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Modeling Abstractness and Metaphoricity

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This paper presents and evaluates a model of how the abstractness of source and target concepts influences metaphoricity, the property of how metaphoric a linguistic metaphoric expression is. The purpose of this is to investigate the long-standing claim that metaphoric mappings are from less abstract concepts to more abstract concepts. First, abstractness is modeled using Searle's social ontology and this model of abstractness evaluated using a participant-based measure of abstractness. Second, this model of abstractness is used to determine the direction and distance in abstractness of metaphoric mappings. Direction of abstractness in these mappings is whether the source or target concept is the more abstract. Distance is the difference in abstractness between source and target concepts. Both factors influence metaphoricity, as measured using introspection and a participant-based study of metaphoricity. The results give empirical support for a long-standing claim about abstractness in mappings, but also provide important new details about the nature of metaphoric mappings.

THE IMPORTANCE OF ABSTRACTNESS FOR METAPHORIC MAPPINGS

The idea within cognitive linguistics is that metaphor is a conceptual phenomenon connecting an abstract target concept with a concrete source concept (Lakoff & Johnson, 1980, 1999). There are two versions of this hypothesis: first, that metaphor itself helps to form abstract concepts in the long term via structure mapping from concrete concepts, with lasting influence (the strong version); second, that metaphor helps to alter abstract concepts in the short term via structure mapping from concrete concepts, without lasting influence (the weak version). One of the premises underlying both hypotheses is that words/concepts vary in abstractness. Thus, in both cases the study of metaphor assumes a distinction between abstract and concrete words/concepts.

What is the basis of this distinction and how is it operationalized? The standard approach to studying abstractness is to place words/concepts on a scale ranging between abstractness and concreteness using participant-based methods. There are two main definitions for this scale: first, concreteness can be defined as things that "can be seen, heard, felt, smelled, or tasted" and abstractness defined as things that "cannot be experienced by our senses" (Spreen & Schulz, 1966, p. 460). Alternately, abstractness can be given a taxonomic definition in which "the abstractness of a word or a concept is determined by the number of subordinate words it embraces, provided that these subordinates be known" (Kammann & Streeter, 1971, p. 303; cf. level of abstraction in;

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Torreano, Cacciari, & Glucksberg, 2005). Norm-based research on the abstractness-concreteness scale has produced several dictionaries with words rated for abstractness by a number of participants, so that each word has a rating between 0 and 1 that represents its location on this scale (Altarriba, Bauer, & Benvenuto, 1999; Brysbaert, Warriner, & Kuperman, 2014; Clark & Paivio, 2004; Friendly, Franklin, Hoffman, & Rubin, 1982; Gilhooly & Logie, 1980; Paivio, Yuille, & Madigan, 1968; Spreen & Schulz, 1966).

In computational work, norm-based abstractness ratings have been extended to cover larger dictionaries (e.g., Turney & Littman, 2003). These large-coverage dictionaries can then be applied to a number of applications, including the identification of metaphoric language (cf. Dunn, 2013a). For this task, abstractness is sometimes applied directly as word-level features (Assaf et al., 2013; Dunn et al., 2014; Gandy et al., 2013; Neuman et al., 2013; Turney, Neuman, Assaf, & Cohen, 2011) and sometimes indirectly by defining clusters of words as either abstract or concrete (Shutova, Teufel, & Korhonen, 2013). This computational work continues to rely on a single dimension, with abstractness and concreteness at opposing ends of the same scale. The definition of the scale is ultimately carried over from the norm-based research that produced the initial word-ratings: concreteness can be experienced by the senses and abstractness cannot be experienced by the senses.

This paper argues that, although both the strong and weak versions of conceptual metaphor theory depend upon a distinction between abstract and concrete words/concepts, a principled definition of abstractness versus concreteness is never provided. The purpose of the paper, then, is to develop and provide empirical evidence for such a definition of abstractness versus concreteness and its relation to metaphoricity (the property of how strongly metaphoric a given linguistic metaphoric expression is; Dunn, 2010). The hypothesis is that abstractness can be defined by how much a word/concept depends upon human beings and in what way it depends upon human beings. The definition of dependence upon human beings is drawn from Searle's social ontology (1995, 2010). Given this model of abstractness, the hypothesis is that the direction of abstractness (e.g., from a less abstract to a more abstract concept) and the distance of abstractness (e.g., difference in abstractness between two concepts) both increase the metaphoricity of a given metaphoric expression. This model is focused specifically on source-target metaphors (Dunn, 2015).

The first part of the paper problematizes the one-dimensional definition of abstractness-concreteness given above. The second part investigates the relationship between a multidimensional ontology-based model of abstractness (Dunn, 2014a, 2014b) and a norm-based approach (Brysbaert et al., 2014). The third part formulates a constraint on the direction of mappings using this ontological definition of abstractness. The fourth part investigates the relationship between abstractness and metaphoricity using a norm-based definition of metaphoricity (Dunn, 2014a, 2014b, 2015). The fifth part considers how this model of abstractness and metaphoricity relates to existing work on image-schemas, primary metaphors, resemblance versus non-resemblance metaphors, and emergent features.

TOWARDS A DEFINITION OF ABSTRACTNESS

The traditional definition of abstractness is focused on the senses: abstract concepts cannot be experienced by the senses while concrete concepts can be. This definition has been implemented as a scale (in norm-based research) and as a dichotomy (in intuition-based research; e.g.,

conceptual metaphor theory). There are two problems with this definition. The first problem is that most concepts contain elements that can be experienced by the senses alongside elements that cannot be experienced by the senses. For example, the concept *"POLICEMAN"* combines physical information about the physical characteristics of policemen with nonphysical information about the social role of policemen. More specifically, words/concepts can be incapable of being experienced by the senses either (1) because of their ontological fact status (e.g., *"IDEA,"* which is a singular-intentional-mental-state) or (2) because of embedded function information (e.g., *"policeman,"* which is a physical object that has been assigned a function not accessible to the senses).

The second, related, problem is that this traditional definition imagines a discernible distinction between concepts that refer to external reality (the physical world, available to the senses) and those that refer to internal reality (the mental world, with no real ontological status). This dichotomy is too simple. As Searle says, "The world of Supreme Court decisions and of the collapse of communism is the same world as the world of the formation of planets and of the collapse of the wave function in quantum mechanics" (1995, p. 120). In short, the distinction between words/concepts available to the senses and those not available to the senses is not possible in most cases because concepts contain both physical and nonphysical information. Instead of a simple dichotomy, we need a multidimensional model of abstractness.

This section argues that the definition of abstractness versus concreteness should not be based on the degree to which a word/concept is available to the human senses, but rather on the degree to which a word/concept depends for its existence on human beings. There are two properties that describe the dependence of a word/concept on human beings: fact-status and function-status.[1]

Fact-Status

The first portion of Searle's social ontology (1995, 2010) is fact-status, a property that transitions from the purely physical to the purely social. Some concepts refer to things that exist in the external world. These brute-physical-facts do not depend upon human consciousness and are the prototypical concrete concepts: *"TREE," "BIRD," "WATER," "MOUNTAIN,"* etc. These sorts of concepts are not problematic for the traditional definition of abstractness.

There are, however, concepts with a different ontological source: mental-facts that depend to some degree on human consciousness. In other words, these concepts are created by humans. The first of these mental-facts are non-intentional sensations: *"PAIN," "HUNGER," "TIREDNESS."* Opposed to this are intentional-mental-facts*: "DESIRE," "IDEA," "BELIEF," "IMAGINATION."* Intentionality here is defined by Searle as "that capacity of the mind by which it is directed at, or about, objects and states of affairs in the world, typically independent of itself" (2010, p. 25). Intentional-mental-facts "are always about, or *refer* to, something" (25) while non-intentional-mental-facts are sensations or perceptions that do not

[1]It should be noted that abstractness versus concreteness is a different property than level of abstraction (e.g., Glucksberg & Keysar, 1990; Torreano et al., 2005) in that it is a constant property of words/concepts. Level of abstraction, on the other hand, is a property of uses of words/concepts, made important because words/concepts often appear in metaphoric uses that differ in abstractness from their canonical forms.

refer to something outside the mind. While non-intentional-mental-facts exist only in the individual, these intentional-mental-facts can exist either in individuals or in groups of individuals. Thus, many concepts are cultural and their existence depends upon being shared among many individuals. Collective-intentional-mental-facts are things that exist only if many individuals believe or accept that they exist: *"TREATY," "GOVERNMENT," "SCHOOL," "SATIRE," "BASEBALL."*

We thus have a distinction between physical-facts and mental-facts, a distinction between non-intentional and intentional mental-facts, and a distinction between singular and collective intentional-mental-facts. In terms of the abstract-concrete scale, physical-facts (*"ROCK," "FLOWER," "RAIN")* are the prototypical concrete concepts. Non-intentional-mental-facts (*"DESPAIR," "ANXIETY," "THIRST") A*re the most concrete mental-facts, in that they exist only within individuals and can be experienced unintentionally as a sort of mental phenomenon. Singular intentional-mental-facts (*"LEARN," "IDEALIZE," "PONDER")* are the next most abstract, in that these concepts still require only a single individual in order to exist. Collective intentional-mental-facts (*"CAMPAIGN," "LITIGATION," "IMMIGRATION")*, on the other hand, cannot exist unless a group of individuals believes or accepts that they exist, so that their source is even more dependent on human beings.

Function-Status

The second relevant property of concepts is the function information that they contain. As Searle argues, function information is inherently ontologically subjective, even when it is embedded in physical-facts: "This consequence follows from the observer-relative character of all functional attributions" (1995, p. 123). The function-status of a concept refers to this embedded function information, to the purpose of a concept as defined by humans: "[A] function is a cause that serves a purpose. And the purposes have to come from somewhere; in this case, they come from human beings" (2010, p. 59). This means, in other words, that function information is abstract because it depends upon humans for its existence, and, at the same time, even concepts referring to physical-facts can contain abstract and human-dependent function information.

Many concepts, of course, contain no function information at all: *"ROCK," "TREE," "DIRT," "GRASS."* These concepts are again the prototypical concrete concepts. Other concepts contain function information that is nevertheless not dependent on humans. These non-agentive functions, or natural functions, are things like *"HEART"* (purpose: to pump blood), *"DIGESTION"* (purpose: to convert food to energy), *"BREATHE"* (purpose: to intake oxygen). These functions are performed on their own without human intervention. Thus, these are less concrete than functionless concepts, but remain mostly concrete. Non-agentive functions add purpose information to causal information, which allows these concepts to be evaluated according to how well they achieve their purpose (Searle, 2010, p. 59).

On the other hand, though, many concepts contain function information that does depend entirely upon human consciousness. These are agentive functions, which contain human-centered information about how these concepts are used by or for humans. Causal-agentive-functions are those in which the function is performed as a result of the essential properties of the concept itself: *"HAMMER," "CAR," "CLOTHING," "FOOD."* These are concepts that are used for

a particular purpose by humans and that thus embed this functional-information. Institutional-agentive-functions are those in which the function is performed not by the object in question but only by the consent of some group of humans: *"TREATY," "MONEY," "EMPLOYMENT," "MARRIAGE."* These functions are attached by humans to concepts and are performed only when humans believe or accept that the functions have been performed.

We thus have another hierarchy: concepts with no function information (*"GRAY," "SOUR," "BEACH," "ATOM"*) are the most concrete, followed by non-agentive functions (*"EYE," "DOG," "SUNLIGHT," "VOLCANO"*). Causal-agentive-functions are next most abstract (*"DOGSLED," "UNDERWEAR," "TROMBONE," "CIGAR")* in that much of the definition of the physical object comes from how humans use that object. The most abstract are institutional-agentive-functions (*"POLICE," "NOVELIST," "PROTEST," "ELECTION"*) because much of the definition of these concepts comes from their use by humans and yet that use is a matter of human convention and acceptance (e.g., an election is not performed unless a group of humans believes or accepts that an election has been performed).

Two-Dimensions of Abstractness

This provides us, then, with a two-dimensional scale of abstractness: fact-status and function-status together describe any given concept and contribute to the abstractness of that concept. Abstractness in this sense is defined as the degree to which a concept depends upon human beings for its existence. Because there are two dimensions of abstractness, there are relationships between the dimensions. For example, the set of physical-facts varies in abstractness according to the function-status of each concept.

There are, of course, patterns in the relationships between fact-status and function-status. Non-intentional-mental-facts do not usually contain function information because they are not under human control and thus cannot be used for a given purpose. Collective-intentional-mental-facts, on the other hand, which exist only when a group of humans accepts that they exist, almost always contain function information. These concepts are created in order to perform functions and usually have causal or institutional function information. Physical-facts more often have non-agentive or causal functions, if any, because physical items can actually be used to perform many tasks; a smaller number of institutional functions are also present, however (e.g., *"PARKING METER," "SCHOOLYARD," "FLAG"*).

The first consequence of this two-dimensional definition of abstractness is that sense-experience, while involved, is not the main predictor of abstractness. Thus, this is a theory of why certain concepts are considered more abstract than others. We expect differences in norm-based abstractness to follow differences in fact-status and function-status.

The second consequence of this two-dimensional definition of abstractness is that we see a continuum between physical and nonphysical concepts, so that, as Searle argues, planets and Supreme Court decisions can be seen as part of the same world, the same ontology. This is because purely physical objects like *"CARS"* can have function information and because there is a hierarchy of types of mental-facts and types of functions: a continuum, not a dichotomy (as in the presumed distinction between abstract and concrete concepts in conceptual metaphor theory).

TABLE 1
Annotating for Fact-Status

1	(A) Does the concept depend strictly upon definition (e.g., *"DEDUCTION"*)? (B) Does the concept exist only within a formal system (e.g., *"INTEGER," "INTEGRAL"*)? (C) Does the concept exist in multiple domains (such as *"PHYSICAL," "MENTAL," "SOCIAL"*; e.g., *"ADEQUATE"* or *"INCOMPLETE"*)? If yes to any: fact-status is abstract If no to all: continue to 2
2	(A) Can the concept be experienced by the senses (sight, sound, smell, touch; e.g., *"TABLE"* vs. *"IDEA"*)? (B) If yes, is the concept distinguished from similar concepts by characteristics that can be experienced by the senses (e.g., *"TABLE"* vs. *"CHAIR"* as opposed to *"JUDGE"* vs. *"POLICEMAN"*)? If Yes to both: fact-status is physical If no to either: continue to 3
3	(A) Can the characteristics that distinguish the concept from similar concepts exist in the mind of a single individual in isolation (e.g., *"IDEA"* vs. *"LAW"* and *"BELIEVE"* vs. *"MARRIAGE"*)? If yes: fact-status is singular-mental If no: continue to 4
4	(A) Do the characteristics that distinguish the concept from similar concepts depend upon or exist only when common to the minds of a group of individuals (e.g., *"WIFE"* and *"WIDOW"*)? (B) Does the concept exist only if its existence is accepted or acknowledged by a group of individuals (e.g., *"LAW," "TREATY," "MONEY"*)? If yes to either: fact-status is collective-mental If no: restart decision tree

Decision Tree for Annotating Abstractness

The annotation of fact-status and function-status can be performed using the respective decision trees presented in Table 1 and Table 2. For each concept/word, answer the questions until a categorization is reached. One important criterion that is repeated in the decision trees is the way in which a given concept is distinguished from similar concepts. Take, for example, a series of concepts referring ultimately to human beings: *"WIDOW," "JUDGE," "BUTCHER," "GIANT."* The essential characteristics of these concepts is not what they refer to (which in this case is a physical object) but rather the imposed or sense-based properties that distinguish them from one another. The first two are collective-mental concepts (*"WIDOW," "JUDGE"*) in that it is not possible to define either concept except against a backdrop of a larger social frame (cf. Lakoff, 1987). The second has a causal function in that it is a series of actions that distinguishes *"BUTCHER"* from other professions. Finally, *"GIANT"* is simply a physical fact in that it is a description of a human as a physical object.

While norm-based approaches to abstractness focus on the referent of a word/concept, this approach focuses on the sense of that word/concept. This is because language and the conceptual system are not dealing with the referenced items directly but rather with their representations in the mind. Thus, these decision trees focus on determining the properties of the sense without considering necessarily the physical properties of the referent.

TABLE 2
Annotating for Function-Status

1	(A) Does the concept contain or carry by default any information about the purpose, function, use, or role of the concept (e.g., not *"CLAY"* or *"MEADOW"*)? If no: function-status is no-function If yes: continue to 2
2	(A) Is the concept's purpose, function, use, or role carried out without human intervention (e.g., bees make honey and cows produce milk)? (B) Does the concept have a natural cause-and-effect relationship that is interpreted by humans as a purposeful act that can, for example, go well or go badly (e.g., the heart pumps blood)? If yes to either: function-status is non-agentive If no to both: continue to 3
3	(A) Is the purpose, function, use, or role of the concept carried out by means of or according to the intrinsic properties of the concept itself (*"HAMMER"* vs. *"STOP-SIGN"*)? If yes: function-status is causal-agentive If no: continue to 4
4	(A) Is the purpose, function, use, or role of the concept carried out only by the consent of a group of individuals (e.g., *"MARRIAGE"* and *"TREATY"*)? (B) Is the purpose, function, use, or role of the concept performed only when a group of individuals accepts or acknowledges that it has been performed (e.g., *"CHRISTENING," "BAPTISM"*)? If yes to either: function-status is institutional If no to both: restart decision tree

Comparing Approaches to Abstractness

The social ontology approach to abstractness is compared with earlier norm-based approaches in Table 3. An example from each attested category of fact-status and function-status is shown with its normalized rating from Spreen & Schulz (1966), Friendly et al. (1982), and Brysbaert et al. (2014). The purpose of this table is not to undertake a large-scale comparison of the two basic approaches, which is undertaken below, but rather to show the nuances that the social ontology approach to abstractness allows. The table goes from the predicted least concrete concepts at the top to the predicted most concrete concepts at the bottom. The three sets of concreteness ratings generally follow the same order, with some significant deviations.

The main thing to observe about Table 3 is that norm-based ratings, based on the standard of whether a concept is available to the senses, do not make distinctions based on the source of abstractness or the reason that a given concept is abstract. For example, in the Friendly et al. norms, *"LISTENING"* and *"MARRIAGE"* have the same concreteness value, although one is inherently an individual act and the other an inherently social or collective act. This lack of discrimination leads to a situation in which most concreteness values fall into a limited range. Figure 1 shows concreteness values from Brysbaert et al. by frequency. These values have been rounded to the nearest whole number to make the frequency counts more easily visualized and then normalized (e.g., 20% means that these concepts have 20% of the possible concreteness). We see that over 60% of the concepts are rated to be between 20% and 40% of possible concreteness. Such a peak is perfectly acceptable, except that in this case we need to make meaningful

TABLE 3
Alternate Operationalizations of Abstractness, Normalized

Fact-Status	*Function*	*Spreen*	*Friendly*	*Brysbaert*
Abstract	None	0.422 (percent)	0.414 (array)	0.330 (probability)
Mental: Non-Intentional	None	0.344 (anger)	0.414 (happy)	0.430 (cheerless)
Mental: Intentional: Sing.	Causal	0.408 (choice)	0.542 (review)	0.468 (interpret)
Mental: Intentional: Sing.	None	0.324 (memory)	0.600 (listen)	0.480 (remember)
Mental: Intentional: Coll.	Institutional	0.461 (crime)	0.600 (marriage)	0.614 (graduate)
Mental: Intentional: Coll.	Causal	0.714 (tribe)	0.942 (mayor)	0.680 (decorate)
Mental: Intentional: Coll.	None	0.857 (aunt)	0.900 (widow)	0.758 (vegan)
Physical	Institutional	0.948 (uniform)	0.842 (temple)	0.972 (cathedral)
Physical	Causal	0.987 (desk)	0.957 (basket)	0.760 (knife)
Physical	Non-Agentive	0.948 (bee)	0.928 (feather)	0.936 (liver)
Physical	None	0.935 (dust)	0.842 (meadow)	0.962 (bay)

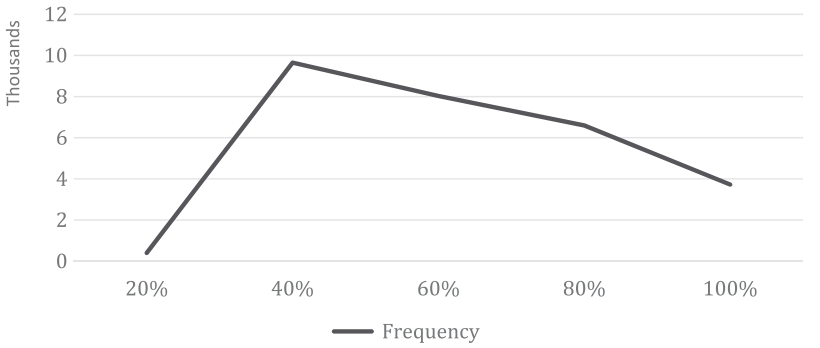

FIGURE 1 Rounded normalized concreteness values from Brysbaert et al.

distinctions. This small range of frequent values ends up mingling many types and sources of abstractness together.

In other words, then, the norm-based measures represent abstractness but do not attempt to explain it. The argument in this paper, however, is that abstractness is related to metaphoricity not as a property in and of itself but rather as a function of the dependence on human beings

that causes abstractness. Thus, abstractness covaries with metaphoricity rather than causing metaphoricity. This is the essential difference between these approaches to operationalizing abstractness: existing approaches are measures of abstractness and the current approach is a model of abstractness. The goal is to explain why naïve participants share judgements that some concepts are more abstract than others.

Summary of Abstractness as Dependence on Human Beings

In summary, then, this allows a theory of abstractness that goes beyond brute definitions that rely on a concept being available to sense experience or require a strict distinction between the physical and the nonphysical. As Searle argues, humans "have a capacity to create a reality by representing it as existing" (2010, p. 89). Concepts are abstract to the degree that they are created or made to exist by human beings, whether by single humans or by groups of humans. The degree to which a concept is created by human intentionality (fact-status) and the human-centered purpose embedded in a concept (function-status) both contribute to abstractness in this model.

ABSTRACTNESS RATINGS AND SEARLE'S SOCIAL ONTOLOGY

The first experiment compares traditional word abstractness ratings (a measure of abstractness) with a multidimensional definition of abstractness based on Searle's ontology (a model of abstractness). The ratings from Brysbaert et al. (2014) are used, as they are the largest and most recent set of rated words. A subset of the 40,000 rated lemmas is categorized using Searle's ontology, so that each word has two properties: fact-status and function-status. The hypothesis is that both of these ontological properties contribute to abstractness and that various categories within these properties are more abstract than others, as discussed above.

A stratified random sample was taken, with 2,000 each of adjectives, nouns, and verbs included in the study. The ratings from Brysbaert et al. include information about the number of participants who did not know a given word and the number of participants who rated a given word. Only words known by all participants and rated by at least 26 participants were included in the study. Thus, the study consists of a total of 6,000 lemmas with norm-based abstractness ratings categorized using the two-dimensional ontological approach to abstractness.

Annotation began with a rough distinction between concept domains, at a very high level: *"PHYSICAL," "MENTAL," "SOCIAL,"* and *"ABSTRACT"* concepts. *"ABSTRACT"* concepts are those which do not fit into the other domains or which are ambiguous between domains. This domain ambiguity is assumed to reflect a more abstract definition that covers both domains. For example, *"deteriorating"* could be applied to *"PHYSICAL," "MENTAL,"* or *"SOCIAL"* concepts. It is a member of the abstract domain, then, because the concept itself defines a status of conditions that could apply in multiple domains. The abstract domain is not a part of Searle's taxonomy, being outside the consideration of physical-facts and mental-facts, and is added here as a third type of fact-status. The initial annotation also categorized words according to their event-status: *"OBJECT," "STATE," "EVENT."* The purpose of both of these initial annotations is to prepare words for the more precise annotation according to fact-status and function-status.

TABLE 4
Examples of Categorization

Word	*Fact-Status*	*Function-Status*	*#*	*Abstr.*	*Std. Dev.*
probability	Abstract (No Fact-Status)	None	953	2.599	1.242
unhappy	Mental: Non-Intentional	None	430	2.176	1.179
watch	Mental: Intentional: Singular	None	146	2.066	1.142
study	Mental: Intentional: Singular	Causal	158	2.320	1.209
widow	Mental: Intentional: Collective	None	37	3.097	1.118
recess	Mental: Intentional: Collective	Causal	711	2.821	1.237
forge	Mental: Intentional: Collective	Institutional	1,180	2.580	1.224
clay	Physical	None	945	3.471	1.219
knee	Physical	Non-Agentive	288	4.025	0.972
telescope	Physical	Causal	1,038	3.956	1.042
cathedral	Physical	Institutional	114	4.271	0.946

TABLE 5
Abstractness by Fact-Status

Fact-Status	*#*	*Avg. Abstr.*	*Avg. Std. Dev.*
Abstract (No Fact-Status)	953	2.599	1.242
Mental: Singular	734	2.185	1.178
Non-Intentional	*430*	*2.176*	*1.179*
Intentional	*304*	*2.198*	*1.177*
Mental: Collective	1,928	2.679	1.228
Physical	2,385	3.788	1.099

Fact-status consists of five categories: brute physical-facts, non-intentional mental-facts, singular intentional mental-facts, collective intentional mental-facts, and abstract-facts. These are defined as discussed above.

Function-status consists of four categories: no function information, non-agentive functions, causal agentive functions, and institutional agentive functions. These are defined as discussed above.

To illustrate this classification scheme, Table 4 provides fact-status and function-status for each attested category combination along with the number of items with this categorization, the average abstractness value, and the average standard deviation in individual abstractness ratings from Brysbaert et al. (2014).

First, we look at abstractness ratings by fact-status, as shown in Table 5. The abstract-fact category (not part of the hierarchy proper) has an average abstractness rating of 2.599. Excluding this category, we see a progression from singular-mental-facts (2.185) to collective-mental-facts (2.679) to physical-facts (3.788).[2] The jump from mental-facts to physical-facts is the largest, as we would expect given that the distinction between singular and collective mental-facts is more

[2]These ratings reflect concreteness, so that higher numbers are more concrete and lower numbers more abstract.

TABLE 6
Abstractness by Function-Status

Function-Status	*#*	*Avg. Abstr.*	*Avg. Std. Dev.*
None	2,511	2.830	1.216
Non-Agentive	288	4.025	0.972
Causal	1,907	3.397	1.129
Institutional	1,294	2.729	1.199

fine-grained than the distinction between mental-facts and physical-facts. The two subcategories of singular-mental-facts, intentional versus non-intentional, are quite close and perhaps indistinguishable. Using a one-way ANOVA test with abstractness as the dependent variable and with fact-status defining five groups (i.e., with singular-mental-facts divided into intentional and non-intentional), the hypothesis that the groups come from the same population is rejected with a significance of $p < 0.0001$. Thus, we have both an intuitive hierarchy of average abstractness ratings across fact-status categories as well as a statistically very significant difference between the groups formed by fact-status. Thus, fact-status is significantly related to norm-based abstractness as measured by Brysbaert et al. (2014).

Next we turn to function-status, as shown in Table 6. Here we expect a hierarchy in abstractness from least function-information (no function) to non-agentive to causal to institutional functions. The no function category, however, stands outside the expected hierarchy (2.830). This is likely because it becomes a miscellaneous category, describing the absence of function rather than a particular type of function. The other function-types, however, fall into the expected hierarchy: institutional functions are the most abstract (2.729), followed by causal functions (3.397), and finally by non-agentive functions (4.025). Non-agentive functions are expected to be the least abstract because they are natural functions present without human intervention and thus do not depend upon human consciousness to define them (only to interpret causes as purposes). Using a one-way ANOVA as above, with four groups consisting of each function-status and abstractness as a dependent variable, the hypothesis that the groups come from the same population is rejected with a significance of $p < 0.0001$. Thus, function-status is also significantly related to norm-based abstractness as measured by Brysbaert et al. (2014).

This section has shown that both fact-status and function-status are significantly related to norm-based abstractness and, further, that the categories largely conform to the expected hierarchies (the two miscellaneous categories, abstract-fact and no-function being the exceptions). This supports the hypothesis that abstractness depends on how human-dependent or consciousness-dependent a particular word/concept is. The next task is to ask how abstractness defined in this way relates to metaphoricity.

FACT-STATUS, FUNCTION-STATUS, AND METAPHORIC MAPPINGS

The assumption within conceptual metaphor theory is that abstract concepts serve as targets and concrete concepts as sources within metaphoric mappings. Given the definition of abstractness

TABLE 7
Hierarchies in Abstractness

Type	*Hierarchy*
Fact-Status	Physical > Singular-Mental > Collective-Mental
Function-Status	Non-Agentive > Causal-Agentive > Institutional-Agentive

as the degree to which a concept depends upon human beings for its existence and the hierarchy of categories discussed above and repeated in Table 7, we can hypothesize the following rule: target concepts equal to or above source concepts on the abstractness hierarchy in both fact-status and function-status produce acceptable metaphoric expressions with low metaphoricity; target concepts below the source concepts on the abstractness hierarchy for either fact-status or function-status create more highly metaphoric expressions that may pass beyond the threshold of acceptability (e.g., become unacceptable as metaphoric expressions). We first test this constraint using introspection and then, in the next section, turn to a participant-based study of metaphoricity to study the influence of distance between source and target concepts on the abstractness hierarchy.

This constraint can be viewed as a further generalization of constraints on distance between domains (e.g., Chiappe, Kennedy, & Smykowski, 2003; Katz, 1989; Tourangeau & Sternberg, 1982) in that the definition of a domain here is one of ontological-status or abstractness and not based on content, subject, or specific mappings. Further, it is a generalization on Katz's (1989) study of preferences for concrete source concepts because it focuses on relative positions on an abstractness scale of both source and target concepts rather than on fixed positions.[3] Importantly, non-reversibility is only hypothesized to be a property of source and target concepts given differences in abstractness (i.e., not influencing specific mappings except as predicted by differences in abstractness) and the penalty for mapping from more abstract to less abstract concepts is increased metaphoricity rather than unacceptability (cf. Barnden, Glasbey, Lee, & Wallington, 2004; Campbell & Katz, 2006).

This hypothesis will be tested below using introspective linguistic analysis of minimal pairs (e.g., sentences whose metaphoric mappings differ only in the direction of mapping). First, however, it is helpful to offer a definition of metaphoricity. Metaphor-in-language is an expression of metaphor-in-thought. As such, utterances can be metaphoric when their meaning derives to some extent from metaphor-in-thought. At the same time, metaphoric utterances are not equally metaphoric: some are highly or markedly metaphoric while others are mildly or unmarkedly metaphoric. There is often no clear boundary between low metaphoricity utterances and non-metaphoric utterances, which makes it difficult to model metaphor-in-language in such a way that linguistic metaphoric utterances can be easily identified. The metaphoricity of an utterance depends on several factors, including how much of the utterance depends on metaphor-in-thought and on properties of the metaphor-in-thought itself (Dunn, 2010). Some metaphoric utterances have stable interpretations (for example, Dunn, 2013b; Kintsch & Bowles, 2002; Utsumi, 2005) and others do not (e.g., Davidson, 1978) and it is possible to predict to some degree

[3] It should be noted that metaphoricity, as defined here, is not the same as aptness as used by Katz.

both metaphoricity and the stability of metaphoric interpretations, which is closely related to metaphoricity (Dunn, 2013b, 2015). The question here, however, is how we can use introspection to determine the level of metaphoricity of an utterance.

For our purposes we can identify five more or less objective (epistemically: Searle, 1995) criteria for distinguishing high and low metaphoricity utterances. These criteria are not intuitions themselves (e.g., such as grammaticality or acceptability), but products of introspection that can be reproduced across individuals (e.g., the participant-based study of metaphoricity below). Most examples used as illustrations come from the participant-based study of metaphoricity below (the exceptions being 5C and 5D). These criteria are markers of metaphoricity or properties of high metaphoricity utterances. Any given utterance does not need to exhibit all of these properties to have high metaphoricity, but the presence of each is a sign of high metaphoricity in itself.

First, high metaphoricity utterances show instability of interpretations across contexts (including both linguistic and discourse contexts). In other words, the meaning of high metaphoricity utterances is markedly more unstable than the meaning of other types of utterances. For example, the utterances in (1A) and (1B) were rated as mildly metaphoric while those in (1C) and (1D) were highly metaphoric. The interpretation of (1A) is consistent across contexts, as is that of (1B). For (1C), however, there is a subtle change in interpretation: if the speaker in question is apologizing for a past transgression, then "buying" his statement means a passive acceptance. However, if the speaker is advocating a particular policy position, then "buying" his statement means a more active pursuit of that same position. Similarly, (1D) could mean that the theory is unpopular and rarely discussed, or it could mean that a particular piece of evidence has come forward to disprove the theory. These constitute two different interpretations, a sign of higher metaphoricity.

(1A) "*My sister holds several misleading beliefs.*"

(1B) "*He tried to undermine her belief in religion.*"

(1C) "*I really buy what he said during the last debate.*"

(1D) "*Their theory was dead and buried.*"

Second, high metaphoricity utterances have less precise inferences. The precision of inferences can be operationalized as the number of inferences that can be canceled by context: more uncancelable inferences is a marker of lower metaphoricity (e.g., Dunn, 2013b). For example, the lower metaphoricity utterances in (2A) and (2B) have a core number of un-cancelable inferences: for example, a leading theory has the most adherents and has more supporting evidence. On the other hand, the inferences of the higher metaphoricity utterances in (2C) and (2D) are more often cancelable. For example, the idea in (2C) may have been regained, if specified by context, and the answer in (2D) may be partially visible, again if specified by context. But that these inferences depend more upon context (i.e., that they can be canceled by the context) is a trait of higher metaphoricity utterances.

(2A) "*Evolution is the leading biological theory.*"

(2B) "*All the credit lies with him, and much of the blame as well.*"

(2C) "*The idea slipped through my fingers*."

(2D) "*The answer could be right in front of us*."

Third, utterances that contain both a metaphor and the reasoning/inferences of that metaphor are more metaphoric than those that contain only the metaphor itself. For example, the utterances in (3A) and (3B) are metaphoric expressions, but do not contain metaphoric inferences like those in (3C) and (3D). The presence of metaphoric inferences is thus also a marker of higher metaphoricity.

(3A) "*We've got to explore this problem further*."

(3B) "*What view does he uphold on the health care debate?"*

(3C) "*I'm just in a fog today and I don't know what is going on*."

(3D) "*His clothes were loud and shouted his bad taste to the world*."

Fourth, high metaphoricity utterances require more context (in this case, linguistic context) for the metaphor to be interpretable or comprehensible. For example, the low metaphoricity utterances in (4A) and (4B) do not require linguistic context or specific instances of concepts (e.g., they contain pronouns) to be interpretable. However, the high metaphoricity utterances in (4C) and (4D) do require more context: a specific subject ("economic stimulus package") and a specific outcome ("run out of cash"). Without these specified, the interpretation is very dependent on the discourse context. Thus, metaphoric utterances that require specific pieces of information to be supplied or require larger linguistic context show a marker of high metaphoricity.

(4A) "*He deserves credit for his efforts*."

(4B) "*I'm holding you accountable*."

(4C) "*The economic stimulus package gave our society a shot in the arm.*"

(4D) "*Your boyfriend is just sponging off of you until you run out of cash*."

Fifth, more conventional, more frequent, and more familiar expressions of metaphors have lower metaphoricity. This property is not quantified in this analysis. For example, the low metaphoricity utterance in (5A) is a more conventional expression of the same metaphor present in the higher metaphoricity utterance in (5C). Similarly, the low metaphoricity utterance in (5B) differs only in conventional expression from the higher metaphoricity utterance in (5D). Thus, another marker of high metaphoricity is an unconventional, less frequent, or less familiar linguistic expression.

(5A) "*I shot down her arguments."*

(5B) "*I really buy what he said during the last debate*."

(5C) "*I machine-gunned her arguments*."

(5D) "*I really put my money in what he said during the last debate*."

These five properties of or markers for metaphoricity can be annotated using the questions in Table 8. These questions are guides for annotating metaphoricity, and do not constitute a model of metaphoricity as such.

TABLE 8
Questions for Annotating for Metaphoricity

1	Does the utterance have unstable interpretations across linguistic and discourse contexts? If yes: higher metaphoricity
2	Can many of the inferences of the utterance be easily negated or canceled by context? If yes: higher metaphoricity
3	Does the utterance include both a metaphoric mapping and inferences of that mapping? If yes: higher metaphoricity
4	Does the utterance require specific information or more context to be comprehensible? If yes: higher metaphoricity
5	Is the linguistic expression of the metaphor unconventional, unfamiliar, or infrequent? If yes: higher metaphoricity

The Fact-Status Hierarchy

First we look at the predicted hierarchy for source and target concepts using fact-status, focusing on adjacent positions in the hierarchy and providing counterfactuals for each case. The purpose of focusing on adjacent positions (e.g., singular vs. collective mental-facts) is to test the hardest cases, those with the smallest differences in abstractness.

Physical and Singular-Mental

According to the hierarchy, singular-mental-facts are more abstract than physical-facts. The first case examined in (6) involves a physical-fact and a singular-mental fact without function information: *"WEED"* and *"PASSIONS."* The posited direction of mapping produces the acceptable metaphoric expression in (6B) and the reverse direction produces the unacceptable metaphoric expression in (6C). In this framework, the metaphoric expression is unacceptable because its level of metaphoricity is too high.

(6A) Source: *"weed"* (physical-fact; no-function)

(6A') Target: *"passions"* (singular-mental-fact; no-function)

(6B) *"The passions grow up like weeds wherever the soul is left untended."*

(6C) * *"The weeds in our flower garden need to be brought up in confession."*

Moving to concepts with a causal function, the case examined in (7) involves the concepts *"CAMERA"* and *"OBSERVING."* The mapping from physical to singular-mental in (7B) produces an acceptable metaphoric expression, while the reverse in (7C) again produces an acceptable metaphoric expression. In this case the reverse mapping is acceptable but results in high metaphoricity.

(7A) Source: *"camera"* (physical-fact; causal-function)

(7A') Target: *"observing"* (singular-mental-fact; causal-function)

(7B) *"She watched his walk and stored the images in her head for later."*

(7C) *"The camera was her eyes and the roll of film her only memory."*

Finally, the case in (8) examines further examples with a causal function: the concepts *"TELESCOPE"* and *"IDEA*." The mapping from less abstract to more abstract in (8B) is acceptable and not highly metaphoric. The reversed mapping, on the other hand, is acceptable in some contexts but remains, as expected, more metaphoric than (8B).

(8A) Source: "*telescope"* (physical-fact; causal-function)

(8A') Target: *"idea"* (singular-mental-fact; causal-function)

(8B) *"Their idea of computational analysis was a telescope that allowed them to view distant data points in close-up detail."*

(8C) *"The Hubble telescope came into his head suddenly and resolved the unsolvable problem."*

Singular-Mental and Collective-Mental

The next link in fact-status is between singular-mental and collective-mental concepts. This distinction offers a new level of precision over existing analyses. The basic difference between singular and collective mental facts is that collective mental facts are social in nature: a group of human beings must believe or accept or entertain the concept before it can be said to exist. In case (9), *"KNOWLEDGE"* can exist in the individual but *"MARRIAGE"* is a social relationship that must be believed to exist by many before it can exist. The mapping from least abstract to most abstract in (9B) is an acceptable metaphoric expression. The reverse mapping in (9C), which maps from *"MARRIAGE"* to *"KNOWLEDGE,"* is also acceptable but with higher metaphoricity. In these cases, function-status is difficult to keep constant given that collective-mental-facts usually have institutional functions while singular-mental-facts do not.

(9A) Source: *"knowledge"* (singular-mental-fact; no-function)

(9A') Target: *"marriage"* (collective-mental-fact; institutional-function)

(9B) *"A good marriage takes time, study, and teaching to mature."*

(9C) *"His knowledge of tax law stayed with him despite his many adulteries with corporate law and only occasionally nagged him about his misdoings."*

A similar case is found in (10) with the concepts *"WRITING"* and *"BANKRUPTCY."* The mapping from least to most abstract in (10B) is an acceptable metaphoric expression, but the reverse in (10C) has high metaphoricity. The case in (11) uses the concepts *"PREMISES"* and *"DETECTIVES." "PREMISES"* can be maintained by individuals, but the definition of a *"DETECTIVE"* is a collective-mental-fact and the function of a *"DETECTIVE"* (e.g., finding and accusing suspected criminals) is not achieved unless a group accepts that it has been performed. The mapping from least to most abstract in (11B) is acceptable and not highly metaphoric, but the reverse mapping in (11C), while acceptable, is highly metaphoric.

(10A) Source: *"writing"* (singular-mental-fact; no-function)

(10A') Target: *"bankruptcy"* (collective-mental-fact; institutional-function)

(10B) *"Bankruptcy allows you to rewrite your past and try again."*

(10C) *"Writing is a last resort for discharging your mental and emotional debts."*

(11A) Source: *"premises"* (singular-mental-fact; causal-function)

(11A') Target: *"detective"* (collective-mental-fact; institutional-function)

(11B) *"The police detectives are the premises and the courts are the reasoning and conclusions."*

(11C) *"Your premises are corrupt detectives that can pin the case on whatever conclusion they want."*

The point of the introspective analysis in this section has been to show that the abstractness hierarchy for fact-status influences the metaphoricity of an expression resulting from a metaphoric mapping, with the proviso that some produced mappings are beyond the threshold of acceptability and thus unacceptable as metaphoric utterances. This analysis is an advance over the traditional conceptual analysis in that it allows greater precision with the distinction between singular and collective mental-facts and makes predictions about metaphoricity rather than brute acceptability.

The Function-Status Hierarchy

Second, we look at the predicted hierarchy for source and target concepts using function-status, again focusing on adjacent positions in the hierarchy and again providing counterfactuals for each case. The observations above involving the fact-status hierarchy provide greater precision than traditional analyses within conceptual metaphor theory but remain within the framework. This section looks at differences in function-information that influence metaphoricity but do not fall within the scope of domain mapping as traditionally conceived.

Non-Agentive and Causal

The case in (12) involves the concept *"GROWING"* with a non-agentive function, and the concept *"RECYCLING"* with a causal function. The function information in *"GROWING"* assigns purpose to a naturally occurring causation while the function information in *"RECYCLING"* describes a human-caused process. The mapping from least to most abstract in (12B) produces an acceptable metaphoric expression with lower metaphoricity than the reversed mapping in (12C). In this case the concepts have the same domain (e.g., both are physical-facts) and it is only the abstractness caused by the embedded function information that causes this higher metaphoricity.

(12A) Source: *"growing"* (physical-fact; non-agentive-function)

(12A') Target: *"recycling"* (physical-fact; causal-function)

(12B) *"Recycling allows us to grow new products out of old products."*

(12C) *"Every fall the trees turned in their empty leaves to the recycling center and waited to receive their refurbished leaves in the spring."*

The case in (13) again looks at a non-agentive function (*"DIGEST"*) and a causal function (*"IDEA"*), this time combined with differing fact-status types. The mapping from least to most abstract produces an acceptable metaphoric expression in (13B). The reversed mapping, however, produces the questionably acceptable and highly metaphoric utterance in

(13C). This suggests that combining fact-status and function-status hierarchy reversals further increases the metaphoricity of an utterance. Similarly, the case in (14) involves the concepts *"SLEEPWALKING"* and *"REHEARSE,"* which differ in both fact-status and function-status. The mapping from least to most abstract produces the acceptable metaphoric expression in (14B), but the reverse mapping produces the highly metaphoric and questionable utterance in (14C). This again shows the interactions between both dimensions of abstractness with metaphoricity.

(13A) Source: *"digest"* (physical-fact; non-agentive-function)

(13A') Target: *"idea"* (singular-mental-fact; causal-function)

(13B) *"Ideas take time to digest newly discovered facts into new theories."*

(13C) ?*"My indigestion is an idea that sometimes comes out of nowhere and then leaves as quickly."*

(14A) Source: *"sleepwalking"* (physical-fact; non-agentive-function)

(14A') Target: *"rehearse"* (collective-mental-fact; causal-function)

(14B) *"We will rehearse until we can do all this walking in our sleep."*

(14C) ?*"My younger brother sleepwalked every night, rehearsing for the next day at school."*

Causal and Institutional

We next look at causal and institutional functions and their influence on metaphoricity; examples in this section keep fact-status constant across cases. In the case in (15), *"KIDNAPPING"* has a causal function, in that the purpose of the action is carried out by the action itself; *"ELECTING"* has an institutional function, on the other hand, because the purpose is only carried out if a group of people believes or accepts or acknowledges that it has been carried out. In other words, *"ELECTING"* is something that "we get away with . . . to the extent that we can get other people to accept it. As long as there is collective recognition or acceptance of the institutional facts, they will work" (Searle, 2010, p. 106). *"KIDNAPPING,"* on the other hand, does not require social acceptance in order to occur. In this way, then, *"ELECTING"* is more dependent on human beings and more abstract. The mapping from least to most abstract produces the acceptable metaphoric expression in (15B), but the reverse mapping in (15C) produces an utterance whose metaphoricity is sufficiently high to force a literal interpretation instead (e.g., that the kidnappers are involved in an actual election).

(15A) Source: *"kidnapping"* (collective-mental-fact; causal-function)

(15A') Target: *"electing"* (collective-mental-fact; institutional-function)

(15B) *"They kidnapped the election with campaign contributions and received their ransom later."*

(15C) ?*"The kidnappers campaigned hard to pass their rival gang in the primaries."*

The case in (16) involves the concepts *"STAGE-HAND"* and *"LAWMAKER,"* again differing in function-status but not in fact-status. The mapping from least to most abstract produces the acceptable metaphoric expression in (16B). The reverse mapping, on the other hand, produces the unacceptable metaphoric expression in (16C). Because institutional functions are carried out

only by virtue of being accepted, the function information is unable to map meaningfully onto a concept with a causal function. In the case in (17), the concept *"UNDRESSING"* has a causal function involving the physical purpose of clothing and of removing clothing. *"THEATER,"* however, is a physical-fact whose function is performed only when the cast and audience accept that the actions performed are to be interpreted as fiction. In other words, what separates an actual battle and a staged battle is the shared knowledge and acceptance that the latter is fictional. The mapping from least to most abstract produces the acceptable metaphoric expression in (17B). The reverse mapping produces a highly metaphoric utterance.

(16A) Source: *"stage-hand"* (collective-mental-fact; causal-function)

(16A') Target: *"lawmaker"* (collective-mental-fact; institutional-function)

(16B) *"Members of congress are just stage-hands doing what the big corporations require."*

(16C) * *"The stage-hands passed a bill to change the scene from a forest to a lake."*

(17A) Source: *"undressing"* (physical-fact; causal-function)

(17A') Target: *"theater"* (physical-fact; institutional-function)

(17B) *"Acting in front of audiences leaves you exposed and naked up there on the stage."*

(17C) *"He finished undressing with a dancer's flourish and bowed to the audience in the mirror."*

The introspective evidence in this section has shown that function-status, a second dimension of abstractness, also influences metaphoricity and that the combination of the abstractness hierarchy for fact-status and function-status combine to influence metaphoricity. Further, function-status can influence metaphoricity even when concepts come from the same domain (e.g., mental and physical concepts), showing the importance of function information for metaphor.

Discussion of Direction and Reversibility

The argument above is that the direction of mapping influences metaphoricity, with mappings from more abstract to less abstract concepts increasing metaphoricity but not necessarily producing unacceptable metaphoric expressions. There is, however, no minimum distance in abstractness necessary to produce a metaphor (e.g., there are plenty of metaphoric expressions with a mapping between the same fact-status and function-status, as discussed further below). Approaches to metaphor based on conceptual blending (e.g., Coulson & Matlock, 2001) predict that, because all input spaces are involved in constructing meaning, the direction of mapping should not matter (i.e., there is no *direction*, just blending). It is useful, then, to examine work on the influence of direction of mapping on metaphoricity and metaphor interpretations.

Katz (1989) uses a source concept selection task in order to determine which concepts are preferred as source domains in metaphoric mappings. One dimension that Katz uses is concreteness versus abstractness.[4] Katz found that there was a significant preference for more concrete source

[4]Katz's referential definition of abstractness differs from the sense-based model used here; for example, it does not distinguish between *"HOUSE"* and *"CHURCH"* and *"STORE,"* as all are physical buildings.

concepts; this finding is not directly comparable to the above hypothesis, however, in that we are dealing with relative and not fixed abstractness relations, which presents a more precise model of the influence of abstractness (e.g., beyond the simple constraint of concrete source concepts). Chiappe et al. (2003) find that reversed mappings are less comprehensible than the original non-reversed metaphors, as expected in some cases by the above model in which high metaphoricity expressions become unacceptable (but expected here only in cases where the concepts differ in abstractness). This model is also in line, however, with the findings of Campbell and Katz (2006) that, given with a discourse context, reversed mappings are nearly as interpretable as the original mappings (2% of original mappings and 8% of reverse mappings are uninterpretable with context, compared to 10% and 24% without context; 2006, p. 10). At the same time, understandability or comprehensibility of metaphors was higher in the original direction of mapping than in the reversed direction, as expected in the present model (again, assuming that the source and target concepts differ in abstractness).

Although there are different nuances in the results, the present introspective evidence and the findings of Katz (1989), Chiappe et al. (2003), and Campbell and Katz (2006) show that there is an influence of direction on metaphoric mapping. That influence does not prevent reversed mappings but makes them more metaphoric, a property that leaves some uninterpretable and gives others a wider range of interpretations (e.g., interpretive metaphors; Dunn, 2015). A model such as conceptual blending that sees the input spaces as equal, therefore, seems unable to describe this influence or effect. At the same time, though, the concept of metaphoricity (that some metaphoric utterances are stronger or more metaphoric than others and that there is not a clear boundary between metaphoric and non-metaphoric) fits nicely with the premise behind conceptual blending that metaphoric meaning is not entirely distinct from literal meaning. One difficulty in this discussion is that linguistic metaphoric expressions, the main source of evidence about metaphor-in-thought, are under-analyzed in many frameworks. Thus, the discussion of reversibility of mappings above applies largely to source-target metaphoric utterances (Dunn, 2015), while conceptual blending is better suited to describe modulated metaphoric utterances.

MULTIDIMENSIONAL ABSTRACTNESS AND METAPHORICITY

This section presents a second experiment that looks at the relationship between a participant-based measure of metaphoricity and the two-dimensional ontological model of abstractness discussed above. The purpose of the experiment is to examine the influence of the relationship between source and target concept abstractness on metaphoricity. The introspective evidence examined above dealt with the direction of mapping and showed that mapping from more abstract to less abstract concepts increases the metaphoricity of an utterance, sometimes beyond the threshold of acceptability. This section uses a participant-based measure of metaphoricity to examine a second hypothesis: that metaphoricity also increases within a given direction of mapping (in this case, from less to more abstract concepts) as the distance between source and target concepts in abstractness increases. This is again a generalization of work by Tourangeau and Sternberg (1982) and Katz (1989), in that the definition of distance does not depend upon semantic content. Abstractness as used here is not a matter of elements in the final metaphoric expression (e.g., Mashal, Shen, & Kastel, 2014), but rather a property of underlying metaphoric mappings.

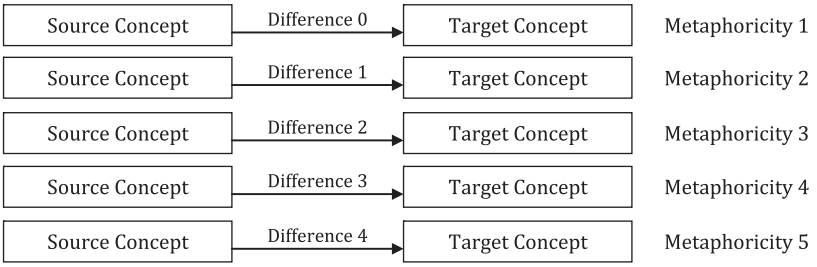

FIGURE 2 Hypothesis: distance between source and target abstractness increases metaphoricity.

The hypothesis can be formally stated thus: the metaphoricity of a mapping A in which the distance between target and source concept abstractness is large is greater than the metaphoricity of a mapping B in which the distance between target and source concept abstractness is small. The metaphoricity of a given mapping is measured using the average metaphoricity of a number of metaphoric expressions instantiating that mapping.

The hypothesis is that both fact-status and function-status influence metaphoricity. The difference between source and target concept abstractness is thus measured using both fact-status and function-status. Each dimension of abstractness has three values. A source-target pair that shares the same value has a difference of 0. A source-target pair that has values adjacent on the scale (e.g., physical-fact and singular-mental-fact) has a difference of 1. A source-target pair that has values at the ends of the scale (e.g., physical-fact and collective-mental-fact) has a difference of 2. Because both fact-status and function-status are posited to influence metaphoricity, the difference in abstractness across both categories is added together. This creates five attested categories, ranging from concepts that share fact-status and function-status values to concepts with a difference of 2 for each. In this operationalization of abstractness, differences in fact-status and function-status can independently increase metaphoricity and also combine to increase metaphoricity. This setup can be visualized as in Figure 2.

This hypothesis is tested by determining whether the mean metaphoricity for a set of sentences belonging to each category is arranged as follows: difference 0 < difference 1 < difference 2 < difference 3 < difference 4. An ANOVA is used to determine whether the difference in metaphoricity across these categories of difference in abstractness is significant. Fact-status and function-status are tested together, on the view that both contribute to metaphoricity.

Measuring the Dependent Variable: Metaphoricity

The dependent variable of metaphoricity is participant-based, collected through MechanicalTurk. Mapping conditions (e.g., a more abstract source concept and a less abstract target concept) are realized as metaphoric expressions (see below for more detail). Following Dunn (2015), participants are given a sentence (in this case, without context) and asked if the sentence is literal or metaphoric. The metaphoricity of a sentence is then defined as the percentage of participants who rate it as metaphoric (out of 20 total participants for each sentence). The idea is that naïve participants are not sensitive to scales of metaphoricity (e.g., rating sentences on a 5-point scale

between literal and highly metaphoric), so that the simple binary decision between literal (i.e., non-metaphoric) and metaphoric is the only basic task that can be reliably performed. The more metaphoric a sentence is, the more the participants will be aware of this and agree that it is metaphoric.

Each HIT (human intelligence task, the minimal unit on MechanicalTurk) consists of one demographic question to ensure the participant is a native speaker of English (defined as having attended elementary or primary school in English, for convenience), one grammatical question to ensure the participant is fluent in English, and 20 sentence-rating questions and one attention-check question. One third of the sentence-rating questions contain non-metaphors and two thirds contain metaphoric expressions representing the source-target mappings in question. Each participant can answer a particular HIT only once, but there is no limit to the number of HITs a participant can answer.

Collecting and Categorizing Test Sentences

Both metaphoric mappings and metaphoric expressions that instantiate these mappings are taken from the master metaphor list (Lakoff, Espenson, & Schwartz, 1991), in part because this hypothesis applies specifically to the source-target metaphors described by conceptual metaphor theory. Mappings and concepts are taken as identified therein (e.g., a systematic ontology is not used as a source for concepts, and concepts are not available independently of their identification in the mappings). The use of the master metaphor list introduces a strong selection bias into the study, on several dimensions (e.g., metaphoric expressions are invented; the number of expressions for a given mapping is not systematically controlled; the choice of source concepts is limited by the scope of the analysts' intuitions). However, the advantage of using this data set is that all metaphoric expressions are posited to come from conceptual metaphors.

Source and target concepts are annotated for fact-status and function-status, as discussed above. Table 9 shows a breakdown of those categories of abstractness difference attested in the master metaphor list. Most categories of abstractness difference have several possible combinations of fact-status and function-status contributing to them. Starting with a difference of 1, both possible combinations are attested; however, difference in fact-status is much more common. Only two out of three possible combinations for a difference of 2 are attested, with a difference of 2 in function-status coupled with the same fact-status not appearing. The most common

TABLE 9
Categories of Abstractness Difference

Diff.	*Fact-Status Diff.*	*Function-Status Diff.*	*#*
0	0	0	91
1	0	1	15
	1	0	181
2	1	1	62
	2	0	31
3	2	1	57
4	2	2	42

TABLE 10
Breakdown of Mapping Types in Categories of Abstractness Difference

Diff.	*Mapping Type*	*#*
0	Singular+Non-Agentive <> Singular+Non-Agentive	9
	Singular+Causal <> Singular+Causal	30
	Collective+Causal <> Collective+Causal	35
	Collective+Institutional <> Collective+Institutional	17
1	Physical+Causal <> Physical+Non-Agentive	15
	Physical+Causal <> Singular+Causal	142
	Singular+Causal <> Collective+Causal	39
2	Physical+Non-Agentive <> Singular+Causal	37
	Physical+Causal <> Singular+Non-Agentive	25
	Physical+Causal <> Collective+Causal	31
3	Physical+Non-Agentive <>Collective+Causal	10
	Physical+Causal <> Collective+Institutional	47
4	Physical+Non-Agentive <> Collective+Institutional	42

difference of 2 is a difference in both fact-status and function-status. A difference of 3 only occurs with a fact-status difference of 2 and a function-status difference of 1. Only one combination is possible for a difference of 4.

A further breakdown of types of mappings in each category of difference in abstractness is shown in Table 10, along with the number of metaphoric expressions of each type in the master metaphor list. This shows the generalizations represented by the abstractness difference categories, as each is made up of a number of different mapping types.

For this study, 40 metaphoric expressions are included for each category of abstractness difference, for a total of 200 metaphoric expressions. An additional 100 non-metaphoric utterances are included in the study, both as a contrast for metaphor and to avoid biasing participants. Metaphoric expressions within each difference category are chosen to equally represent attested mapping types within that category (e.g., 10 of each of the mapping types in the 0 difference category). Example test sentences with their annotations are provided in Appendix A.

Results and Discussion

First, the measure of metaphoricity is tested using a *t*-test to determine if the metaphoric expressions come from a different population than the literal sentences used in the study. The hypothesis that they form a single population is rejected with a two-tailed significance of $p < 0.0001$. In other words, there is a clear distinction between the literal sentences (average metaphoricity 0.079) and the entire set of metaphoric sentences (average metaphoricity 0.801). This shows that the measure is, in fact, detecting metaphoricity, at least at this general level.

A one-way ANOVA across the posited levels of abstractness (five conditions with 40 sentences per condition), rejects the hypothesis that these conditions come from the same population with a significance of $p < 0.0001$. Thus, we see that the hypothesized difference between the abstractness-defined conditions in terms of metaphoricity is both present and statistically very significant. The average and standard deviation in metaphoricity is shown in Table 11 across all

TABLE 11
Average and Standard Deviation of Metaphoricity Across Categories

Category	*Instances*	*Avg. Met.*	*Std. Dev. Met.*
Literal	100	0.079	0.130
Difference 0	40	0.545	0.336
Difference 1	40	0.727	0.283
Difference 2	40	0.917	0.154
Difference 3	40	0.883	0.223
Difference 4	40	0.937	0.068

categories. The second portion of the hypothesis is that the differences in metaphoricity will follow the differences in abstractness using the classification discussed above. The hypothesized order in metaphoricity does obtain in all cases except for the order of difference 2 and difference 3, which is reversed.

A further breakdown of the specific mapping types in the difference 2 and difference 3 categories is shown in Table 12 together with the average metaphoricity of each category. This shows that the inverted position in the metaphoricity hierarchy is not caused by a single wayward internal category but rather is a general feature across the mappings. The only subcategory in the difference 2 category that falls below the difference 3 average metaphoricity is that formed by a difference of 2 in fact-status and no difference in function-status. This suggests, then, that while difference in both fact-status and function-status contribute to metaphoricity, larger differences in a single dimension are not equivalent to smaller differences in both dimensions. In other words, the categories thus formed could be altered by weighting differences in both categories higher than larger differences in a single category. Interestingly, only these two categories can be formed by either a difference of 2 in a single dimension of abstractness or a difference of 1 on both dimensions. For example, the difference 1 category shows that a difference in either fact-status or function-status, and at any level of the hierarchy, creates similar metaphoricity. And the difference 4 category shows that the largest possible difference on both dimensions creates highly metaphoric expressions. This reverse ordering of the difference 2 and difference 3 category, then, shows that both fact-status and function-status contribute equally to metaphoricity, but that larger differences on a single dimension do not contribute as much as smaller differences on both dimensions together.

TABLE 12
Breakdown of Difference 2 and Difference 3 Categories

Category	*Fact Mapping*	*Funct. Mapping*	*Instances*	*Avg. Met.*
Difference 2	Physical<>Singular	Non-Agentive<>Causal	15	0.944
Difference 2	Physical<>Singular	Causal<>Non-Agentive	10	0.921
Difference 2	Physical<>Collective	Causal<>Causal	15	0.886
Difference 3	Physical<>Collective	Non-Agentive<>Causal	8	0.853
Difference 3	Physical<>Collective	Causal<>Institutional	32	0.890

Overall, this experiment shows that a participant-based measure of metaphoricity orders the categories of abstractness largely as expected in terms of metaphoricity, and does so with a high level of significance. This is important because the hypothesized categories here do not depend upon content or topic (e.g., on a source or target concept belonging to a particular domain), but rather on the relative distance between the source and target concepts on a well-motivated and experimentally supported two-dimensional scale of abstractness. As shown in Table 9, many different combinations of fact-status and function-status values contribute to a small number of categories of differences in abstractness, and yet the participant-based metaphoricity values fall nicely into the hypothesized order. This is an important generalization, then, which both provides support for the previously vague claim that metaphoric mappings tend to be from less abstract source concepts to more abstract target concepts, but also provides a motivated model of abstractness that in turn helps to shed light on the nature of metaphoric mappings.

IMPLICATIONS FOR METAPHOR AS A COGNITIVE AND SOCIAL PHENOMENON

Abstractness, Image-Schemas, and Primary Metaphors

Image-schemas are "representations of spatial relations and movements in space" (Gibbs & Colston, 1995, p. 349) in the conceptual system that are derived from recurring human sensorimotor experience (Lakoff & Johnson, 1999, p. 77). Commonly discussed image-schemas include center-periphery, container, end-of-path, force, and source-path-goal (Lakoff, 1987). The invariance principle (Lakoff, 1993) states that metaphoric mappings must preserve image-schema structure in the source domain when mapping that structure onto the target domain, in such a way that is consistent with the target domain. In other words, not all image-schema structure is involved in a given metaphoric mapping, and that portion that is involved must be preserved when mapped onto the target domain, as far as is possible given the image-schema structure of the target domain itself. One of the important descriptive generalizations of image-schemas combined with the invariance principle is the description of the imposition of structures like container and source-path-goal onto abstract concepts that otherwise would have no such structure. The problem with the invariance principle is constructing a model of what structure is transferred and what structure is not transferred; without such a model, it becomes a mere *post hoc* analysis.

Primary metaphors (Grady, 1997) are basic metaphors that arise in the stage of development when physical sensorimotor experiences co-occur with abstract mental and social experiences in such a way that the two are conflated (i.e., are mapped together in a lasting way). Commonly discussed primary metaphors include "*IMPORTANT IS BIG," "HAPPY IS UP," "DIFFICULTIES ARE BURDENS," "MORE IS UP,"* and "*CATEGORIES ARE CONTAINERS."* The idea is that primary metaphors form permanent mappings that allow or enable other, more complex metaphoric mappings to take place. These mappings connect abstract concepts with physical sensorimotor experiences in the form of image-schemas.

In trying to model image-schemas, primary metaphors, and their instantiation in language (which remains that largest source of evidence for and the main reason for investigating these constructs), a pressing issue is how to define abstractness. What constitutes a physical concept or experience? The difficulty, illustrated above, is that many physical concepts have

abstract material embedded in them. For example, consider the following classic examples from Lakoff and Johnson (1980): *"IDEAS ARE FOOD," "IDEAS ARE PLANTS," "IDEAS ARE COMMODITIES," "IDEAS ARE RESOURCES," "IDEAS ARE MONEY," "IDEAS ARE FASHIONS."* In each of these metaphors the target concept is abstract, but so too is the source concept. Each of these source concepts is abstract, in the very least, by containing function information that is imposed by human beings and thus dependent on human beings. *"Food"* is not any physical or organic material, but only such material designated for the purpose of eating. *"PLANTS,"* as used in the metaphoric expressions based on this metaphor, have a non-agentive function in which a purpose is attached to their normal causations: the purpose of plants is to grow and mature, and plants that do not grow fail to meet that purpose. *"COMMODITIES"* have a specific function that is socially defined, as well as having a collective-mental fact-status. *"RESOURCES,"* like *"FOOD,"* differ from unspecified physical material in having a human-defined function. *"MONEY"* and *"FASHION"* both have a collective-mental fact-status (i.e., they only exist as accepted or acknowledged by groups of humans), as well as institutional functions (i.e., you are not fashionable unless some group accepts that you are fashionable). In each of these cases the metaphoric mapping applies the abstract and human-dependent function information from the target concept onto the source concept. This is why the question of abstractness is essential for a model of image-schemas, conceptual metaphors, and primary metaphors: what is the ontological source or status of the information that is being mapped? In this case, the source concepts are concrete by reference, but it is, in fact, abstract sense information that is being mapped. A simple dichotomy between physical and nonphysical concepts, experiences, and processes is not adequate.

A second problem for modeling primary metaphors and conceptual metaphors is that many source concepts are collective-mental-facts. In other words, many source concepts only exist when humans create them by accepting or acknowledging, implicitly or explicitly, the existence of these concepts as a group. Examples from the study above include the source concepts *"FIGHTING," "WRITING,"* and *"MONEY."* Collective-mental-facts cannot be explained by cognitive processes in the development of individuals because they do not depend solely upon individuals. Because these concepts and metaphors depend upon collective cognition, individual embodied experiences, while perhaps necessary, are not sufficient for their genesis. The linguistic instantiation of such metaphors show higher metaphoricity and are less frequent; thus, they are not the prototypical metaphors. Neither, however, are they rare. Thus, accurate modeling of conceptual and primary metaphors requires dealing with collective cognitive processes as well as with individual processes.

Abstractness and Resemblance Metaphors

A distinction is sometimes made between such conceptual/source-target metaphors (also called correlation metaphors, in that the source and target domains are conflated by correlated experiences; Grady, 1999) and resemblance/image metaphors that are formed directly by comparing visual representations, perhaps using image-schemas (e.g., Lakoff, 1993). A more general categorization for these two types is resemblance versus non-resemblance metaphors (Ureña & Faber, 2010), a classification that brings together motionless image metaphors and movement-based or behavioral image metaphors into a single gradient category of resemblance.

A series of examples of image metaphors from marine biology (from Ureña & Faber, 2010) is shown below in (18). Resemblance thus captures generalizations across shape/color, behavior, static images, and dynamic images. The essential difference between resemblance and non-resemblance metaphors is the distinction between reference and sense, respectively. In other words, non-resemblance metaphors (source-target, conceptual, correlation metaphors) involve the human-dependent sense information of a concept for the target and often also for the source. Resemblance metaphors, like the traditional referent-based definition of concreteness, however, involve human-independent referent-based information of a concept, information that does not depend upon human beings. Image metaphors, in other words, are the only truly nonabstract metaphors for which the model presented above is not necessary.

(18A) *"SEAHORSE"* = resemblance in shape or color

(18B) *"ARCHERFISH"* = resemblance in behavior

(18C) *"GARDEN EEL"* = resemblance in static image

(18D) *"CHAMELEON FISH"* = resemblance in dynamic image

Abstractness and Feature Emergence in Metaphor Comprehension

Some aspects or features of metaphoric meaning emerge during the interpretation of the metaphor, rather than being present as similarities between or properties of concepts before the metaphoric mapping takes place. Gineste, Indurkhya, and Scart (2000), for example, found that the majority of features of a metaphor are not features of either the source or target concept; these emergent features are novel to the metaphor itself and created during interpretation. Utsumi (2005) shows, contrary to predictions, that lower similarity between source and target concepts does not lead to larger numbers of emergent features. However, larger numbers of emergent features do create richer interpretations, where richness is defined as interpretive diversity using a measure of the uniformity of distribution of interpretive features (similar in function to the finding that difficult metaphors produce less coherent interpretations than easy metaphors: Kintsch & Bowles, 2002).

An alternate formulation of emergent features comes from conceptual blending (e.g., Coulson & Oakley, 2000), in which the source and target concepts constitute input spaces and the interpretation takes place in a blended space that contains conceptual structure not present in the input spaces or in the background structure (the generic space). This means that "metaphor involves a complex of mappings with multiple spaces in conceptual integration networks" (Coulson & Matlock, 2001, p. 300) and that there is not a discrete metaphoric meaning associated with metaphoric language. Similarly, in the interaction theory of metaphor (e.g., Black, 1962), both concepts influence each other, rather than a simple directional mapping from source to target (cf. Barnden et al., 2004). Feature emergence in this model is a product of the blending process. Because blending is not specific to metaphoric language, emergent features are expected, and found, in non-metaphoric language. The theory thus lessens the importance of the literal-figurative distinction, but does so by arguing that even literal language involves mapping and blending at the conceptual level (e.g., Coulson, 2006).

Abstractness and directness of mapping do have an influence on metaphoricity, as discussed above, which suggests that the hypothesis that metaphoric mappings are completely directionless is too strong. However, that mapping has some directional properties leaves open the question of where these emergent features come from. Current investigations of emergent features look at cognitive structures of individuals in isolation. The social ontology model of abstractness, however, allows both individual and collective cognitive structures to influence feature emergence within a single model. This is important because, as suggested by Kövecses (2013), such mappings may be formed across generations rather than in the development of individuals. In other words, the assumption that the emergence of features during metaphor comprehension is a synchronic individual cognitive process is unnecessary. The next step is to investigate the influence of multidimensional abstractness on the number of emergent features in a study similar to Gineste et al. (2000) and Utsumi (2005), as well as to investigate the influence of the number of emergent features on metaphoricity.

Summary of the Argument

This study has several important findings. The first, of course, is to provide evidence for the long-standing claim that metaphoric mappings are from less abstract to more abstract concepts. In providing evidence, however, two important details have emerged:

First, both the direction of mapping and the distance of mapping influence metaphoricity. Reverse mappings (e.g., from more abstract to less abstract concepts) are not illegal in the sense that they produce unacceptable metaphoric expressions. Rather, they serve to increase metaphoricity (as one factor among many). Similarly, mappings with less distance in abstractness produce metaphoric expressions with lower metaphoricity (again, as one factor among many).

Second, the direction and distance of mapping is relevant not only for domain (i.e., discussed here as the better defined concept of fact-status), but importantly also in terms of function-status, representing underlying embedded function information. This is important because even brute physical facts can have embedded function information.

In this way, then, the verification of this long-standing claim adds detail about the mechanics of how the underlying mapping, modeled in terms of abstractness, influences the metaphoricity of resulting metaphoric expressions.

Further, though, the first part of the paper argued that abstractness is not simply a matter of the degree to which a concept is available to the senses but rather the degree to which a concept depends on human beings for its existence, drawing from Searle's work on social ontology. The point is that even concepts that refer to objects accessible to the senses can embed human-dependent function information so that, for example, *"CANE"* is more abstract than *"STICK."* The study showed that the hierarchies of human-dependence for both fact-status and function-status correspond with norm-based ratings of abstractness. Regardless of the more philosophical justifications for this theory of abstractness, though, what are the advantages of using an operationalization that is ultimately categorical (e.g., fact-status and function-status) over one that is scalar (e.g., norm-based abstractness ratings)?

The attractiveness of this approach is that it allows us to reconcile metaphor as both a cognitive and a social phenomenon. The current tendency is to examine conceptual mappings and primary metaphors as cognitive processes within individuals distinct from social patterns and

collective cognition. Searle's social ontology, on the other hand, provides a seamless ontology from physical-facts to singular-mental-facts to collective-mental-facts. Thus, it allows the false barrier between the cognitive and social aspects of metaphor to be taken down.

The argument goes like this: First, concepts fall on a hierarchy of abstractness defined by how dependent each concept is on human beings, from physical-facts to singular-mental-facts (e.g., cognitive phenomena) to collective-mental-facts (e.g., social phenomena). Thus, both cognitive and social phenomena fall on a single scale of abstractness. Second, metaphoric mappings can be defined by the direction and distance between source and target concepts in terms of abstractness. Both of these properties influence the metaphoricity of metaphoric expressions instantiating these mappings. This model thus treats both cognitive and social aspects of metaphor and makes testable predictions about metaphoricity, an observable property of actual metaphoric expressions.

REFERENCES

Altarriba, J., Bauer, L., & Benvenuto, C. (1999). Concreteness, context availability, and imageability ratings and word associations for abstract, concrete, and emotion words. *Behavior Research Methods, Instruments, & Computers*, *31*(4), 578–602. doi:10.3758/BF03200738

Assaf, D., Neuman, Y., Cohen, Y., Argamon, S., Howard, N., Last, M. . . . Koppel, M. (2013). *Why "Dark Thoughts" aren't really dark: A novel algorithm for metaphor identification*. Proceedings of the IEEE Symposium Series on Computational Intelligence, pp. 60–65, Singapore.

Barnden, J., Glasbey, S., Lee, M., & Wallington, A. (2004). Varieties and directions of interdomain influence in metaphor. *Metaphor & Symbol*, *19*(1), 1–30. doi:10.1207/S15327868MS1901_1

Black, M. (1962). Metaphor. In M. Black (Ed.), *Models and metaphors* (pp. 25–47). Ithaca, NY: Cornell University Press.

Brysbaert, M., Warriner, A., & Kuperman, V. (2014). Concreteness ratings for 40 thousand generally known English word lemmas. *Behavior Research Methods*, *46*(3), 904–911. doi:10.3758/s13428-013-0403-5

Campbell, J., & Katz, A. (2006). On reversing the topics and vehicles of metaphor. *Metaphor & Symbol*, *21*(1), 1–22. doi:10.1207/s15327868ms2101_1

Chiappe, D., Kennedy, J., & Smykowski, T. (2003). Reversibility, aptness, and the conventionality of metaphors and similes. *Metaphor & Symbol*, *18*(2), 85–105. doi:10.1207/S15327868MS1802_2

Clark, J., & Paivio, A. (2004). Extensions of the Paivio, Yuille, and Madigan (1968) norms. *Behavior Research Methods, Instruments, & Computers*, *36*(3), 371–383. doi:10.3758/BF03195584

Coulson, S. (2006). Constructing meaning. *Metaphor & Symbol*, *21*(4), 245–266. doi:10.1207/s15327868ms2104_3

Coulson, S., & Matlock, T. (2001). Metaphor and the space structuring model. *Metaphor & Symbol*, *16*(3–4), 295–316. doi:10.1080/10926488.2001.9678899

Coulson, S., & Oakley, T. (2000). Blending basics. *Cognitive Linguistics*, *11*(3/4), 175–196.

Davidson, D. (1978). What metaphors mean. *Critical Inquiry*, *5*(1), 31–47. doi:10.1086/ci.1978.5.issue-1

Dunn, J. (2010). Gradient semantic intuitions of metaphoric expressions. *Metaphor & Symbol*, *26*(1), 53–67. doi:10.1080/10926488.2011.535416

Dunn, J. (2013a). Evaluating the premises and results of four metaphor identification systems. In A. Gelbukh (Ed.), *Proceedings of the Conference on Intelligent Text Processing and Computational Linguistics, Vol. 1 [CICLING 2013]* (pp. 471–486). Heidelberg, Germany: Springer.

Dunn, J. (2013b). How linguistic structure influences and helps to predict metaphoric meaning. *Cognitive Linguistics*, *24*(1), 33–66. doi:10.1515/cog-2013-0002

Dunn, J. (2014a). Measuring metaphoricity. In A. Koller and M. Yusuke (Eds.), *Proceedings of the annual meeting of the Association for Computational Linguistics, Vol. 2 [ACL 2014]* (pp. 745–751). Stroudsburg, PA: Association for Computational Linguistics.

Dunn, J. (2014b). Multi-dimensional abstractness in cross-domain mappings. In B. Beigman-Klebanov, E. Shutova and P. Lichtenstein (Eds.), *Proceedings of the annual meeting of the Association for Computational Linguistics: Second workshop on metaphor in NLP [ACL 2014]* (pp. 27–32). Stroudsburg, PA: Association for Computational Linguistics.

Dunn, J. (2015). Three types of metaphoric utterances that can synthesize theories of metaphor. *Metaphor & Symbol*, *30*(1), 1–23. doi:10.1080/10926488.2015.980694

Dunn, J., Beltran De Heredia, J., Burke, M., Gandy, L., Kanareykin, S., Kapah, O. . . . Argamon, S. (2014). *Language-independent ensemble approaches to metaphor identification*. Proceedings of the 28th Conference on Artificial Intelligence: Workshop on Cognitive Computing for Augmented Human Intelligence [AAAI 2014], pp. 6–12, Quebec, Canada.

Friendly, M., Franklin, P., Hoffman, D., & Rubin, D. (1982). The Toronto word pool: Norms for imagery, concreteness, orthographic variables, and grammatical usage for 1,080 words. *Behavior Research Methods & Instrumentation*, *14*(4), 375–399. doi:10.3758/BF03203275

Gandy, L., Allan, N., Atallah, M., Frieder, O., Howard, N., Kanareykin, S. . . . Argamon, S. (2013). *Automatic identification of conceptual metaphors with limited knowledge*. Proceedings of the 27th AAAI Conference on Artificial Intelligence [AAAI 2013], pp. 328–334, Bellevue, WA.

Gibbs, R., & Colston, H. (1995). The cognitive psychological reality of image schemas and their transformations. *Cognitive Linguistics*, *6*, 347–378. doi:10.1515/cogl.1995.6.4.347

Gilhooly, K., & Logie, R. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words. *Behavior Research Methods & Instrumentation*, *12*(4), 395–427. doi:10.3758/BF03201693

Gineste, M., Indurkhya, B., & Scart, V. (2000). Emergence of features in metaphor comprehension. *Metaphor & Symbol*, *15*(3), 117–135. doi:10.1207/S15327868MS1503_1

Glucksberg, S., & Keysar, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review*, *97*(1), 3–18. doi:10.1037/0033-295X.97.1.3

Grady, J. (1997). Theories are buildings revisited. *Cognitive Linguistics*, *8*(4), 267–290. doi:10.1515/cogl.1997.8.4.267

Grady, J. (1999). A typology of motivation for conceptual metaphor: Correlation vs. resemblance. In R. Gibbs, & G. Steen (Eds.), *Metaphor in cognitive linguistics: Selected papers from the 5th international cognitive linguistics conference, Amsterdam, 1997* (pp. 79–100). Amsterdam, Netherlands: John Benjamins.

Kammann, R., & Streeter, L. (1971). Two meanings of word abstractness. *Journal of Verbal Learning and Verbal Behavior*, *10*, 303–306. doi:10.1016/S0022-5371(71)80058-0

Katz, A. (1989). On choosing the vehicles of metaphors: Referential concreteness, semantic distances, and individual differences. *Journal of Memory and Language*, *28*, 486–499. doi:10.1016/0749-596X(89)90023-5

Kintsch, W., & Bowles, A. (2002). Metaphor comprehension: What makes a metaphor difficult to understand? *Metaphor & Symbol*, *17*(4), 249–262. doi:10.1207/S15327868MS1704_1

Kövecses, Z. (2013). The metaphor-metonymy relationship: Correlation metaphors are based on metonymy. *Metaphor & Symbol*, *28*(2), 75–88. doi:10.1080/10926488.2013.768498

Lakoff, G. (1987). *Women, fire, and dangerous things: What categories reveal about the mind*. Chicago, IL: University of Chicago Press.

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and thought* (2nd ed., pp. 202–251). Cambridge, UK: Cambridge University Press.

Lakoff, G., Espenson, J., & Schwartz, A. (1991). *The master metaphor list* (2nd ed.). Technical Report, Berkeley, CA: University of California at Berkeley.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought*. New York, NY: Basic Books.

Mashal, N., Shen, Y., & Kastel, D. (2014). Element order in metaphorical and literal phrases. *Metaphor & Symbol*, *29*, 113–128. doi:10.1080/10926488.2014.889990

Neuman, Y., Assaf, D., Cohen, Y., Last, M., Argamon, S., Howard, N., & Frieder, O. (2013). Metaphor identification in large texts Corpora. *PLoS One*, *8*(4), e62343. doi:10.1371/journal.pone.0062343

Paivio, A., Yuille, J., & Madigan, S. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology*, *76*(1, Pt.2), 1–25. doi:10.1037/h0025327

Searle, J. (1995). *The construction of social reality*. New York, NY: The Free Press.

Searle, J. (2010). *Making the social world: The structure of human civilization*. Oxford, UK: Oxford University Press.

Shutova, E., Teufel, S., & Korhonen, A. (2013). Statistical metaphor processing. *Computational Linguistics*, *39*(2), 301–353.

Spreen, O., & Schulz, R. (1966). Parameters of abstraction, meaningfulness, and pronunciability for 329 nouns. *Journal of Verbal Learning and Verbal Behavior*, *5*, 459–468. doi:10.1016/S0022-5371(66)80061-0

Torreano, L., Cacciari, C., & Glucksberg, S. (2005). When dogs can fly: Level of abstraction as a cue to metaphorical use of verbs. *Metaphor & Symbol*, *20*(4), 259–274. doi:10.1207/s15327868ms2004_2

Tourangeau, R., & Sternberg, R. (1982). Understanding and appreciating metaphors. *Cognition*, *11*, 203–244. doi:10.1016/0010-0277(82)90016-6

Turney, P., & Littman, M. (2003). Measuring praise and criticism: Inference of semantic orientation from association. *ACM Transactions on Information Systems*, *21*, 315–346. doi:10.1145/944012

Turney, P., Neuman, Y., Assaf, D., & Cohen, Y. (2011). Literal and metaphorical sense identification through concrete and abstract context. In W. Che (Ed.), *Proceedings of Empirical Methods in Natural Language Processing* (pp. 680–690). Stroudsburg, PA: Association for Computational Linguistics.

Ureña, J., & Faber, P. (2010). Reviewing imagery in resemblance and non-resemblance metaphors. *Cognitive Linguistics*, *21*(1), 123–149. doi:10.1515/cogl.2010.004

Utsumi, A. (2005). The role of feature emergence in metaphor appreciation. *Metaphor & Symbol*, *20*(3), 151–172. doi:10.1207/s15327868ms2003_1

Appendix A: Example Test Sentences

Category	*Fact #*	*Fact Mapping*	*Func. #*	*Func. Mapping*	*Met.*
0	0	Singular <> Singular	0	Causal <> Causal	0.4761
Sentence:		*"Let's take a closer look at that proposal."*			
0	0	Singular <> Singular	0	Non-Agent. <> Non-Agent.	0.6500
Sentence:		*"He still has the illusions of his youth."*			
0	0	Collective <> Collective	0	Causal <> Causal	0.4285
Sentence:		*"The newer theory of relativity won out in the end."*			
0	0	Collective <> Collective	0	Institutional <> Institutional	0.4736
Sentence:		*"I couldn't possibly repay your kindness."*			
1	0	Physical <> Physical	1	Causal <> Non-Agentive	0.6500
Sentence:		*"Behind a pleasant face there is always a dark secret."*			
1	1	Physical <> Singular	0	Causal <> Causal	0.5238
Sentence:		*"Sally traded ideas with Sam."*			
1	1	Singular <> Collective	0	Causal <> Causal	0.7894
Sentence:		*"The evidence all points in the same direction."*			
2	1	Physical <> Singular	1	Non-Agentive <> Causal	0.6315
Sentence:		*"That outdated belief continues to live on."*			
2	1	Physical <> Singular	1	Causal <> Non-Agentive	0.6111
Sentence:		*"There was a definite Spanish flavor to the music."*			
2	2	Physical <> Collective	0	Causal <> Causal	0.7894
Sentence:		*"He was bombarded by insults."*			
3	2	Physical <> Collective	1	Non-Agentive <> Causal	0.7894
Sentence:		*"Reagan brought intense pressure to bear upon his cabinet."*			
3	2	Physical <> Collective	1	Causal <> Institutional	0.7368
Sentence:		*"They held him firmly to his massive obligations."*			
4	2	Physical <> Collective	2	Non-Agentive<> Institutional	0.9523
Sentence:		*"Our society is sick with countless ills."*			