WRAPPING YOUR HEAD AROUND IDIOM PROCESSING: SUBJECTIVE AND OBJECTIVE LINGUISTICS CONSTRAINTS

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1.   Introduction

Figurative language plays an important role in every-day verbal communication (Fillmore, 1979). Idioms are a special type of figurative language whose meaning has been conventionalized in the language (Cacciari & Tabossi, 1998) and whose figurative meaning does not (necessarily) derive from the meaning of its constituents (Jackendoff, 1995). The general question of interest for psycholinguists is how idioms are represented in the mind and how they are processed. Models of idiom processing favour one of three broad views: 1) idioms are represented as a single word and thus their processing is non-compositional (Bobrow & Bell, 1973; Swinney & Cutler, 1979), 2) idioms are processed compositionally, similar to regular language processing (Gibbs, Nayak, & Cutting, 1989; Hamblin & Gibbs, 1999), and 3) idiom processing is a combination of both compositional and non-compositional (direct retrieval) analysis (Cacciari & Tabossi, 1988; Titone & Connine, 1994). According to the third view, known as the hybrid view, idioms are processed compositionally until they become recognizable to language users, which then allows for direct retrieval.

The introduction of hybrid views shifted attention towards idiom-specific factors that facilitate direct retrieval of idiomatic meaning, however, emphasis on these factors varies across studies. For example, the predictability of idioms (i.e., the likelihood of the correct prediction of the last word of the idiom) has been claimed to play a key role in the availability of direct retrieval. In other words, direct retrieval is a privilege for idioms that can be predicted and recognized before their offset (Cacciari & Tabossi, 1988). According to the proposed Configuration Hypothesis (CH), the idiomatic meaning is connected through association with a particular configuration. This hypothesis postulates that when enough information is available for the idiom to be recognized by the language user, a point referred to as the idiomatic key, then the idiomatic configuration will be available, which results in direct retrieval and processing of the idiomatic string. On the other hand, the availability of an idiom's figurative meaning has been said to depend on multiple linguistic factors, which assert their roles at various stages of processing (Libben &Titone, 2008; Titone & Libben, 2014; Titone, Lovseth, Kasparian, & Tiv, 2019).

Given the importance of considering multiple dimensions on idiom processing, the current experiment examines the effect of multiple factors on the processing of idioms. Several idiom-specific subjective measures were taken into consideration for the current study: 1. *Familiarity*, which is how frequently language users encounter or use a specific idiom in daily communication, 2. *Decomposability*, which refers to the contribution of idiom's constituents meaning to the figurative meaning, and 3. *Literal-plausibility*, whether the idiomatic expression has a possible literal interpretation. In addition to idiom-specific factors, the effect of objective factors, such as word frequency on idiom comprehension,

has also received attention in previous literature (Libben & Titone, 2008). Therefore, the objective variables of interest in this study are: *Noun Frequency*, *Noun Concreteness, Verb Frequency,* and *Verb Concreteness.*

In a moving window (self-paced) reading task participants read Idioms and Matched Literal sentences for comprehension and their Reaction Times (RT) were recorded. Among Objective factors, only Noun Frequency impacted the processing of both idiomatic and literal sentences. Subjective factors found to be most influential in the processing of idioms were Decomposability and Literal Plausibility, such that a higher Decomposability rating was associated with faster RT and higher Literal Plausibility resulted in slower RT. More importantly, an interaction between Decomposability and Literal Plausibility was found.

The remainder of this paper is organized as follows; Section 2 focuses on the review of the previous literature. In Section 3, the methodological details of the study are discussed which is followed by the presentation of the result in Section 4. Finally, discussion of the result and the conclusion is provided in Sections 5 and 6.

2.   Background

2.1   Idiom comprehension and processing

The principle of compositionality assumes that the meaning of an expression is a function of the meaning of its parts and of the way in which they are syntactically combined. An idiomatic expression, on the other hand, is conventionally defined as an expression whose figurative meaning does not (necessarily) derive from the meaning of its constituents (Jackendoff, 1995). For example, upon hearing "Their first date was about to turn into a real disaster, but he cracked a joke and broke the ice between them." a native speaker of English would not imagine someone using a hammer to physically crack something. In addition, by the time the listener hears "ice", enough context is provided to suppress the literal meaning of breaking layers of ice, rather, the hearer easily interprets it as "relieving the tension" between them. By and large, this example implicates that idioms defy the traditional view of the principle of compositionality. One of the main concerns for all idiom comprehension and processing models is to put forward assumptions about how and to what extent the literal meaning of individual constituents of an idiomatic expression contributes to the comprehension of idiomatic expressions. While early models of idiom comprehension overemphasized the role of literal meaning, more recent models propose different and sometimes contrasting views on this issue. In what follows, we present a brief overview of these models.

Generally speaking, models of idiom comprehension can be divided into compositional and non-compositional models (Panou, 2017). Non-compositional views of figurative language comprehension date back to the models of conventional language comprehension which put a strong emphasis on the priority of literal meaning comprehension. An example of a compositional model is the *Lexical Representation Hypothesis* proposed by Swinney and Cutler (1979) which indicates that idioms are stored in the same manner as regular words. This model claims that access to the idiomatic meaning starts at the beginning of the expression parallel to the computation of the literal meaning. Gibbs (1980, 1985) offers a more radical view of idiom comprehension; the

Direct-access model. This model proposes that when language users encounter an idiom with a possible literal interpretation (e.g. *spill the beans*), the conventional, non-literal meaning is processed automatically *prior* to the literal meaning. Later, Mueller and Gibbs (1987), qualified this assumption by pointing out the importance of the availability of multiple functional meanings of an idiomatic expression on their representation and processing. Hence, they proposed that not all idioms are represented in the same way in the mental lexicon. Rather idioms with multiple idiomatic and/or literal meanings have multiple entries in the lexicon and consequently have faster retrieval and processing time. The more recent generation of idiom processing models assumes the possibility of the existence of compositional processing during idiom comprehension.

Cacciari and Tabossi (1988), conducted a set of experiments to systematically investigate the processing of idiomatic expressions predicted by the non-compositional models. In the first experiment, they embedded Italian idioms with no possible literal interpretation in a non-biasing sentence context (e.g., "after the excellent performance, the tennis player was in seventh heaven"). In a cross-modal lexical decision task, participants heard these sentences and at the offset of the sentence were presented with a visual word. These words were either semantically related to the last word of the idiomatic expression (e.g., literal-related target: saint), semantically related to the meaning of the idiomatic string (e.g., idiom-related target: happy), or an unrelated control (e.g., umbrella). They argued that a literal-first model would predict the fastest RTs to literal-related targets, while an idiom-first model would predict that the idiom-related target would evoke the fastest RTs. Yet, according to the Lexical Representation Hypothesis, RTs to both literal-related and idiom-related targets should be equally quicker than unrelated controls. The results of this study are seemingly consistent with an idiom-first model; participants were generally faster in response to idiom-related targets than the other two conditions. Furthermore, they argued that this processing advantage may be due to high predictability of the last word in the idiomatic expression which consequently resulted in early recognition and processing of the idiomatic expression, and earlier accessibility to its meaning. To test this assumption, they conducted a similar experiment during which participants were, instead, presented with low predictable idiomatic strings (e.g., "The girl decided to tell her boyfriend to go to the devil, once and for all") with the same three previous conditions. This time they found the fastest RTs to literal-related targets, rather than idiom-related targets. Inconsistent with the first experiment, they did not find any significant difference between idiom-related targets and the unrelated control. They argued that when there is no prior cue for the recognition of the string, in the context nor in the string itself, the idiomatic expression is processed as a regular literal expression. If this assumption is true, then RTs to idiom-related lexical items should show the same facilitative effect observed in the first experiment if the target words are presented with a longer lag time (e.g., 300 ms), when participants have had enough time to process and access the idiomatic meaning. They tested this assumption in another experiment, which resulted in similar RTs to idiom-related and literal-related targets than to the unrelated controls. They generally conclude that neither of the proposed non-compositional models will sufficiently explain the results of these three experiments. Instead, they propose The Configuration Hypothesis (CH) whose main assumptions are that idioms are not encoded as separate lexical entries and that the processing advantage of idioms over literal expressions can be explained by assuming that the idiomatic meaning is connected through association with a particular

configuration. The notion of "configuration" is explained in terms of the distributed representation of lexical items and the connection between them. For example, consider the strings "spill the beans" versus "spill the coffee". The individual constituents (i.e., spill, bean, and coffee) each have separate lexical entries in the lexicon. However, the weight of the connections between the nodes representing an expression with possible idiomatic meaning (i.e., the connection between "spill" and "beans") is stronger than the connection between the strings of words that have no idiomatic meaning (i.e., "spill" and "coffee"). Finally, this hypothesis postulates that when enough information is available for the idiom to be recognized by the language user, at a point that is called idiomatic key, then the stronger connection between the configurations results in faster retrieval and processing of the idiomatic string.

2.2   Which factor is more important and when?

Titone and Connine (1994) conducted a set of experiments to further investigate the assumptions postulated by CH. They suggested that in order to confidently make any claim about the assumptions of CH, idiom dimensions should be manipulated more carefully. While Cacciari and Tabossi (1988) only used literally plausible idioms, Titone and Connine (1994) used both literally plausible and implausible idioms. Moreover, they also manipulated the predictability of idioms (high predictability versus low predictability). All idioms were highly familiar and non-decomposable. In the first experiment, they used a cross-modal lexical decision design where they embedded high and low predictable idioms in a sentence context. Participants listened to the sentence and, when a string of letters popped up visually, decided whether or not they were an acceptable word in English. The target words were either semantically related to the meaning of the idiomatic string or an unrelated control (e.g., "The secretary wanted to bite someone's head off after the mishap"; visual targets: "yell" or "spin"). The words were presented at the offset of the audio stimuli. It was found that for both idiom types, high and low predictability, the idiomatic-related meaning was available at the offset of the idiomatic expression (e.g., after "off" in the above example). In order to more precisely detect the time-course at which the idiomatic meaning becomes available, the first experiment was repeated presenting the target visual stimuli at the offset of the penultimate word of the idiomatic expression (e.g., after the word "head" in the above example). This time they found a processing advantage for the idiom-related targets over the unrelated controls only for highly predictable, but not for low predictable, idioms. In another experiment, they chose highly predictable idioms with and without a plausible literal interpretation to investigate the effect of this dimension on the literal activation of the constituents. This time they used literal-related targets, instead of idiom-related targets along with unrelated controls (e.g., literally plausible idiom: "the young student had cold feet", visual target "toes" or "toll"; literally implausible idiom: "Harry had to burn the midnight oil to finish the project", visual targets" "fuel" or "foil"). A processing advantage was observed for literal-related targets over controls, but only for idioms with a plausible literal interpretation. According to the result of these experiments, Titone and

Connine (1994) proposed an extension of CH. They postulated that when an idiom is highly predictable, all of its constituents are activated at the idiom key position (i.e., the point that the idiom is recognized). This consequently results in the activation of both the idiomatic configuration (as CH predicts), as well as the activation of the literal meaning of the rest of the words of the expression. Hence, if the idiomatic expression is ambiguous, that is, it has a possible literal meaning available, and the prior context is not biasing towards either interpretation, the literal meaning of the words remain activated until enough context is available to determine either the literal or idiomatic interpretation. For example, upon hearing/reading "They tied the…" the literal meaning of the word "knot" gets activated along with the idiomatic meaning of the expression "they got married". However, in the case of literally implausible idioms, the activation of the literal meaning of the words will be immediately suppressed, since it contradicts the language user's world knowledge. For example, upon hearing "He gave him the cold…." The activation of the word "shoulder" will be suppressed, since "give him the cold shoulder" does not have a literal interpretation and it contradicts the language user's general knowledge. These two later views (Cacciari & Tabossi, 1988; Titone & Connine, 1994) are sometimes referred to as *hybrid approaches*. These, as well as other hybrid proposals, do not offer strict separation of compositional versus non-compositional analysis for idiom comprehension (Abel, 2003). Instead, they incorporate assumptions of both compositional and non-compositional theories, such that both types of analysis take over during processing.

While it seems that contemporary models of idiom comprehension favour the hybrid view for idiom processing, a second important and related question is which linguistic attributes of idioms (decomposability, literal plausibility, etc.) are responsible for idiom processing and whether these dimensions are responsible for different stages of processing at different time courses. Libben and Titone (2008) conducted a series of experiments to more closely investigate how different dimensions of idioms exert an effect on their comprehension. They first collected normative measures on a set of idiomatic expressions with a "She/he/it verb$_{ed}$ x noun" structure (e.g., "It crossed his mind"). Participants rated the expressions for the level of decomposability [1], familiarity, meaningfulness, literal plausibility, and predictability. A set of offline and online tasks were also conducted, during which they considered these measures along with the word frequency as independent variables to investigate their effects on idiom comprehension. Among all dimensions, idiom familiarity exerted consistent and reliable effects over all types of tasks. They argued that it is likely that familiarity is an indicator for the configuration of idioms in memory, hence the more familiar an idiom is, the more likely it is to be retrieved directly during comprehension. In contrast to familiarity, decomposability only exerted an effect on comprehension in offline tasks where participants had to make overt judgments on idiom meaningfulness. They concluded that familiarity exerts the role at earlier stages of processing, while decomposability may be responsible for later stages of processing. A "constraint-based" model for idiom processing was proposed, which assumes idioms

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[1] Measures of decomposability consisted of global decomposability, noundecomposability, and verb decomposability.

dynamically interact with the ongoing compositional analysis. Idiomatic constraints, such as their familiarity, literal plausibility, etc., may come into play at different time courses.

2.3   Other potential factors

Generally, studies show that there are differences in the representation, processing, and comprehension of concrete and abstract concepts, and many studies show a concreteness effect (i.e., faster recognition and processing time for concrete words compared to abstract words; Milburn, 2018). Norming studies show that figurative meanings are often abstract (Citron et al., 2016 cited in Milburn, 2018). In a large-scale study, Nordmann et al. (2014) found that the majority of figurative meanings are associated with abstract concepts. If idioms are more similar to abstract concepts in terms of their representation and processing, then what type of interaction would occur between the processing of the idiomatic expression and the processing of the (concrete) individual constituents? In other words, is there any difference between the processing of idioms with a concrete offset word (e.g., "spill the beans") and an idiom with an abstract offset word (e.g., "he cracked a joke")? Is it possible that upon the activation of an idiomatic configuration and parallel activation of its abstract constituents, the similar nature of representation and processing, facilitates idiom processing, whereas when the individual words of an idiom are concrete, the qualitatively different representations and processing between the abstract configuration of the idiomatic and the concrete word, inhibits the processing of the more abstract concept of the idioms?

2.4   Current study, goals and hypothesis

The goal of this study is to differentiate between several factors in idiom processing and investigate how these factors predict the processing of idioms. We divided the factors into two groups: Subjective and Objective factors. Subjective factors consist of participants' judgment on idioms. For example, the level of their familiarity with idioms. On the other hand, idioms have some factors that relate to the characteristics of their constituents; referred to as objective factors. These factors, such as the frequency of nouns and verbs, may affect idiom processing.

In addition to the factors that have been investigated in prior studies, we considered one extra linguistic factor, the concreteness of the individual words of the idioms, to investigate whether concreteness of the idiom's constituents impacts its processing. We hypothesize that since the nature of idioms is similar to abstract concepts, the presence of a concrete word would have a disruptive effect. In other words, the existence of abstract words will have a facilitative effect on the processing of idioms.

3.   Methods

3.1. Participants

In total, 27 participants (19 females, mean age = 19.4) were recruited for this study through the University of Ottawa's Psychology Integrated System of Participation in Research (ISPR) in exchange for course credit. All participants were native speakers of English.

3.2. Material

The experimental material consisted of 54 idiomatic expressions chosen from 219 normed idiomatic expressions in the Titone and Libben (2008) study. All idiomatic expressions were in the form of "She/He/It verb$_{past\ tense}$ x noun" (e.g., "It slipped his mind"). A list of 80 Matched Literal sentences was then created with the same structure, verbs, and nouns used in the idiomatic expressions. However, we combined the verbs and nouns such that the resulting sentences do not have an idiomatic meaning (e.g., "He *swallowed* his pride", and "he sugared the *pill*", resulted in the "He *swallowed* his *pill*"). Additionally, 40 Filler sentences of the same structure with no intentional control for verb or noun similarity (e.g., "he missed his meeting") were included. The purpose of including Fillers was to increase the total number of literal sentences compared to idiomatic expressions. Comprehension (yes/no) questions were created for 15 sentences per condition.

The operational definitions of the subjective measures were taken from Libben and Titone (2008): 1. Predictability: an idiom predictability refers to the possibility of recognizing an idiom before its final word. For example, when encountering the string "he shot the…" it is less likely that the hearer/reader predicts the idiom "he shot the breeze", while the string "it crossed his …" is more likely to activate "it crossed his mind". 2. Literal Plausibility: the availability of a literal interpretation for an idiomatic string. For example, the string "he tied the knot" can be interpreted literally while "he clipped her wings" is less likely to be interpreted literally. Literally plausible idioms are sometimes referred to as an "ambiguous idiom" in the literature. 3. Decomposability: the decomposability of an idiom refers to the degree of contribution of individual word meaning to the idiomatic interpretation. For example, an idiom such as "she covered her track" is more likely to be placed higher on a decomposability ranking than "he bought a farm". 4. Familiarity: the language user's degree of exposure to the idiom in its either spoken or written form. For the collection of subjective measures on the idiomatic expressions, we prepared a booklet containing three different parts (Idiom-judgment booklet) using the same instructions from Titone and Libben (2008)[2]. Examples of stimuli are provided in Table1.

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[2] The final predictability and decomposability measures are a number between 0 to 1. The final literal plausibility and familiarity measures are a number between 1 to 5.

Table 1. *Example stimuli. The ratings represent average over participants' rating*

Condition	Example	Familiarity	Decomposability	Literal Plausibility	Predictability
Idioms	She broke her word.	4.42	0.93	.98	0.00
	He hit the sack.	4.73	0.00	3.97	0.21
Matched Literal	She broke her leg. He lifted the sack.	NA	NA	NA	NA
Fillers	She met his Friend. He bought a car.	NA	NA	NA	NA

Note: Idioms varied continuously concerning these measures. The following numbers show the minimum and maximum ratings for each measure: Familiarity: 1.33, 4.89; Decomposability: 0.00, .98; Literal Plausibility: 1.33, 4,78; Predictability: 0.00, .85

Objectives ratings were taken from different databases. Verb and noun frequency were extracted from Brysbaert and New (2009), whereas verb and noun concreteness were extracted from Brysbaert, Warriner, and Kuperman (2014). Table 2 shows a summary of these measures.

Table 2. *Average word frequency and length per conditions*

Condition	Verb Frequency	Noun Frequency	Verb Concreteness	Noun Concreteness
Idioms	3.08	3.12	3.82	4.22
Matched Literal sentences	3.08	3.12	3.82	4.46
Fillers	3.32	3.59	4.01	4.37

3.3. Procedure

All participants were tested individually, each starting with filling out a language background questionnaire, LBQ (Sabourin et al., 2016). Participants then performed a moving window self-paced reading task via E-prime (version 3), while seated in front of a computer monitor in a sound attenuated testing room in the ERPLing laboratory at the University of Ottawa. Participants were instructed to read sentences for comprehension. A set of 6 practice trials proceeded the beginning of the study. To ensure that the practice trials are representative, we included all three types of sentences (Idiom/Matched Literals, and Fillers), with and without comprehension questions. After the self-paced reading task, participants completed the idiom-judgment booklet. Each part was explained to them verbally by the experimenter. Participants were also encouraged to read the written instructions. The experimenter was present during the practice trials, to respond to any possible questions.

4.   Results

Overall accuracy on the comprehension questions was 97 % for literal sentences and 89% for idiomatic sentences, indicating that participants were attentive during the experiment. Further investigation revealed that the majority of the incorrect responses for idiomatic conditions were attributed to low familiar idioms. A total of 9% of data with RTs longer than 1800 ms or shorter than 200 ms were considered outliers and removed from the analysis. Table 3 shows RT for all words of the expressions for two experimental conditions.

Table 3. *Reaction Time for all words of the expressions and two experimental conditions*

Condition	Word1 RT	Word2 RT	Word3 RT	Word4 RT
Idioms	345.62	366.53	362.03	489.22
Matched Literals	352.77	363.88	359.85	485.54

RT data was analyzed using linear mixed effects (LME) models (R Development Core Team, 2013) and lme4 (Bates et al., 2015). Two LMER models were built with RTs to the last word of the expressions as the dependent measure, one with Objective (noun frequency, noun concreteness, verb frequency, and verb concreteness) and one with Subjective (familiarity, literal plausibility, decomposability, and predictability) factors as the fixed effects. In both models, *Participant* and *Item* were included as random factors. Sentence Type was included as a fixed effect only in the Objective model, since only objective variables are common between both literal and idiomatic language. Moreover, the interaction between sentence type and all objective factors were also included in this model. In the Subjective model, we included a full order interaction and lower order interactions between all subjective variables. Tables 4 and 5 represent the values of Subjective and Objective models, respectively.
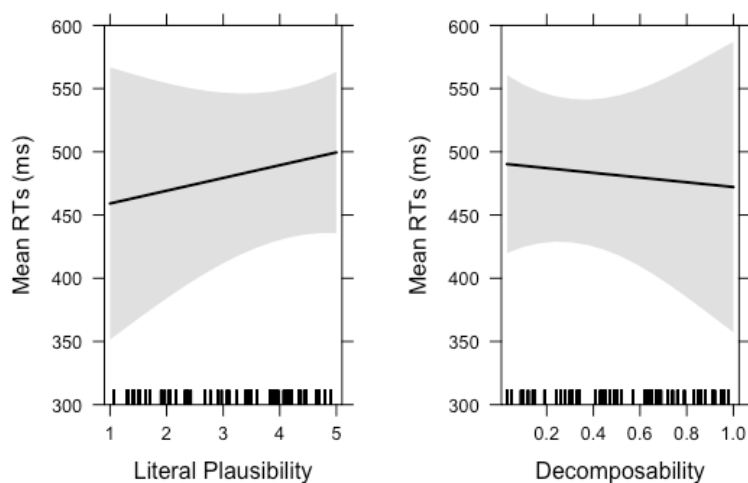
Table 4. *Full model output for Subjective measures*

Fixed effects	Effect Size	SE	t-Value	Pr(>|t|)
Intercept	968.27	188.55	5.13	<0.001 ***
Familiarity (F)	-188.76	65.07	-1.82	0.075 .
Literal Plausibility (LP)	-145.51	134	-2.59	<0.05*
Predictability (P)	59.43	277.47	0.02	0.98
Decomposability (D)	-811.23	392.12	-2.06	0.04*
F*LP	38.18	19.08	1.89	0.06 .
F*P	91.92	735	0.12	0.90
LP*P	-78.9	914.07	-0.08	0.93
F*D	184.84	103.02	1.79	0.08
LP*D	271.21	115.49	1.79	0.02*
P*D	-1728.16	4435.56	2.34	0.69
F*LP*P	-13.49	230.37	-0.05	0.95
F*LP*D	-61.08	30.71	-1.98	0.05 .
F*P*D	249.32	904.78	0.27	0.78
LP*P*D	409.05	1338.28	0.30	0.76
F*LP*P*D	-58.20	249.21	-0.19	0.84
Random effects	Variance	SD		

Item	964.8	31.06
Subject	18877.5	137.40
Residual	35446.2	188.27

As shown in Table 4, a significant effect of Literal plausibility, a significant effect of Decomposability, and a significant interaction of Literal Plausibility by Decomposability were found for subjective measures. Figure 1 schematically shows these effects.
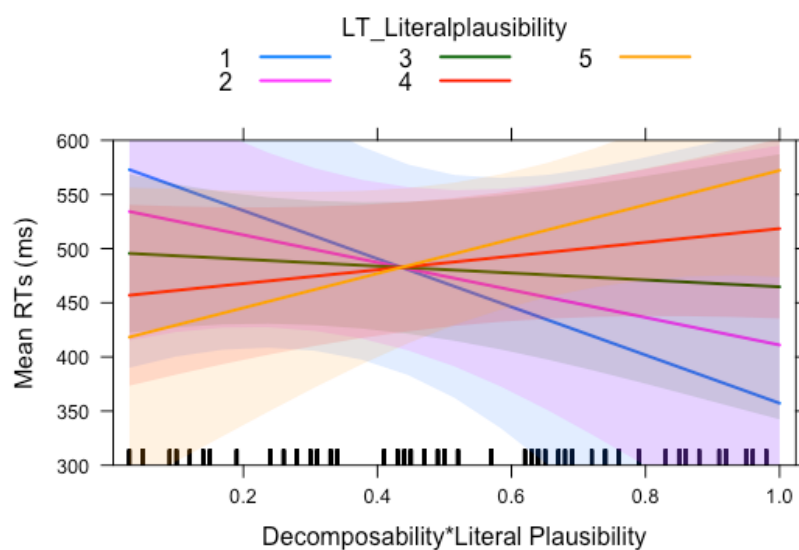
a.

b.

Figure 1. Partial effects plot of RT as a function of Literal plausibility (panel a, left), decomposability (panel a, right), and Interaction of Literal Plausibility by Decomposability (panel b). Error shadings reflect ± 1 standard error of the mean.

Table 5. *Full model output for Objective measures*

Fixed effects	Effect Size	SE	t-Value	Pr(>|t|)
Intercept	498.62	69.18	7.20	<0.001 ***
Sentence Type_ML (T_ML)	-33.81	91.60	-0.36	0.71
Noun Concreteness (NC)	0.60	7.67	0.07	0.93
Noun Frequency (NF)	-20.01	8.10	-2.46	0.01*
Verb Concreteness (VC)	1.55	10.57	0.14	0.88
Verb Frequency (VF)	11.17	7.97	1.40	0.16
T_ML*NC	2.58	12.74	0.20	0.83
T_ML*NF	2.18	11.88	0.18	0.85
T_ML*VC	2.45	14.42	0.17	0.86
T_ML*VF	3.45	11.31	0.30	0.76
Random effects	Variance	SD		
Item	673.5	25.95		
Subject	18858.3	137.33		
Residual	38515.3	196.25		

As shown in Table 5, only Noun Frequency contributed a significant impact on the processing. This effect was similar for both sentence conditions, confirmed by a non-significant interaction between Sentence Type and Noun Frequency. Figure 2 schematically depicts this effect.
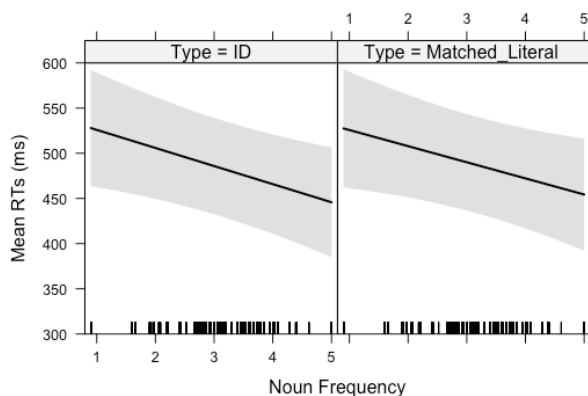

Figure 2. Partial effects plot of RT as a function of Noun Frequency for idiomatic condition (panel left) and Matched Literals (panel right)

5.   Discussion

According to Constraint-Based models of idiom processing, language users simultaneously use all available information during idiom comprehension (Titone et al., 2015). Following

this view, the current study, investigated how two types of linguistic factors, objective and subjective, modulate figurative meaning comprehension. Unlike prior studies, we differentiated these two types of factors. Subjective factors reflect language users' subjective opinion on several idiom-specific characteristics, such as their level of familiarity with idioms. Whereas objective factors, such as word-frequency, are common between figurative and non-figurative language. We hypothesized that the separation of these two factors might uncover some new angles that otherwise have been obscured in the studies that do not separate these factors.

When considering the effect of Objective factors, we compared the processing of these two types of sentences (Idioms and Matched Literals). A significant effect was found only for Noun Frequency. Importantly there was no difference between idiomatic and literal expressions confirming that, in general, idioms do not show a processing advantage or disadvantage over literal language processing. In other words, the same factors impact the processing of both types of language in the same direction, as long as these factors are common between these types of languages.

When considering Subjective factors, instead of comparing the processing of idioms with literal language, we focused on how these factors contribute to the processing of idioms. We focused on Familiarity, Decomposability, Predictability, and Literal plausibility. A number of previous studies suggest that familiarity indexes the ease of direct retrieval of an idiomatic meaning from semantic memory. Accordingly, these studies report a robust facilitation effect for idioms with a higher familiarity level and conclude that this factor might be a more potent determinant of idiom processing (Titone & Libben, 2014; Libben & Titone, 2008, Titone & Connine, 1994). Contrary to these findings, the level of familiarity did not show a significant facilitation effect on the processing of idioms in the current study. However, this finding is not utilized to reject the importance of familiarity as a factor for idiom processing. One possibility for the lack of significance of familiarity is that in this experiment we created Matched Literal sentences using the exact same words that were used in the Idiomatic expressions. This may have inhibited participants from predicting the idiomatic meaning, since, for example in a sentence like "He swallowed his …", they would equally expect to see a word that turns the meaning of the whole expression idiomatic: "pride", or a word that makes the expression literal: "pill". In other words, because the proportion of these two types of sentences were equal, the activation of the idiomatic meaning due to its familiarity was inhibited. The same reason can explain the lack of facilitative effect for the Predictability measure.

While Literal Plausibility is consistently found to be an inhibitory factor in idiom processing, such that idioms whose literal interpretation is available are processed more difficulty, the status of Decomposability is unclear in the literature (Titone & Libben, 2014). For example, Caillies and Butcher (2007) reported that decomposable idioms possess a processing advantage over non-decomposable idioms. Libben and Titone (2014) assert that "[we observed] no facilitative effect of decomposability at any time point during comprehension" (p. 490). Consistent with prior studies, the present study found that literally implausible idiom had a reading rate advantage (i.e., faster reading time for the last word of the expression) over literally plausible idioms. This shows that for the later type of idioms both plausible meaning, i.e., idiomatic and literal, are activated at the offset of the expression leading to slower RT resulting from competition between meanings.

Higher decomposability (the stronger connection between the meaning of idiomatic constituent and the whole idiomatic expression) was also found to be associated with quicker RT at the expressions' offset confirming the general facilitative effect of this measure.

More importantly, the current study shows an interaction between decomposability and literal plausibility. In other words, when an idiom has no literally plausible available meaning (this has been shown in Figure 3, panels "c" and "d"; the pale colour for Literal box represent low Literal plausibility for these expressions), the idiom with a higher decomposability rating (panel "d") is processed more easily than the idiom with a lower decomposability rating (panel "c"). This facilitative effect shows that during idiom processing, the individual word meanings get activated (this activation is shown in Figure 3 by lines connecting an expression and an individual word; by a thick line representing strong connection and a thin line representing weak connection). When the meaning of an idiom has a strong connection with the meaning of its constituents, the activation of the individual words excites the activation of the idiomatic meaning, making its processing less effortful.

In contrast, when an idiom has an available literal interpretation (Figure 3, panels "a" and "b") then the idiom with lower decomposability (panels "a") has a processing advantage over a highly-decomposable idiom (panel "b").When an idiom is highly decomposable, the connection between the idiom and its constituent is strong. However, when the idiom has a literally plausible interpretation, the same strong connection exists between the individual words and the literal interpretation of the expression. This double connection excites the multiple activations of idiomatic and literal meaning resulting in competition between two meanings.
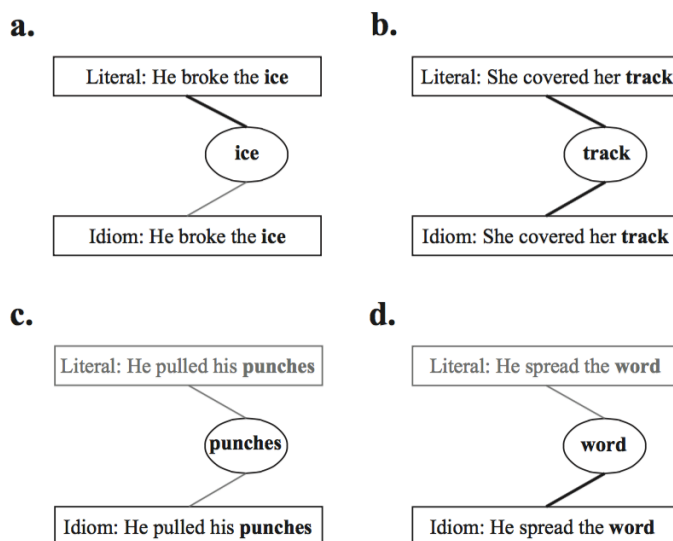

a.

Literal: He broke the **ice**

(**ice**)

Idiom: He broke the **ice**

b.

Literal: She covered her **track**

(**track**)

Idiom: She covered her **track**

c.

Literal: He pulled his **punches**

(**punches**)

Idiom: He pulled his **punches**

d.

Literal: He spread the **word**

(**word**)

Idiom: He spread the **word**

Figure 3. Interaction between Decomposability and Literal Plausibility (LP). Panel "a" and "b" shows idioms with high LP; Panel "a" is an idiom with low Decomposability,

while panel "b" is an idiom with high Decomposability. Panels "c" and "d" represent two idioms with low LP; "c" with low Decomposability and "d" with high decomposability. The lines show the connection between an individual word and the Literal and Idiomatic meaning of expression; the thick line represents the stronger connection.

6.   Conclusion

To conclude, the findings of the present study support the Constraint-Based Model of idiom processing. Similar to literal language processing, multiple linguistics factors simultaneously impact the processing of idioms. When comprehenders read sentences, the same objective factors govern both figurative and literal language comprehension. Additionally, idiom processing is modulated by idiom-specific factors and the interaction between those factors. To better understand the processing of idioms, using online measures such as Event Related Potentials (ERPs) will help us to specify the processing differences between idioms with different levels of subjective factors. Consequently, we are currently conducting studies to tap into neurophysiological underpinnings of idioms processing using ERPs.

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