CHAPTER 6

Metaphor as Structure-Mapping

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Introduction

Metaphor is pervasive in language and thought: in scientific discovery (Gentner, 1982; Gentner & Jeziorski, 1993; Gruber, 1995; Nersessian, 1992), in literature (Gibbs, 1994; Miller, 1993; Steen, 1989; Turner, 1987), and in everyday language (Fauconnier & Turner, 1998; Lakoff & Johnson, 1980). Not surprisingly, this richness has engendered a number of approaches to metaphor (Steen, 2007).

Our approach to metaphor centers on the question of how metaphors are processed. This approach unifies metaphor with processes of analogy and similarity. We use structure-mapping, a theory of analogy and similarity,[1] as our framework. In the first part of the chapter, we describe research that shows that the real-time processing of many metaphors and similes can be captured by detailed models from analogy. Then we turn to studies of the processing of large-scale conceptual metaphors such as *Love is a journey* and present evidence that such metaphors can be seen as extended structure-mappings between domains.

In the second part, we lay out the "career of metaphor" hypothesis, which considers the evolution of figurative statements. We review evidence in support of the claim that figurative statements begin as novel comparison statements and evolve gradually into category-inclusion statements as the base (or vehicle) terms develop an associated metaphorical abstraction.

Metaphor Is Like Analogy

An analogy is a mapping between two represented[2] situations in which common relational structure is aligned (Gentner, 1983; Gentner & Markman, 1997; Holyoak, Gentner, & Kokinov, 2001). According to structure-mapping theory, analogical mapping is a process of establishing a *structural alignment* between two represented situations and then projecting inferences[3] (Falkenhainer, Forbus, & Gentner, 1989; Gentner & Markman, 1997; Markman & Gentner, 1993). An alignment consists of an explicit set of correspondences between the representational elements of the two

situations with an emphasis on relational matches. The alignment is determined according to *structural consistency* constraints: (1) one-to-one correspondence between the mapped elements in the base and target and (2) parallel connectivity, in which the arguments of corresponding predicates also correspond. In addition, the selection of an alignment is guided by the *systematicity principle*: a matching system of relations connected by higher-order constraining relations such as causal relations is preferred over a match with an equal number of independent correspondences. Once the alignment is made, further candidate inferences are spontaneously projected from base to target (Falkenhainer et al., 1989). Systematicity also guides analogical inference: people do not import random facts from base to target but instead project inferences that complete the common system of relations (Bowdle & Gentner, 1997; Clement & Gentner, 1991).

Two analogy findings are particularly relevant for metaphor. The first is evidence demonstrating the systematicity preference: people implicitly prefer analogies that share large, deep relational structures (all else being equal) (Forbus, Gentner, & Law, 1995; Gentner, Rattermann, & Forbus, 1993); and the same is true for metaphors. A major determinant of aptness in metaphor is the presence of a substantial relational match (Gentner & Clement, 1988; Gentner & Wolff, 1997). The second is that the common system derived from a comparison becomes more salient after the comparison and more available for transfer to new contexts (Gentner, Loewenstein, & Thompson, 2003; Gick & Holyoak, 1983; Loewenstein & Gentner, 2001). Thus, the process of comparison, including metaphorical comparison, is a way of deriving new abstractions.

Of course, not all metaphors are analogies (see Gentner, 1982, for discussion). Metaphors can range from purely relational comparisons (analogies), as in (1), to purely attributional comparisons, as in (2); and some metaphors, such as (3), simply defy description in terms of alignment.

1. Patience is bitter, but its fruit is sweet.
2. His eyes were deep pools of misery.
3. The voice of your eyes is deeper than all the roses. (e. e. cummings)

Most of the metaphors studied in the psychological literature are analogies – that is, they convey chiefly relational commonalities (e.g., *Encyclopedias are gold mines, My job is a jail*) – though some are surface matches (e.g., *Hair is like spaghetti*). Finally, a bit of terminology: in naming the parts of a figurative statement such as "An X is (like) a Y," X is the *topic* (or *target* in the terminology of analogy), and Y is the *vehicle* (or *base*, or *source* in analogical terminology).

Aptness and relationality. Adults in general prefer relational metaphors, as noted in the previous section. Gentner and Clement (1988) had participants write our descriptions of objects and then interpret metaphors containing those objects (e.g., *Blood vessels are aqueducts*). Whereas the object descriptions contained both object attributes (e.g., that blood vessels are red, elastic, delicate) and relations (e.g., they carry blood through the body), the metaphor interpretations focused mainly on relations (e.g., both aqueducts and blood vessels transport something needed; they bring it to far parts of the system). More importantly, Gentner and Clement (1988) found that subjects' judgments of the aptness of metaphors were positively correlated with the relationality of their interpretations of those metaphors, and negatively correlated with the degree to which their interpretations relied on simple object properties. Thus, although relationality is not the only influence on aptness (e.g., novelty and fit with prior beliefs may enter in), still, to a large degree, people consider metaphors apt to the extent that they can find relational interpretations for them.

The processing of metaphors. Structure-mapping makes a number of predictions about the processing of individual metaphors that should follow if metaphors are processed like analogies. SME serves as a process model to motivate these predictions. SME, the structure-mapping engine

Target
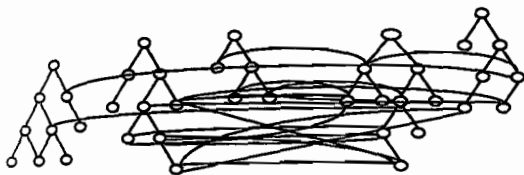
Stage 1
Local matches
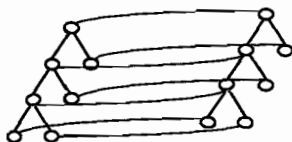
Stage 2
Structural
coalescence
into consistent
mappings
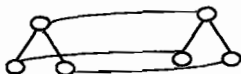
Stage 3
Small structures
combined into
maximal interpretation;
candidate inferences

Figure 6.1. SME's three stages of mapping.

(Falkenhainer, Forbus, & Gentner, 1989; Forbus, Ferguson, & Gentner, 1994; Forbus, Gentner, & Law, 1995) utilizes a local-to-global[4] alignment process to arrive at a structural alignment of two representations. Figure 6.1 shows SME's three stages of mapping. In the first stage, SME begins blind and local by matching all identical predicates in the two representations. Semantic similarity is captured through partial identities: e.g., *give* and *donate* both contain the subpredicate "transfer possession" (see Gentner & Kurtz, 2006; Yan, Forbus, & Gentner, 2003). This initial mapping is typically inconsistent, containing many-to-one matches. In the second phase, these local matches are coalesced into structurally consistent connected clusters (called *kernels*). The kernels

are essentially partial mappings – connected sets of structurally consistent corresponding base–target pairs. They are given structural evaluations that depend not only on the sheer number of predicates but also on the depth of the kernel's relational system (Forbus & Gentner, 1989).

In the third stage, the kernels are merged into one or a few structurally consistent global interpretations (mappings displaying *one-to-one correspondences* and *parallel connectivity*). SME does not produce all possible interpretations (a psychologically implausible process); instead, it uses a *greedy merge* algorithm (Forbus & Oblinger, 1990) that operates in linear time over the number of kernels. It begins with the maximal kernel and then adds the largest kernel that is

structurally consistent with the first one, continuing until no more kernels can be added without compromising consistency. It then carries out this process beginning with the second largest kernel to produce a second interpretation.

SME then produces a structural evaluation of the interpretation(s), using a kind of cascade-like algorithm in which evidence is passed down from predicates to their arguments. This method is used – both here and for the individual kernel evaluations mentioned previously – because it favors deep systems over shallow systems, even given equal numbers of matches (Forbus & Gentner, 1989). Up to this point, the processing has been a role-neutral process of alignment. Now, however, a directional inference process takes place. Predicates connected to the common structure in the base, but not initially present in the target, are projected as *candidate inferences* in the target. Thus, structural completion can lead to spontaneous unplanned inferences.

SME has several appealing features as applied to metaphor. First, it begins blindly, without needing to know the point of the comparison in advance. Second, SME can simultaneously derive two interpretations of a comparison (e.g., a literal and a metaphorical interpretation). Because metaphor is processed in the same way as literal comparison, there is no need to initiate a special metaphoric processing routine. (Some theories implicitly postulate different processes for metaphor than for literal language, leading to a knotty problem: you have to know that a statement is a metaphor in order to process it; but you have to process it to know that it is a metaphor.) Third, inference occurs as a natural outcome of comparison, fitting the psychological intuition that inferences often arise unbidden from metaphors, and may even surprise the reasoner.

Stages of processing. This framework gives rise to a number of processing predictions, of which we focus on these:

• Metaphor comprehension begins with a symmetric (nondirectional) alignment process.

• If an alignment is found, then further inferences are directionally projected from base to target.
• Thus, directionality in metaphor comprehension arises *after* the initial stage of processing.

The assertion that metaphor is initially nondirectional is highly counterintuitive because, as Ortony (1979) pointed out, strong directionality is one of the hallmarks of metaphors. However, Gentner and Wolff (1997, 2000; Wolff & Gentner, 2000) have found evidence for these predictions. In one set of studies, Wolff and Gentner (2000) used the metaphor interference technique initially developed by Glucksberg, Gildea, and Bookin (1982) to investigate very early processing during metaphor comprehension. Glucksberg et al. had found that when participants made true–false judgments among statements like *Some birds are robins* and *Some birds are apples*, they took longer to reject metaphors (e.g., *Some brains are warehouses*) than to reject ordinary false statements (*Some birds are warehouses*), indicating that metaphor processing is initiated *before* literal processing has terminated.

Wolff and Gentner (2000) applied this metaphor interference technique to investigate early processing: specifically, to ask whether forward and reversed metaphors differ in the early processing stages. For forward metaphors, the results replicated Glucksberg et al.'s interference effect: forward metaphors (*Some suburbs are parasites*) took longer to reject than anomalous statements. The key question is the reversed metaphors. If metaphor is processed by a symmetric alignment, then the reversed metaphors will initially behave exactly like the forward metaphors. But if the terms of the metaphor are processed differently from the start, as in Glucksberg's attributive category theory, then reversed metaphors will not show an interference effect.[5]

Importantly, however, Wolff and Gentner found precisely the same interference effects for reversed metaphors as for forward metaphors, supporting the claim of an early nondirectional alignment

process. These findings held even though the metaphors had highly conventional vehicle terms – such as *parasites*. These results are consistent with the structure-mapping claim that the initial processes in metaphor comprehension are symmetric alignment processes.

Wolff and Gentner also verified that the metaphors in the above study were strongly directional. When participants were simply asked to judge the comprehensibility of the metaphors (rather than to assess literal truth values), (1) as predicted, forward metaphors were far more likely to be judged comprehensible than reversed metaphors; and (2) as expected, response times were considerably longer than in the true–false task. These findings are consistent with the claim that even for highly directional metaphors, directionality emerges later in processing.

In a further study, Wolff and Gentner (in preparation) used a deadline task to examine stages of processing. Participants were shown forward (e.g., "A rumor is a virus") and reversed (e.g., "A virus is a rumor") metaphors and asked for comprehensibility judgments. Consistent with a symmetric early alignment process, comprehensibility judgments for forward and reversed metaphors did not differ early in processing; even though (as noted just above) forward metaphors were judged far more comprehensible than reversed metaphors later in processing. Overall, the findings suggest an early symmetric alignment process followed by a directional inference process.

Extended mappings. The structure-mapping view of metaphor extends naturally to extended metaphors. Structure-mapping predicts that people can process extended metaphors and can incrementally extend such mappings (Gentner, 1982; Forbus, Ferguson, & Gentner, 1994; Keane & Brayshaw, 1988). This interpretation is also consonant with domain-mapping theories such as that of Rumelhart and Abrahamson (1973) and Tourangeau and Sternberg (1981) and with theory (e.g., Kittay & Lehrer, 1981; Lakoff & Johnson, 1980) and research suggesting that metaphors are processed as large-scale conceptual systems (Gibbs, 1990, 1994; Gibbs,

Nayak, & Cutting, 1989). In contrast, localist theories – such as the attributional category account (Glucksberg & Keysar, 1990; Glucksberg, McGlone, & Manfredi, 1997), which views metaphors as category inclusions – have no natural way of handling extended metaphors.

Gentner and Boronat tested whether extended metaphors are processed on-line as domain mappings (Boronat, 1990; Gentner & Boronat, 1992, Gentner, Bowdle, Wolff, & Boronat, 2001; Gentner, 1992). Specifically, our studies tested for a metaphoric consistency effect – a rise in response time when there is a shift in mapping from one base to another, even where the target and even the inferred meaning are equated. Our method was inspired by the mixed metaphors frequently captured by *The New Yorker*, for example,

> *It seems that at every turn now in my campaign, I am confronted with my fellow Republicans stabbing me in the back.*

and

> *The U.S. and the Middle East are on parallel but non-converging paths.*

If people comprehend metaphors by setting up structurally consistent, systematic domain mappings, then a shift of metaphoric base should create a disruption in the mapping process, and lead to slower processing. We used this mixed metaphor technique to test whether people can carry out an extended metaphorical mapping. All the experiments followed the same logic (see Figure 6.2). There were three kinds of passages: those with a *consistent metaphoric mapping*, those with an *inconsistent metaphoric mapping*, and a *literal control*.

The consistent passages utilized the same base throughout; for the inconsistent passages, the base was switched at the last sentence. The three passages all had the same story line, and all shared the same last sentence – the target sentence (always metaphorical), on which reading times were collected. The passages differed in the main body of the text. In the consistent passages, the same global metaphor was used in the
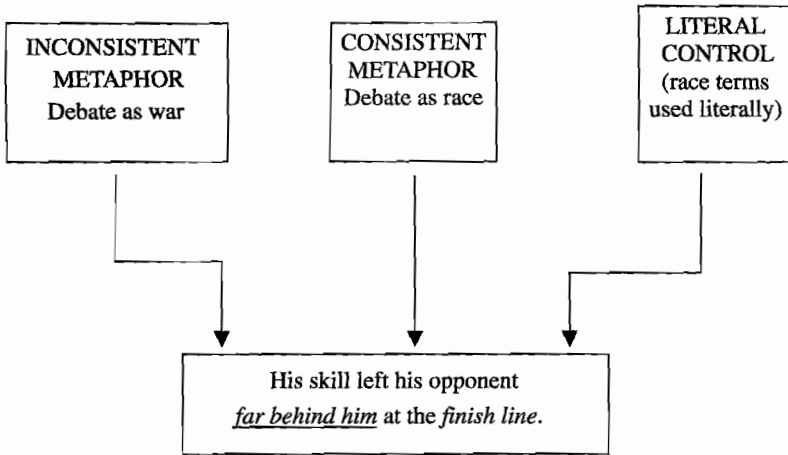
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┌─────────────────┐   ┌─────────────────┐   ┌─────────────────┐
│  INCONSISTENT   │   │   CONSISTENT    │   │    LITERAL      │
│   METAPHOR      │   │   METAPHOR      │   │    CONTROL      │
│  Debate as war  │   │  Debate as race │   │  (race terms    │
│                 │   │                 │   │  used literally)│
└─────────────────┘   └─────────────────┘   └─────────────────┘
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His skill left his opponent
far behind him at the *finish line.*

Figure 6.2. Design of the domain-mapping study (Boronat, 1990; Gentner & Boronat, 1992).

passage's body as in the target sentence; but in the inconsistent passages, a different global metaphor was used in the body, so that the target sentence required a switch to a new metaphor (though it expressed the same idea). In the literal controls, the body contained all of the metaphoric *terms* of the corresponding within-domain passages, but these terms were used literally.[6]

For example, there were three versions of a story about a debate (see Figure 6.2). The consistent passage used the global metaphor A DEBATE IS A RACE (e.g., *he had to steer his course carefully in the competition*). The inconsistent passage used the global metaphor A DEBATE IS A WAR (e.g., *he had to use every weapon at his command in the competition*). For both passages, the last sentence used the RACE metaphor (e.g., *His skill left his opponent far behind him at the finish line*). For the consistent passage, this represented a continuation of the global metaphor. However, for the inconsistent passage, the critical final sentence made a switch from the DEBATE AS WAR metaphor to the DEBATE AS RACE metaphor.

The domain-mapping hypothesis predicts that the last sentence will be read more quickly when it continues the same metaphoric mapping as that in the passage than when the global metaphor is changed (i.e., faster in the consistent condition than in the inconsistent condition), because the former extends an established base-to-target mapping, while the latter disrupts it. In short, the domain-mapping account predicts that the critical test metaphors will be read faster in the consistent condition than in the inconsistent condition. In contrast, localist metaphor theories, such as the class-inclusion theory of Glucksberg and Keysar (1990) and Glucksberg, McGlone, and Manfredi (1997), would predict no difference between the two metaphoric conditions, since the key (metaphoric) sentence is the same.

In the first two studies, we used novel figuratives from existing conceptual mappings. The results showed a metaphoric consistency effect, consistent with the domain-mapping account: Subjects read the critical last sentence significantly faster when it extended the existing mapping (*consistent* version) than when it switched the metaphoric mapping (*inconsistent version*). The critical last sentence was also read faster following the metaphorically consistent passage than it was following the matched literal control passage, ruling out the possibility that the reading time advantage for the metaphorically consistent passages could be attributed to mere associative priming between the words in the passage and the words in the final sentence.

The evidence thus supports the domain-mapping hypothesis for novel figuratives.

However, the results were quite different for conventional figuratives. In two further studies, Gentner and Boronat utilized passages that contained conventional figuratives, often from the same global conceptual metaphors as the novel figuratives in the earlier studies[7] – for example, DEBATE AS WAR – but here the individual metaphors were conventional.

When the individual metaphors were highly conventional, the metaphoric consistency effect disappeared (Gentner & Boronat, 1992; see also Keysar, Shen, Glucksberg, & Horton, 2000). There was no apparent cost of shifting between global metaphors. This suggests that the localist account may be correct for conventional figuratives: for highly conventional metaphors, the metaphorical interpretation becomes an alternate word sense, and the metaphor can then be processed on a lexical basis. However, one must go beyond sentence-by-sentence processing to account for the global mapping effects found for the novel figuratives.

Directional asymmetry: How can a comparison approach account for the strong directionality of metaphors? People show strong directional preferences in metaphor. For example, (1) seems far better as a metaphor than does (2):

1. Some jobs are jails.
2. Some jails are jobs.

The strong directionality of metaphors has been used to argue that metaphors are essentially class-inclusion statements (which are clearly asymmetric) rather than comparisons. But research on analogy shows robust asymmetries in analogy and similarity as well. In processing analogy and metaphor, the initial symmetric alignment process is followed by directional inferences. Further, because inferences are understood to flow from base to target, people prefer comparison statements that have the more informative term in the base position.

Bowdle and Gentner (1997) explored asymmetry in comparison by giving participants two brief narrative passages that were similar except that one passage (the *sys-*

tematic passage) contained a causal structure linking the events, and the other (the *nonsystematic passage*) did not. Participants preferred the direction of comparison that placed the systematic passage in the base; and when asked to generate inferences from one passage to the other, they overwhelmingly drew inferences from the more systematic passage to the less systematic one. These findings show that asymmetry in analogy follows naturally from a preference for rich inferential potential. Notably, this strong asymmetry only occurred for *alignable* pairs of passages. When the passages were unrelated, participants had no order preference, and simply drew inferences independently from within one passage or the other.

We suggest that this preference for having the more systematic representation as the base can explain the directional asymmetry of metaphor. Indeed, as Bowdle and Gentner (1997) suggested, systematicity imbalance is likely to be far stronger for metaphor than for literal similarity, with a concomitantly greater directional asymmetry. This would fit with the human predilection for metaphors that draw on highly familiar domains, such as spatial relations and bodily force dynamics – domains that are understood well enough to provide inferential structure for other domains (Fauconnier & Turner, 1998; Lakoff & Johnson, 1980).

The Career of Metaphor

Novel and conventional figuratives differ in their behavior. Consider first a novel metaphoric base term, *snowflake*. Without being paired with a target, it is difficult to guess what meaning the term might be used to metaphorically convey. When paired with a target, however, the meaning becomes clear. For example, the metaphor *Children are snowflakes* conveys that each child is unique. Further, pairing a novel base with different targets can lead to different abstractions. For example, the metaphor *Accolades are snowflakes* conveys that praise is ephemeral. In general, novel metaphoric bases do not automatically

evoke metaphoric categories in isolation. Further, the fact that they can take on radically different meanings in different contexts suggests that the comprehension of novel metaphors involves a comparison between the two terms.

Consider next a conventional metaphoric base term, *gold mine*. Even when it is not paired with a target, the hearer can already guess the metaphoric meaning of this term: *something that is a source of something valuable*. Further, pairing this base with a range of different targets (e.g., *an encyclopedia, the World Wide Web, a shopping mall*, even *the backyard*) does not substantially alter its meaning. Unlike novel bases, conventional bases can automatically evoke stable metaphoric categories.

These observations, together with Wolff and Gentner's findings, led us to propose a theoretical framework for figurative processing that takes into account the effects of conventionalization. We have called this theory *the career of metaphor* (Bowdle, 1998; Bowdle & Gentner, 1995, 1999, 2005; Gentner & Bowdle, 2001; Gentner & Wolff, 1997; Wolff & Gentner, 2000). According to the career of metaphor hypothesis, a metaphor undergoes a process of gradual abstraction and conventionalization as it evolves from its first novel use to becoming a conventional "stock" metaphor. This process results in a shift in mode of alignment. Novel metaphors are processed as comparisons, in which the target concept is structurally aligned with the literal base concept. But each such alignment makes the abstraction more salient, so if a given base is used repeatedly in a parallel way, it accrues a metaphoric abstraction as a secondary sense of the base term. When a base term reaches a level of conventionality such that its associated abstract schema becomes sufficiently accessible, the term can function as a category name.

Importantly, on our account, the basic process for understanding a figurative statement remains the same – an initial structural alignment followed by the directional projection of inferences (and sometimes by re-representation). What changes with conventionalization is not the *process* itself

but the representation of the base term, whose metaphorical abstraction becomes more salient and more accessible. As the base term develops a clear metaphorical abstraction that can be accessed during comprehension, a kind of short cut becomes available. The listener can access the abstract metaphorical sense directly instead of having to derive it by aligning the two literal terms. Thus, the alignment process shifts from a horizontal alignment – that is, a comparison between two literal meanings – to a vertical alignment – that is, a comparison between a concrete literal meaning (for the target term) and an abstraction (for the base term). In general, aligning with an abstraction is easier than aligning with a more concrete representation (e.g., Ross, 1989), because there are fewer inconsistent predicates. Therefore, as conventionalization occurs there will be a corresponding decrease in comprehension time (Bowdle & Gentner, 2005).

Metaphor and category formation. While novel metaphors do not depend on the application of metaphoric categories, they may be used to create such categories. According to the career of metaphor hypothesis, novel and conventional metaphors draw on different representations and, hence, involve different comprehension strategies: novel metaphors are processed by direct comparison, whereas conventional metaphors are processed by accessing the metaphorical abstraction and applying it (via structural alignment) to the target – essentially treating the base term as a category of which the target is an instance. This shift from horizontal to vertical alignment is not coincidental; rather, it is a natural consequence of the structural alignment process used to interpret novel metaphors.

Consider again how novel metaphors are processed according to structure-mapping theory. First, the target and base are placed in structural correspondence. Second, further predicates connected to the aligned system in the base are mapped to the target as candidate inferences, which then count as further correspondences. One outcome of this process is that the resultant system of commonalities is highlighted.

Both the common system and the set of related inferences become more salient and more likely to be used in future situations. This process of highlighting and abstraction is also seen in studies of analogical reasoning in which learners appear to induce problem schemas as a result of structural alignment (e.g., Gentner, Loewenstein, & Thompson, 2003; Gick & Holyoak, 1983; Loewenstein & Gentner, 2001; Novick & Holyoak, 1991; Ross & Kennedy, 1990). It is also consistent with abstraction models of category learning (e.g., Elio & Anderson, 1981). Further, because structural alignment favors connected relational systems (Bowdle & Gentner, 1997; Clement & Gentner, 1991; Gentner & Medina, 1998), the abstractions that arise are often relational systems that have explanatory power.

On this view, when a given concept is encountered as the base of a metaphor for the first time, it does not evoke a metaphoric category independently of the target; rather, the category emerges from the alignment of the target and base. However, if the same abstraction is derived repeatedly in the context of the base, it may become conventionally associated with that term and may eventually be lexicalized as a secondary meaning of the base term. Only once a base term reaches this level of conventionality does it achieve dual representation of the type described by Glucksberg and Keysar (1990). This account is in line with Swinney and Cutler's (1979) lexical representation hypothesis, according to which idioms and other conventionalized "stock" expressions have stable nonliteral meanings that can be accessed directly without needing to be derived anew. This hypothesis is supported by findings indicating that the nonliteral meanings of idioms (Cacciari & Tabossi, 1988; Gibbs, 1980, 1994; Gibbs & O'Brien, 1990) and conventionalized metaphors (Blank, 1988; Blasko & Connine, 1993; Swinney & Cutler, 1979) are processed as fast, or faster, than their literal meanings. As Giora (1997) has persuasively argued, whenever a term is associated with more than one meaning, the most salient of these meanings will typically dominate during comprehension, even if this meaning is figurative rather than literal.

Evidence for the career of metaphor hypothesis has mounted over the past decade. As discussed earlier in this chapter, Gentner and Wolff (1997) found that only when the base terms of metaphors were highly conventional did they prime metaphor comprehension more effectively than the target terms. More generally, it has repeatedly been demonstrated that conventional metaphors are processed more quickly and automatically than novel metaphors (e.g., Blank, 1988; Gildea & Glucksberg, 1983; Martin, 1992). This pattern buttresses the conclusion that conventionalization results in a shift in metaphor processing from on-line active interpretation to retrieval of stored meanings (Bowdle & Gentner, 1995, 1999, 2005; Gentner et al., 2001; Gentner & Wolff, 1997; Wolff & Gentner, 2000).

An important implication of the career of metaphor framework is that metaphors can indeed give rise to new categories but only over time, as they become conventionalized. Thus, the career of metaphor view agrees in part (but not entirely) with Glucksberg and Keysar's (1990) category-inclusion model. In their original theory, the base or vehicle gives rise to a metaphoric category that is either already associated with or newly derived from the·base term. Our evidence supports the first claim but not the second: a metaphor can be processed as a category statement if there is already an abstraction associated with the base; but otherwise, comparison of the two literal representations is necessary, and the abstraction emerges from the alignment process. Thus, highly conventional metaphors can indeed serve as category statements, but novel metaphors in general do not.

Degrees of conventionalization. This evolution can be described in terms of four stages of conventionalization, as shown in Figure 6.3. In a *novel* metaphor (as discussed earlier), the base concept has no standard metaphorical category attached to it, although the comparison between base and target will promote the formation of such a category. In a *conventional* metaphor, the
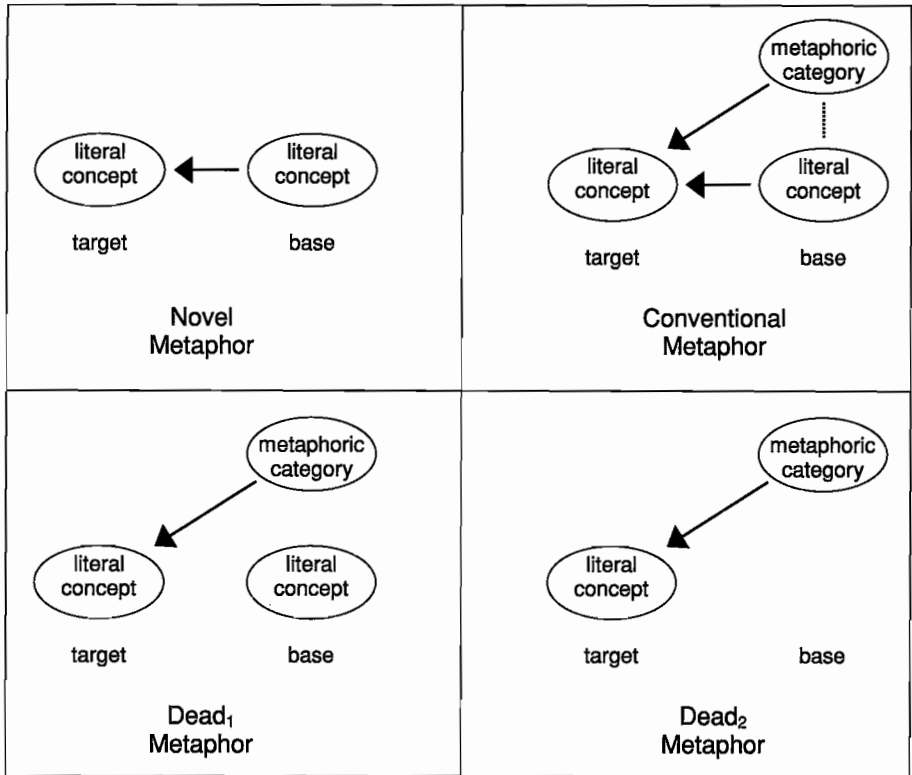
Figure 6.3. Living and dead metaphors.

base refers simultaneously to a literal concept and to a metaphoric category. Typically, the relationship between these senses is clearly recognizable: for example, the term *river* (as in *Time is a river*) has two associated senses: namely, *a large stream of flowing water* and *anything that moves continuously forward*. For these kinds of polysemous bases, the two senses may be processed simultaneously (Williams, 1992). However, metaphors often evolve further, to the point where the metaphoric sense seems to stand on its own, with only a tenuous relation to the literal sense. These are often called *frozen metaphors* or *dead metaphors*.

The conclusion of this evolutionary process is the death of metaphors as such (though, Phoenix-like, they often take on new life as literal category senses). Thus, in *dead₂* metaphors, the base term refers *only* to the derived abstract sense, which is now taken as a literal meaning; the original specific sense no longer exists. A good example is the term *blockbuster* (as in *"Star Wars"*

was a blockbuster), which roughly means *something that has a profound popular effect.* This term does not seem metaphoric; in fact, most people are unaware of the original sense of *blockbuster,* namely, *a bomb that can demolish an entire city block.*

But on the way from conventional metaphor to dead₂ metaphor, there is an intriguing intermediate stage, which we call *dead₁* metaphors. These are similar to conventional metaphors in possessing both a literal and a metaphorical meaning, but for dead₁ metaphors, the relation between literal and metaphorical has become obscure. For example, temporal prepositions (e.g., *AT nine o'clock, ON Monday, IN January*) have been analyzed as metaphoric extensions of spatial prepositions (e.g., *AT the swimming pool, ON the cruise ship, IN the Pacific Ocean;* e.g., Clark, 1973; Traugott, 1978). However, a series of studies by Sandra and Rice (1995) suggests that people often do not recognize the semantic relationships between the spatial and temporal uses of prepositions.

Of course, the fact that people do not readily notice the relation does not rule out implicit connections. For example, we use two systems of space–time metaphors – ego-moving (e.g., *We are fast approaching the holidays*) and time-moving (e.g., *Exams are coming closer*). Although speakers typically appear unaware of the metaphorical nature of such usages (see McGlone & Harding, 1998), Gentner, Imai, and Boroditsky (2002) found a metaphoric consistency effect, indicating that these two systems are processed as coherent mappings. Further, Boroditsky (2000) found a priming effect from spatial sentences to temporal uses of the same metaphors. This is consistent with Gibbs's (1980) finding that dead$_1$ metaphors can be "awakened" to their metaphorical roots in some circumstances.

The career of metaphor hypothesis is consistent with the idea that metaphor is a primary source of polysemy – metaphors allow words with specific meanings to take on additional related meanings (e.g., Dirven, 1985; Lee, 1990; Lehrer, 1990; MacCormac, 1985; Miller, 1993; Nunberg, 1979; Sweetser, 1990). Over the career of a metaphor, it can move from having but a single stored (literal) meaning (the novel metaphor stage) to being polysemous (for conventional and dead$_1$ metaphors), and, sometimes, on to again having but a single meaning, namely the derived abstract sense (the dead$_2$ case).

Metaphors and Similes

Proponents of category-based approaches to metaphor comprehension point out that nominal metaphors have the same grammatical form as literal class-inclusion statements, namely, *An X is a Y* (e.g., Glucksberg & Keysar, 1990; Kennedy, 1990; Shen, 1992). However, nominal metaphors can also be paraphrased as similes – figurative comparisons of the form *X is like Y* – which are grammatically identical to literal comparison statements. Thus, we can say both *Time is a river* and *Time is like a river*.

What is the cognitive status of metaphor–simile distinction? The dominant view is that similes are simply clearer than metaphors, explicitly inviting a figurative comparision. For example, many theorists have assumed that metaphors are understood as implicit similes (e.g., Kintsch, 1974; Miller, 1979; Ortony, 1979; Tirrell, 1991). Consistent with this view, Vosniadou and Ortony (1986) found that children were better able to understand similes than metaphors, as would follow from the idea that similes more directly invite the necessary comparison process. However, Glucksberg and Keysar (1990) have argued the reverse position: that similes are understood as implicit metaphors. This is in keeping with their class-inclusion model of figurative meaning: Metaphors directly suggest class-inclusions, and similes must be converted to metaphors in order to be processed.

We propose an integrative account of the metaphor–simile distinction – namely, *grammatical concordance* (Bowdle, 1998; Bowdle & Gentner, 1995, 1999, 2005; Gentner & Bowdle, 2001). A central intuition behind grammatical concordance is that linguistic form tells us something about function. Here we adopt Glucksberg and Keysar's (1990) insight that metaphors are seen as category statements, but we take the idea a step further, and argue that linguistic form also tells us something about similes – namely, that they are seen as comparisons.

On this view, metaphors and similes invite different comprehension strategies. Because metaphors are grammatically identical to literal class-inclusion statements, they invite categorizing the target as a member of a category named by the base. Likewise, because similes are grammatically identical to literal comparison statements, they invite comparing the target with the literal base concept. The combination of grammatical concordance with the career of metaphor hypothesis leads to a set of predictions, and thus offers a valuable route toward testing the career of metaphor hypothesis (Bowdle, 1998; Bowdle & Gentner, 1995, 1999, 2005; Gentner & Bowdle, 2001).

Consider first the case of novel figurative statements. According to the career of metaphor hypothesis, such statements are

interpreted as comparisons between the two literal concepts. Thus, they should most felicitously be phrased as similes. The simile form invites comparison, which accords with the comprehension strategy required. If a novel figurative is phrased as a metaphor, the hearer is invited to access a stored metaphorical sense which does not in fact exist, so comprehension is initially thwarted. The hearer must then start over using a comparison process – a horizontal alignment with the literal concept evoked by the base.

Now consider the case of conventional figurative statements. According to the career of metaphor hypothesis, such statements may be interpreted either as comparisons or as class-inclusions, as the base term refers simultaneously to a specific literal concept and to an abstract metaphoric category. Thus, either form – simile or metaphor – can be processed directly. For conventional figurative statements, then, metaphors are interpreted as class-inclusions, whereas similes are interpreted as comparisons.

This account generates several testable predictions (see Bowdle, 1998; Bowdle & Gentner, 2005; Gentner & Bowdle, 2001). Here, we summarize some findings on grammatical form preference and comprehension time. Later, we turn to studies of the conventionalization process itself.

Grammatical form preferences. If conventionalization results in a processing shift from comparison to categorization, then there should be a corresponding shift in people's preference. People should prefer the comparison (simile) form for novel figuratives and the categorization (metaphor) form for conventional figuratives. Therefore, Bowdle and Gentner (2005) gave individuals novel and conventional figuratives and asked which form they preferred for each statement. To calibrate the results, we also gave participants literally similar statements (e.g., *lemon → orange*), for which the comparison form is most natural, and literal category statements (e.g., *robin → bird*), for which the categorization form is most natural.

As expected, the "X is Y" form was strongly preferred for literal categorizations and the comparison form ("X is like Y")

for literal similarity. More importantly, consistent with our predictions, the preference for the metaphor form was far higher for conventional figurative statements than for novel figurative statements. Indeed, participants' preference for the comparison form was as strong for novel figuratives as it was for literal similarity statements. The conventional figuratives were more mixed, consistent with the claim that conventional figuratives may be treated either as comparisons or as categorizations.

Processing predictions. The career of metaphor hypothesis also makes clear predictions about the effects of conventionality on on-line comprehension. One prediction is that conventional figuratives will be faster to interpret than novel figuratives overall. This is because conventionalization results in storing a metaphorical abstraction; and, as noted earlier, vertical mappings between a target and an abstract category will tend to be computationally less costly than horizontal mappings between two concrete concepts from different domains.[8]

A more critical prediction concerns the effects of conventionality on the relative comprehension times of metaphors and similes. Because novel figuratives must be interpreted as comparisons, novel similes should be easier to comprehend than novel metaphors. This is because the simile form directly invites comparison, whereas the metaphor form prompts the expectation that an abstract metaphorical category is available – a kind of bait-and-switch, since this expectation will be unfulfilled in a novel figurative. In contrast, conventional figuratives should be easier to comprehend as metaphors than as similes. This is because the metaphor form invites categorization – a relatively simple vertical alignment between the target and the abstract metaphoric category named by the base. Here the simile form, by inviting comparison, invites a more demanding horizontal alignment between the target and the literal base concept.

We collected participants' comprehension times for novel and conventional figurative statements phrased as either metaphors or similes. The results were

as predicted. First, conventional figuratives were interpreted faster than novel figuratives. And second, there was an interaction between conventionality and grammatical form, such that novel similes were faster than novel metaphors, but conventional metaphors were faster than conventional similes.

Naturalistic evidence. There is also indirect evidence on the real-life process of conventionalization. First, Zharikov and Gentner (2002) examined the course of development over history for a set of figuratives, based on their occurrences in the *Oxford English Dictionary*. The results showed a frequent pattern of an initial literal meaning, followed over time by figurative uses with overt comparison marking (such as simile form), followed by metaphorical uses. Table 6.1 shows the example of *sanctuary*, which initially referred to a place of worship and came over time to have a secondary reference to any safe place. As predicted by the career of metaphor account, its initial figurative uses had overt similarity markings (e.g., *She was as safe as in a Sanctuary . . .*) with the metaphoric form (e.g., *A Sanctuary was opened in his Court . . .*) occurring later, presumably as the metaphorical abstraction became conventionalized.

Second, a study of natural text by Roncero, Kennedy, and Smyth (2006) suggests that (at least for conventional target–base pairs) similes are more likely than metaphors to be accompanied by explanations. Roncero et al. searched the Internet for figurative expressions linking concepts such as *crime* and *disease* – either as similes (*crime is like a disease*) or as metaphors (*crime is a disease*). They found that similes were more likely than metaphors to be accompanied by explanations such as "Crime is like a disease because it spreads by direct personal influence." They concluded that similes may be preferred when the writer wants to express an out-of-the-ordinary relation between the target and the base. Given that a base has a conventional meaning, if the writer wants to invite going beyond that meaning, a return to the simile form is one way to invite a fresh comparison between base and target.

Table 6.1: Timeline of occurrences of literal and figurative meanings for sanctuary

Initial literal meaning

I. a holy place – a building or place set apart for the worship of God or of one or more divinities: applied, e.g., to a Christian church, the Jewish temple and the Mosaic tabernacle, a heathen temple or site of local worship, and the like; also *fig.* To the church or the body of believers

> 1340 . . . *in that sanctuary oure lord sall be kynge . . .*
>
> 1382 *And thei shulen make to me a seyntuarye, and Y shal dwelle in the myddil of hem.*
>
> 1530. *Sanctuarie, a place hallowed and dedicate vnto god.*

II.a – a church or other sacred place in which, by the law of the medieval church, a fugitive from justice, or a debtor, was entitled to immunity from arrest. Hence, in a wider sense, applied to any place in which by law or established custom a similar immunity is secured to fugitives.

> 1374 *To whiche Iugement they nolden nat obeye but defendedyn hem by the sikernesse of holy howses, that is to seyn fledden in to sentuarye.*
>
> 1463–4 *Eny persone. .that shall dwelle or inhabit within the Sayntwarie and Procyncte of the same Chapell.*

[First figurative meaning]

> 1568 *Vsing alwaise soch discrete moderation, as the scholehouse should be counted a sanctuarie against feare.*
>
> 1596 *That all the while he by his side her bore, She was as safe as in a Sanctuary.*

[First unmarked figurative meaning]

> 1700 *To form his Party, Histories report, A Sanctuary was opened in his Court, Where glad Offenders safely might resort.*

Aptness. Some researchers have suggested that the simile–metaphor difference is one of aptness rather than of conventionality (e.g., Chiappe, Kennedy, & Smykowski, 2003; Glucksberg, 2003; Jones & Estes, 2005). Specifically, it is claimed that the metaphor form is preferred for highly apt figuratives and the simile form for less-apt figuratives. This view is consistent with the sense that the metaphor form seems to suggest a stronger relationship between the target and base concepts than the simile form (e.g.,

Glucksberg & Keysar, 1990; Kennedy, 1990). Indeed, some studies have found a correlation between aptness and conventionality (e.g., Bowdle & Gentner, 2005; Jones & Estes, 2005).

However, there are problems with this line of argument. First, aptness is highly correlated with many other aspects of figurative statements, including relationality (Gentner & Clement, 1988), ease of interpretation, degree of metaphoricity, imagery, subjective familiarity, and the number of alternative interpretations possible (Katz, Paiio, Marschark, & Clark, 1988), as well as with ease of comprehension (Chiappe, Kennedy, & Chiappe, 2003). Thus, it's not clear whether aptness itself or one or more of these correlated dimensions is involved here. It's also not clear how aptness could play a causal role in figurative language processing, as it seems to arise as part of the process of evaluating a metaphor (e.g., Gerrig & Healy, 1983; Gibbs, 1994). Third, the empirical findings are not encouraging.[9] For example, Bowdle & Gentner (2005) found a significant *negative* correlation between rated aptness and preference for the metaphor form among novel figurative statements. That is, the more apt a novel figurative was, the more strongly the simile form was preferred over the metaphor form. For conventional figuratives, there was no difference in aptness between similes and metaphors.

In our view, the likeliest contributor to metaphor preference is relational similarity. There is evidence that relational similarity is a major determinant of aptness (Gentner & Clement, 1988) and that it can facilitate online processing (Wolff & Gentner, 2000). Indeed, Aisenman (1999) proposed that the preference for metaphor form increases with the degree of relational match. Although Aisenman found positive evidence, her study did not control conventionality. When Zharikov and Gentner (2002) orthogonally varied both base conventionality and the relationality of the figurative's interpretation[10] and elicited participants' form preferences, the results showed a strong effect of conventionality in determining a preference for metaphor form, and only a marginal main effect of relationality. In a further study, when participants were give the same figurative statements and asked to rate their agreement with either a relational or an attributional interpretation, they strongly preferred the relational interpretation for both metaphors and similes.

Aisenman's idea that relational similarity contributes to the strength and aptness of a metaphoric mapping seems correct. But the evidence to date suggests that conventionality is a far stronger determinant of preference for the metaphoric form.

From simile to metaphor – the in vitro conventionalization of novel figuratives. The most dramatic evidence for the career of metaphor hypothesis would be a demonstration that conventional metaphoric categories can be generated by repeated and consistent figurative comparisons involving the same base term. Therefore, we decided to test this claim directly by seeing whether we could speed up the process of conventionalization from years to minutes. The idea was to give participants multiple similes with the same base term and parallel meanings, and then test whether this shifted their preference towards the metaphor form for that base term.

There were two phases. The key manipulation occurred in the first (study) phase, in which participants were given a subset of the later test items. These items were always given in simile form in the study phase. Each subject received one-third of the items in the *multiple-similes* condition and one-third in the *multiple-literal* condition; the remaining third was not shown during study and served as the *control* condition. (Item condition was counterbalanced over subjects.) In the multiple-similes condition, the key simile (e.g., *An obsession is like a tumor*) had its base term paired with two new target terms to create new similes (e.g., *Doubt is like a tumor, A grudge is like a tumor*) with roughly parallel interpretations. In the multiple-literal condition, each base term was paired with new target terms to create two further literal comparisons (e.g., *A blister is like a tumor; An ulcer is like a tumor*).

For both these conditions, these examples were followed by an incomplete statement of the form "– is like a tumor." Participants were asked to complete it by writing a target term that would make it "similar in meaning to the first two."

The second (test) phase, which occurred after a 20-minute filler task, was a grammatical form preference test. Participants saw a large set of figuratives (e.g., *An obsession is (like) a tumor*). This included the figuratives they had seen in the study task, plus other figuratives (both novel and conventional), that they had not seen in the study phase. For each statement, they indicated their preference for the simile form versus the metaphor form on a sliding scale.

The key items were the figuratives used in the study task. Consistent with the career of metaphor account, participants were more likely to prefer the metaphor form (i.e., the categorization form) for items in the multiple-similes condition than for items in the multiple-literal condition, which did not differ from items not seen before. Strikingly, seeing/generating a set of novel *similes* led to a shift toward preferring the *metaphor* form. (Note that this cannot be explained in terms of a novel-form preference, for there was no such shift in the multiple-literal condition). A further striking point is that the *same figuratives* were judged in all conditions; thus, the presumed aptness of the match was held constant. Simply by varying the metaphoric conventionality of the base term – by varying participants' experience aligning parallel figurative uses, we were able to induce a shift towards the metaphoric form.

These results are evidence that aligning parallel figuratives (even in our brief *in vitro* condition) can give rise to an abstraction that becomes associated with the base; and, further, that the existence of such an abstraction leads to a preference for the metaphor form.

Summary

We have suggested that metaphor is like analogy – that the basic processes of anal-

ogy are at work in metaphor. Specifically, we suggest that structural alignment, inference projection, progressive abstraction, and re-representation are employed in the processing of metaphor and simile. This view can help resolve some tensions in the field: for example, on this view, metaphor both reflects parallels (Murphy, 1996) and creates new similarities (Lakoff, 1990) between the domain compared, via structural alignment and candidate inferences, respectively.

We further propose that individual metaphors evolve over the course of their lives from comparison – horizontal alignment between literal meanings – in the early stages to categorization – vertical alignment between the literal target term and the base's metaphorical abstraction – as they become conventionalized. Conventionalization often results in local metaphoric categories, but it can also take the form of large-scale conventional systems of metaphors.

The career of metaphor account offers a unified theoretical framework for the study of metaphor, analogy, and similarity (see Steen [2007] for an extended discussion of these issues). It renders explicit the processing differences between metaphors at different levels of conventionality and provides a mechanism for the metaphoric generation of polysemous words. Finally, it reconciles the seemingly opposing intuitions behind traditional comparison models and more recent categorization models. Comparison is not inimical to categorization, but rather engenders it over time.

Author's Notes

Notes

1 Although structure-mapping is best known as a theory of analogy, metaphor has been a focus of the work from its inception (e.g., Gentner, 1982).

2 Structure-mapping theory assumes the existence of structured representations made up of entities and their attributes, functions that map entities to dimensions or to other entities, relations between objects, and higher-order relations between relations.

3 This discussion is taken chiefly from structure-mapping theory (Gentner, 1983; Gentner & Markman, 1997) and its computational model, SME, the structure-mapping engine (Falkenhainer, Forbus, & Gentner, 1989; Forbus, Gentner, & Law, 1995; Forbus & Oblinger, 1990). However, the basic tenets are accepted by most current models of analogy (e.g., Holyoak & Thagard, 1989; Hummel & Holyoak, 1997; Keane & Brayshaw, 1988; Kokinov & Petrov, 2001; Larkey & Love, 2003; Ramscar & Yarlatt, 2000).

4 Local-to-global is not the same as bottom-up, a point that occasionally engenders confusion. In SME, processing starts by identifying matching nodes at *any level* of the structure, from higher-order relations to concrete perceptual attributes. These local identities are then coalesced into global system-mappings (Falkenhainer et al., 1989; Forbus et al., 1995).

5 The attributive category theory can predict a metaphoric slowdown for forward metaphors, such as *some suburbs are parasites*, by assuming that participants implicitly experience a fit between the target, *suburbs*, and the metaphorical category associated with *parasite*, and that this spontaneous categorization temporarily overrides their ability to notice that the statement is literally false. But this explanation is highly implausible for a reversed metaphor, such as *some parasites are suburbs*. Although it might be possible to find a category associated with *suburb* that could apply to *parasite*, the search for such a match would be laborious and deliberate – hardly likely to spontaneously capture participants' attention and prevent them from noticing that the statement is literally false.

6 In this condition, participants encountered the *terms* from the metaphoric base domain in the passage but not the metaphor itself (until the final test sentence). If the facili-

tation for the consistent condition over the inconsistent condition were due merely to associative priming, the final sentence should not differ between the consistent condition and the literal control condition.

7 Note that in both cases, the global metaphors themselves were often familiar conceptual metaphors (e.g., *Debate as war*); the difference lay in whether the individual metaphors were novel or conventional.

8 Of course, if the two concrete concepts are literally similar to each other, the comparison will be quite fast to process, because there will be many mutually supporting matches at both the relational level and the object-attribute level (see Gentner & Kurtz, 2006, for evidence).

9 One difficulty in sorting out the evidence is that some researchers have manipulated the familiarity of the whole figurative statement (that is, the base–target pair; e.g., Blasko & Connine, 1993; Chiappe, Kennedy, & Smykowski, 2003), rather than the conventionality of the base term (the focus of the career of metaphor). These two factors are by no means identical, and sorting out the evidence is not straightforward.

10 To vary the figuratives' interpretations, each figurative was preceded by a short description of the target that focused either on object attributes or on relational structure.

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