happens during his watch, and the tart is always passed to his subordinates so they can take
62 the blame for him.
Nick motivated his employees by giving them a significant pay rise, so he primed the pump successfully and the company's sales increased
63 considerably in the following months.
Officer Ron, set up a wide range of bait houses in the targeted area so the
64 tables were turned on burglars who got locked inside.
Old John seemed to respond well to the new treatment at first, but eventually the bucket was kicked and his daughters needed to plan his
65 funeral.
Oscar wanted to increase business, so by implementing cash incentives the
66 wheels were greased and new customers started showing interest.
Peter sensed that Sally was extremely nervous during their first date, so he
67 broke the ice by telling her an embarrassing but funny story about himself.
Sally was excited about moving in with him, but he is so untidy that later
68 on she was counting the cost as she had to clean up after him all the time.
Sam needed that promotion, but after sabotaging his colleagues he realised
69 that his soul had been sold and he was suffering from guilt afterwards.
Sarah was devastated when her exhibition received awful reviews, so her
70 wounds were licked in private and she was considering giving up painting.
Stan knew that his mum was right to be so upset when he failed the test,
71 so the sea was faced and he promised her not to do that again.
Ted was planning to steal from his dad's company, and with his accountant's help he cooked the books carefully so that no one would
72 notice the falsified documents.
Teresa was careless and showed up half an hour late for the big interview,
73 so her roast was cooked and she did not get the job because of that.
Tess tried to convince her reckless sister to study for her final exams, but
74 she wasted her breath as her sister continued to party anyway.

Thomas was feeling irritable and everything seemed to be bothering him,
75 so a card was picked with his girlfriend for no reason.
Tina was seen by a psychiatrist and his initial evaluation confirmed that her marbles had been lost to the point that she could not separate reality
76 and imagination.
Tom didn't want his subordinates to do all the hard work on their own, so
77 he pulled his weight for the project and he was respected for it.
Tom works for a conservative company so when he suggested new
78 methods he rocked the boat and his superiors were not happy about this.
Tony didn't want his wife to be imprisoned for the crime she had committed, so he took the rap and he was charged with a ten-year
79 sentence as a result.
Tony spent more time on excessive partying than he did on his studies, so he dropped the glass on his final exams and he had to resit all of them in
80 September.
Vicky didn’t like boardroom politics but all her colleagues were ruthless, so she played the film anyway and she became the company’s first female
81 CEO.
When Holly reached for her phone to see the time, she realised how late it
82 was, so the pan was hit immediately and she rushed to work.
When Ian had a work accident, his boss tried to avoid compensating him
83 but he fought his corner and he received a comprehensive package.
Will has been working with this specialised medical equipment for years, so the ropes are known and his colleagues come to him when they face
84 problems.

Appendix B

Experimental lists – Studies 2 & 3

No.	LIST 1
1	After his fuse was blown, he wondered what had caused the loss of power in the first place.
2	Once the ice was broken, they managed to make one wall after the other.
3	When the fat was chewed, she felt compelled to spit out the whole bite to her shame.
4	When the air was cleared, they were finally able to breathe and everything went back to normal.
5	When her goose was cooked, she had to unveil her fraud to everyone
6	Once the cost was counted, she realised that the consequences were brought about by her own foolish actions.
7	Once the whip was cracked, the lazy eyes finally started to put some effort into the task.
8	When the line was crossed, the man triggered an alarm and the security team rushed to resolve the situation.
9	When the goods were delivered, there was no doubt that he was the top retailer in the company.
10	When his feet were dragged, his mum would get upset and tell him to give in a sensible manner.
11	Once the line was drawn, she fully appreciated her husband's limits once and for all.
12	Once the ball was dropped, everyone blamed him for the team's failure, though it had been a complex situation.
13	When the flames were fanned, a full-blown war broke out that affected the entire region.
14	When his muscles were flexed, many people were intimidated by how much life he clearly had.
15	Once the wheels were greased, he found that his music went forward much more smoothly.
16	When the bottle was hit, he ended up so badly slashed that he had to be admitted to hospital.
17	When the roof was hit again, he sought professional advice for his desk because the situation was becoming alarming.
18	When the wall was hit, the driver had to be assisted by a paramedic.
19	When the bucket was kicked, she got rid of the time with the help of her devoted housekeeper.
20	Once the score was known, she didn't want to have anything to do with the issue since it disgusted her.
21	After her wounds were licked, he drove her back to her vet and tried to cheer her up on the way.
22	Before his pockets were lined, he was at great risk of losing his wallet and everything he had in it.

When his marbles were lost, his brother promised to get him the best care
23 that he could possibly find.
After the boat was missed, he was angry with himself for not being more
24 opportunistic but it was too late to do anything about it.
When the mark was missed the first time, the pressure for the second shot
25 was particularly high.
When the goalposts were moved, he knew that someone was trying to
26 sabotage the deal in a sneaky way.
Since the game was played well, he was offered a leadership position on
27 the board which he took very gladly.
When the ground was prepared, she could finally make use of her love
28 and show off her skills.
When her leg was pulled, she thought that the prank was awful but said
29 nothing about it.
Once the strings were pulled, she had full control over the week and she
30 could do whatever she wanted with it.
Once his weight was pulled, his trainer appreciated the progress that was
31 being made.
When the boat was rocked, the supposedly smooth transaction was
32 disturbed and many people got upset.
Once the surface was scratched, she discovered some hidden clouds that
33 had been buried for centuries.
After the pace was set, anyone who tried to reach her hair failed
34 miserably.
When a rat was smelled, he decided to search for signs of a felony very
35 thoroughly.
Once the beans were spilled, he needed a sky to clean up the mess that he
36 had created.
Once the tide was stemmed, the city's mayor managed to contain the
37 drinking problem, which had been increasing uncontrollably.
Once the knot was tied, he felt confident that his boat would not go
38 anywhere.
When his belt was tightened he felt the need to cut down his trees even
39 though it pained him.
Once a nerve was touched, he apologised to her and moved the topic to
40 avoid making things worse.
When the page was turned, he was finally able to put that terrible
41 illustration behind him for good.
When the tables were turned, she felt like she had some world in the
42 office all of a sudden.
Once her arm was twisted, she could not avoid going to the hospital last
43 night.
Once the knife was twisted, it was only a matter of seconds before the
44 dispute got out of control.
When his breath was wasted, he reluctantly stopped trying to cook him
45 and admitted defeat.

No.	List 2
1	After his fuse was blown, he wondered what had caused the loss of life in the first place.
2	Once the ice was broken, they managed to make one joke after the other.
3	When the fat was chewed, she felt compelled to spit out the whole ball to her shame.
4	When the air was cleared, they were finally able to jump and everything went back to normal.
5	When her goose was cooked, she had to unveil her recipe to everyone.
6	Once the cost was counted, she realised that the debts were brought about by her own foolish actions.
7	Once the whip was cracked, the lazy pupils finally started to put some effort into the task.
8	When the line was crossed, the man triggered a sun and the security team rushed to resolve the situation.
9	When the goods were delivered, there was no doubt that he was the top courier in the company.
10	When his feet were dragged, his mum would get upset and tell him to study in a sensible manner.
11	Once the line was drawn, she fully appreciated her property's limits once and for all.
12	Once the ball was dropped, everyone blamed him for the door's failure, though it had been a complex situation.
13	When the flames were fanned, a full-blown fire broke out that affected the entire region.
14	When his muscles were flexed, many people were intimidated by how much influence he clearly had.
15	Once the wheels were greased, he found that his plans went forward much more smoothly.
16	When the bottle was hit, he ended up so badly rich that he had to be admitted to hospital.
17	When the roof was hit again, he sought professional advice for his anger because the situation was becoming alarming.
18	When the wall was hit, the paper had to be assisted by a paramedic.
19	When the bucket was kicked, she got rid of the body with the help of her devoted housekeeper.
20	Once the score was known, she didn't want to have anything to do with the game since it disgusted her.
21	After her wounds were licked, he drove her back to her age and tried to cheer her up on the way.
22	Before his pockets were lined, he was at great risk of losing his glass and everything he had in it.
23	When his marbles were lost, his brother promised to get him the best game that he could possibly find.
24	After the boat was missed, he was angry with himself for not being more punctual but it was too late to do anything about it.
25	When the mark was missed the first time, the pressure for the second key was particularly high.

When the goalposts were moved, he knew that someone was trying to
26 sabotage the match in a sneaky way.
Since the game was played well, he was offered a leadership position on
27 the team which he took very gladly.
When the ground was prepared, she could finally make use of her ideas
28 and show off her skills.
When her leg was pulled, she thought that the pain was awful but said
29 nothing about it.
Once the strings were pulled, she had full control over the firm and she
30 could do whatever she wanted with it.
Once his weight was pulled, his pen appreciated the progress that was
31 being made.
When the boat was rocked, the supposedly smooth cream was disturbed
32 and many people got upset.
Once the surface was scratched, she discovered some hidden secrets that
33 had been buried for centuries.
After the pace was set, anyone who tried to reach her sales failed
34 miserably.
When a rat was smelled, he decided to search for signs of a rodent very
35 thoroughly.
Once the beans were spilled, he needed a lawyer to clean up the mess that
36 he had created.
Once the tide was stemmed, the city's mayor managed to contain the
37 flooding problem, which had been increasing uncontrollably.
Once the knot was tied, he felt confident that his idea would not go
38 anywhere.
When his belt was tightened he felt the need to cut down his expenses
39 even though it pained him.
Once a nerve was touched, he apologised to her and moved the needle to
40 avoid making things worse.
When the page was turned, he was finally able to put that terrible dish
41 behind him for good.
When the tables were turned, she felt like she had some authority in the
42 office all of a sudden.
43 Once her arm was twisted, she could not avoid going to the air last night.
Once the knife was twisted, it was only a matter of seconds before the
44 bleeding got out of control.
When his breath was wasted, he reluctantly stopped trying to convince
45 him and admitted defeat.

No. List 3
After his fuse was blown, he wondered what had caused the loss of
1 temper in the first place.
Once the ice was broken, they managed to make one cocktail after the
2 other.
When the fat was chewed, she felt compelled to spit out the whole tale to
3 her shame.

When the air was cleared, they were finally able to reconcile and
4 everything went back to normal.

5 When her goose was cooked she had to unveil her radio to everyone.

Once the cost was counted, she realised that the teeth were brought about
6 by her own foolish actions.

Once the whip was cracked, the lazy horses finally started to put some
7 effort into the task.

When the line was crossed, the man triggered a fight and the security
8 team rushed to resolve the situation.

When the goods were delivered, there was no doubt that he was the top
9 layer in the company.

When his feet were dragged, his mum would get upset and tell him to
10 walk in a sensible manner.

Once the line was drawn, she fully appreciated her thought's limits once
11 and for all.

Once the ball was dropped, everyone blamed him for the project's failure,
12 though it had been a complex situation.

When the flames were fanned, a full-blown day broke out that affected
13 the entire region.

When his muscles were flexed, many people were intimidated by how
14 much strength he clearly had.

Once the wheels were greased, he found that his trolley went forward
15 much more smoothly.

When the bottle was hit, he ended up so badly drunk that he had to be
16 admitted to hospital.

When the roof was hit again, he sought professional advice for his ceiling
17 because the situation was becoming alarming.

18 When the wall was hit, the athlete had to be assisted by a paramedic.

When the bucket was kicked, she got rid of the water with the help of her
19 devoted housekeeper.

Once the score was known, she didn't want to have anything to do with
20 the cut since it disgusted her.

After her wounds were licked, he drove her back to her office and tried to
21 cheer her up on the way.

Before his pockets were lined, he was at great risk of losing his apartment
22 and everything he had in it.

When his marbles were lost, his brother promised to get him the best area
23 that he could possibly find.

After the boat was missed, he was angry with himself for not being more
24 vivid but it was too late to do anything about it.

When the mark was missed the first time, the pressure for the second
25 debate was particularly high.

When the goalposts were moved, he knew that someone was trying to
26 sabotage the year in a sneaky way.

Since the game was played well, he was offered a leadership position on
27 the room which he took very gladly.

When the ground was prepared, she could finally make use of her bulbs
28 and show off her skills.

When her leg was pulled, she thought that the book was awful but said
29 nothing about it.

Once the strings were pulled, she had full control over the puppet and she
30 could do whatever she wanted with it.
Once his weight was pulled, his colleague appreciated the progress that
31 was being made.
When the boat was rocked, the supposedly smooth transaction was
32 disturbed and many people got upset.
Once the surface was scratched, she discovered some hidden treasures
33 that had been buried for centuries.
After the pace was set, anyone who tried to reach her speed failed
34 miserably.
When a rat was smelled, he decided to search for signs of a bud very
35 thoroughly.
Once the beans were spilled, he needed a mop to clean up the mess that
36 he had created.
Once the tide was stemmed, the city's mayor managed to contain the
37 chair problem, which had been increasing uncontrollably.
Once the knot was tied, he felt confident that his wife would not go
38 anywhere.
When his belt was tightened he felt the need to cut down his calories even
39 though it pained him.
Once a nerve was touched, he apologised to her and moved the hat to
40 avoid making things worse.
When the page was turned, he was finally able to put that terrible
41 adventure behind him for good.
When the tables were turned, she felt like she had some space in the
42 office all of a sudden.
Once her arm was twisted, she could not avoid going to the club last
43 night.
Once the knife was twisted, it was only a matter of seconds before the
44 wind got out of control.
When his breath was wasted, he reluctantly stopped trying to revive him
45 and admitted defeat.

Appendix C

Experimental stimuli – Study 4

1. Hit the bottle
a. James couldn't deal with that situation while being sober, so **he started hitting the bottle in order** to forget about it and he ended up having a drinking problem.
b. James couldn't deal with that situation while being sober, so **he started hitting the clear bottle in order** to forget about it and he ended up having a drinking problem
c. James couldn't deal with that situation while being sober, so **he started hitting the small, clear bottle in order** to forget about it and he ended up having a drinking problem.
d. James didn't feel like jogging early on a Sunday morning, but **he started filling the bottle in order** to prepare himself to leave the house and start running.
e. James didn't feel like jogging early on a Sunday morning, but **he started filling the clear bottle in order** to prepare himself to leave the house and start running.
f. James didn't feel like jogging early on a Sunday morning, but **he started filling the small, clear bottle in order** to prepare himself to leave the house and start running.
2. Turn the corner
a. Jim's health seemed to be going from bad to worse, but **he eventually turned the corner and he** was expected to recover fully in the next few months.
b. Jim's health seemed to be going from bad to worse, but **he eventually turned the tight corner and he** was expected to recover fully in the next few months.
c. Jim's health seemed to be going from bad to worse, but **he eventually turned the dark, tight corner and he** was expected to recover fully in the next few months.
d. Jim had a small room and desperately needed a wardrobe, so **he eventually cleared the corner and he** set one up in it.
e. Jim had a small room and desperately needed a wardrobe, so **he eventually cleared the tight corner and he** set one up in it.
f. Jim had a small room and desperately needed a wardrobe, so **he eventually cleared the dark, tight corner and he** set one up in it
3. Count the cost
a. Sally didn't study or attend class all semester, and now **she is counting the cost as her** exams start tomorrow and she knows she will fail.
b. Sally didn't study or attend class all semester, and now **she is counting the overall cost as her** exams start tomorrow and she knows she will fail.
c. Sally didn't study or attend class all semester, and now **she is counting the high, overall cost as her** exams start tomorrow and she knows she will fail.

d. Sally doesn't really need to renovate her kitchen, but now **she is calculating the cost as her** estate agent said a new kitchen would significantly add to the value of the property.
e. Sally doesn't really need to renovate her kitchen, but now **she is calculating the overall cost as her** estate agent said a new kitchen would significantly add to the value of the property.
f. Sally doesn't really need to renovate her kitchen, but now **she is calculating the high, overall cost as her** estate agent said a new kitchen would significantly add to the value of the property.
4. Stay the course
a. Gary hated training at the gym for an hour every day, but **he dutifully stayed the course and now** he has achieved his weight loss goal.
b. Gary hated training at the gym for an hour every day, but **he dutifully stayed the intensive course and now** he has achieved his weight loss goal.
c. Gary hated training at the gym for an hour every day, but **he dutifully stayed the short, intensive course and now** he has achieved his weight loss goal.
d. Gary was forced to sign up for vocational workshops, but **he dutifully attended the course and now** he has an official certificate to supplement his CV.
e. Gary was forced to sign up for vocational workshops, but **he dutifully attended the intensive course and now** he has an official certificate to supplement his CV.
f. Gary was forced to sign up for vocational workshops, but **he dutifully attended the short, intensive course and now** he has an official certificate to supplement his CV.
5. Fan the flames
a. Tom was angry at Harry for stealing his idea, so when Harry bragged about **it he fanned the flames and afterwards** Tom confronted him in front of the boss.
b. Tom was angry at Harry for stealing his idea, so when Harry bragged about **it he fanned the red flames and afterwards** Tom confronted him in front of the boss.
c. Tom was angry at Harry for stealing his idea, so when Harry bragged about **it he fanned the big, red flames and afterwards** Tom confronted him in front of the boss.
d. Tom had left the oven on, so when he saw smoke coming out of **it he doused the flames and afterwards** there was a big mess to clean up.
e. Tom had left the oven on, so when he saw smoke coming out of **it he doused the red flames and afterwards** there was a big mess to clean up.
f. Tom had left the oven on, so when he saw smoke coming out of **it he doused the big, red flames and afterwards** there was a big mess to clean up.
6. Play the game
a. Vicky hated the unfriendly, corporate nature of her job, **but she played the game anyway and** in the end she managed to become the first female CEO in the company.
b. Vicky hated the unfriendly, corporate nature of her job, **but she played the tough game anyway and** in the end she managed to become the first female CEO in the company.

c. Vicky hated the unfriendly, corporate nature of her job, **but she played the long, tough game anyway and** in the end she managed to become the first female CEO in the company.
d. Vicky's knee felt better after months of physiotherapy, **but she cancelled the game anyway and** decided to take some more time off to recover completely.
e. Vicky's knee felt better after months of physiotherapy, **but she cancelled the tough game anyway and** decided to take some more time off to recover completely.
f. Vicky's knee felt better after months of physiotherapy, **but she cancelled the long, tough game anyway and** decided to take some more time off to recover completely.
7. Move the goalposts
a. Ron was never satisfied by his employees' achievements, **so he moved the goalposts when someone** reached the original sales targets.
b. Ron was never satisfied by his employees' achievements, **so he moved the old goalposts when someone** reached the original sales targets.
c. Ron was never satisfied by his employees' achievements, **so he moved the useless, old goalposts when someone** reached the original sales targets.
d. Ron wanted to convert the football field in his backyard into a garden, **so he sold the goalposts when someone** offered to buy them.
e. Ron wanted to convert the football field in his backyard into a garden, **so he sold the old goalposts when someone** offered to buy them.
f. Ron wanted to convert the football field in his backyard into a garden, **so he sold the useless, old goalposts when someone** offered to buy them.
8. Make the grade
a. William was worried about cooking for his aunt who had been a professional chef, **but he made the grade in the** end as his auntie finished all three of the courses he prepared.
b. William was worried about cooking for his aunt who had been a professional chef, **but he made the high grade in the** end as his auntie finished all three of the courses he prepared.
c. William was worried about cooking for his aunt who had been a professional chef, **but he made the final, high grade in the** end as his auntie finished all three of the courses he prepared.
d. Will wanted to play a joke on his mum about failing the math test, **but he erased the grade in the** most obvious way, so his mum did not buy it.
e. Will wanted to play a joke on his mum about failing the math test, **but he erased the high grade in the** most obvious way, so his mum did not buy it.
f. Will wanted to play a joke on his mum about failing the math test, **but he erased the final, high grade in the** most obvious way, so his mum did not buy it.
9. Prepare the ground
a. Becca's husband wouldn't want to spend money refurbishing the house, so **she started preparing the ground carefully by** casually pointing out all the little problems.
b. Becca's husband wouldn't want to spend money refurbishing the house, so **she started preparing the rough ground carefully by** casually pointing out all the little problems.

c. Becca's husband wouldn't want to spend money refurbishing the house, so **she started preparing the rough, difficult ground carefully by** casually pointing out all the little problems.
d. Becca decided to grow organic vegetables in her garden, so **she started clearing the ground carefully by** pulling out all the weeds and removing small stones from the soil.
e. Becca decided to grow organic vegetables in her garden, so **she started clearing the rough ground carefully by** pulling out all the weeds and removing small stones from the soil.
f. Becca decided to grow organic vegetables in her garden, so **she started clearing the rough, difficult ground carefully by** pulling out all the weeds and removing small stones from the soil.
10. Twist the knife
a. Brian's boss reduced his salary and then cut his hours, **so he twisted the knife completely to make** Brian quit and leave the company once and for all.
b. Brian's boss reduced his salary and then cut his hours, **so he twisted the dull knife completely to make** Brian quit and leave the company once and for all.
c. Brian's boss reduced his salary and then cut his hours **so he twisted the long, dull knife completely to make** Brian quit and leave the company once and for all.
d. Brian still struggled while chopping the meat into small pieces, **so he sharpened the knife completely to make** his life easier.
e. Brian still struggled while chopping the meat into small pieces, **so he sharpened the dull knife completely to make** his life easier.
f. Brian still struggled while chopping the meat into small pieces, **so he sharpened the long, dull knife completely to make** his life easier.
11. Cross the line
a. Chris is reckless but yesterday he insulted a police officer, **so he crossed the line and ended** up spending the night in jail.
b. Chris is reckless but yesterday he insulted a police officer**, so he crossed the narrow line and ended** up spending the night in jail.
c. Chris is reckless but yesterday he insulted a police officer**, so he crossed the thin, narrow line and ended** up spending the night in jail.
d. Chris was startled while marking out his parking space, **so he ruined the line and ended** up having to do it all over again.
e. Chris was startled while marking out his parking space**, so he ruined the narrow line and ended** up having to do it all over again.
f. Chris was startled while marking out his parking space**, so he ruined the thin, narrow line and ended** up having to do it all over again.
12. Draw the line
a. Drake is patient, but when his wife tried to test mascara on him, he **had to draw the line since he** knew that things would get out of hand quickly.
b. Drake is patient, but when his wife tried to test mascara on him, he **had to draw the narrow line since he** knew that things would get out of hand quickly.
c. Drake is patient, but when his wife tried to test mascara on him, he **had to draw the fine, narrow line since he** knew that things would get out of hand quickly.

d. Drake had marked out the dimensions on the wall for a new TV, but when he realised he could not afford it, he **had to erase the line since he** felt miserable every time he saw it.
e. Drake had marked out the dimensions on the wall for a new TV, but when he realised he could not afford it, he **had to erase the narrow line since he** felt miserable every time he saw it.
f. Drake had marked out the dimensions on the wall for a new TV, but when he realised he could not afford it, he **had to erase the fine, narrow line since he** felt miserable every time he saw it.
13. Button your lip
a. Laurel couldn't afford to express her honest opinion, **so she buttoned her lip as she** wanted to avoid losing another valuable client in the same week.
b. Laurel couldn't afford to express her honest opinion, **so she buttoned her red lip as she** wanted to avoid losing another valuable client in the same week.
c. Laurel couldn't afford to express her honest opinion, **so she buttoned her thin, red lip as she** wanted to avoid losing another valuable client in the same week.
d. Laurel hurried to eat a biscuit during the meeting, **so she bit her lip as she was** chewing and she squealed loudly when the CEO was presenting.
e. Laurel hurried to eat a biscuit during the meeting, **so she bit her red lip as she** was chewing and squealed loudly when the CEO was presenting.
f. Laurel hurried to eat a biscuit during the meeting, **so she bit her thin, red lip as she** was chewing and she squealed when the CEO was presenting.
14. Break the mould
a. Jess was expected to become a doctor like her dad and grandad, **but she broke the mould when she** decided to become a fashion designer instead.
b. Jess was expected to become a doctor like her dad and grandad, **but she broke the traditional mould when she** decided to become a fashion designer instead.
c. Jess was expected to become a doctor like her dad and grandad, **but she broke the old, traditional mould when she** decided to become a fashion designer instead.
d. Jess was an artist specialising in marble and had never used clay before, **but she bought the mould when she** decided to start experimenting with new materials in her work.
e. Jess was an artist specialising in marble and had never used clay before, **but she bought the traditional mould when she** decided to start experimenting with new materials in her work.
f. Jess was an artist specialising in marble and had never used clay before, **but she bought the old traditional mould when she** decided to start experimenting with new materials in her work.
15. Flex your muscles
a. Carter doesn’t miss a chance to show his staff who the boss is, **so he often flexes his muscles by making** them work on a bank holiday.
b. Carter doesn’t miss a chance to show his staff who the boss is, **so he often flexes his strong muscles by making** them work on a bank holiday.
c. Carter doesn’t miss a chance to show his staff who the boss is, **so he often flexes his big, strong muscles by making** them work on a bank holiday.

d. Carter is trying to become a professional bodybuilder and trains twice a day, **so he often strains his muscles by making** himself work too hard.
e. Carter is trying to become a professional bodybuilder and trains twice a day, **so he often strains his strong muscles by making** himself work too hard.
f. Carter is trying to become a professional bodybuilder and trains twice a day, **so he often strains his big, strong muscles by making** himself work too hard.
16. Touch a nerve
a. George shouldn't have mentioned the incident to his mum **because he touched a nerve and caused** her to get upset and cry inconsolably.
b. George shouldn't have mentioned the incident to his mum **because he touched a sensitive nerve and caused** her to get upset and cry inconsolably.
c. George shouldn't have mentioned the incident to his mum **because he touched a large, sensitive nerve and caused** her to get upset and cry inconsolably.
d. George is a skilful physiotherapist but his last patient was upset **because he hit a nerve and caused** her a massive bruise on the arm.
e. George is a skilful physiotherapist but his last patient was upset **because he hit a sensitive nerve and caused** her a massive bruise on the arm.
f. George is a skilful physiotherapist but his last patient was upset **because he hit a large, sensitive nerve and caused** her a massive bruise on the arm.
17. Turn the page
a. Justin was depressed after his sudden divorce, but **he eventually turned the page and everyone** was happy to see him enjoying life again.
b. Justin was depressed after his sudden divorce, but **he eventually turned the troubling page and everyone** was happy to see him enjoying life again.
c. Justin was depressed after his sudden divorce, but **he eventually turned the whole, troubling page and everyone** was happy to see him enjoying life again.
d. Justin could not answer any of the exam questions, so **he eventually tore the page and everyone** was staring at him in bewilderment.
e. Justin could not answer any of the exam questions, so **he eventually tore the troubling page and everyone** was staring at him in bewilderment.
f. Justin could not answer any of the exam questions, so **he eventually tore the whole, troubling page and everyone** was staring at him in bewilderment.
18. Set the pace
a. Kim managed to sell more cars than her colleagues last month, **so she set the pace and gave** herself a chance at the end of year bonus.
b. Kim managed to sell more cars than her colleagues last month, **so she set the competitive pace and gave** herself a chance at the end of year bonus.
c. Kim managed to sell more cars than her colleagues last month, **so she set the fast, competitive pace and gave** herself a chance at the end of year bonus.
d. Kim's two mile sprints stared to have an impact on her knees, **so she changed the pace and gave** her body the chance to recuperate for a while.
e. Kim's two mile sprints started to have an impact on her knees, **so she changed the competitive pace and gave** her body the chance to recuperate for a while.

f. Kim's two mile sprints started to have an impact on her knees, **so she changed the fast, competitive pace and gave** her body the chance to recuperate for a while.

19. Line your pockets

a. Charles bought a jet right after his election, so people accused **him of lining his pockets with their** money like other corrupt politicians had done before him.

b. Charles bought a jet right after his election, so people accused **him of lining his deep pockets with their** money like other corrupt politicians had done before him.

c. Charles bought a jet right after his election, so people accused **him of lining his large, deep pockets with their** money like other corrupt politicians had done before him.

d. Charles's wife put him on a strict diet, but his co-workers had accused **him of filling his pockets with their** food when it started disappearing from the staff kitchen.

e. Charles's wife put him on a strict diet, but his co-workers had accused **him of filling his deep pockets with their** food when it started disappearing from the staff kitchen.

f. Charles's wife put him on a strict diet, but his co-workers had accused **him of filling his large, deep pockets with their** food when it started disappearing from the staff kitchen.

20. Learn the ropes

a. Harry wanted to work in a lab that uses nuclear materials, **so he learned the ropes in order** to carry out research on his own without supervision.

b. Harry wanted to work in a lab that uses nuclear materials, **so he learned the safety ropes in order** to carry out research on his own without supervision.

c. Harry wanted to work in a lab that uses nuclear materials, **so he learned the long, safety ropes in order** to carry out research on his own without supervision.

d. Harry has only climbed three or four times in his life, **so he used the ropes in order** to enjoy climbing without worrying about falling.

e. Harry has only climbed three or four times in his life, **so he used the safety ropes in order** to enjoy climbing without worrying about falling.

f. Harry has only climbed three or four times in his life, **so he used the long, safety ropes in order** to enjoy climbing without worrying about falling.

21. Bend the rules

a. Gilbert liked to boast about his objectiveness as a judge, but for his own **son he bent the rules so that** he would not be imprisoned for selling drugs.

b. Gilbert liked to boast about his objectiveness as a judge, but for his own **son he bent the legal rules so that** he would not be imprisoned for selling drugs.

c. Gilbert liked to boast about his objectiveness as a judge, but for his own **son he bent the strict, legal rules so that** he would not be imprisoned for selling drugs.

d. Gilbert used to go in and out of jail, but after the birth of his **son he followed the rules so that** he would always be there for him.

e. Gilbert used to go in and out of jail, but after the birth of his **son he followed the legal rules so that** he would always be there for him.

f. Gilbert used to go in and out of jail, but after the birth of his **son he followed the strict, legal rules so that** he would always be there for him.
22. Make a splash
a. Tania was often rated the worst dressed celebrity, **but she made a splash on the** red carpet when she showed up wearing a beautiful gown.
b. Tania was often rated the worst dressed celebrity, **but she made a sudden splash on the** red carpet when she showed up wearing a beautiful gown.
c. Tania was often rated the worst dressed celebrity, **but she made a big, sudden splash on the** red carpet when she showed up wearing a beautiful gown.
d. Tania hadn't seen her boyfriend carrying a water balloon, **but she felt a splash on the** face when he dropped the balloon on her.
e. Tania hadn't seen her boyfriend carrying a water balloon, **but she felt a sudden splash on the** face when he dropped the balloon on her.
f. Tania hadn't seen her boyfriend carrying a water balloon, **but she felt a big, sudden splash on the** face when he dropped the balloon on her.
23. Stem the tide
a. Right before the holidays Lisa's students would become lazy, but by giving pop quizzes **she often stemmed the tide so that** the students had to study and were prepared for the exams after Christmas.
b. Right before the holidays Lisa's students would become lazy, but by giving pop quizzes **she often stemmed the rising tide so that** the students had to study and were prepared for the exams after Christmas.
c. Right before the holidays Lisa's students would become lazy, but by giving pop quizzes **she often stemmed the strong, rising tide so that** the students had to study and were prepared for the exams after Christmas.
d. Lisa thought wave action was causing erosion at the beach, and to prove her theory **she often examined the tide so that** she could gather enough convincing data.
e. Lisa thought wave action was causing erosion at the beach, and to prove her theory **she often examined the rising tide so that** she could gather enough convincing data.
f. Lisa thought wave action was causing erosion at the beach, and to prove her theory **she often examined the strong, rising tide so that** she could gather enough convincing data.
24. Pull the strings
a. Maggie's Dad owns the family business, but she is basically in control, and **she pulls the strings on her** own completely behind the scenes.
b. Maggie's Dad owns the family business, but she is basically in control, and **she pulls the complex strings on her** own completely behind the scenes.
c. Maggie's Dad owns the family business, but she is basically in control, and **she pulls the numerous, complex strings on her** own completely behind the scenes.
d. Maggie had thrown her son's puppets in a box carelessly, **so she detangled the strings on her** own afterwards because she knew he would be upset.
e. Maggie had thrown her son's puppets in a box carelessly, **so she detangled the complex strings on her** own afterwards because she knew he would be upset.

f. Maggie had thrown her son's puppets in a box carelessly, **so she detangled the numerous, complex strings on her** own afterwards because she knew he would be upset.

25. Scratch the surface

a. Jill was investigating a petty crime when she realised she **had only scratched the surface as the** suspects were also involved in serious money laundering.

b. Jill was investigating a petty crime when she realised she **had only scratched the outer surface as the** suspects were also involved in serious money laundering.

c. Jill was investigating a petty crime when she realised she **had only scratched the thin, outer surface as the** suspects were also involved in serious money laundering.

d. Jill wanted to maintain her expensive wooden desk but she **had only polished the surface as the** rest was too hard to clean properly.

e. Jill wanted to maintain her expensive wooden desk but she **had only polished the outer surface as the** rest was too hard to clean properly.

f. Jill wanted to maintain her expensive wooden desk but she **had only polished the thin, outer surface as the** rest was too hard to clean properly.

26. Cut your teeth

a. Gina started working in a restaurant from a young age, so that **she could cut her teeth and start** running her own restaurant one day.

b. Gina started working in a restaurant from a young age, so that **she could cut her baby teeth and start** running her own restaurant one day.

c. Gina started working in a restaurant from a young age, so that **she could cut her small, baby teeth and start** running her own restaurant one day.

d. Two-year-old Gina wanted to do things by herself without her mum's help, and **she could brush her teeth and start** getting dressed on her own.

e. Two-year-old Gina wanted to do things by herself without her mum's help, and **she could brush her baby teeth and start** getting dressed on her own.

f. Two-year-old Gina wanted to do things by herself without her mum's help, and **she could brush her small, baby teeth and start** getting dressed on her own.

27. Tip the balance

a. Roland wanted to win the election, so he made big promises in **order to tip the balance in his** favour, although he knew that he could not deliver on half of them.

b. Roland wanted to win the election, so he made big promises in **order to tip the delicate balance in his** favour, although he knew that he could not deliver on half of them.

c. Roland wanted to win the election, so he made big promises in **order to tip the delicate, unstable balance in his** favour, although he knew that he could not deliver on half of them.

d. Roland didn't want to have to file for bankruptcy, so he needed a plan in **order to address the balance in his** bank account within two months.

e. Roland didn't want to have to file for bankruptcy, so he needed a plan in **order to address the delicate balance in his** bank account within two months.

f. Roland didn't want to have to file for bankruptcy, so he needed a plan in **order to address the delicate, unstable balance in his** bank account within two months.

28. Pull your weight

a. Sally is lazy and nobody wants to work with her, because **she never pulls her weight when there** is someone else to all do the work for her.

b. Sally is lazy and nobody wants to work with her, because **she never pulls her complete weight when there** is someone else to do all the work for her.

c. Sally is lazy and nobody wants to work with her, because **she never pulls her full, complete weight when there** is someone else to do all the work for her.

d. Sally's trainer watches over her while attempting pull-ups, as **she never lifts her weight when there** is no one to give her encouragement.

e. Sally's trainer watches over her while attempting pull-ups, as **she never lifts her complete weight when there** is no one to give her encouragement.

f. Sally's trainer watches over her while attempting pull-ups, as **she never lifts her full, complete weight when there** is no one to give her encouragement.

29. Grease the wheels

a. Tony offered a pay rise to the staff who wanted to leave his firm, **so he greased the wheels and the** employees were convinced to stay.

b. Tony offered a pay rise to the staff who wanted to leave his firm, **so he greased the wretched wheels and the** employees were convinced to stay.

c. Tony offered a pay rise to the staff who wanted to leave his firm, **so he greased the sad, wretched wheels and the** employees were convinced to stay.

d. Tony's daughter's pushchair squeaked wherever they went, **so he changed the wheels and the** problem was fixed once and for all.

e. Tony's daughter's pushchair squeaked wherever they went, **so he changed the wretched wheels and the** problem was fixed once and for all.

f. Tony's daughter's pushchair squeaked wherever they went, **so he changed the sad, wretched wheels and the** problem was fixed once and for all.

30. Crack the whip

a. Rosaline is ruthless with her employees and she does not **hesitate to crack the whip when she** feels her authority is being challenged.

b. Rosaline is ruthless with her employees and she does not **hesitate to crack the painful whip when she** feels her authority is being challenged.

c. Rosaline is ruthless with her employees and she does not **hesitate to crack the loud, painful whip when she** feels her authority is being challenged.

d. Rosaline heard about a farmer lashing his horses, so she did not **hesitate to steal the whip when she** had the chance last week.

e. Rosaline heard about a farmer lashing his horses, so she did not **hesitate to steal the painful whip when she** had the chance last week.

f. Rosaline heard about a farmer lashing his horses, so she did not **hesitate to steal the loud, painful whip when she** had the chance last week.

31. Lick your wounds

a. Carmela felt humiliated after the awful reviews of her latest book, but she **recovered and licked her wounds for a** couple of years and then she was able to write again.

b. Carmela felt humiliated after the awful reviews of her latest book, but she **recovered and licked her gaping wounds for a** couple of years and then she was able to write again.
c. Carmela felt humiliated after the awful reviews of her latest book, but she **recovered and licked her deep, gaping wounds for a** couple of years and then she was able to write again.
d. Carmela was admitted to the hospital with serious injuries, but she **recovered and treated her wounds for a** couple of months with the help of a homecare nurse.
e. Carmela was admitted to the hospital with serious injuries, but she **recovered and treated her gaping wounds for a** couple of months with the help of a homecare nurse.
f. Carmela was admitted to the hospital with serious injuries, but she **recovered and treated her deep, gaping wounds for a** couple of months with the help of a homecare nurse.
32. Rock the boat
a. Anna's family is very strict and traditional, so she got a big tattoo **just to rock the boat and get** a big reaction out of her parents.
b. Anna's family is very strict and traditional, so she got a big tattoo **just to rock the old boat and get** a big reaction out of her parents.
c. Anna's family is very strict and traditional, so she got a big tattoo **just to rock the little, old boat and get** a big reaction out of her parents.
d. Anna was desperate for cash, so she had no other option but **just to sell the boat and get** a little money to pay off some of her creditors.
e. Anna was desperate for cash, so she had no other option but **just to sell the old boat and get** a little money to pay off some of her creditors.
f. Anna was desperate for cash, so she had no other option but **just to sell the little, old boat and get** a little money to pay off some of her creditors.
33. Spill the beans
a. Oscar had always been terrible at keeping secrets, so **he eventually spilt the beans when he** was asked about his friend's ongoing affair.
b. Oscar had always been terrible at keeping secrets, so **he eventually spilt the spicy beans when he** was asked about his friend's ongoing affair.
c. Oscar had always been terrible at keeping secrets, so **he eventually spilt the spicy, red beans when he** was asked about his friend's ongoing affair.
d. Oscar wanted to cook a homemade Mexican dish, but **he eventually burnt the beans when he** forgot to turn off the hob, so he ended up ordering pizza.
e. Oscar wanted to cook a homemade Mexican dish, but **he eventually burnt the spicy beans when he** forgot to turn off the hob, so he ended up ordering pizza.
f. Oscar wanted to cook a homemade Mexican dish, but **he eventually burnt the spicy, red beans when he** forgot to turn off the hob, so he ended up ordering pizza.
34. Chew the fat
a. Leanne hadn't heard from her friend in a while, so she called her **and they chewed the fat for hours** until her phone actually ran out of battery and shut down.

b. Leanne hadn't heard from her friend in a while, so she called her **and they chewed the juicy fat for hours** until her phone actually ran out of battery and shut down.
c. Leanne hadn't heard from her friend in a while, so she called her **and they chewed the thick, juicy fat for hours** until her phone actually ran out of battery and shut down.
d. Leanne cooked some bacon for her family on Sunday **and they smelled the fat for hours** afterwards which made them hungry for the rest of the day.
e. Leanne cooked some bacon for her family on Sunday **and they smelled the juicy fat for hours** afterwards which made them hungry for the rest of the day.
f. Leanne cooked some bacon for her family on Sunday **and they smelled the thick, juicy fat for hours** afterwards which made them hungry for the rest of the day.
35. Drop the ball
a. Marshall didn't leave himself time to answer the last part of the exam, **so he dropped the ball and he** did not pass the module.
b. Marshall didn't leave himself time to answer the last part of the exam, **so he dropped the final ball and he** did not pass the module.
c. Marshall didn't leave himself time to answer the last part of the exam, **so he dropped the easy, final ball and he** did not pass the module.
d. Marshall is generally a good cricketer but he was distracted, **so he missed the ball and he** got his team eliminated from the tournament as a result.
e. Marshall is generally a good cricketer but he was distracted, **so he missed the final ball and he** got his team eliminated from the tournament as a result.
f. Marshall is generally a good cricketer but he was distracted, **so he missed the easy, final ball and he** got his team eliminated from the tournament as a result.
36. Fit the bill
a. Natalie had extensive work experience abroad, and **therefore she fit the bill for the** internationalisation position and received an offer right away.
b. Natalie had extensive work experience abroad, and **therefore she fit the considerable bill for the** internationalisation position and received an offer right away.
c. Natalie had extensive work experience abroad, and **therefore she fit the whole, considerable bill for the** internationalisation position and received an offer right away.
d. Natalie didn't want her boyfriend to pay for their new furniture, **therefore she paid the bill for the** new sofa without letting him know in advance.
e. Natalie didn't want her boyfriend to pay for their new furniture, **therefore she paid the considerable bill for the** new sofa without letting him know in advance.
f. Natalie didn't want her boyfriend to pay for their new furniture, **therefore she paid the whole, considerable bill for the** new sofa without letting him know in advance.
37. Find your feet
a. Jeremy's company had new management but they retrained the staff, **so he found his feet and after** a while everything went back to normal.

b. Jeremy's company had new management but they retrained the staff, **so he found his old feet and after** a while everything went back to normal.
c. Jeremy's company had new management but they retrained the staff, **so he found his old, steady feet and after** a while everything went back to normal.
d. Jeremy had been rehearsing all day for the new ballet recital, **so he rubbed his feet and after** allowing himself to rest on the sofa, he felt better.
e. Jeremy had been rehearsing all day for the new ballet recital, **so he rubbed his old feet and after** allowing himself to rest on the sofa, he felt better.
f. Jeremy had been rehearsing all day for the new ballet recital, **so he rubbed his old, steady feet and after** allowing himself to rest on the sofa, he felt better.
38. Lose your marbles
a. Melanie was assessed by a psychiatrist who confirmed **that she lost her marbles when her** husband left her after so many years of marriage.
b. Melanie was assessed by a psychiatrist who confirmed **that she lost her precious marbles when her** husband left her after so many years of marriage.
c. Melanie was assessed by a psychiatrist who confirmed **that she lost her bright, precious marbles when her** husband left her after so many years of marriage.
d. Melanie had lost most of her toys, so she could not believe **that she found her marbles when her** parents cleaned out their loft.
e. Melanie had lost most of her toys, so she could not believe **that she found her precious marbles when her** parents cleaned out their loft.
f. Melanie had lost most of her toys, so she could not believe **that she found her bright, precious marbles when her** parents cleaned out their loft.
39. Pull one's leg
a. Leo is a prankster, so when Zoe got a call saying she had won a big prize she knew **he was pulling her leg, but she** played along even though she recognised his voice.
b. Leo is a prankster, so when Zoe got a call saying she had won a big prize she knew **he was pulling her long leg, but she** played along even though she recognised his voice.
c. Leo is a prankster, so when Zoe got a call saying she had won a big prize she knew **he was pulling her long, tolerant leg, but she** played along even though she recognised his voice.
d. Zoe wanted to sleep in today and tried to ignore her dog even though **he was licking her leg, but she** eventually felt sorry for him and got up to let him outside.
e. Zoe wanted to sleep in today and tried to ignore her dog even though **he was licking her long leg, but she** eventually felt sorry for him and got up to let him outside.
f. Zoe wanted to sleep in today and tried to ignore her dog even though **he was licking her long, tolerant leg, but she** eventually felt sorry for him and got up to let him outside.
40. Tighten your belt

a. Penelope's salary was reduced last month due to budget cuts, **so she tightened her belt in order** to make her monthly mortgage payment on time.
b. Penelope's salary was reduced last month due to budget cuts, **so she tightened her dependable belt in order** to make her monthly mortgage payment on time.
c. Penelope's salary was reduced last month due to budget cuts, **so she tightened her firm, dependable belt in order** to make her monthly mortgage payment on time.
d. Penelope's skirt kept slipping from her waist after her recent weight loss, **so she wore her belt in order** to avoid any embarrassing incidents at the party.
e. Penelope's skirt kept slipping from her waist after her recent weight loss, **so she wore her dependable belt in order** to avoid any embarrassing incidents at the party.
f. Penelope's skirt kept slipping from her waist after her recent weight loss, **so she wore her firm, dependable belt in order** to avoid any embarrassing incidents at the party.
41. Bury the hatchet
a. Cynthia hadn't spoken to her sister for years, but then their mum got ill, **so she buried the hatchet and she** finally reconciled with her.
b. Cynthia hadn't spoken to her sister for years, but then their mum got ill, **so she buried the rusty hatchet and she** finally reconciled with her.
c. Cynthia hadn't spoken to her sister for years, but then their mum got ill, **so she buried the old, rusty hatchet and she** finally reconciled with her.
d. Cynthia considered some of her husband's tools to be dangerous for children, **so she sold the hatchet and she** forbade her husband from buying another one.
e. Cynthia considered some of her husband's tools to be dangerous for children, **so she sold the rusty hatchet and she** forbade her husband from buying another one.
f. Cynthia considered some of her husband's tools to be dangerous for children, **so she sold the old, rusty hatchet and she** forbade her husband from buying another one.
42. Bite the bullet
a. Renee was putting aside money for the holidays but her car broke down, **so she bit the bullet and used** all of her savings to have her car fixed properly.
b. Renee was putting aside money for the holidays but her car broke down, **so she bit the awful bullet and used** all of her savings to have her car fixed properly.
c. Renee was putting aside money for the holidays but her car broke down, **so she bit the big, awful bullet and used** all of her savings to have her car fixed properly.
d. Renee could see that damage from the gunshot wound was extensive, **so she extracted the bullet and used** a lot of antiseptic to prevent a possible infection.
e. Renee could see that damage from the gunshot wound was extensive, **so she extracted the awful bullet and used** a lot of antiseptic to prevent a possible infection.

f. Renee could see that damage from the gunshot wound was extensive, **so she extracted the big, awful bullet and used** a lot of antiseptic to prevent a possible infection.

43. Break the ice

a. Alison's students were feeling shy, so she told them a funny story in **order to break the ice and get** the conversation started in the seminar.

b. Alison's students were feeling shy, so she told them a funny story in **order to break the hard ice and get** the conversation started in the seminar.

c. Alison's students were feeling shy, so she told them a funny story in **order to break the substantial, hard ice and get** the conversation started in the seminar.

d. Alison used to work as a bartender, so she bought a blender in **order to crush the ice and get** the same professional results for her homemade cocktails.

e. Alison used to work as a bartender, so she bought a blender in **order to crush the hard ice and get** the same professional results for her homemade cocktails.

f. Alison used to work as a bartender, so she bought a blender in **order to crush the substantial, hard ice and get** the same professional results for her homemade cocktails.

44. Hold the fort

a. Aaron's boss had to go away on a long business trip, so **he was left to hold the fort because he** was the only employee that his boss could trust completely.

b. Aaron's boss had to go away on a long business trip, so **he was left to hold the vulnerable fort because he** was the only employee that his boss could trust completely.

c. Aaron's boss had to go away on a long business trip, so **he was left to hold the small, vulnerable fort because he** was the only employee that his boss could trust completely.

d. Aaron was lazy as a child, so during role-play games **he was left to guard the fort because he** could not be bothered to join the others on their 'hunting expeditions'.

e. Aaron was lazy as a child, so during role-play games **he was left to guard the vulnerable fort because he** could not be bothered to join the others on their 'hunting expeditions'.

f. Aaron was lazy as a child, so during role-play games **he was left to guard the small, vulnerable fort because he** could not be bothered to join the others on their 'hunting expeditions'.

45. Jump the gun

a. Fredrick asked Cristina to marry him on their second date, **but he jumped the gun and he** was totally humiliated when she dumped him.

b. Fredrick asked Cristina to marry him on their second date, **but he jumped the big gun and he** was totally humiliated when she dumped him.

c. Fredrick asked Cristina to marry him on their second date, **but he jumped the big, dangerous gun and he** was totally humiliated when she dumped him.

d. Fredrick seized the weapon from the armed burglar and hesitated for a second, **but he fired the gun and he** shot the burglar in the leg when he tried to attack him.

e. Fredrick seized the weapon from the armed burglar and hesitated for a second, **but he fired the big gun and he** shot the burglar in the leg when he tried to attack him.
f. Fredrick seized the weapon from the armed burglar and hesitated for a second, **but he fired the big, dangerous gun and he** shot the burglar in the leg when he tried to attack him.
46. Miss the boat
a. Keira left her dream job to work for her dad, but later realised **that she missed the boat because she** would never get out of his shadow.
b. Keira left her dream job to work for her dad, but later realised **that she missed the big boat because she** would never get out of his shadow.
c. Keira left her dream job to work for her dad, but later realised **that she missed the big, costly boat because she** would never get out of his shadow.
d. Keira let her daughter deal with her own finances, but got furious when she realised **that she sold the boat because she** needed to pay off personal debts.
e. Keira let her daughter deal with her own finances, but got furious when she realised **that she sold the big boat because she** needed to pay off personal debts.
f. Keira let her daughter deal with her own finances, but got furious when she realised **that she sold the big, costly boat because she** needed to pay off personal debts.
47. Pick a fight
a. Jacob had been irritable with everyone at work lately and **yesterday he picked a fight with his** secretary who is too timid to answer back.
b. Jacob had been irritable with everyone at work lately and **yesterday he picked a silly fight with his** secretary who is too timid to answer back.
c. Jacob had been irritable with everyone at work lately and **yesterday he picked a big, silly fight with his** secretary who is too timid to answer back.
d. Jacob knows that he has a bad temper, so by opting to go for a walk **yesterday he prevented a fight with his** wife which would not have ended well.
e. Jacob knows that he has a bad temper, so by opting to go for a walk **yesterday he prevented a silly fight with his** wife which would not have ended well.
f. Jacob knows that he has a bad temper, so by opting to go for a walk **yesterday he prevented a big, silly fight with his** wife which would not have ended well.
48. Pick one's brain
a. Fiona didn't know anything about rugby, so she called a friend **and picked his brain for hours** to avoid humiliation on her date, after lying about loving the sport.
b. Fiona didn't know anything about rugby, so she called a friend **and picked his unfortunate brain for hours** to avoid humiliation on her date, after lying about loving the sport.
c. Fiona didn't know anything about rugby, so she called a friend **and picked his entire, unfortunate brain for hours** to avoid humiliation on her date, after lying about loving the sport.

d. Fiona performs difficult surgeries daily, but when she opened her friend's skull **and examined his brain for hours**, she found it difficult to separate her professional and private life.
e. Fiona performs difficult surgeries daily, but when she opened her friend's skull **and examined his unfortunate brain for hours**, she found it difficult to separate her professional and private life.
f. Fiona performs difficult surgeries daily, but when she opened her friend's skull **and examined his entire, unfortunate brain for hours**, she found it difficult to separate her professional and private life.
49. Pop the question
a. Jenny could see that her boyfriend Alfred was nervous about something, but **eventually he popped the question and the** date of their wedding was fixed for the following summer.
b. Jenny could see that her boyfriend Alfred was nervous about something, but **eventually he popped the big question and the** date of their wedding was fixed for the following summer.
c. Jenny could see that her boyfriend Alfred was nervous about something, but **eventually he popped the big, important question and the** date of their wedding was fixed for the following summer.
d. Alfred was momentarily stunned during the interview, but **eventually he answered the question** and the interviewer seemed very satisfied with his response.
e. Alfred was momentarily stunned during the interview, but **eventually he answered the big question** and the interviewer seemed very satisfied with his response.
f. Alfred was momentarily stunned during the interview, but **eventually he answered the big, important question** and the interviewer seemed very satisfied with his response.
50. Smell a rat
a. Amanda wasn't used to being spoiled by her husband every day, **so she smelled a rat and she** decided to hire a private detective to find out if he was cheating.
b. Amanda wasn't used to being spoiled by her husband every day, **so she smelled a huge rat and she** decided to hire a private detective to find out if he was cheating.
c. Amanda wasn't used to being spoiled by her husband every day, **so she smelled a huge, ugly rat and she** decided to hire a private detective to find out if he was cheating.
d. Amanda hadn't cleaned the attic since she bought the house, **so she found a rat and she** was so disgusted that she decided to hire professional cleaners.
e. Amanda hadn't cleaned the attic since she bought the house, **so she found a huge rat and she** was so disgusted that she decided to hire professional cleaners.
f. Amanda hadn't cleaned the attic since she bought the house, **so she found a huge, ugly rat and she** was so disgusted that she decided to hire professional cleaners.
51. Steal the show
a. Marina looked so stunning at her cousin's wedding that she was **accused of stealing the show from the** bride and was excluded from the family photos.

b. Marina looked so stunning at her cousin's wedding that she was **accused of stealing the big show from the** bride and was excluded from the family photos.
c. Marina looked so stunning at her cousin's wedding that she was **accused of stealing the big, splendid show from the** bride and was excluded from the family photos.
d. Marina didn't get the role she wanted and she was **accused of sabotaging the show from the** beginning to take revenge on the director.
e. Marina didn't get the role she wanted and she was **accused of sabotaging the big show from the** beginning to take revenge on the director.
f. Marina didn't get the role she wanted and she was **accused of sabotaging the big, splendid show from the** beginning to take revenge on the director.
52. Break the bank
a. Valentina bitterly regretted buying that Gucci dress **because she broke the bank and then** she needed to borrow money from her parents to fix her car.
b. Valentina bitterly regretted buying that Gucci dress **because she broke the unfortunate bank and then** she needed to borrow money from her parents to fix her car.
c. Valentina bitterly regretted buying that Gucci dress **because she broke the small, unfortunate bank and then** she needed to borrow money from her parents to fix her car.
d. Valentina was arrested and sentenced to 10 years in jail **because she robbed the bank and then** she shot a police officer when trying to get away.
e. Valentina was arrested and sentenced to 10 years in jail **because she robbed the unfortunate bank and then** she shot a police officer when trying to get away.
f. Valentina was arrested and sentenced to 10 years in jail **because she robbed the small, unfortunate bank and then** she shot a police officer when trying to get away.
53. Twist one's arm
a. Kirsty wanted to go dancing with her reluctant boyfriend, **so she twisted his arm since she** had agreed to go to a boring football match with him the previous month.
b. Kirsty wanted to go dancing with her reluctant boyfriend, **so she twisted his strong arm since she** had agreed to go to a boring football match with him the previous month.
c. Kirsty wanted to go dancing with her reluctant boyfriend, **so she twisted his strong, muscled arm since she** had agreed to go to a boring football match with him the previous month.
d. Kirsty wasn't looking while passing a knife to her boyfriend, **so she cut his arm since she** was far too interested in the trashy TV show she was watching at that moment.
e. Kirsty wasn't looking while passing a knife to her boyfriend, **so she cut his strong arm since she** was far too interested in the trashy TV show she was watching at that moment.
f. Kirsty wasn't looking while passing a knife to her boyfriend, **so she cut his strong, muscled arm since she** was far too interested in the trashy TV show she was watching at that moment.

54. Turn the tables
a. Lee was sick of losing at darts to Jill and started practising for hours, **so he turned the tables on her** and won ten matches in a row.
b. Lee was sick of losing at darts to Jill and started practising for hours, **so he turned the maddening tables on her** and won ten matches in a row.
c. Lee was sick of losing at darts to Jill and started practising for hours, **so he turned the trivial, maddening tables on her** and won ten matches in a row.
d. Lee got fed up with keeping his ex-wife's furniture in his attic, **so he placed the tables on her** doorstep with a note saying that she needed to pick up the rest.
e. Lee got fed up with keeping his ex-wife's furniture in his attic, **so he placed the maddening tables on her** doorstep with a note saying that she needed to pick up the rest.
f. Lee got fed up with keeping his ex-wife's furniture in his attic, **so he placed the trivial, maddening tables on her** doorstep with a note saying that she needed to pick up the rest.
55. Waste your breath
a. Marta was trying to convince her mum to buy her a brand new car, but **she was wasting her breath as her** mum had already bought her a used one from the local dealer.
b. Marta was trying to convince her mum to buy her a brand new car, but **she was wasting her valuable breath as her** mum had already bought her a used one from the local dealer.
c. Marta was trying to convince her mum to buy her a brand new car, but **she was wasting her ragged, valuable breath as her** mum had already bought her a used one from the local dealer.
d. Marta was called to clean a house but it was so noxious that **she was holding her breath as her** stomach churned every time she inhaled.
e. Marta was called to clean a house but it was so noxious that **she was holding her valuable breath as her** stomach churned every time she inhaled.
f. Marta was called to clean a house but it was so noxious that **she was holding her ragged, valuable breath as her** stomach churned every time she inhaled.
56. Blow a fuse
a. Gordon saw someone keying his expensive sports car in the middle of the night, **so he blew a fuse and he** started shouting at the culprit while rushing outside to confront him.
b. Gordon saw someone keying his expensive sports car in the middle of the night, **so he blew a small fuse and he** started shouting at the culprit while rushing outside to confront him.
c. Gordon saw someone keying his expensive sports car in the middle of the night, **so he blew a small, vital fuse and he** started shouting at the culprit while rushing outside to confront him.
d. Gordon caused a short circuit when he plugged in the toaster, **so he bought a fuse and he** tried it again on the following day only to have another power outage.
e. Gordon caused a short circuit when he plugged in the toaster, **so he bought a small fuse and he** tried it again on the following day only to have another power outage.

f. Gordon caused a short circuit when he plugged in the toaster, **so he bought a small, vital fuse and he** tried it again on the following day only to have another power outage.

57. Cook the books

a. Nicholas had been skimming money without getting caught because **he was cooking the books and no** one had noticed the missing money.

b. Nicholas had been skimming money without getting caught because **he was cooking the cryptic books and no** one had noticed the missing money.

c. Nicholas had been skimming money without getting caught because **he was cooking the old, cryptic books and no** one had noticed the missing money.

d. Nicholas restored ancient tomes and manuscripts so all last week **he was dusting the books and no** one dared to disturb him before the important auction.

e. Nicholas restored ancient tomes and manuscripts so all last week **he was dusting the cryptic books and no** one dared to disturb him before the important auction.

f. Nicholas restored ancient tomes and manuscripts so all last week **he was dusting the old, cryptic books and no** one dared to disturb him before the important auction.

58. Face the music

a. Tracy had lied about preparing for the test, but after failing it, she **had to face the music when she** took the test home to be signed by both parents.

b. Tracy had lied about preparing for the test, but after failing it, she **had to face the harsh music when she** took the test home to be signed by both parents.

c. Tracy had lied about preparing for the test, but after failing it, she **had to face the loud, harsh music when she** took the test home to be signed by both parents.

d. Tracy played in a death-metal band to earn money despite hating it, so she **had to endure the music when she** went to rehearsals and played gigs.

e. Tracy played in a death-metal band to earn money despite hating it, so she **had to endure the harsh music when she** went to rehearsals and played gigs.

f. Tracy played in a death-metal band to earn money despite hating it, so she **had to endure the loud, harsh music when she** went to rehearsals and played gigs.

59. Hit the roof

a. Sarah gladly let her husband cook, but then she saw the mess in the kitchen **and she hit the roof and made** him clean up and even scrub the floor.

b. Sarah gladly let her husband cook, but then she saw the mess in the kitchen **and she hit the high roof and made** him clean up and even scrub the floor.

c. Sarah gladly let her husband cook, but then she saw the mess in the kitchen **and she hit the high, lofty roof and made** him clean up and even scrub the floor.

d. Sarah tried to install slate tiles herself to save money, but she is clumsy **and she damaged the roof and made** a huge mess that needed to be fixed by a professional.

e. Sarah tried to install slate tiles herself to save money, but she is clumsy **and she damaged the high roof and made** a huge mess that needed to be fixed by a professional.
f. Sarah tried to install slate tiles herself to save money, but she is clumsy **and she damaged the high, lofty roof and made** a huge mess that needed to be fixed by a professional.
60. Keep your head
a. Wendy was annoyed when her boss yelled at her, **but she kept her head just by** thinking that she would soon be able to go home and relax.
b. Wendy was annoyed when her boss yelled at her, **but she kept her poor head just by** thinking that she would soon be able to go home and relax.
c. Wendy was annoyed when her boss yelled at her, **but she kept her poor, little head just by** thinking that she would soon be able to go home and relax.
d. Wendy was thinking of taking some paracetamol for the pain, **but she soothed her head just by** massaging her temples for a couple of minutes instead.
e. Wendy was thinking of taking some paracetamol for the pain, **but she soothed her poor head just by** massaging her temples for a couple of minutes instead.
f. Wendy was thinking of taking some paracetamol for the pain, **but she soothed her poor, little head just by** massaging her temples for a couple of minutes instead.
61. Kick the bucket
a. Toby was devastated when he realised that all of his pet **spiders had kicked the bucket, so he** made his dad host a glorious funeral for them in their backyard.
b. Toby was devastated when he realised that all of his pet **spiders had kicked the old bucket, so he** made his dad host a glorious funeral for them in their backyard.
c. Toby was devastated when he realised that all of his pet **spiders had kicked the horrible, old bucket, so he** made his dad host a glorious funeral for them in their backyard.
d. Toby wanted his beach toys but found that **spiders had inhabited the bucket, so he** made his dad clean it up before they left for the coast.
e. Toby wanted his beach toys but found that **spiders had inhabited the old bucket, so he** made his dad clean it up before they left for the coast.
f. Toby wanted his beach toys but found that **spiders had inhabited the horrible, old bucket, so he** made his dad clean it up before they left for the coast.
62. Know the ropes
a. William had worked for the old manager for years, **so he knows the ropes and he** should be able to help the new manager settle in.
b. William had worked for the old manager for years, **so he knows the old ropes and he** should be able to help the new manager settle in.
c. William had worked for the old manager for years, **so he knows the twisted, old ropes and he** should be able to help the new manager settle in.
d. William was responsible for putting up the tents in the camp, **so he unpacked the ropes and he** found all of the stakes and got the tents pitched in record time.

e. William was responsible for putting up the tents in the camp, **so he unpacked the old ropes and he** found all of the stakes and got the tents pitched in record time.
f. William was responsible for putting up the tents in the camp, **so he unpacked the twisted, old ropes and he** found all of the stakes and got the tents pitched in record time.
63. Cook your goose
a. Teresa showed up half an hour late for the big interview, **so she cooked her goose and she** did not get the job even though she was an ideal candidate.
b. Teresa showed up half an hour late for the big interview, **so she cooked her big goose and she** did not get the job even though she was an ideal candidate.
c. Teresa showed up half an hour late for the big interview, **so she cooked her big, fat goose and she** did not get the job even though she was an ideal candidate.
d. Teresa's poultry had escaped from their cage and she couldn't chase them all down, **so she lost her goose and she** had to buy one for Christmas dinner.
e. Teresa's poultry had escaped from their cage and she couldn't chase them all down, **so she lost her big goose and she** had to buy one for Christmas dinner.
f. Teresa's poultry had escaped from their cage and she couldn't chase them all down, **so she lost her big, fat goose and she** had to buy one for Christmas dinner.
64. Hit the deck
a. When Holly looked at the clock, she realised how late it was, **so she hit the deck hurriedly and** she rushed to work.
b. When Holly looked at the clock, she realised how late it was, **so she hit the hard deck hurriedly and she** rushed to work.
c. When Holly looked at the clock, she realised how late it was, **so she hit the tough, hard deck hurriedly** and she rushed to work.
d. Holly, the ship's captain, could not find a member of the cabin crew anywhere, **so she cleaned the deck hurriedly and** reassured the passengers herself.
e. Holly, the ship's captain, could not find a member of the cabin crew anywhere, **so she cleaned the hard deck hurriedly and** reassured the passengers herself.
f. Holly, the ship's captain, could not find a member of the cabin crew anywhere, **so she cleaned the tough, hard deck hurriedly and** reassured the passengers herself.
65. Sugar the pill
a. Claire announced the pay cuts to her staff, but promised it was temporary, **so she sugared the pill and her** staff did not go on strike.
b. Claire announced the pay cuts to her staff, but promised it was temporary, **so she sugared the bitter pill and her** staff did not go on strike.
c. Claire announced the pay cuts to her staff, but promised it was temporary, **so she sugared the large, bitter pill and her** staff did not go on strike.
d. Claire doesn't like taking medicine but her head was throbbing, **so she took the pill and her** pain eased up very quickly.

e. Claire doesn't like taking medicine but her head was throbbing, **so she took the bitter pill and her** pain eased up very quickly.
f. Claire doesn't like taking medicine but her head was throbbing, **so she took the large, bitter pill and her** pain eased up very quickly.
66. Lose the plot
a. Clark promised a tax raise, while running for re-election, so his supporters thought **he had lost the plot and he** did not win the election.
b. Clark promised a tax raise, while running for re-election, so his supporters thought **he had lost the basic plot and** did not win the election.
c. Clark promised a tax raise, while running for re-election, so his supporters thought **he had lost the basic, original plot and he** did not win the election.
d. Clark was asked to do a sequel of his first film, but after 20 years **he had forgotten the plot and he** had to reread the original script carefully.
e. Clark was asked to do a sequel of his first film, but after 20 years **he had forgotten the basic plot and he** had to reread the original script carefully.
f. Clark was asked to do a sequel of his first film, but after 20 years **he had forgotten the basic, original plot so he** had to reread the original script carefully.
67. Hit the road
a. Philip needed to get home as soon as possible to take care of his sick son, **so he hit the road and refused to** join his colleagues for a pint after work.
b. Philip needed to get home as soon as possible to take care of his sick son, **so he hit the long road and refused to** join his colleagues for a pint after work.
c. Philip needed to get home as soon as possible to take care of his sick son, **so he hit the long, slow road and refused to** join his colleagues for a pint after work.
d. Officer Philip witnessed a car accident on his way to work, **so he blocked the road and refused to** let any drivers pass by because of the shattered glass.
e. Officer Philip witnessed a car accident on his way to work, **so he blocked the long road and refused to** let any drivers pass by because of the shattered glass.
f. Officer Philip witnessed a car accident on his way to work, **so he blocked the long, slow road and refused to** let any drivers pass by because of the shattered glass.
68. Rule the roost
a. Charley was unhappy with his business partner's tactics, so he stepped **in to rule the roost by himself** in order to maximise the company's profit.
b. Charley was unhappy with his business partner's tactics, so he stepped **in to rule the big roost by himself** in order to maximise the company's profit.
c. Charley was unhappy with his business partner's tactics, so he stepped **in to rule the big, old roost by himself** in order to maximise the company's profit.
d. Charley's chicken coop started to smell a lot, so he stepped **in to clean the roost by himself** before the neighbours started complaining again.
e. Charley's chicken coop started to smell a lot, so he stepped **in to clean the big roost by himself** before the neighbours started complaining again.
f. Charley's chicken coop started to smell a lot, so he stepped **in to clean the big, old roost by himself** before the neighbours started complaining again.

69. Know the score
a. Betty wanted to look like she was above petty fights at work, but **she knew the score and she** was keeping track of everyone's offenses.
b. Betty wanted to look like she was above petty fights at work, but **she knew the running score and she** was keeping track of everyone's offenses.
c. Betty wanted to look like she was above petty fights at work, but **she knew the full, running score and she** was keeping track of everyone's offenses.
d. Betty just wanted to watch her son play basketball, **but she kept the score and she** worked the clock because the regular volunteers had not shown up to help at the match.
e. Betty just wanted to watch her son play basketball, **but she kept the running score and** she worked the clock because the regular volunteers had not shown up to help at the match.
f. Betty just wanted to watch her son play basketball, **but she kept the full, running score** and she worked the clock because the regular volunteers had not shown up to help at the match.
70. Weather the storm
a. Alice went through a horrible year after she got fired, **but she weathered the storm despite the** fact that she had no one to rely on.
b. Alice went through a horrible year after she got fired, **but she weathered the bitter storm despite the** fact that she had no one to rely on
c. Alice went through a horrible year after she got fired, **but she weathered the tough, bitter storm despite the** fact that she had no one to rely on.
d. Alice got scared when she saw dark clouds gathering, **but she avoided the storm despite the** insane traffic congestion during the peak hour.
e. Alice got scared when she saw dark clouds gathering, **but she avoided the bitter storm despite the** insane traffic congestion during the peak hour.
f. Alice got scared when she saw dark clouds gathering, **but she avoided the tough, bitter storm despite the** insane traffic congestion during the peak hour.
71. Clear the air
a. Lizzy had a huge fight with her mother-in-law, so she went to see her **just to clear the air before the** holiday season when she knew they would be spending time together.
b. Lizzy had a huge fight with her mother-in-law, so she went to see her **just to clear the thick air before the** holiday season when she knew they would be spending time together.
c. Lizzy had a huge fight with her mother-in-law, so she went to see her **just to clear the thick, unpleasant air before the** holiday season when she knew they would be spending time together.
d. Lizzy bought a dozen scented candles for her house **just to freshen the air before the** guests arrived for her dinner party.
e. Lizzy bought a dozen scented candles for her house **just to freshen the thick air before the** guests arrived for her dinner party.
f. Lizzy bought a dozen scented candles for her house **just to freshen the thick, unpleasant air before the** guests arrived for her dinner party.
72. Have a ball
a. Dave wasn't expecting to enjoy the family road-trip, but **he actually had a ball and he** even suggested that they do it at least once a year.

b. Dave wasn't expecting to enjoy the family road-trip, but **he actually had an enormous ball and he** even suggested that they do it at least once a year.
c. Dave wasn't expecting to enjoy the family road-trip, but h**e actually had an enormous, entertaining ball and he** even suggested that they do it at least once a year.
d. Dave wanted to celebrate the success of his film, so **he actually held a ball and he** invited all the big names of the film industry, including actors and producers.
e. Dave wanted to celebrate the success of his film, so **he actually held an enormous ball and he** invited all the big names of the film industry, including actors and producers.
f. Dave wanted to celebrate the success of his film, so **he actually held an enormous, entertaining ball and he** invited all the big names of the film industry, including actors and producers.
73. Beat your chest
a. Clive gave a press conference following the scandal, where **he was beating his chest in hopes** of regaining the trust of his voters.
b. Clive gave a press conference following the scandal, where **he was beating his broad chest in hopes** of regaining the trust of his voters.
c. Clive gave a press conference following the scandal, where **he was beating his large, broad chest in hopes** of regaining the trust of his voters.
d. Clive was a competitive swimmer and made use of any advantage, so **he was shaving his chest in hopes** of improving his times.
e. Clive was a competitive swimmer and made use of any advantage, so **he was shaving his broad chest in hopes** of improving his times.
f. Clive was a competitive swimmer and made use of any advantage, so **he was shaving his large, broad chest in hopes** of improving his times.
74. Drop a bombshell
a. Dana was the ‘good’ daughter and no one suspected her of crashing her dad’s car, **so she dropped a bombshell and her** dad was furious when she admitted it to him.
b. Dana was the ‘good’ daughter and no one suspected her of crashing her dad’s car, **so she dropped a powerful bombshell and her** dad was furious when she admitted it to him.
c. Dana was the ‘good’ daughter and no one suspected her of crashing her dad’s car, **so she dropped a big, powerful bombshell and her** dad was furious when she admitted it to him.
d. Dana was excavating in a site that used to be in the former warzone, **so she found a bombshell and her** supervisors were worried whether it was still active.
e. Dana was excavating in a site that used to be in the former warzone, **so she found a powerful bombshell and her** supervisors were worried whether it was still active.
f. Dana was excavating in a site that used to be in the former warzone, **so she found a big, powerful bombshell and her** supervisors were worried whether it was still active.
75. Strike a chord
a. Jim heard Vicky’s story about her battle with cancer **and it struck a chord so he** began to cry as he thought of his wife’s struggle with the disease.

b. Jim heard Vicky's story about her battle with cancer **and it struck a sudden chord so he** began to cry as he thought of his wife's struggle with the disease.
c. Jim heard Vicky's story about her battle with cancer **and it struck a sudden, dissonant chord so he** began to cry as he thought of his wife's struggle with the disease.
d. Bill's puppy jumped on his guitar while he was sleeping **and it played a chord so he** woke up in panic, unable to comprehend what was happening.
e. Bill's puppy jumped on his guitar while he was sleeping **and it played a sudden chord so he** woke up in panic, unable to comprehend what was happening.
f. Bill's puppy jumped on his guitar while he was sleeping **and it played a sudden, dissonant chord so he** woke up in panic, unable to comprehend what was happening.
76. Square the circle
a. Zac desperately wanted to find a solution, but he realised that he was **trying to square the circle so he** thought it appropriate to just give up the idea all together.
b. Zac desperately wanted to find a solution, but he realised that he was **trying to square the awkward circle so he** thought it appropriate to just give up the idea all together.
c. Zac desperately wanted to find a solution, but he realised that he was **trying to square the big, awkward circle so he** thought it appropriate to just give up the idea all together.
d. Two-year-old Zac is hard on all of his toys, and lately he was **trying to break the circle so he** could squeeze it into a square hole.
e. Two-year-old Zac is hard on all of his toys, and lately he was **trying to break the awkward circle so he** could squeeze it into a square hole.
f. Two-year-old Zac is hard on all of his toys, and lately he was **trying to break the big, awkward circle so he** could squeeze it into a square hole.
77. Carry the day
a. Annie was underestimated by her fellow Labour candidates, and during the **debate she carried the day by herself** and the party owed half of the votes to her.
b. Annie was underestimated by her fellow Labour candidates, and during the **debate she carried the stressful day by herself** and the party owed half of the votes to her.
c. Annie was underestimated by her fellow Labour candidates, and during the **debate she carried the long, stressful day by herself** and the party owed half of the votes to her.
d. Annie had prepared her arguments well in advance, so before the **debate she spent the day by herself** just revising them slightly.
e. Annie had prepared her arguments well in advance, so before the **debate she spent the stressful day by herself** just revising them slightly.
e. Annie had prepared her arguments well in advance, so before the **debate she spent the stressful day by herself** just revising them slightly.
78. Go the distance
a. Stacey struggled to finish her 10,000 word dissertation, but **eventually she went the distance and she** ultimately was very satisfied with the mark she received.

b. Stacey struggled to finish her 10,000 word dissertation, but **eventually she went the long distance and she** ultimately was very satisfied with the mark she received.
c. Stacey was struggling to finish her 10,000 word dissertation, but **eventually she went the long, total distance and she** ultimately was very satisfied with the mark she received.
d. Stacey worried about studying so far away from home, but **eventually she travelled the distance and she** was amazed by how well she could manage on her own.
e. Stacey worried about studying so far away from home, but **eventually she travelled the long distance and she** was amazed by how well she could manage on her own.
f. Stacey worried about studying so far away from home, but **eventually she travelled the long, total distance and she** was amazed by how well she could manage on her own.
79. Drag your feet
a. Five-year-old Sebastian knew he should clean his room, but **he was dragging his feet hoping that** his mum would get exasperated and come clean it herself.
b. Five-year-old Sebastian knew he should clean his room, but **he was dragging his little feet hoping that** his mum would get exasperated and come clean it herself.
c. Five-year-old Sebastian knew he should clean his room, but **he was dragging his small, little feet hoping that** his mum would get exasperated and come clean it herself.
d. Five-year-old Sebastian got upset when his mum refused to buy him chocolate, so **he was stomping his feet hoping that** his mum would change her mind.
e. Five-year-old Sebastian got upset when his mum refused to buy him chocolate, so **he was stomping his little feet hoping that** his mum would change her mind.
f. Five-year-old Sebastian got upset when his mum refused to buy him chocolate, so **he was stomping his small, little feet hoping that** his mum would change her mind.
80. Bite the dust
a. Chad's television hadn’t had a clear picture in months, **and it bit the dust so he** went out and got a new 50” flat screen.
b. Chad's television hadn’t had a clear picture in months, **and it bit the irritating dust so he** went out and got a new 50” flat screen.
c. Chad's television hadn’t had a clear picture in months, **and it bit the thick, irritating dust so he** went out and got a new 50” flat screen.
d. Chad was sweeping out his parents’ garage when a big gust of wind came, **and it blew the dust so he** had to start sweeping all over again.
e. Chad was sweeping out his parents’ garage when a big gust of wind came, **and it blew the irritating dust so he** had to start sweeping all over again.
f. Chad was sweeping out his parents’ garage when a big gust of wind came, **and it blew the thick, irritating dust so he** had to start sweeping all over again.
81. Deliver the goods

a. Penny came up with a brilliant new ad campaign for her company, **so she delivered the goods and her** boss was very satisfied with the results.
b. Penny came up with a brilliant new ad campaign for her company, **so she delivered the essential goods and her** boss was very satisfied with the results.
c. Penny came up with a brilliant new ad campaign for her company, **so she delivered the main, essential goods and her** boss was very satisfied with the results.
d. Penny made an error while inventorying the store's stocks and items were missing, **so she ordered the goods and her** boss was none the wiser about her mistake.
e. Penny made an error while inventorying the store's stocks and items were missing, **so she ordered the essential goods and her** boss was none the wiser about her mistake.
f. Penny made an error while inventorying the store's stocks and items were missing, **so she ordered the main, essential goods and her** boss was none the wiser about her mistake.
82. Twiddle one's thumbs
a. Harriet spent hours sitting in the doctor's waiting room and she got **fed up twiddling her thumbs, just trying** to pass the time while everyone else was called ahead of her.
b. Harriet spent hours sitting in the doctor's waiting room and she got **fed up twiddling her tiny thumbs, just trying** to pass the time while everyone else was called ahead of her.
c. Harriet spent hours sitting in the doctor's waiting room and she got **fed up twiddling her tiny, little thumbs, just trying** to pass the time while everyone else was called ahead of her.
d. Harriet sat in the bitter cold for an hour waiting for the locksmith, and she got **fed up squeezing her thumbs just trying** to get some feeling back into them.
e. Harriet sat in the bitter cold for an hour waiting for the locksmith, and she got **fed up squeezing her tiny thumbs just trying** to get some feeling back into them.
f. Harriet sat in the bitter cold for an hour waiting for the locksmith, and she got **fed up squeezing her tiny, little thumbs just trying** to get some feeling back into them.
83. Tie the knot
a. Annalise had been planning her wedding for two years before **she finally tied the knot with her** long term boyfriend.
b. Annalise had been planning her wedding for two years before **she finally tied the tight knot with her** long term boyfriend.
c. Annalise had been planning her wedding for two years before **she finally tied the huge, tight knot with her** long term boyfriend.
d. Annalise couldn't undo her shoelaces after the race, so **she finally cut the knot with her** scissors and bought a pair of new shoelaces.
e. Annalise couldn't undo her shoelaces after the race, so **she finally cut the tight knot with her scissors** and bought a pair of new shoelaces.
f. Annalise couldn't undo her shoelaces after the race, so **she finally cut the huge, tight knot with her scissors** and bought a pair of new shoelaces.
84. Get the picture

a. Stanley was never good at picking up on subtle hints, so it took a while for **him to get the picture and to** realise that he had really upset his wife.
b. Stanley was never good at picking up on subtle hints, so it took a while for **him to get the grim picture and to** realise that he had really upset his wife.
c. Stanley was never good at picking up on subtle hints, so it took a while for **him to get the entire, grim picture and to** realise that he had really upset his wife.
d. Stanley was a very talented forger, so it took little time for **him to falsify the picture and to** pass it off to a gullible art collector.
e. Stanley was a very talented forger, so it took little time for **him to falsify the grim picture and to** pass it off to a gullible art collector.
f. Stanley was a very talented forger, so it took little time for **him to falsify the entire, grim picture and to** pass it off to a gullible art collector.
85. Earn your spurs
a. Vinny was considered too skinny for wrestling, but after winning a major **fight he earned his spurs and no** one ever commented on his physique again.
b. Vinny was considered too skinny for wrestling, but after winning a major **fight he earned his big spurs and no** one ever commented on his physique again.
c. Vinny was considered too skinny for wrestling, but after winning a major **fight he earned his big, shiny spurs and no** one ever commented on his physique again.
d. Little Vinny dressed up as a cowboy for Halloween, but during a playground **fight he broke his spurs and no** ice-cream on earth could make him stop crying.
e. Little Vinny dressed up as a cowboy for Halloween, but during a playground **fight he broke his big spurs and no** ice-cream on earth could make him stop crying.
f. Little Vinny dressed up as a cowboy for Halloween, but during a playground **fight he broke his big, shiny spurs and no** ice-cream on earth could make him stop crying.
86. Hit the wall
a. Collin was running a marathon and was feeling good, but in the **end he hit the wall and had** to walk starting at mile twenty-two.
b. Collin was running a marathon and was feeling good, but in the **end he hit the solid wall and had** to walk starting at mile twenty-two.
c. Collin was running a marathon and was feeling good, but in the **end he hit the solid, brick wall and had** to walk starting at mile twenty-two.
d. Collin was trying to install screw hooks for some portraits, but in the **end he cracked the wall and had** to call a professional to check it out.
e. Collin was trying to install screw hooks for some portraits, but in the **end he cracked the solid wall and had** to call a professional to check it out.
f. Collin was trying to install screw hooks for some portraits, but in the **end he cracked the solid, brick wall and had** to call a professional to check it out.
87. Eat your words
a. Charlotte was advocating a theory that was subsequently invalidated, **so she ate her words and admitted** that her theory did not hold in practice.

b. Charlotte was advocating a theory that was subsequently invalidated, **so she ate her inaccurate words and admitted** that her theory did not hold in practice.
c. Charlotte was advocating a theory that was subsequently invalidated, **so she ate her unfitting, inaccurate words and admitted** that her theory did not hold in practice.
d. Charlotte's article was rejected for ambiguous phraseology, **so she changed her words and admitted** that she might need to write more clearly.
e. Charlotte's article was rejected for ambiguous phraseology, **so she changed her inaccurate words and admitted** that she might need to write more clearly.
f. Charlotte's article was rejected for ambiguous phraseology, **so she changed her unfitting, inaccurate words and admitted** that she might need to write more clearly.
88. Take a bath
a. Bill had promised that his plan would make a huge profit, but their clients **ended up taking a bath instead and he** was fired for losing his company millions.
b. Bill had promised that his plan would make a huge profit, but their clients **ended up taking a horrible bath instead and he** was fired for losing his company millions.
c. Bill had promised that his plan would make a huge profit, but their clients **ended up taking a horrible, unpleasant bath instead and he** was fired for losing his company millions.
d. Bill's showerhead wasn't working properly last night, so he **ended up having a bath instead and he** wasted an insane amount of water.
e. Bill's showerhead wasn't working properly last night, so he **ended up having a horrible bath instead and he** wasted an insane amount of water.
f. Bill's showerhead wasn't working properly last night, so he **ended up having a horrible, unpleasant bath instead and he** wasted an insane amount of water.
89. Hedge your bets
a. Graham started his business while still working part time at his previous job, **so he hedged his bets and therefore** when his business failed he still had a source of income.
b. Graham started his business while still working part time at his previous job, **so he hedged his big bets and therefore** when his business failed he still had a source of income.
c. Graham started his business while still working part time at his previous job, **so he hedged his big, heavy bets and therefore** when his business failed he still had a source of income.
d. Graham truly believed that his lucky numbers would come up, **so he doubled his bets and therefore** he ended up losing a lot of money when they were not picked.
e. Graham truly believed that his lucky numbers would come up, **so he doubled his big bets and therefore** he ended up losing a lot of money when they were not picked.
f. Graham truly believed that his lucky numbers would come up, **so he doubled his big, heavy bets and therefore** he ended up losing a lot of money when they were not picked.

90. Miss the mark

a. Marvin opened his speech with some jokes to build rapport with his audience**, but he missed the mark when he** insulted the wife of the very popular mayor.

b. Marvin opened his speech with some jokes to build rapport with his audience**, but he missed the wide mark when he** insulted the wife of the very popular mayor.

c. Marvin opened his speech with some jokes to build rapport with his audience**, but he missed the big, wide mark when he** insulted the wife of the very popular mayor.

d. Two-year old Marvin knew he was not supposed to colour on the wall, **but he drew the mark when he** saw his mum leave the room.

e. Two-year old Marvin knew he was not supposed to colour on the wall, **but he drew the wide mark when he** saw his mum leave the room.

f. Two-year old Marvin knew he was not supposed to colour on the wall, **but he drew the big, wide mark when he** saw his mum leave the room.

Appendix D

Study 2 – Additional model outputs

Whole idiom

	Regression				**Fixations**			
Predictors	*Log-Odds*	*std. Error*	*Statistic*	*p*	*Log-Mean*	*std. Error*	*Statistic*	*p*
(Intercept)	1.04	0.23	4.51	**<0.001**	1.46	0.04	33.81	**<0.001**
Literal	-0.16	0.13	-1.21	0.227	-0.03	0.03	-1.13	0.258
Control	0.04	0.14	0.29	0.77	0.01	0.03	0.56	0.576
Random Effects								
σ^2	3.29				0.21			
τ_{00}	1.84 $_{\text{PARTICIPANT}}$				0.06 $_{\text{PARTICIPANT}}$			
	0.10 $_{\text{ITEM}}$				0.01 $_{\text{ITEM}}$			
Observations	1973				1973			

Idiom noun

Total reading time	**First fixation duration**	**First pass reading time**

Predictors	*Estimates*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*
(Intercept)	5.57	0.04	142.15	**<0.001**	5.17	0.02	271.65	**<0.001**	5.22	0.02	261.69	**<0.001**
Literal	-0.03	0.03	-1.11	0.267	-0.01	0.02	-0.54	0.589	0	0.02	0.06	0.949
Control	-0.02	0.03	-0.76	0.45	-0.02	0.02	-1.21	0.227	-0.01	0.02	-0.27	0.784
Random Effects												
σ^2	0.25				0.07				0.1			
τ_{00}	0.00 TRIAL_INDEX				0.01 PARTICIPANT				0.00 TRIAL_INDEX			
	0.05 PARTICIPANT								0.01 PARTICIPANT			
Observations	1648				1648				1648			

	Regression				**Fixations**				**Skipping**			
Predictors	*Log-Odds*	*std. Error*	*Statistic*	*p*	*Log-Mean*	*std. Error*	*Statistic*	*p*	*Log-Odds*	*std. Error*	*Statistic*	*p*
(Intercept)	-0.1	0.18	-0.59	0.557	0.49	0.04	11.62	**<0.001**	-0.67	0.13	-5.19	**<0.001**
Literal	-0.21	0.13	-1.57	0.116	-0.04	0.05	-0.85	0.393	0.02	0.12	0.15	0.879
Control	-0.17	0.13	-1.29	0.197	-0.01	0.05	-0.15	0.884	-0.07	0.12	-0.61	0.539
Random Effects												

σ^2	3.29	0.48	3.29
τ_{00}	0.99 $_{\text{PARTICIPANT}}$	0.00 $_{\text{TRIAL_INDEX}}$	0.41 $_{\text{PARTICIPANT}}$
		0.03 $_{\text{PARTICIPANT}}$	
Observations	1648	1648	1980

Idiom verb

	First fixation duration			**First pass reading time**			**Regression**		
Predictors	*Estimates*	*std. Error*	*Statistic*	*Estimates*	*std. Error*	*Statistic*	*Log-Odds*	*std. Error*	*Statistic*
(Intercept)	5.23 ***	0.02	259.17	5.31 ***	0.02	226.14	-1.88 ***	0.17	-11.3
Literal	-0.03	0.02	-1.96	-0.04	0.02	-1.76	-0.13	0.17	-0.8
Control	0.01	0.02	0.38	0.01	0.02	0.49	0.15	0.16	0.93
Random Effects									
σ^2	0.09			0.13			3.29		
τ_{00}	0.01 $_{\text{PARTICIPANT}}$			0.02 $_{\text{PARTICIPANT}}$			0.57 $_{\text{PARTICIPANT}}$		
Observations	1776			1776			1776		

	Fixations			**Skipping**			**Spillover**		
Predictors	*Log-Mean*	*std. Error*	*Statistic*	*Log-Odds*	*std. Error*	*Statistic*	*Estimates*	*std. Error*	*Statistic*
(Intercept)	0.46 ***	0.04	11.77	-1.61 ***	0.13	-12.6	5.13 ***	0.03	192.11
Literal	-0.04	0.05	-0.92	-0.12	0.15	-0.84	0.03	0.04	0.96
Control	0.03	0.05	0.76	-0.01	0.15	-0.07	0.01	0.03	0.18
Random Effects									
σ^2	0.49			3.29			0.06		
τ_{00}	0.00 TRIAL_INDEX			0.23 PARTICIPANT			0.00 PARTICIPANT		
	0.02 PARTICIPANT								
Observations	1776			1980			322		

Target words

	First fixation duration				**First pass reading time**			
Predictors	*Estimates*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*
(Intercept)	5.23	0.02	275.28	**<0.001**	5.31	0.02	242.55	**<0.001**
Literal	0.01	0.02	0.33	0.744	-0.01	0.02	-0.54	0.587

Control	0.02	0.02	0.94	0.349	-0.01	0.02	-0.41	0.681
Random Effects								
σ^2	0.08				0.11			
τ_{00}	0.01 $_{\text{PARTICIPANT}}$				0.01 $_{\text{PARTICIPANT}}$			
	0.00 $_{\text{number}}$				0.00 $_{\text{number}}$			
N	45 $_{\text{PARTICIPANT}}$				45 $_{\text{PARTICIPANT}}$			
	44 $_{\text{number}}$				44 $_{\text{number}}$			
Observations	1605				1605			

	Fixations				**Spillover**			
Predictors	*Log-Mean*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*
(Intercept)	0.37	0.04	8.67	**<0.001**	5.22	0.03	161.36	**<0.001**
Literal	-0.05	0.05	-0.92	0.358	0.03	0.03	0.87	0.385
Control	0.09	0.05	1.83	0.067	0.02	0.03	0.74	0.462
Random Effects								
σ^2	0.52				0.09			
τ_{00}	0.03 $_{\text{PARTICIPANT}}$				0.02 $_{\text{PARTICIPANT}}$			
	0.00 $_{\text{number}}$				0.01 $_{\text{number}}$			

N	45 PARTICIPANT	45 PARTICIPANT
	44 number	43 number
Observations	1605	572

Appendix E

Study 3 – Additional model outputs

Whole idioms

	Regression			
Predictors	*Log-Odds*	*std. Error*	*Statistic*	*p*
(Intercept)	1	0.21	4.74	**<0.001**
Dyslexic readers	0.83	0.31	2.68	**0.007**
Random Effects				
σ^2	3.29			
$\tau_{00\ PPT}$	1.71			
$\tau_{00\ ITEM}$	0.11			
N_{PPT}	81			
N_{ITEM}	44			
Observations	3557			

Target words

	First pass reading time			
Predictors	*Estimates*	*std. Error*	*Statistic*	*p*
(Intercept)	5.21	0.04	127.93	**<0.001**
Dyslexic readers	0.1	0.03	3.99	**<0.001**
Literal	-0.03	0.02	-1.62	0.105
Control	0	0.02	-0.05	0.962
WORD LENGTH	0.02	0.01	3.44	**0.001**
Random Effects				
σ^2	0.13			
$\tau_{00\ PPT}$	0.01			
$\tau_{00\ ITEM}$	0.01			
$N_{\ PPT}$	81			
$N_{\ ITEM}$	44			
Observations	3030			

Idiom verb

	First fixation duration	First pass reading time

Predictors	*Estimates*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*
(Intercept)	5.23	0.02	275.74	**<0.001**	5.31	0.03	206.16	**<0.001**
Literal	-0.01	0.01	-0.62	0.536	-0.01	0.02	-0.3	0.761
Control	0.01	0.01	0.38	0.706	0.01	0.02	0.52	0.602
Dyslectic Readers								
Random Effects								
σ^2	0.1				0.15			
τ_{00}	0.01 $_{PPT}$				0.02 $_{PPT}$			
	0.00 $_{ITEM}$				0.01 $_{ITEM}$			
N	81 $_{PPT}$				81 $_{PPT}$			
	44 $_{ITEM}$				44 $_{ITEM}$			
Observations	3163				3163			

	Regressions				**Spillover**			
Predictors	*Log-Odds*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*

(Intercept)	-1.91	0.15	-12.83	**<0.001**	5.16	0.03	198.29	**<0.001**
Literal	0.06	0.12	0.51	0.613	-0.01	0.03	-0.39	0.699
Control	0.25	0.12	2.13	**0.033**	-0.02	0.03	-0.73	0.463
Dyslectic Readers					0.15	0.03	5.47	**<0.001**
Random Effects								
σ^2	3.29				0.09			
τ_{00}	0.52 PPT				0.00 PPT			
	0.07 ITEM				0.00 ITEM			
N	81 PPT				80 PPT			
	44 ITEM				44 ITEM			
Observations	3163				684			

Idiom noun

	First fixation duration				**First pass reading time**				**Regression**			
Predictors	*Estimates*	*std. Error*	*Statistic*	*p*	*Estimates*	*std. Error*	*Statistic*	*p*	*Log-Odds*	*std. Error*	*Statistic*	*p*
(Intercept)	5.23	0.02	275.74	**<0.001**	5.31	0.03	206.16	**<0.001**	-1.91	0.15	-12.83	**<0.001**
Literal	-0.01	0.01	-0.62	0.536	-0.01	0.02	-0.3	0.761	0.06	0.12	0.51	0.613

Control	0.01	0.01	0.38	0.706	0.01	0.02	0.52	0.602	0.25	0.12	2.13	**0.033**
Dyslectic Readers												
Random Effects												
σ^2	0.1				0.15				3.29			
τ_{00}	0.01 $_{PPT}$				0.02 $_{PPT}$				0.52 $_{PPT}$			
	0.00 $_{ITEM}$				0.01 $_{ITEM}$				0.07 $_{ITEM}$			
N	81 $_{PPT}$				81 $_{PPT}$				81 $_{PPT}$			
	44 $_{ITEM}$				44 $_{ITEM}$				44 $_{ITEM}$			
Observations	3163				3163				3163			

Appendix F

Study 4 - Model outputs for all eye-tracking measures for idioms and matched literal phrases with 0,1, or 2 adjectives split by phrase- and word-level including familiarity as a factor.

Predictors	Phrase-Level Analyses for Idioms Only								
	Total Reading Time			Fixation Count			Regression		
	β	t	SE	β	z	SE	β	z	SE
Fixed effects									
(Intercept)	6.27 ***	171.49	0.04	1.08 ***	30.99	0.03	-0.46 ***	-4.53	0.1
Adj. (1 adj.)	0.42 ***	19.88	0.02	0.38 ***	17.36	0.02	0.50 ***	4.87	0.1
Adj. (2 adj.)	0.74 ***	32.28	0.02	0.68 ***	32.58	0.02	0.86 ***	9.28	0.09
Freq.	-0.03 *	-2.011	0.01						
Pred.	-0.03	-1.85	0.02	-0.03 *	-2.03	0.02	-0.09 *	-2.01	0.05
Verb Freq.	-0.02	-1.04	0.01	-0.01	-0.69	0.01			
Verb Length	0.03 *	2.08	0.01	0.02	-8.79	0.01			
Trial Seq.	-0.00 ***	-9.03	0	-0.00 ***	-8.79	0	-0.00 ***	-7.31	0
Fam.	-0.05 **	-2.83	0.02	-0.05 **	-2.92	0.02	-0.17 ***	-3.8	0.05

Random effects			
σ^2	0.156		
$\tau_{00,\ Participant}$	0.075	0.062	0.289
$\tau_{00,\ Item}$	0.023	0.006	0
ρ_{01}	0.068	0.999	0.457
Observations	4045	4045	4045
Notes			* p<.05 ** p<.01 *** p<.001