

Are Figurative Interpretations of Idioms Directly Retrieved, Compositionally Built, or Both? Evidence From Eye Movement Measures of Reading

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Idioms are part of a general class of multiword expressions where the overall interpretation cannot be fully determined through a simple syntactic and semantic (i.e., compositional) analysis of their component words (e.g., *kick the bucket*, *save your skin*). Idioms are thus simultaneously amenable to direct retrieval from memory, and to an on-demand compositional analysis, yet it is unclear which processes lead to figurative interpretations of idioms during comprehension. In this eye-tracking study, healthy adults read sentences in their native language that contained idioms, which were followed by figurative- or literal-biased disambiguating sentential information. The results showed that the earliest stages of comprehension are driven by direct retrieval of idiomatic forms; however, later stages of comprehension, after which point the intended meaning of an idiom is known, are driven by both direct retrieval and compositional processing. Of note, at later stages, increased idiom decomposability *slowed* reading time, suggesting more effortful figurative comprehension. Together, these results are most consistent with multidetermined or hybrid models of idiom processing.

Public Significance Statement

Idiomatic expressions, such as *kick the bucket*, *have a lark*, frequently occur in language. Idioms vary in ways that can affect how they are understood, that is, whether their figurative interpretations are directly retrieved from memory, or created in the moment, on-demand. We found that people initially understand idioms by directly retrieving them from memory, although following this initial comprehension stage, people show evidence of being sensitive to how idioms' component words relate to their figurative meanings.

Keywords: comprehension, eye-tracking, formulaic language, idioms, reading

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Idioms (e.g., *kick the bucket*; *have a lark*; *pop the question*), and the general class of formulaic multiword expressions to which they belong, comprise a substantial portion of natural language that is essential to language acquisition (e.g., Jackendoff, 2003; Pawley & Syder, 1983; Nattinger & DeCarrico, 1992; Tomasello, 2003).

Whereas early accounts set idioms apart as exceptions to normal language (Chomsky, 1980; Fraser, 1970), more recent accounts posit that the processes involved in learning and using idioms, and other aspects of formulaic language, are emblematic of how language is generally acquired by first- and second-language learners


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used for this paper can be downloaded at the OSF repository: <https://osf.io/axnm6/>.

 The data are available at <http://re3data.org/>

 The experiment materials are available at <http://re3data.org/>

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(Carrol & Conklin, 2019; Geeraert, Newman, & Baayen, 2017; Goldberg, 1995, 2006; Tomasello, 2003; Wray, 2002; Wulff, 2008).

Of relevance to the present study, despite a long-standing interest in idioms across many disciplines (i.e., theoretical and applied linguistics, L1 and L2 language learning, psycholinguistics, corpus linguistics, literary and cultural studies), fundamental psycholinguistic questions remain about how idioms are represented in memory and processed during online comprehension. Here, we focus on a set of core but unresolved questions: Are idioms represented holistically and directly retrieved from memory in a manner similar to words, are their figurative interpretations built-up incrementally and compositionally in a manner similar to longer sequences of so-called “literal” language, or do both processes occur simultaneously? We address these questions by examining how native or first language speakers naturally process a set of linguistically well-characterised English idioms using eye movement measures of reading.

Central to this endeavor is the notion of compositionality, which Frege defined as “the principle that the meaning of a complex expression is determined by the meanings of its parts and the way they are put together” (Pagin & Westerstahl, 2010a, 2010b). Idioms historically challenge the principle of compositionality because their figurative meanings are often, but not always, strikingly distinct from the meanings and combinations of their constituent words (*kick the bucket*, which figuratively means *to die*). Thus, the questions raised by idiomatic language and multiword sequences generally are central to concerns regarding storage, productivity, and reuse spanning levels of linguistic analysis (Geeraert et al., 2017; O’Donnell, 2015; O’Donnell, Snedeker, Tenenbaum, & Goodman, 2011).

As is true of other linguistic domains, such as word morphology (Geeraert et al., 2017; O’Donnell, 2015), there are at least three logical options for how people compute a figurative interpretation of idioms: (a) an idiom’s constituent words are accessed individually from memory, compositionally analysed, and the figurative interpretation generated on demand as a direct outcome of these incremental, semantic and syntactic processes, (b) an idiomatic form is recognised as a previously learned multiword pattern and its figurative meaning is directly retrieved from memory, or finally (c) direct retrieval of multiword forms and compositional processing of word constituents proceed in parallel, and the figurative interpretation is a multidetermined product of both. Indeed, these logical options largely map onto the available set of idiom processing models posited in the psycholinguistic literature (for reviews of this literature specific to idioms, see Titone, Columbus, Whitford, Mercier, & Libben, 2015). Thus, within psycholinguistics there is (a) *the compositional view*, where an idiom’s constituent words are accessed individually, and the *figurative* interpretation is built up word by word (Gibbs, Nayak, & Cutting, 1989; Gibbs, 1980, 1992; Nunberg, 1978; Nunberg, Sag, & Wasow, 1994; Snider & Arnon, 2012); (b) *the direct retrieval view*, where the idiom is recognised as a familiar expression and its figurative meaning is directly retrieved from memory as one unit (Bobrow & Bell, 1973; Cacciari & Tabossi, 1988; Swinney & Cutler, 1979), and (c) *the hybrid or multidetermined approach*, where both compositional analysis and direct retrieval processes take place (e.g., Libben & Titone, 2008; Titone & Connine, 1999; Titone & Libben, 2014; see also, Sprenger, Levelt, & Kempen, 2006).

Early support for the compositional view was based on the existence of semantically similar idioms (e.g., *get the picture*, *get the message*), and on observations that idioms retain their figurative meaning when they are syntactically or semantically modified (e.g., *she didn’t spill a single bean*; Nunberg, 1978; see also Cacciari & Glucksberg, 1991; Gibbs et al., 1989; McGlone, Glucksberg, & Cacciari, 1994). Later work supporting the compositional view investigated how an idiom’s degree of semantic decomposability affected its comprehension (Gibbs, 1992, 2006; Gibbs, Bogdanovich, Sykes, & Barr, 1997; Nunberg, 1978). This work generally reported facilitation for decomposable idioms (e.g., faster semantic judgment decisions, greater figurative priming), whose component words and/or their combination are semantically related to their figurative meaning (e.g., *spill the beans*), compared with nondecomposable idioms, whose component words and/or their combination are semantically unrelated to its figurative meaning (e.g., *kick the bucket*; Gibbs et al., 1989; Hamblin & Gibbs, 1999; see also Caillies & Butcher, 2007). Facilitation for decomposable over nondecomposable idioms was argued to reflect a default attempt of the language processing system to first generate a figurative interpretation of idioms compositionally—thus, decomposable idioms, for which this process will readily succeed, should be easier to process than nondecomposable idioms, for which this process will run into trouble.

Such findings were compelling in their support of compositional models; however, several limitations were apparent. First, the comprehension tasks typically used in the aforementioned studies may not optimally reflect immediate comprehension, as they generally involved overt judgments that exceed the normal time course of real-world comprehension, or that may change the nature of comprehension by calling unusual attention to how the idioms’ internal structure relates to its figurative meaning. Second, such studies typically used small numbers of idioms as stimuli that may also have varied systematically in other ways that affect comprehension, such as their familiarity or literal plausibility. Indeed, decomposability ratings are often correlated with familiarity ratings (Bulkes & Tanner, 2017; Libben & Titone, 2008; Titone & Connine, 1994). Given such issues, it is not surprising that other studies have failed to replicate facilitative effects of increased decomposability during online idiom processing (Tabossi, Fanari, & Wolf, 2008, 2009; Tabossi, Wolf, & Koterle, 2009; Titone & Connine, 1999; Titone & Libben, 2014).

In contrast with compositional models, *direct retrieval accounts* posit that idiomatic forms and their figurative meanings are stored and retrieved holistically from memory (i.e., the lexicon) in a process similar to morphologically complex words (Bobrow & Bell, 1973; Swinney & Cutler, 1979). The direct retrieval view is supported by highly replicated observations of facilitative effects of idioms versus nonidioms as a whole, or as a function of increased idiom familiarity or predictability (Cacciari & Tabossi, 1988; Carrol & Conklin, 2019; Conklin & Schmitt, 2008; Cronk & Schweigert, 1992; see also Giora, 1997; Libben & Titone, 2008; McGlone et al., 1994; Schweigert, 1986; Siyanova-Chanturia & Sditis, 2018; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Tabossi, Fanari, & Wolf, 2009; Underwood, Schmitt, & Galpin, 2004). Interestingly, direct retrieval accounts have taken many forms over the years, including the often cited *configuration hypothesis* (Cacciari & Tabossi, 1988), according to which idioms are processed literally in a compositional, word by word fashion,

until a recognition point (an *idiom key*) is reached where sufficient information has been encountered for the figurative meaning to be retrieved (Cacciari & Corradini, 2015; Cacciari, Padovani, & Corradini, 2007; Cacciari & Tabossi, 1988; Tabossi et al., 2009; Vespignani, Canal, Molinaro, Fonda, & Cacciari, 2010). Here, the location of the recognition point is influenced by predictability, with an earlier recognition point for highly predictable idioms (Cacciari & Corradini, 2015; Cacciari et al., 2007; Fanari, Cacciari, & Tabossi, 2010; Tabossi et al., 2009). After the point of recognition, the idiomatic meaning is retrieved in its entirety from semantic memory, and may conflict with the literal interpretation of the idiom string (for compatible ERP evidence, see Canal et al., 2017; Molinaro & Carreiras, 2010; Molinaro, Carreiras, & Duñabeitia, 2012; Rommers, Dijkstra, & Bastiaansen, 2013; Vespignani et al., 2010).¹

Combining elements of both compositional and direct retrieval accounts, Titone and colleagues proposed a *hybrid or multidetermined model* of idiom processing (Libben & Titone, 2008; Titone & Connine, 1999; for a similar production model, see Sprenger et al., 2006). According to this view, multiple information sources (i.e., direct retrieval and compositional analysis) are used to compute a figurative implication, though over different time courses. Assuming that direct retrieval of the whole idiomatic form is a fast process that can occur prior to the phrase-final word (e.g., Cacciari & Tabossi, 1988), any variable manipulating the ease of direct retrieval, such as familiarity and predictability, would modulate the early stages of comprehension. Conversely, given that an online compositional analysis is more effortful and requires each of the idiom's words to be encountered (e.g., *spill*, *the*, and *beans*, which is compositional; vs. *kick*, *the*, and *bucket*, which is not compositional), any variable manipulating the ease of compositional processing (i.e., decomposability) would modulate comprehension at later stages. This model predicts that facilitative effects of decomposability should emerge only (a) when an idiom is unfamiliar and direct retrieval is impeded and (b) at later stages of comprehension for either high or low familiar idioms when the task requires an evaluation of how a directly retrieved figurative meaning may relate to an idiom's constituent words. Thus, this view takes two important considerations into account: differences among idiom characteristics, as well as the nature of the task used to probe comprehension.

With the hybrid model in mind, Libben and Titone (2008) investigated the effects of decomposability in combination with familiarity, and how task effects may modulate the role of these factors in comprehension. That study specifically examined the comprehension of idioms that followed a consistent sentence structure (verb-determiner-noun), and used a variety of online and off-line measures: paper-and-pencil ratings across a range of linguistic dimensions (Exp. 1), explicit meaningfulness judgments (Exp. 2 and 3), and self-paced moving window reading (Exp. 4). Facilitative effects of decomposability were only found for off-line tasks (paper-and-pencil ratings and explicit meaningfulness judgments), but not for the self-paced reading tasks where participants were instructed to read for comprehension. In contrast, facilitative effects of increased familiarity (indexing how easily idioms are directly retrieved as chunks from memory) were found across all tasks. Consistent with Titone and Connine (1999), these data suggest that the initial stages of idiom comprehension are chiefly driven by direct retrieval, whereas a compositional analysis (af-

ected by decomposability ratings) only takes place when attention is directly focused on how an idiom's words may relate to its figurative meaning (e.g., in a task requiring an explicit semantic judgment or comprehending a specific meaning of an idiomatic sequence). These findings emphasised the importance of considering task demands in any model of idiom processing. However, the idioms in this study were presented in short neutral contexts, making it difficult to determine what linguistic factors and cognitive operations may have led to a figurative interpretation.

More recently, Titone and Libben (2014) used cross-modal priming and linear mixed effects (LME) regression (Baayen, Davidson, & Bates, 2008; Barr, Levy, Scheepers, & Tily, 2013) to examine the processing of idioms that varied continuously along several linguistic dimensions (decomposability, familiarity and literal plausibility) as a function of time. The advantage of cross-modal priming (compared with visual priming) is that the presentation of visual targets can be precisely timed with the unfolding of spoken sentences, and may more accurately reflect the time course of meaning activation (Cacciari & Tabossi, 1988; Titone & Connine, 1994). The authors found that idiom meaning activation increased gradually as comprehension unfolded, and that multiple linguistic factors constrained the direct retrieval of the figurative meaning from memory at different temporal stages. Prior to idiom offset, the priming effect was greater for literally implausible than plausible idioms, suggesting that phrase-level ambiguity impeded initial access to the figurative interpretation. At offset, high familiar idioms were more primed than low familiar idioms. Following offset, nondecomposable idioms were more primed than decomposable idioms, suggesting that the figurative meaning of nondecomposable idioms may be retrieved from memory whereas that for decomposable idioms may be compositionally computed on demand (like metaphor, e.g., Columbus et al., 2015). Thus, the totality of results contradicted purely compositional models and were most consistent with a hybrid view.

The Present Study

Of relevance here, many of the findings just reviewed relied on somewhat artificial tasks that may not reflect comprehension as it naturally proceeds when the only goal is to process language purely to comprehend. Thus, to reconcile past inconsistencies in the literature, and to garner empirical evidence to adjudicate between different models of idiom comprehension, we examined idiom processing in English native speakers using eye movement measures of reading. Eye movement measures of reading provide a rich source of data from which we may draw conclusions about early versus late stages of comprehension, which require no overt

¹ The configuration hypothesis also bears some relation to compositional accounts because of its provision that an idiom's words are processed in a manner similar to so-called nonliteral language, at least to the point of generating a literal interpretation of an idiomatic string. What remains unclear, however, is whether the configuration model affirmatively predicts that a compositional analysis contributes to an idiom's *figurative* interpretation. Whereas early descriptions of the configuration model were silent on this point (e.g., Cacciari & Tabossi, 1988), more recent accounts explicitly state that whether an idiom is nondecomposable or decomposable plays no role in its recognition (Tabossi et al., 2008; though see Cacciari, 2014). Because of this uncertainty, we feel most comfortable classing this model as a direct retrieval model rather than a compositional or a hybrid model.

task other than the simple act of comprehension (Rayner, 1998, 2009). Measures such as first fixation, gaze duration, and skipping reflect early processes, such as lexical access, whereas total reading time and regression proportion reflect later processes, such as semantic integration (Rayner, 1998, 2009; Rayner, Pollatsek, Ashby, & Clifton, 2011).

Our aim was to shed light on the ongoing debate between theoretical models of idiom processing by testing whether both direct retrieval and compositional analysis play a role in arriving at a figurative interpretation, at different processing stages. Specifically, we predicted that direct retrieval (as indexed by a global idiom advantage or facilitative effects of familiarity) should occur at the earliest stages of comprehension, whereas compositional processing (as indexed by facilitative or inhibitory effects of decomposability) should occur when direct retrieval is not possible (e.g., an idiom is low familiar), or at later stages of comprehension when there is adequate time for people to deliberate over how an idiom's figurative meaning relates to its component words. Although prior studies have investigated similar questions, as previously mentioned, methodological concerns across tasks and materials make it difficult to draw firm theoretical conclusions. To overcome these limitations, our materials consisted of a relatively large, linguistically well-characterised set of structurally similar idioms, which we embedded in sentences that required readers to interpret them figuratively or literally by the end of the sentence.

Method

Participants

Thirty-six native English speakers (Age $M = 22.5$, $SD = 4.1$; 23 female, 13 male) from McGill University and the Montreal community participated for course credit or compensation of \$10/hr. All participants had normal or corrected-to-normal vision and no self-reported history of speech or hearing disorders.

Stimuli

The stimuli consisted of 60 English idioms embedded into sentences (see the Appendix and Libben & Titone, 2008 for normative data, along with the entire list of idioms from which this subset was derived; of note, these norming data were originally acquired at McGill, where the current study took place). All idioms had a verb-article-noun structure (e.g., *She had a lark*), and were highly literally plausible such that both the figurative and literal senses of the idiom could be contextually realised. Literal control phrases were generated by changing the verb of each idiom (e.g., *She saw a lark*). Between idiom and control conditions, verbs were

matched in character length (± 1 character) and word frequency (± 5 counts per million, Kučera & Francis, 1967). Of note, the phrase-final word was identical across the idiom and literal conditions.

Each idiom was embedded in one of three sentence conditions: (a) an idiom followed by a figuratively biased disambiguating region (Id-Id: *Ruby had a lark when she switched her family's sugar to salt as a joke*), (b) an idiom followed by a literally biased disambiguating region (Id-Lit: *Ruby had a lark when she was a child but now wanted a parrot instead*), or (c) literal, nonidiomatic phrases followed by a literal supporting context (Lit-Lit: *Ruby saw a lark at the pet store and thought that it was very beautiful*). This design permitted us to examine idiom recognition and the factors modulating comprehension at two critical time points, namely prior to and during/after the disambiguation region. Table 1 presents example sentences from each condition, and Table 2 presents average normative characteristics of the idioms and sentences. The entire set of materials (including normative data in the data files) can also be found on the Open Science Framework repository: <https://osf.io/axnm6/>.

For each idiom, ratings of familiarity, decomposability, literal plausibility, and final-word predictability were obtained (Libben & Titone, 2008). Familiarity was defined as the subjective frequency with which participants encountered an idiom in its written or spoken form, regardless of their familiarity with its figurative meaning. Decomposability ratings reflect the proportion of participants who indicated that the constituent words of an idiom contribute to its figurative meaning. Literal plausibility was defined as an idiom's potential to have a literal interpretation. Final-word predictability reflects the proportion of participants who completed phrases idiomatically (e.g., providing "bucket" to complete "kick the ____").

Apparatus

We used an Eye-Link 1000 tower mounted system (SR-Research, Ontario, Canada) to record eye movements (1000 Hz sampling rate). Viewing was binocular but eye movements were recorded from the right eye only. Stimuli were presented on a 21" ViewSonic CRT monitor with a screen resolution of 1024×768 pixels, using EyeTrack 7.10 software developed at UMass Amherst (<http://blogs.umass.edu/eyelab/software/>). Text was presented on a single line in yellow 10-point Monaco font on a black background. Participants' eyes were positioned 71 cm from the monitor, thus one degree of visual angle comprising approximately three characters of text. Single fixations < 80 ms were automatically discarded prior to data aggregation within EyeDry software also available at the UMASS repository just mentioned.

Table 1
Example Sentences From Id-Id, Id-Lit, and Lit-Lit Conditions

Condition	Sentence
Id-Id	Ruby <i>had a lark</i> when she switched her family's sugar to salt as a joke.
Id-Lit	Ruby <i>had a lark</i> when she was a child but now wanted a parrot instead.
Lit-Lit	Ruby <i>saw a lark</i> at the pet store and thought that it was very beautiful.

Note. The disambiguating region consists of all text following the idiom region, which is demarcated here in bold and italic font.

Table 2
Minimum Values, Maximum Values, Means, and Standard Deviations for Measurements (Familiarity, Decomposability, Literal Plausibility) of Idiom Norms (Taken From Libben & Titone, 2008), and Character Length for Noun and Idiom Phrase in Each Condition (Idiom, Literal) and Disambiguating Region in Each Condition (Id-Id, Id-Lit, Lit-Lit)

Variable	Condition	Measurement	Min	Max	Mean	SD
Idiom norms		Familiarity	1.60	4.80	3.40	.85
		Decomposability	.00	.97	.43	.24
		Literal Plausibility	1.50	5.00	3.87	.77
Noun		Length (characters)	3	8	4.67	1.24
Idiom phrase	Idiom	Length (characters)	11	20	15.78	2.16
	Literal		11	20	15.68	2.13
Disambiguating region	Id-Id	Length (characters)	42	63	54.25	4.32
	Id-Lit		43	62	53.80	4.31
	Lit-Lit		43	61	53.42	4.15

Procedure

Each participant completed a consent form and online language background questionnaire. Participants were instructed to read sentences naturally for comprehension while their eye movements were recorded. Before each trial, participants were instructed to direct their gaze toward a small fixation circle at the centre of the screen. The experimenter initiated the trial only once the participant's gaze was fixed on the circle. A fixation square appeared at the location of the sentence-initial word. Gazing at the fixation square automatically triggered sentence presentation. Participants were instructed to press a button on a controller pad once they had finished reading and understood the sentence.

Participants viewed one of three sets of sentences in a fully counterbalanced and randomized fashion. Within each set, each idiom appeared in only one of its respective sentence contexts. No participant saw the same idiom more than once. In addition to the 60 experimental sentences, each participant read 19 filler sentences, 10 practice sentences, and 22 true/false comprehension questions. The filler and practice sentences resembled literal sentences and were between 11 and 17 words in length. Comprehension questions appeared on roughly 20% of trials. Participants responded to the question by pressing the controller pad. The research was carried out with the approval of the McGill University Research Ethics Board.

Results

Overall accuracy on the comprehension questions was 93%, indicating that participants were attentive during the experiment. Eye movement data were analysed using linear mixed effects (LME) models (lme4 package, R Development Core Team, 2013). One important advantage of LME over traditional statistics (e.g., ANOVAs) is that it allows us to simultaneously investigate continuous variables that are based on subject-related differences and item-related differences (see Baayen et al., 2008).

To index early processes prior to the disambiguating region, we analysed noun gaze duration of the idiom-final noun (i.e., *lark*, in the idiom, *have a lark*; Noun GD) and whole idiom first pass gaze duration (*Idiom FPGD*). To index later comprehension processes, we examined first pass gaze duration of the disambiguating region (*Disambiguating FPGD*) and total reading time for the whole idiomatic phrase (*Idiom TRT*).

Prior to analysis, 2.3% of the total fixations were removed because of track loss (e.g., eyeblinks) or fixation durations shorter than 80 milliseconds. We then fit LME models to each eye movement measure. In each model, *condition* (categorical), *familiarity* (continuous), *decomposability* (continuous), and their interactions were fixed effects; *trial order* (continuous) and literal plausibility ratings (continuous) were control variables. Categorical predictors were treatment-coded (i.e., 0, 1), thus reflecting simple effects contrasts rather than main effects characteristic of ANOVA. All continuous predictors were scaled to reduce collinearity, though as with prior work (e.g., Libben & Titone, 2008; Titone & Connine, 1994), there was a correlation between familiarity and decomposability, which in this subsample of idioms was approximately -0.44 across models. All remaining correlations among predictors across models were less than the absolute value of 0.22.

For predisambiguation eye-movement measures (Noun GD and Idiom FPGD), only one model was required for each of the dependent variables, as the treatment-coded categorical predictor (*condition*) has only two levels (idiom [baseline] vs. literal). For postdisambiguation measures, two treatment-coded models were required for each dependent variable (Disambiguating FPGD and Idiom TRT), as there were three levels of condition (Id-Id, Id-Lit, Lit-Lit). Specifically, the first model contrasts the Lit-Lit condition (baseline) against both the Id-Id condition and Id-Lit conditions individually. In contrast, the second model contrasts the Id-Id condition (baseline) against both the Id-Lit condition (not tested in Model 1) and the Lit-Lit condition (already tested in Model 1, thus, redundant in the second model). For each model, the estimated coefficient (*b*), standard error (*SE*), *t*, and *p* values (using Satterthwaite approximations for degrees of freedom) are reported (*df* approximations may be found in the complete model outputs we provide at the Open Access repository (<https://osf.io/axnm6/>)).

Early Effects Prior to the Disambiguation Region

These data for both Noun GD and Idiom FPGD address the question of how idioms were processed prior to encountering a disambiguating context that biased either the figurative or literal interpretation. By examining how differences in familiarity or decomposability of idioms interact with condition (idiomatic vs. literal), we assessed whether factors modulating the ease of direct

retrieval or compositional processing affect initial stages of idiom comprehension.

Data from the Id-Id and Id-Lit sentence conditions were combined to form a single “Idiom” condition, given that these two conditions were identical prior to the disambiguating region of the sentence. The literal condition (control) was mapped to the intercept (see the OSF repository for more detail, <https://osf.io/axnm6/>).

Noun gaze duration (Noun GD). First, we analysed noun gaze duration of the idiom-final noun (i.e., *lark*, in the idiom, *have a lark*). We found a significant effect of condition ($b = -13.25$, $SE = 6.02$, $t = -2.20$, $p < .05$), indicating that nouns in literal sentences had longer gaze duration than the same nouns in idiom sentences. Condition did not interact significantly with familiarity or decomposability (all $ps > 0.1$).

Idiom first pass gaze duration (Idiom FPGD). Next, we analysed whole idiom first pass gaze duration (i.e., *have a lark*). We found a significant effect of condition, reflecting shorter first pass gaze duration for idiom sentences than literal sentences ($b = -40.34$, $SE = 14.22$, $t = -2.84$, $p < .005$). Interactions with familiarity and decomposability did not reach significance (all $ps > 0.1$). These results showed that during a first pass reading of the idiomatic phrase, before participants could know that the idiomatic meaning was intended, idioms were read faster than literal control phrases.

To summarise, the results for early reading measures prior to the disambiguating region showed an overall facilitation for the idiomatic *form*, given that idioms were facilitated relative to literal sentences on all first pass reading measures prior to the disambiguation context. This finding is consistent with the direct retrieval view at the early processing stage.

Later Effects Subsequent to First Pass Reading of the Idiom Region

Increased difficulty in processing a later figuratively biasing, disambiguating context (i.e., the Id-Id condition) would suggest that readers did not initially interpret the idiom figuratively. Conversely, difficulty in processing a later literally biasing, disambiguating context (i.e., the Id-Lit condition) would suggest that the figurative meaning was accessed early on, and that readers experienced a processing cost upon encountering a literal continuation of the sentence. In our analyses, we also examined the impact of familiarity and decomposability on direct retrieval and compositional processing, respectively. To account for the variability between disambiguating contexts across trials, we entered length (in characters) of the disambiguating region as a covariate in our models, along with trial order and literal plausibility.

Disambiguating region First Pass Gaze Duration (FPGD).

Contrasting idiom conditions (Id-Id, Id-Lit) to the Lit-Lit baseline. First pass gaze duration of the disambiguating region (i.e., all text following the idiom region, e.g., *when she switched her family's sugar to salt as a joke* in the sentence, *Ruby had a lark when she switched her family's sugar to salt as a joke*) did not differ statistically for Id-Id sentences compared with Lit-Lit sentences, although there was a trend for literal continuations to be read more quickly ($b = 79.64$, $SE = 45.54$, $t = 1.75$, $p = .08$). For the Id-Lit versus Lit-Lit contrast, the Id-Lit condition received longer first pass gaze durations than the Lit-Lit condition ($b =$

159.12 , $SE = 45.47$, $t = 3.50$, $p < .0005$). There was also a significant two-way interaction between condition and familiarity ($b = 134.17$, $SE = 46.21$, $t = 2.90$, $p < .005$). As shown in Figure 1, increased familiarity induced a processing cost (i.e., longer FPGD) when the disambiguating context biased a literal, rather than figurative interpretation, in Id-Lit sentences. This suggests that readers initially interpreted the idiom figuratively, and were garden-pathed when encountering a later literally biased disambiguating region.

Contrasting idiom conditions (Id-Lit, Lit-Lit) to the Id-Id baseline. The model above was modified to compare both idiom conditions with each other, by mapping the Id-Id condition to the intercept. There was a significant interaction between condition and familiarity ($b = 156.29$, $SE = 46.48$, $t = 3.36$, $p < .005$; see Figure 1). As idiom familiarity increased, there was a greater processing advantage when the later context was consistent with the figurative meaning (Id-Id) compared with the literal interpretation (Id-Lit). Interestingly, the two-way interaction between condition and decomposability also reached significance ($b = -100.70$, $SE = 47.58$, $t = -2.12$, $p < .05$). As shown in Figure 2, when idioms were high in decomposability, Id-Id sentences lost their reading advantage over Id-Lit sentences. This suggests that high versus low decomposable idioms were *less* likely to be interpreted figuratively on the first pass.

In sum, for disambiguating FPGD, familiarity and decomposability exerted independent effects on reading; increased familiarity incurred a processing cost for *literal continuations* of idioms (Id-Lit). In contrast, increased decomposability incurred a processing cost for *figurative continuations* of idioms (Id-Id) compared with literal continuations of idioms (Id-Lit).

Idiom Total Reading Time (TRT). Next, we compare total reading time at the idiom region (i.e., *have a lark*). Of note, total reading time takes into account any regressions to the idiom that may be indicative of reanalysis from having read a biased post-disambiguation region.

Contrasting idiom conditions (Id-Id, Id-Lit) to the Lit-Lit baseline. Overall idiom total reading times did not differ statistically for Id-Id sentences compared with Lit-Lit sentences ($p >$

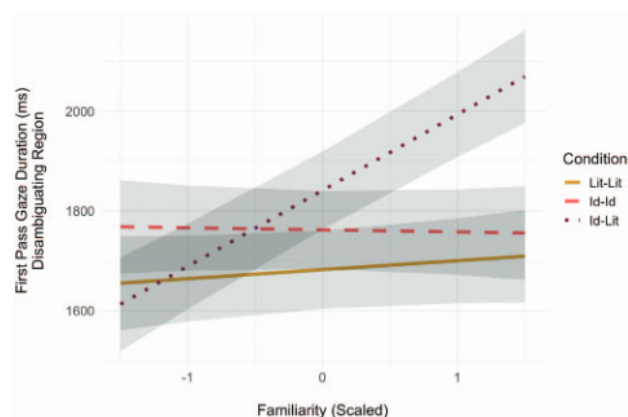


Figure 1. Partial effects plot of first pass gaze duration of the disambiguating region as a function of familiarity for the Lit-Lit, Id-Id, and Id-Lit conditions. Error shadings reflect ± 1 standard error of the mean. See the online article for the color version of this figure.

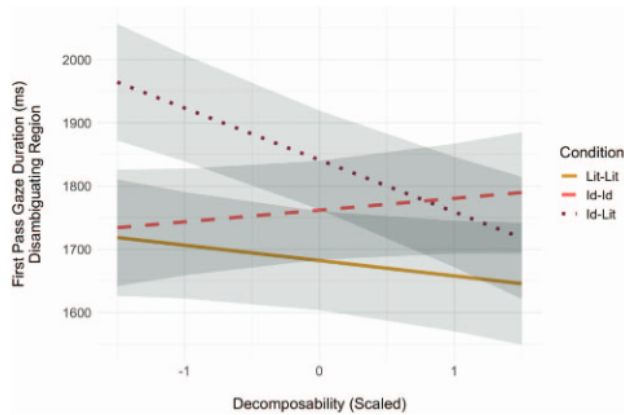


Figure 2. Partial effects plot of first pass gaze duration of the disambiguating region as a function of decomposability for the Lit-Lit, Id-Id, and Id-Lit conditions. Error shadings reflect ± 1 standard error of the mean. See the online article for the color version of this figure.

1). However, idioms were read more quickly overall for Id-Lit sentences than Lit-Lit sentences ($b = -53.10$, $SE = 22.81$, $t = -2.33$, $p < .05$). Additionally, for the Id-Id versus Lit-Lit contrast, there was a significant three-way interaction between condition, familiarity and decomposability ($b = 50.47$, $SE = 21.90$, $t = 2.30$, $p < .05$). As depicted in Figure 3, as familiarity increased, reading times for idioms in Id-Id sentences decreased relative to Lit-Lit sentences, and this effect was larger for idioms with low rather than high decomposability. The three-way interaction between condition, familiarity, and decomposability also reached significance for the Id-Lit versus Lit-Lit contrast ($b = 44.65$, $SE = 21.65$, $t = 2.06$, $p < .05$). As shown in Figure 3, familiarity did not play a role when decomposability was high. When decomposability was low, idiom sentences were read more slowly than literal sentences; however, increasing familiarity facilitated reading times for idioms in the Id-Lit condition relative to Lit-Lit sentences.

Contrasting idiom conditions (Id-Lit, Lit-Lit) to the Id-Id baseline. The model above was modified to compare both idiom conditions with each other, mapping the Id-Id condition to the intercept. The difference in Idiom TRT between the two conditions did not reach significance (all $ps > 0.1$).

To summarise the results for idiom TRT, familiarity and decomposability interacted; increased familiarity facilitated the processing of idioms relative to literal sentences. However, this effect was more pronounced when decomposability was low, rather than high. Counterintuitively, this suggests that increased decomposability slowed activation of the figurative meaning, particularly for low familiar idioms, presumably because readers were more likely to initially commit to a literal interpretation of the phrase on the first pass. When idioms were highly familiar and less decomposable (i.e., more word-like), their figurative processing was accelerated. In contrast, the more the idiom resembled novel literal language, the more figurative/literal ambiguity was created, incurring a processing cost that slowed online comprehension. Thus, high decomposable idioms may have been functioning more like novel metaphorical language, where the figurative interpretation must be computed on demand (e.g., Columbus et al., 2015).

Discussion

We used eye-movement measures of sentence reading with native English speakers to determine whether both direct retrieval and compositional analysis play a role in online idiom comprehension. There were a number of key findings, which will each be discussed in turn.

Early Idiom Advantage Prior to the Disambiguation Region

Prior to encountering a disambiguating context that biased either a figurative or literal meaning, readers experienced easier processing for idiomatic sentences compared with literal sentences. Two analyses converged on this finding. First, nouns in idiomatic sentences received shorter gaze durations than the same nouns in the literal condition. Second, the idiom region received shorter first-pass gaze durations than what was found for literal sentences. These results indicate that before encountering contextual information about whether a figurative meaning was intended, first pass reading of idioms was faster than literal control phrases. This suggests that readers anticipated the phrase-final words of idioms to a greater extent than they did for nonidiomatic sentences, consistent with the view that the idiomatic form could be retrieved prior to the phrase-final word (e.g., Cacciari & Tabossi, 1988; Titone & Connine, 1994). Importantly, at this early stage of online comprehension, there was an overall processing advantage for idioms, irrespective of decomposability. This finding is in line with the eye-tracking study by Titone and Connine (1999), which reported that there was no effect of decomposability on reading speed when idioms occurred in the unbiased context at the beginning of sentences, prior to a context that disambiguated its intended meaning. It is also consistent with the results of Titone and Libben (2014), using cross-modal priming, where decomposability had no impact on early figurative priming for idioms auditorily presented in neutral sentence contexts.

Interestingly, familiarity was also not a significant factor for comprehension prior to the disambiguating region, in contrast to a

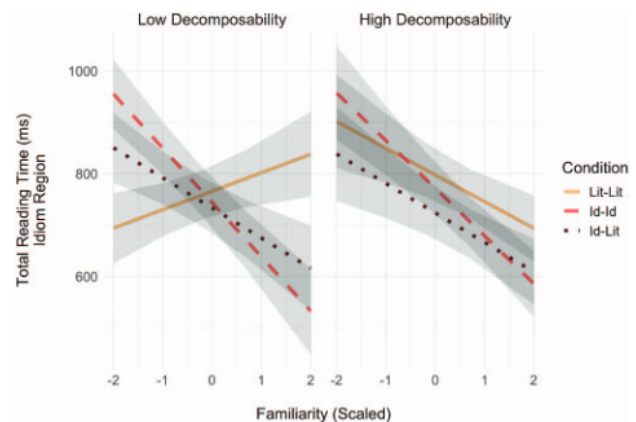


Figure 3. Partial effects plot of total reading time of the whole idiom region as a function of familiarity (x axis) and decomposability (median split across the left and right panels) for the Id-Id, Id-Lit, and Lit-Lit conditions. Error shadings reflect ± 1 standard error of the mean. See the online article for the color version of this figure.

number of previous studies highlighting the facilitative effect of familiarity (e.g., Cronk & Schweigert, 1992; Libben & Titone, 2008; Schweigert, 1986; Titone & Libben, 2014). However, we do not believe that this necessarily contradicts prior research given that, in our data, both high and low familiar idioms showed an early processing advantage over nonidiomatic literal strings. One possible reason for the lack of a familiarity effect here is that eye-tracking measures of comprehension may be more sensitive in observing overall form-level facilitation compared with lexical decision or other reading measures based on button-press tasks. Also, there are relative merits of analysing idiom processing as a function of familiarity ratings compared with final-word predictability ratings, as has been done by some prior work (e.g., Cacciari & Tabossi, 1988). In the present study, we elected to focus on familiarity rather than final-word predictability (i.e., Cloze) measures for the simple reason that the former has a more consistent spread of scores across idioms, suggesting that it was a psychometrically useful continuous measure. In contrast, when we plotted the distribution of final word predictability measures for the same idioms, about half of idioms had values of 0, and the remainder varied between >0 and moderate values (e.g., 0.3). Thus, we reasoned that familiarity ratings would be a more sensitive measure of idiom accessibility than final-word predictability.

Thus, the results from early processing measures are consistent with the direct retrieval account of idiom processing (e.g., Bobrow & Bell, 1973; Carrol & Conklin, 2019; Conklin & Schmitt, 2008; Swinney & Cutler, 1979; Siyanova-Chanturia et al., 2011). This view predicts facilitation of the idiomatic *form*, which is argued to be stored and retrieved from lexical memory similarly to morphologically complex words (see also, Geeraert et al., 2017; O'Donnell, 2015; O'Donnell et al., 2011).

Familiarity and Decomposability Effects on Later Reading Measures

Eye-movement measures that reflect processing *after* encountering the disambiguating context revealed several key findings. With respect to first pass reading time of the disambiguating region, sentences containing idioms that were followed by a figuratively biased context (i.e., Id-Id) were read just as quickly as literal control sentences (Lit-Lit). Thus, there was neither a cost nor an advantage associated with reading a figuratively biased context following an idiom. In contrast, the disambiguating region received longer first pass gaze durations (i.e., reflecting greater processing difficulty) in the Id-Lit condition where the context biased the literal interpretation after having encountered an idiom, compared with literal control sentences. The processing cost associated with encountering a literal continuation of an idiom was exacerbated by increasing familiarity—first-pass gaze durations increased when highly familiar idioms were followed by a context biasing their literal interpretation. This finding is consistent with prior evidence that when idioms are highly familiar, readers are strongly committed to the (dominant) figurative interpretation, and processing is disrupted when readers' expectation is not confirmed by the subsequent context and the sentence must be reanalyzed to compute a literal interpretation (Holsinger & Kaiser, 2013; see also Cacciari et al., 2007; Cronk & Schweigert, 1992; Libben & Titone, 2008; Schweigert, 1986; Titone & Libben, 2014).

As well, when contrasting both idiom conditions (Id-Id vs. Id-Lit), we found that familiarity and decomposability exerted independent effects on first-pass gaze durations of the disambiguating region. As idiom familiarity increased, processing was less effortful when the subsequent disambiguating context biased the figurative (Id-Id) rather than the literal interpretation (Id-Lit). However, when idioms were highly decomposable, and thus more like literal language, counterintuitively, the difference between Id-Id and Id-Lit sentences was reduced, indicating that *increased decomposability* may have *interfered* with the ability to access the figurative meaning of an idiom by fostering the viability of its literal interpretation. This *decomposability interference effect* for high familiar idioms contradicts the claim of pure compositional models, which would predict overall facilitation for decomposable idioms (Gibbs & Nayak, 1989; Gibbs et al., 1989; Hamblin & Gibbs, 1999). However, it is consistent with the cross-modal priming study by Titone and Libben (2014), showing that later figurative priming for idioms was greater the *less* decomposable the idioms were.

Given the increased speed of reading times for Id-Lit sentences, a potential source of the interference effect for highly decomposable idioms is the enhanced ambiguity in selecting between a figurative and literal interpretation. When idioms are highly familiar and nondecomposable, native English readers must select between two semantically distinct phrase-level meanings in a manner similar to what occurs for homonyms with semantically overlapping meanings (Colombo, 1998; Klepousniotou, Titone, & Romero, 2008; Titone & Connine, 1999). Under this view, it would be easier to inhibit activation of the irrelevant literal interpretation while maintaining activation of the figurative meaning. On the other hand, when idioms are both highly familiar and highly decomposable, the directly retrieved figurative meaning competes with the literal interpretation, thus making it more difficult to select one over the other, resulting in longer reading times.

For our second late comprehension measure, idiom total reading time, we found that familiarity and decomposability interacted with sentence condition in their impact on processing. When comparing Id-Id sentences to literal control sentences (i.e., Lit-Lit), higher familiarity led to faster reading times for figurative continuations (Id-Id), and this facilitatory effect was greater for idioms with low rather than high decomposability. As discussed above in the context of first-pass gaze duration results, this indicates that increased decomposability slowed the activation or integration of the figurative meaning. When comparing Id-Lit sentences to literal control sentences (Lit-Lit), we found that familiarity had no effect on processing when decomposability was high. Conversely, when decomposability was low, idioms that were followed by a literal interpretation took more time to read overall, but increasing familiarity sped up idiom reading times. In contrast, the more similar the idiom was to novel literal language (i.e., in cases of high decomposability), the more ambiguity was created between its figurative and literal sense, and the greater the processing cost during online comprehension.

Thus, the initial stages of idiom comprehension are chiefly driven by direct retrieval, whereas a compositional analysis (affected by decomposability) may take place during the selection and integration of one of the competing meanings (figurative vs. literal) into the sentence context. Taken together, these results are most consistent with a hybrid or multidetermined model, which

posits that all available information (i.e., resulting from direct retrieval and compositional analysis) is used during comprehension, but over different time courses. According to hybrid models, these different sources of information interact; if the result of direct retrieval is particularly salient, as in the case of highly familiar idioms, a reader may not engage in compositional processes. In contrast, if direct retrieval is not as efficient, as for low familiar idioms, a compositional analysis may instead dominate. Consistent with this view, our prior work shows that nonidiomatic literal word meaning activation is reduced for highly predictable and literally implausible idioms, and that figurative meanings of highly predictable idioms are retrieved prior to encountering their phrase-final words (Titone & Connine, 1994). Conversely, our other work has shown that increased decomposability facilitated meaningfulness judgments for unfamiliar idioms but not highly familiar idioms (Libben & Titone, 2008).

With respect to open questions about idiom processing that remain unaddressed here, it is unclear whether the same pattern of familiarity and decomposability effects on idiom processing would hold when disambiguating contexts precede idioms rather than follow them. Prior contexts generally facilitate idiom processing (e.g., Fanari et al., 2010; Mueller & Gibbs, 1987; Titone & Connine, 1999). Although the effects of a prior context would most likely arise from preactivation of an idiomatic form in memory, it is possible that a prior context would make the semantic relation between an idiom's figurative meaning and its component words more salient on the first pass, thus increasing the likelihood that the figurative interpretation would be built compositionally and directly retrieved at the same time. A prior context that is figuratively biased might also cause relatively more suppression of a literal phrasal interpretation than what was found in the present study (e.g., Milburn & Warren, 2019).

Another open question concerns the debate about decomposability ratings or intuitions (Bortfeld, 2003; Keysar & Bly, 1995; Skoufaki, 2009), and whether decomposability effects were found are attributable to prospective decomposability (driven by the verb, which occurs earlier in the sentence) or retrospective decomposability (driven by the noun; e.g., Bortfeld, 2003; Keysar & Bly, 1995). To address this question, we ran additional models for the postdisambiguating measures (Disambiguating FPGD, Idiom TRT) where we replaced global decomposability with continuous, standardized measures of verb or noun relatedness, taken from Libben and Titone (2008). These variables were operationally defined as the extent to which the constituent verb and/or noun is related to the overall figurative meaning of the phrase (see Libben & Titone, 2008). The results of this post hoc analysis suggested that increased verb relatedness had a facilitatory effect and led to shorter first pass gaze durations of the disambiguating region for Id-Lit sentences compared with Lit-Lit sentences, but not for Id-Id sentences. Interestingly, we found no significant effect of noun relatedness.

This suggests that the figurative processing cost incurred by increased decomposability is likely *prospective* (rather than *retrospective*) in nature, given that it hinges on verb but not noun relatedness. Thus, when readers first encounter a verb, they simply activate its meaning as they do not yet know that verb is part of an idiomatic construction. Consequently, if the idiomatic construction turns out to be nondecomposable in that it has low verb relatedness, getting to the idiom's figurative meaning requires readers to inhibit

the verb meaning previously activated and boost activation of the idioms figurative meaning (a similar dynamic plays out in verb particle constructions, e.g., Blais & Gonnerman, 2013; Herbay, Gonnerman, & Baum, 2018; Smolka et al., 2018; Tiv et al., 2019). However, if the verb meaning previously activated is still relevant to the figurative meaning of the idiom, which as a whole is crucially different from its normal literal meaning (e.g., to figuratively vs. literally *save your skin*), the comprehension process becomes more laboured. This would occur because readers deliberate between two viable phrasal interpretations, which slows reading times. We believe that this kind of dynamic causes decomposable idioms, particularly those that hinge on verb relatedness, to take longer to read once the sentence calls for a specific, figurative interpretation.

One logical question that arises in any study of idioms is how such expressions compare to the more general class of multiword sequences, which typically only have normal literal meanings (*have a nice day*; e.g., Arnon & Snider, 2010). Of relevance here, the current study is unique compared with past work in terms of investigating the simultaneous influence of both idiom familiarity and decomposability. Thus, one could argue that idioms having high decomposability are very similar to normal literal multiword expressions (e.g., *have a nice day*), with the exception that for the idioms used in this study (though not for all idioms in normative lists such as Libben & Titone, 2008), the high decomposable idioms had potentially two phrasal senses, albeit ones that were likely semantically related. Accordingly, if one wished to link the findings obtained for idioms here to prior work on multiword expressions generally, one could consider the higher decomposable idioms as being conceptually identical to what people often describe as multiword expressions generally.

Another interesting connection to the present work concerns what we know about idioms and brain-based measures, in particular event-related potentials (ERPs) that have the ability to finely track idiom time course. In the ERP literature on idioms and formulaic language generally, the P300 is thought to indicate that formulaic language activates a template that may be akin to direct retrieval of idiomatic forms (Molinaro & Carreiras, 2010; Roehm, Bornkessel-Schlesewsky, Rösler, & Schlewsky, 2007; Siyanova-Chanturia, Conklin, Caffarra, Kaan, & van Heuven, 2017; Vespignani et al., 2010). Related to the discussion about regarding multiword expressions generally, Siyanova-Chanturia et al. (2017) find evidence for a template with completely compositional formulaic language (binomials: "knife and FORK") where the meaning is transparent. Roehm et al. (2007) find similar results for highly predictable language ("the opposite of black is WHITE"). Such findings are entirely consistent with a hybrid or multidetermined model of idiom processing, particularly if one justifiably expands the notion of what an idiom is to extend beyond *kick the bucket* style idioms (i.e., verb-determiner-noun).

Conclusions

We investigated idiom comprehension using a relatively large, linguistically well-characterised set of structurally similar idioms, embedded in sentences that required people to interpret them figuratively or literally by the end of the sentence. The results suggest that different stages of idiom processing were differentially affected by different kinds of linguistic attributes of idioms (e.g., familiarity, decomposability) depending on the comprehen-

sion stage probed. Early stages of comprehension, prior to contextual information about what meaning is intended, were driven by direct retrieval of idiomatic forms, such that all idioms, even low familiar ones, showed reading advantages over matched literal phrases. In contrast, later stages of comprehension, during which the contextually intended meaning is known, were driven both by familiarity and decomposability, depending on whether the contextually intended meaning was figuratively or literally biased. These results are most consistent with hybrid or multidetermined models of comprehension (e.g., Libben & Titone, 2008; Titone & Connine, 1999; Titone & Libben, 2014), which assert the importance of both direct retrieval and compositional processes along different time courses. Whether this conceptualisation is functionally equivalent to more recent computational models of idiom processing is an open question (e.g., Geeraert et al., 2017). Whether these results and this interpretation extend to comprehension situations where the intended meaning is known prior to encountering an idiom, or to second language readers, are questions we are currently pursuing.

Résumé

Les expressions idiomatiques (idiomes) appartiennent à une classe générale d'expressions à mots multiples dont l'interprétation globale est impossible à déterminer pleinement par une analyse syntaxique et sémantique (c.-à-d., compositionnelle) de chaque mot qui les compose (p. ex., *casser sa pipe, sauver sa peau*). Les idiomes se prêtent donc simultanément à l'extraction directe de la mémoire et à l'analyse compositionnelle sur demande. Pourtant, il est difficile de déterminer les processus qui mènent aux interprétations figuratives des expressions idiomatiques durant le processus de compréhension. Dans le cadre de cette étude avec suivi oculaire, on a demandé à des adultes en santé de lire des phrases dans leur langue maternelle contenant des expressions idiomatiques, suivies d'informations figuratives ou littérales de désambiguïsation des éléments de la phrase. Il ressort des résultats que les premiers stades de la compréhension reposent sur l'extraction directe des formes idiomatiques. Cependant, les stades ultérieurs de la compréhension, après quoi la signification voulue d'un idiom est connue, reposent à la fois sur l'extraction directe et sur le traitement compositionnel. Il convient de noter qu'aux stades ultérieurs, la décomposabilité accrue des idiomes *augmentait* le temps de lecture. Ensemble, ces résultats reflètent le mieux les modèles hybrides ou déterminés par de multiples éléments du traitement des expressions idiomatiques.

Mots-clés : compréhension, suivi oculaire, langage fondé sur des formules, idiomes, expressions idiomatiques, lecture.

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Appendix

Stimulus Materials

Item number	Idiom	Condition	Sentence
1	He lost his seat	Id-Id	Otto lost his seat on the council after he was caught embezzling funds.
1	He lost his seat	Id-Lit	Otto lost his seat at the football game when he got up to get some beer.
1	He lost his seat	Lit-Lit	Otto left his seat unoccupied when he left quickly to use the bathroom.
2	She knew the score	Id-Id	Vicki knew the score well enough to not ask for an extension on the essay.
2	She knew the score	Id-Lit	Vicki knew the score because she had been following the playoffs closely.
2	She knew the score	Lit-Lit	Vicki told the score to the young fans who had just arrived at the game.
3	She packed her bags	Id-Id	Bernie packed his bags when he became disillusioned with the company's ethics.
3	She packed her bags	Id-Lit	Bernie packed his bags when he realized his plane was leaving in half an hour.
3	She packed her bags	Lit-Lit	Bernie emptied his bags as soon as he returned home from the long vacation.
4	He hit the books	Id-Id	Penelope hit the books only two weeks before the dreaded final examination.
4	He hit the books	Id-Lit	Penelope hit the books with her hand when she sat down quickly at the desk.
4	He hit the books	Lit-Lit	Penelope put the books on the shelf when she returned home from the library.
5	She got the message	Id-Id	Rona got the message when her friends refused to talk to her after the breakup.
5	She got the message	Id-Lit	Rona got the message on the answering machine when she arrived home from school.
5	She got the message	Lit-Lit	Rona put the message on the fridge so she wouldn't forget to call her mother.
6	He flooded the market	Id-Id	Rupert flooded the market with his over-abundant soybean crop last year.
6	He flooded the market	Id-Lit	Rupert flooded the market while fixing a leak in the store's plumbing.
6	He flooded the market	Lit-Lit	Rupert entered the market determined to buy only the items on his list.

(Appendix continues)

Appendix (continued)

Item number	Idiom	Condition	Sentence
7	She wore the trousers	Id-Id	Cindy wore the trousers in her family in the weeks after her father died.
7	She wore the trousers	Id-Lit	Cindy wore the trousers after deciding it was too cold to wear the skirt.
7	She wore the trousers	Lit-Lit	Cindy gave the trousers to her son after she was finished hemming them.
8	He smelled a rat	Id-Id	Myrna smelled a rat when her coworker wouldn't look her in the eye yesterday.
8	He smelled a rat	Id-Lit	Myrna smelled a rat the moment she entered the cluttered and dirty pet store.
8	He smelled a rat	Lit-Lit	Myrna trapped a rat in the garage after she saw it eating the bag of birdseed.
9	He used his head	Id-Id	Ben used his head to outsmart his opponents even though they were stronger.
9	He used his head	Id-Lit	Ben used his head to bump the ball straight into the opponent team's net.
9	He used his head	Lit-Lit	Ben hurt his head when he sat up too quickly and struck the top bunk bed.
10	He cleared the air	Id-Id	Royce cleared the air by completely explaining why he was late coming home.
10	He cleared the air	Id-Lit	Royce cleared the air by opening the window and turning the exhaust fan on.
10	He cleared the air	Lit-Lit	Royce forced the air into the flat tire before it could deflate itself again.
11	She smacked her lips	Id-Id	Alice smacked her lips at the thought of the pay raise she had been promised.
11	She smacked her lips	Id-Lit	Alice smacked her lips to feel the texture of the lipstick she had purchased.
11	She smacked her lips	Lit-Lit	Alice traced her lips in the mirror as she tried on a new shade of lipstick.
12	She had a lark	Id-Id	Ruby had a lark when she switched her family's sugar to salt as a joke.
12	She had a lark	Id-Lit	Ruby had a lark when she was a child but now wanted a parrot instead.
12	She had a lark	Lit-Lit	Ruby saw a lark at the pet store and thought that it was very beautiful.
13	He passed the buck	Id-Id	Taylor passed the buck when she was accused of losing the major account.
13	He passed the buck	Id-Lit	Taylor passed the buck when her friend didn't have enough cash for lunch.
13	He passed the buck	Lit-Lit	Taylor saved a buck when she brought in her coupon at the grocery store.
14	She covered her tracks	Id-Id	Stacey covered her tracks so that she wouldn't be caught embezzling money.
14	She covered her tracks	Id-Lit	Stacey covered her tracks so that she couldn't be followed through the snow.
14	She covered her tracks	Lit-Lit	Stacey cleared her tracks from the garden once she was finished weeding it.
15	She scratched her head	Id-Id	Niles scratched his head when he could not determine where his dog was hiding.
15	She scratched her head	Id-Lit	Niles scratched his head when he returned from camp covered in mosquito bites.
15	She scratched her head	Lit-Lit	Niles examined his head when he returned from camp covered in mosquito bites.
16	She showed her cards	Id-Id	Norah showed her cards when she invited the handsome man to the wedding party.
16	She showed her cards	Id-Lit	Norah showed her cards to the other poker players to show that she had bluffed.
16	She showed her cards	Lit-Lit	Norah counted her cards to determine who had more points when the game ended.
17	They hit a wall	Id-Id	Marge hit a wall in her renovations when she realized she was out of materials.
17	They hit a wall	Id-Lit	Marge hit a wall while digging her garden too close to the house's foundation.
17	They hit a wall	Lit-Lit	Marge fit a wall in between the gazebo and the path around the garden's pond.
18	He got the picture	Id-Id	Eric got the picture when his blind date didn't show up after 40 minutes.
18	He got the picture	Id-Lit	Eric got the picture when his mother finally mailed it to him overnight.
18	He got the picture	Lit-Lit	Eric put the picture on the mantelpiece as a reminder of his fun vacation.
19	He bought the farm	Id-Id	Harry bought the farm unexpectedly after developing lung cancer late in life.
19	He bought the farm	Id-Lit	Harry bought the farm from his uncle after inheriting a large sum of money.
19	He bought the farm	Lit-Lit	Harry loved the farm and always enjoyed visiting his uncle there on holidays.
20	She changed her tune	Id-Id	Maggie changed her tune and supported the policy when she recognized its benefits.
20	She changed her tune	Id-Lit	Maggie changed her tune to a livelier melody when the audience was unresponsive.
20	She changed her tune	Lit-Lit	Maggie hummed her tune happily as she returned from a successful choir practice.
21	He made a bundle	Id-Id	Hank made a bundle over the summer working full time at the community pool.
21	He made a bundle	Id-Lit	Hank made a bundle out of his towels before stuffing them in his suitcase.
21	He made a bundle	Lit-Lit	Hank gave a bundle of clothes to the Salvation Army at least once a year.
22	He lined his pockets	Id-Id	Keith lined his pockets with the money he got for selling the stolen stereos.
22	He lined his pockets	Id-Lit	Keith lined his pockets with fleece after he got frostbite on his fingertips.
22	He lined his pockets	Lit-Lit	Keith sewed his pockets when he started losing change through several holes.
23	She dropped a bundle	Id-Id	Jane dropped a bundle when she stayed in a five-star hotel for her vacation.
23	She dropped a bundle	Id-Lit	Jane dropped a bundle when she tried to carry too much laundry up the stairs.
23	She dropped a bundle	Lit-Lit	Janice carried a bundle of clothes down the street to the local Laundromat.
24	He bit the bullet	Id-Id	Larry bit the bullet and bought diamond earrings for his wife's birthday.
24	He bit the bullet	Id-Lit	Larry bit the bullet to verify the quality of casings on his ammunition.
24	He bit the bullet	Lit-Lit	Larry hid the bullet so the police would not find the crucial evidence.
25	He followed his nose	Id-Id	Billy followed his nose when hiring rather than checking applicant references.
25	He followed his nose	Id-Lit	Billy followed his nose to the kitchen where his mother was baking apple pies.
25	He followed his nose	Lit-Lit	Billy splashed his nose with cold water in an effort to relieve the swelling.
26	She trimmed her sails	Id-Id	Blake trimmed his sails after he started paying for his own tuition fees.
26	She trimmed her sails	Id-Lit	Blake trimmed his sails in preparation for the local yacht competition.
26	She trimmed her sails	Lit-Lit	Blake raised the sails in preparation for the local yacht competition.

(Appendix continues)

Appendix (continued)

Item number	Idiom	Condition	Sentence
27	She took the veil	Id-Id	Rosemary took the veil because she had always wanted to devote her life to God.
27	She took the veil	Id-Lit	Rosemary took the veil because she didn't want to forget it before the wedding.
27	She took the veil	Lit-Lit	Rosemary tore the veil accidentally because the gauzy material was too fragile.
28	He dropped a line	Id-Id	Hal dropped a line to his old roommate after remembering it was his birthday.
28	He dropped a line	Id-Lit	Hal dropped a line to see if the fish were biting this early in the season.
28	He dropped a line	Lit-Lit	Hugo printed a line in colored ink to find out if the ink cartridge was full.
29	He kicked the bucket	Id-Id	Mary kicked the bucket after suddenly becoming seriously ill on the weekend.
29	He kicked the bucket	Id-Lit	Mary kicked the bucket when it was blocked from her view by the chair.
29	He kicked the bucket	Lit-Lit	Mary tipped the bucket to sprinkle fertilizer into her new flower garden.
30	He held the fort	Id-Id	Haden held the fort by taking care of his brother while their mom was at work.
30	He held the fort	Id-Lit	Haden held the fort high above the table while his Lego armies battled below.
30	He held the fort	Lit-Lit	Haden left the fort because he no longer wanted to work there in the summer.
31	He missed the mark	Id-Id	Steve missed the mark when he claimed the Yankees won a World Series in 1960.
31	He missed the mark	Id-Lit	Steve missed the mark when his shoulder slipped from the weight of the rifle.
31	He missed the mark	Lit-Lit	Steve placed the mark at the place where the runners began the city marathon.
32	She pulled his leg	Id-Id	Bailey pulled David's leg because he was great fun to joke around with.
32	She pulled his leg	Id-Lit	Bailey pulled David's leg because he was stuck halfway down the slide.
32	She pulled his leg	Lit-Lit	Bailey rubbed David's leg to increase blood flow to his frozen feet.
33	They buried the hatchet	Id-Id	Yvonne and Lucy buried the hatchet after both forgot why they were fighting.
33	They buried the hatchet	Id-Lit	Yvonne and Lucy buried the hatchet after stealing it from the hardware store.
33	They buried the hatchet	Lit-Lit	Yvonne and Lucy threw the hatchet at the approaching bear hoping to scare it.
34	She faced the music	Id-Id	Regan faced the music when her parents caught her returning home after curfew.
34	She faced the music	Id-Lit	Regan faced the music when she wanted to determine which speaker was loudest.
34	She faced the music	Lit-Lit	Regan hated the music and stayed out of the house when his brother practiced.
35	He hedged his bets	Id-Id	Carol hedged her bets by double majoring in computer science and accounting.
35	He hedged his bets	Id-Lit	Carol hedged her bets at the horse races by wagering on all the favorites.
35	He hedged his bets	Lit-Lit	Carol changed her bets when she learned that one of the horses hurt its leg.
36	He blew a fuse	Id-Id	Sarah blew a fuse when the material she had studied most wasn't on the test.
36	He blew a fuse	Id-Lit	Sarah blew a fuse when her bedside lamp had a severe electrical malfunction.
36	He blew a fuse	Lit-Lit	Sarah fixed a fuse that always failed when she used the plug beside the sink.
37	He lost the thread	Id-Id	Charlie lost the thread of the story and couldn't grasp its conclusion.
37	He lost the thread	Id-Lit	Charlie lost the thread when he dropped the sewing needle on the floor.
37	He lost the thread	Lit-Lit	Charlie made the thread out of cotton fibers he got at the fabric store.
38	She skimmed the cream	Id-Id	Heather skimmed the cream by only hiring the top graduating students for the job.
38	She skimmed the cream	Id-Lit	Heather skimmed the cream by dragging a big spoon through the fresh jug of milk.
38	She skimmed the cream	Lit-Lit	Heather skimmed the cream when she reached across the table for the sugar bowl.
39	They cleared the deck	Id-Id	Jeff cleared the decks by finishing his project before undertaking a new one.
39	They cleared the deck	Id-Lit	Jeff cleared the decks by sweeping away the leaves before his guests arrived.
39	They cleared the deck	Lit-Lit	Jeff cleaned the decks so they would be spotless for his party at the marina.
40	He broke the ice	Id-Id	Bruce broke the ice by quickly introducing himself to everyone at the wedding.
40	He broke the ice	Id-Lit	Bruce broke the ice by driving his snowmobile directly onto the thawing lake.
40	He broke the ice	Lit-Lit	Bruce stored the ice in his cooler so he could bring it to the holiday party.
41	He got the sack	Id-Id	Derek got the sack after showing up late for work and having a bad attitude.
41	He got the sack	Id-Lit	Derek got the sack that had been hidden behind boxed in the kitchen pantry.
41	He got the sack	Lit-Lit	Derek put the sack in the pantry when he was finished peeling the potatoes.
42	She spilled the beans	Id-Id	Dolan spilled the beans when he mentioned the surprise party to his friend.
42	She spilled the beans	Id-Lit	Dolan spilled the beans when he tried to pour too many into the soup pot.
42	She spilled the beans	Lit-Lit	Dolan cooked the beans before he started adding vegetables to the soup pot.
43	She straddled the fence	Id-Id	Dolores straddled the fence as she couldn't decide which position to believe.
43	She straddled the fence	Id-Lit	Dolores straddled the fence as she climbed over it into her neighbor's yard.
43	She straddled the fence	Lit-Lit	Dolores destroyed the fence before building a new one with fresh cedar rails.
44	She dropped a bomb	Id-Id	Winston dropped a bomb on his parents when he announced his engagement.
44	She dropped a bomb	Id-Lit	Winston dropped a bomb on the enemy's base as his plane flew overhead.
44	She dropped a bomb	Lit-Lit	Winston planted a bomb in the enemy's headquarters early that morning.
45	They spread the word	Id-Id	Bailey spread the word about the party to all her friends by sending an email.
45	They spread the word	Id-Lit	Bailey spread the word across the top of her poster to use up all the space.
45	They spread the word	Lit-Lit	Bailey feared the word that her strict father was about to say to her was no.
46	He turned the tables	Id-Id	Jade turned the tables on his opponent by using the new tennis technique.
46	He turned the tables	Id-Lit	Jade turned the tables upside down so that they could be easily dismantled.
46	He turned the tables	Lit-Lit	Jade washed the tables after the customers had left the Thai restaurant.

(Appendix continues)

Appendix (continued)

Item number	Idiom	Condition	Sentence
47	He showed his teeth	Id-Id	Pete showed his teeth when he caught the local boys bullying his sister.
47	He showed his teeth	Id-Lit	Pete showed his teeth when his mother asked if he had brushed that morning.
47	He showed his teeth	Lit-Lit	Paul cleaned his teeth when his mother reminded him for the third time.
48	She went to town	Id-Id	Alice went to town on the preparations for her son's elaborate wedding.
48	She went to town	Id-Lit	Alice went to town to buy decorations for her son's elaborate wedding.
48	She went to town	Lit-Lit	Alice came to town to visit her relatives over the Christmas holidays.
49	She missed the bus	Id-Id	Yvette missed the bus when she didn't hand in her application on time.
49	She missed the bus	Id-Lit	Yvette missed the bus when she forgot to set her alarm Monday morning.
49	She missed the bus	Lit-Lit	Yvette drove the bus from the high-school to drop off the students.
50	He bore his cross	Id-Id	Josh bore his cross the entire flight and didn't complain about the snoring man.
50	He bore his cross	Id-Lit	Josh bore his cross down the center aisle of the church during the passion play.
50	He bore his cross	Lit-Lit	Josh lost his cross when he dropped it in the grass on the way home from church.
51	He lost his shirt	Id-Id	Brian lost his shirt when his new hobby shop went bankrupt last winter.
51	He lost his shirt	Id-Lit	Brian lost his shirt when it blew off the clothesline during the storm.
51	He lost his shirt	Lit-Lit	Brian left his shirt at the Laundromat when he had to leave in a hurry.
52	She hit the ceiling	Id-Id	Sally hit the ceiling when the course she'd prepared for was cancelled.
52	She hit the ceiling	Id-Lit	Steph hit the ceiling when she tried to jump on her trampoline indoors.
52	She hit the ceiling	Lit-Lit	Sally lit the ceiling on fire when the Christmas tree lights overheated.
53	He forced her hand	Id-Id	Kaitlyn's father forced her hand by telling her where to attend high school.
53	He forced her hand	Id-Lit	Kaitlyn's father forced her hand away from the stove before she was burned.
53	He forced her hand	Lit-Lit	Kaitlyn's father pushed her hand away from the stove before she was burned.
54	She licked her wounds	Id-Id	Rose licked her wounds after being defeated badly in the tennis championship.
54	She licked her wounds	Id-Lit	Rose licked her wounds since there was no clean water available to wash them.
54	She licked her wounds	Lit-Lit	Rose washed her wounds with peroxide so that they would not become infected.
55	He paved the way	Id-Id	Jerry paved the way for his son by setting up a trust fund for university.
55	He paved the way	Id-Lit	Jerry paved the way for his son so he wouldn't trip over the gravel again.
55	He paved the way	Lit-Lit	Jerry found the way to the top of the mountain without the help of a guide.
56	She gave her word	Id-Id	Vicki gave her word to Jack that she would help him paint his room the next day.
56	She gave her word	Id-Lit	Vicki gave her word to Jack when he started finding the scrabble game difficult.
56	She gave her word	Lit-Lit	Vicki felt her word was too strong for the context and regretted saying it.
57	He hit the roof	Id-Id	Sam hit the roof when he discovered someone had taken his new golf clubs.
57	He hit the roof	Id-Lit	Sam hit the roof to check the condition of the old and crumbling shingles.
57	He hit the roof	Lit-Lit	Sam cut the roof into pieces with his saw after he dismantled the old barn.
58	She bit her lip	Id-Id	Roxy bit her lip and tried to keep the plans for the surprise party a secret.
58	She bit her lip	Id-Lit	Roxy bit her lip as she rushed through breakfast in a hurry to get to school.
58	She bit her lip	Lit-Lit	Roxy cut her lip on a branch when she climbed too high up the cedar tree.
59	She got the axe	Id-Id	Ramona got the axe after being repeatedly warned not to be late for work.
59	She got the axe	Id-Lit	Ramona got the ax after being asked to help chop kindling for the fire.
59	She got the axe	Lit-Lit	Ramona had the axe that she borrowed from her neighbor to chop fire wood.
60	He pulled the plug	Id-Id	Dara pulled the plug on her brother's money when she caught him gambling.
60	He pulled the plug	Id-Lit	Dara pulled the plug of the bathtub when the water began to get very cold.
60	He pulled the plug	Lit-Lit	Dara removed the plug from the bathtub when the water began to get cold.

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