

Idiom Complexity in Apple-Pie Order: the Disentanglement of Decomposability and Transparency

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Abstract

Both decomposability and transparency investigate the interplay between literality and figurativity in idioms. For this reason, they have often been merged. This study argues that idiom decomposability and transparency are related but conceptually different constructs, thus advocating for their distinction. Leveraging a normed lexicon of Italian and English idioms, the respective effects of decomposability and transparency on idiom meaning recognition are explored via statistical modeling. Results show the two variables contribute differently to idiom meaning recognition in the two languages, while the absence of collinearity underscores their distinct contributions. Based on this empirical evidence, the study finally proposes FrameNet and MetaNet as computational tools for modeling idiom decomposability and transparency. This study thus not only substantiates the separation of idiom decomposability and transparency, but also sets a foundation for future interdisciplinary research to bridge the gap in idiom research between empirical psycholinguistics, cognitive linguistics and computational applications.

Keywords: idioms, decomposability, transparency

1. Introduction

Idioms are multiword expressions bearing a figurative meaning (Cacciari and Tabossi, 2014; Wagner, 2021). The typical interpretation of the idiom *spill the beans* does not indicate the actual spilling of a can of beans, but rather the revelation of a secret. Idioms' distinctive feature is therefore their duality between a compositionally derivable literal meaning and a conventionally associated figurative meaning (Sprenger et al., 2006).

Importantly, idioms constitute a heterogeneous category, varying across several dimensions (Langlotz, 2006; Wulff, 2013). Notably, an idiom's degree of decomposability and transparency are essential for an in-depth analysis of the interplay between an idiom's literality and figurativity (Geeraerts, 2003, 1995; Carrol et al., 2018).

Decomposability refers to the extent to which the figurative meaning of an idiom can be broken down by linking its figurative semantic components to its literal syntactic elements (Sailer, 2021). For instance, with *spill the beans*, the action of spilling corresponds to revealing, and the beans can be mapped onto the secrets being disclosed (Nunberg et al., 1994). Thus, decomposability focuses on the interface between an idiom's syntax and semantics. This is clearly outlined in Geeraerts (2003), who proposes the term "isomorphism", i.e., "a one-to-one correspondence between the formal structure of the expression and the structure of its semantic interpretation" (p. 438).

Transparency refers to the possibility of establishing a synchronic relationship between an idiom's literal and figurative meanings in their entirety (Sailer, 2021; Moreno, 2005). This "semantic bridge" (Dobrovolskij, 2016, p. 23) works as

the rationale for how a multiword expression has been semantically extended from its literal meaning to its idiomatic interpretation, and is grounded in cognitive-conceptual mechanisms like metaphors, metonymies, and encyclopedic knowledge (Koveses and Szabco, 1996; Carrol et al., 2018). In the case of *spill the beans*, the sudden visibility of the spilled beans metaphorically mirrors the revelation of the secret, which, again metaphorically, has come out of its container and is therefore no longer under control.

Since both decomposability and transparency examine idioms' literal-figurative interplay, prior research on idiom features has often conflated them together within a single variable (see the discussions in Hubers et al., 2019; Michl, 2019; Carrol et al., 2018). While agreeing that the two variables are correlated (Carrol et al., 2018), we claim that they are different in kind (Geeraerts, 2003, 1995; Hubers et al., 2019; Carrol et al., 2018).

In addition, the distinction between decomposability and transparency aligns well with the hybrid model of idioms (Cutting and Bock, 1997; Cacciari and Tabossi, 1988; Sprenger et al., 2006; Libben and Titone, 2008; Titone and Connine, 1999). This account claims that idioms are encoded in the mental lexicon in a hybrid manner, through a multi-level interconnection of literal and figurative components. In this regard, Sprenger et al. (2006) argues that "idioms are both unitary and compositional, although at different levels of their cognitive representation" (p. 174). Differentiating between decomposability and transparency provides precise analytical tools with which to investigate with finer granularity the inherently dual nature of idioms. On the one hand, decomposability focuses on the syntax-semantics

interface; on the other hand, transparency targets the connections between the semantic and conceptual levels.

The aim of the present work is precisely to provide empirical evidence in support of the distinction between idiom decomposability and transparency. This is done by conducting an exploratory analysis on the respective effects of decomposability and transparency on idiom meaning recognition in two languages, Italian and English. Idiom meaning recognition is operationalized through the variable *objective knowledge*, which describes the correct identification of an idiom's figurative meaning by a speaker (see also Hubers et al., 2019). To verify the effects of decomposability and transparency on idiom objective knowledge, a cross-linguistic normed idiom lexicon where the variables have been quantitatively assessed ("normed") by native speakers (Pagliai, 2023) is employed.

Finally, one additional purpose is to foster interdisciplinary research on idiom variables and modeling. The analysis conducted here is psycholinguistic in nature, and is intended to be exploited as an empirical basis to support further research in cognitive linguistics, thus responding to the advocacy of Espinal and Mateu (2010) for a cognitive (psycho)linguistic approach. For this reason, the final part of the paper illustrates how idiom decomposability and transparency can be effectively modeled through two computational resources based on cognitive linguistics theories: FrameNet (Ruppenhofer et al., 2006) and MetaNet (Petrucci, 2016).

2. Methods

The cross-linguistic lexicon comprises 150 pairs of Italian and English idioms sharing similar meanings (Pagliai, 2023). The dataset was obtained through the implementation of a cross-linguistic norming study in which idioms were normed by native Italian and English-speaking participants for a number of variables: familiarity, meaningfulness, objective knowledge, literal plausibility, decomposability, and transparency. All variables were operationalized on a 1 to 5 Likert scale, with the exception of objective knowledge. This was presented as a dropdown option including three idiom paraphrases from which to select the correct one. In the present analysis, objective knowledge provides the required measurement of idiom meaning recognition (for more details regarding the dataset creation, as well as the variables' choice, definition, and operationalization, please refer to Pagliai, 2023).

To assess the distinct impacts of decomposability and transparency on idiom objective knowledge in the two languages, generalized linear mixed models (GLMMs) were fitted using the `lme4` package (Bates et al., 2015) in R (v4.3.2, R Core Team,

2023). Maximum cross-linguistic comparability was ensured by employing identical model structures for both languages. Objective knowledge was set as dependent variable, with decomposability and transparency serving as predictors. To account for its influence, meaningfulness (the subjective degree of confidence of knowing the meaning of an idiom) was also included as an additional predictor¹. All predictors were centered; the dependent variable objective knowledge was encoded using treatment coding, with "wrong" responses coded as 0 and "correct" responses as 1. Each model incorporated random intercepts for both participants and items. Due to issues with models' convergence, no random slopes were included (Barr et al., 2013).

To ensure that each predictor variable uniquely contributed to idiom meaning recognition, multicollinearity was tested. Variance inflation factors (VIFs) for both Italian and English models were calculated using the package `performance` (Lüdtke et al., 2021). The same package was exploited for conditional and marginal R^2 calculation.

3. Results

Model results are shown in Table 1. For Italian idioms, the estimated log-odds of objective knowledge significantly increase by 0.82 ($SE = 0.08$, $p < .001$) for each unit increase in meaningfulness, equivalent to an odds ratio (OR) of 2.27, indicating a substantial positive impact. Conversely, decomposability presents a non-significant negative effect ($\beta = -0.04$, $SE = 0.08$, $p = 0.643$; OR ≈ 0.96). Transparency shows a significant positive association, with a log-odds increase of 0.27 ($SE = 0.09$, $p = 0.004$), corresponding to an OR of approximately 1.31.

Turning to English idioms, the same positive effect for meaningfulness is found, with an identical log-odds increase of 0.82 ($SE = 0.06$, $p < .001$; OR ≈ 2.27). In contrast with Italian, decomposability exhibits a significant positive relationship ($\beta = 0.21$, $SE = 0.08$, $p = 0.009$; OR ≈ 1.23). The effect of transparency, while positive, does not reach significance ($\beta = 0.12$, $SE = 0.08$, $p = 0.115$; OR ≈ 1.13).

The different effects of decomposability and transparency on idiom objective knowledge across the two languages are illustrated in Figure 1 for decomposability and Figure 2 for transparency. The plots capture the impact of the two variables on the predicted probability of correctly guessing id-

¹The addition of familiarity (the subjective frequency with which a speaker uses and hears/reads an idiom) as a predictor was also considered. However, comparisons based on the Akaike Information Criterion (AIC) revealed that models excluding familiarity performed better in both Italian and English.

Italian				English			
Fixed effects	β	SE	p	Fixed effects	β	SE	p
(Intercept)	4.57	0.25	<.001	(Intercept)	3.62	0.25	<.001
Mean	0.82	0.08	<.001	Mean	0.82	0.06	<.001
Deco	-0.04	0.08	0.643	Deco	0.21	0.08	0.009
Tra	0.27	0.09	0.004	Tra	0.12	0.08	0.115
Random effects	Variance	Std. Dev.		Random effects	Variance	Std. Dev.	
Intercept: items	1.52	1.23		Intercept: items	1.97	1.40	
Intercept: participants	0.32	0.56		Intercept: participants	0.35	0.59	
Cond. $R^2 = 0.46$; Marg. $R^2 = 0.16$				Cond. $R^2 = 0.55$; Marg. $R^2 = 0.23$			

Table 1: Comparative summary of GLMMs predicting idiom objective knowledge as a function of meaningfulness, decomposability, and transparency. Model outcomes for Italian on the left, for English on the right.

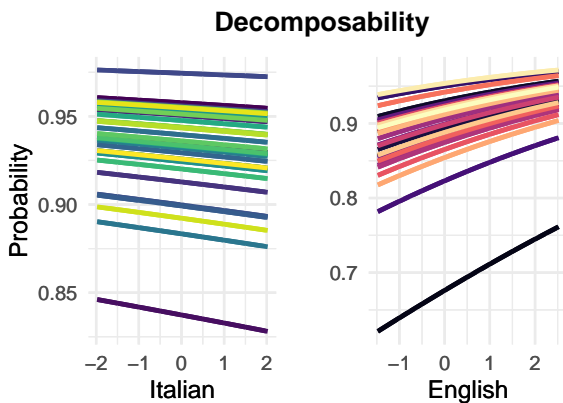


Figure 1: Effect of decomposability on the predicted probability of correctly identifying the meanings of Italian (left) and English (right) idioms, with by-participant variation (random intercepts).

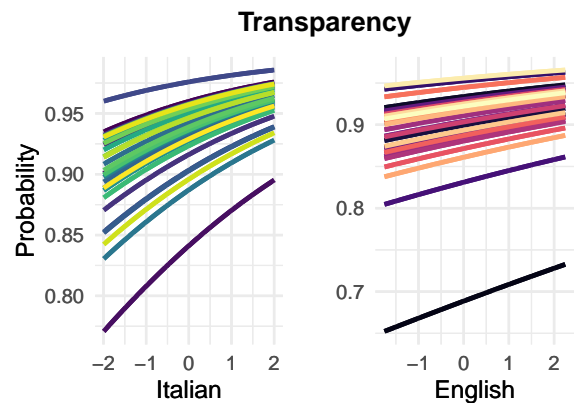


Figure 2: Effect of transparency on the predicted probability of correctly identifying the meanings of Italian (left) and English (right) idioms, with by-participant variation (random intercepts).

idioms' figurative meaning, while accounting for by-participant variation. For Italian, as decomposability increases, there is a slight downward trend in the probability of correct idiom knowledge. In contrast, for English, increased decomposability corresponds with a significant rise in the likelihood of idiom objective knowledge, as indicated by the slopes' upward trajectory. Transparency is associated with an increase in the probability of correct idiom meaning recognition in Italian, a trend that is present in English as well, although weaker and not supported by statistical significance.

Regarding collinearity investigation, results are reported in Table 2. All VIF values are below 1.5 in both Italian and English. This indicates absence of multicollinearity (Winter, 2019), confirming that each predictor variable—including decomposability and transparency—provides a unique and distinct contribution to idiom meaning recognition in both languages.

	Italian			English		
	Mean	Deco	Tra	Mean	Deco	Tra
VIF	1.05	1.19	1.19	1.02	1.41	1.43

Table 2: VIFs for meaningfulness, decomposability and transparency in Italian and English.

4. Discussion

The results underscore the different impact of decomposability and transparency in the two languages. For Italian speakers, the transparency of the relationship between literal and figurative meaning plays a key role in identifying the correct idiom paraphrase, while English speakers rely more on the isomorphism between syntactic and semantic structures. Moreover, the direction of the effect associated with decomposability differs cross-linguistically, being positive in English and negative in Italian.

This cross-linguistic difference could stem from

the characteristics of the dataset, as Italian speakers showed higher knowledge of the idiom sample than English speakers, with respective overall objective knowledge scores of 96% and 89% (percentages obtained by calculating mean objective knowledge across all participants and idioms within each language). This difference might suggest that higher idiom knowledge leads to greater reliance on the conceptual link between literal and figurative meanings for idiom recognition. Conversely, with less knowledge, speakers may depend more on the literal-syntactic structure, possibly due to figurative meanings being less accessible in the mental lexicon. This would render grasping the semantic relationships between idioms' literal and figurative meanings more challenging.

Nevertheless, in the dataset, idiom knowledge is on average high across both languages. Indeed, when resorting to real idioms, it is not uncommon to find that speakers are highly familiar with them (Tabossi et al., 2011; Bulkes and Tanner, 2017), given idioms' recurrent presence in everyday language experiences (Jackendoff, 1995; Searle, 1975). This dataset feature, together with the fact that this is an exploratory study, calls for future confirmatory analysis. To ascertain whether the observed differences can be attributed to the level of idiom knowledge, follow-up research may involve ad-hoc created cross-linguistic idioms along with their paraphrases, to simultaneously control the level of idiom knowledge, decomposability, and transparency. With less skewed data, future studies could more reliably test the hypothesis that transparency's impact is more pronounced for idioms with which speakers are highly familiar, while decomposability plays a more significant role for less known idioms.

Collinearity was not detected in either Italian or English, reinforcing the view that decomposability and transparency are related but distinct variables. This cross-linguistic consistency strengthens the foundation for expanding research in cognitive linguistics relative to these two dimensions of idiomatic variation. Notably, the computational tools FrameNet (Ruppenhofer et al., 2006) and MetaNet (Petrucci, 2016) could enhance our capacity to model decomposability and transparency effectively.

FrameNet is a lexical resource grounded in Frame Semantics theory (Fillmore, 2006). It represents word meanings through frames, "coherent schematizations of experience" (Fillmore, 1985, p. 223) describing situations, events, or objects. Frames are evoked by lexical units (form-meaning pairs; Cruse, 1986), and each frame includes a unique set of Frame Elements (FEs) to detail the roles and participants within these scenarios. MetaNet is a computational resource rooted in Conceptual Metaphor Theory (Lakoff and Johnson,

2008). It is designed to systematically capture and organize metaphors across languages, while highlighting the connections between concepts.

In FrameNet, frames are connected in a hierarchical network (Ruppenhofer et al., 2006, p. 73). Since transparency has been defined as a semantic relationship between the two idiom meanings, it can be modeled as a new literal-figurative frame-to-frame relation linking together the literal and the figurative frames evoked by an idiom. Building on this foundation, the MetaNet database, with its extensive repository of conceptual metaphors, can supply the metaphors that underpin the literal-figurative frame-to-frame relation. As for decomposability, it can be modeled as the possibility of establishing a mapping between the FEs involved in the two frames. Currently, FrameNet includes relationships between FEs, but only within the same frame (Ruppenhofer et al., 2006, p. 21). The decomposability of an idiom, conversely, depends on the possibility of establishing a relation between FEs belonging to two different frames: one literal and the other figurative.

Consider Figure 3, which visually exemplifies how to model the decomposability and transparency of the idiom *spill the beans* by resorting to the tools provided by FrameNet and MetaNet. In isolation, the idiom evokes two frames: the literal Cause_fluidic_motion ("An Agent or a Cause causes a Fluid to move") and the figurative Reveal_secret ("A Speaker reveals Information that was previously secret to an Addressee"). Focusing on the bottom of the figure, let us first consider decomposability. The noun phrase "the beans" corresponds to the FE FLUID ("the entity that changes location and moves in a fluidic way") in the literal frame Cause_fluidic_motion, while it corresponds to the FE INFORMATION ("the content that the Speaker reveals to the Addressee") in the figurative frame Reveal_secret. The mapping between the two FEs underlies the interpretation whereby the spilled beans (FLUID) correspond to the disclosed secrets (INFORMATION). Therefore, decomposability acts at the intersection of syntax and semantics, as evidenced by the triangular relationship connecting the nominal constituent "the beans" and the two FEs, one in the literal and the other in the figurative frame.

Moving upward, transparency can be conceptualized as the frame-to-frame relation that is established between the literal frame Cause_fluidic_motion and the figurative frame Reveal_secret in their entirety (as opposed to decomposability, which is a relationship between frame sub-components). Further enriching this analysis, MetaNet provides the underlying metaphors that scaffold the literal-figurative frame-to-frame relation. EXISTENCE IS VISIBILITY

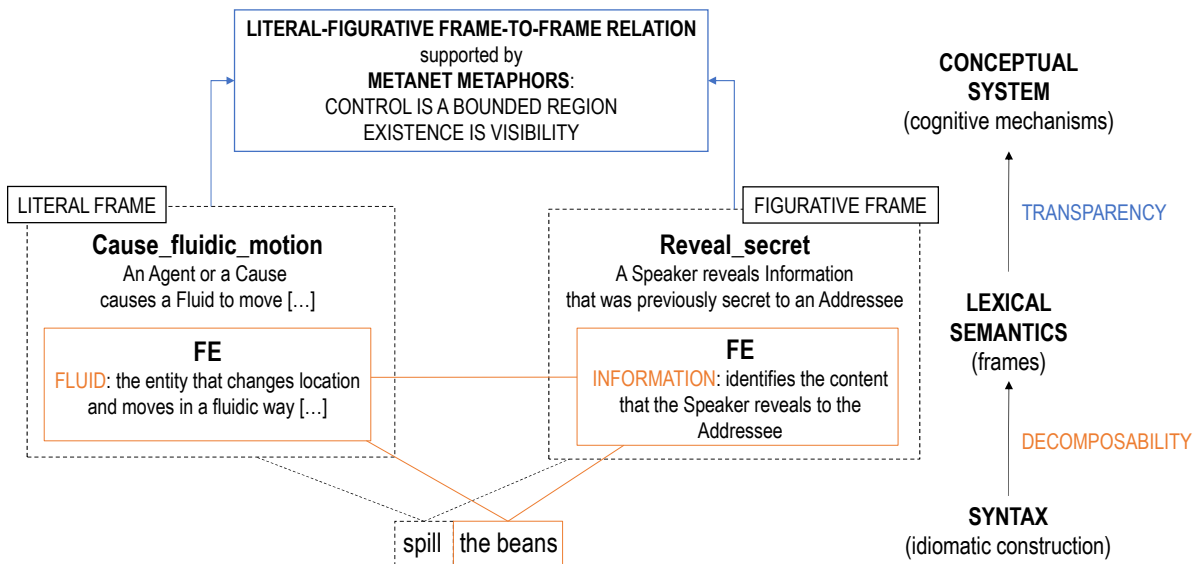


Figure 3: Modeling of the decomposability and transparency of *spill the beans*, resorting to the tools of FrameNet and MetaNet. On the right is highlighted how decomposability and transparency act at two different intersections: between syntax and semantics the former, between semantics and conceptual system the latter.

supports the interpretation that making something visible (spilling beans) is akin to making something known (revealing a secret). Similarly, CONTROL IS A BOUNDED REGION conceptualizes the act of controlling information as keeping it within a defined boundary, with the act of spilling signifying a loss of control and thus the escape of information beyond its intended confines. Therefore, transparency acts at the intersection of lexical semantics and conceptual system: the more the relationship between the frames is motivated (by metaphors, metonymies, encyclopedic knowledge [Kovecses and Szabco, 1996](#); [Carrol et al., 2018](#)), the more transparent it is.

In spite of FrameNet’s suitability for modeling idioms in a multi-layered way (thus fully respecting their complex nature), the English database currently includes only 35 idiomatic lexical units evoking 29 frames. Moreover, annotations based on real text are available for only 12 of these expressions. This means that considerable work is needed: first, to expand the database with new idioms; second, to add the suggested relations to investigate idioms’ decomposability and transparency.

Nevertheless, it is worth recalling that one of Frame Semantics and FrameNet’s core strengths lies in bridging meaning with experience and culture ([Fillmore, 2006](#)) via real text annotations. Idioms, as condensates of cultural, experiential knowledge ([Colston, 2015](#)), offer invaluable insights into this link. Enriching the database with more idioms would be an opportunity to leverage FrameNet’s full potential in capturing the interplay between idioms,

culture and cognition.

5. Conclusion

The present work focused on the distinction between idiom decomposability and transparency, two key variables for the analysis of the interplay between idioms’ literal and figurative dimensions.

Leveraging a normed lexicon of Italian and English idioms, the impact of decomposability and transparency on idiom meaning recognition was analyzed. The results show that decomposability and transparency make different contributions across the two languages, and suggest that the two variables are distinct from each other. Further research is necessary to explore the motivations behind this cross-linguistic difference, for instance by focusing on the interrelationship among idiom knowledge, decomposability, and transparency.

Following the call for a “cognitive (psycho)linguistics” ([Espinal and Mateu, 2010](#)) in idiom investigation, the study leveraged empirical results to foster interdisciplinary research. In this spirit, it was illustrated how FrameNet and MetaNet are ideal computational tools for modeling idiom decomposability and transparency. Accordingly, this interdisciplinary approach is a first step to bridge the existing gap in idiom research between empirical psycholinguistic investigations, theoretical linguistic analyses, and practical computational applications.

6. Acknowledgements

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7. Ethical considerations and limitations

All participants of the cross-linguistic norming study for the creation of the idiom lexicon provided informed consent and were fairly compensated for their time and involvement.

As already pointed out in the text, one major limitation of the study is the high average degree of idiom objective knowledge in the dataset. Therefore, follow-up research based on controlling the degree of idiom knowledge through the creation of ad-hoc idiomatic expressions has been suggested.

One additional limitation stems from the very nature of norming studies, in which participants are asked to assess certain linguistic variables. Such a task requires some degree of training through very specific instructions. This can be cognitively demanding for participants, and data are elicited in a contrived manner. For this reason, more indirect methods for measuring decomposability and transparency should be devised for future research, possibly with idioms in context rather than in isolation.

The suggested idiom analysis should be extended to other and different types of idioms. Just as an example, there are idioms whose transparency is not justified by metaphors. In this case, the literal-figurative frame-to-frame relation would rather be motivated by metonymies or encyclopedic knowledge.

Finally, the inherently limited nature of resources such as FrameNet and MetaNet, which require much manual work, is a further limitation. It has already been mentioned that FrameNet would need additions of new idioms and relations between frames and between FEs to implement the analysis outlined. Yet, these limitations can be viewed as opportunities for pioneering systematic incorporation of more figurative language into the database.

8. Conflict of Interest Statement

The author has no conflicts of interest to declare.

9. Data and Code Availability

The normed lexicon of English and Italian idioms can be found in the [repository of the University of Göttingen](#), and is accessible under the CC BY-NC 4.0 license. The R file with the code of the statistical analysis is available at [this link](#).

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