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Semantic Effects on Metaphor Processing Stages

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by

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Abstract

Metaphors can be processed as comparisons or categorizations (Gibbs & Colston, 2012). The *quality of metaphor* hypothesis suggests that inapt metaphors are processed as comparisons and apt metaphors are processed categorizations (Glucksberg & Haught, 2006). In two experiments, novel metaphors were manipulated on semantic neighbourhood density (SND) and topic concreteness and presented to participants at two reading deadlines that are believed to characterize symmetric (e.g. comparison) and directional (e.g. categorization) processing stages (e.g., Wolff & Gentner, 2011). Participants rated the comprehensibility of metaphors. The results suggest that low SND metaphors are processed as categorizations whereas high SND metaphors are processed as comparisons. In the case of metaphors made up of high SND, an abstract topic is more favourable for categorization than a concrete topic. A new model is proposed to explain how semantic characteristics affect comparison and categorization processes.

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CHAPTER I

REVIEW OF LITERATURE

Metaphor Processing: Comparison versus Categorization

Metaphors pair two unrelated concepts and as a result, propose a meaningful relationship between said concepts. The two concepts are commonly referred to as the topic (first word) and the vehicle (second word). For instance, consider the conventional metaphor TIME IS MONEY. The topic, TIME and the vehicle, MONEY, are two very different things; nonetheless, this statement is comprehensible even though it is literally untrue. Psycholinguists have conducted many experiments to understand how the two unrelated words in a given metaphor may be related to create meaning (Gibbs & Colston, 2012). Nonetheless, an ongoing debate remains in the literature with respect to the processing of metaphor; namely, the comparison vs. categorization debate (see Gibbs & Colston, 2012; Haught, 2013 for reviews). These theories will be briefly described below, and the more recent hybrid theories, will be described in subsequent sections.

Comparison Theories: Structure-Mapping

There is a number of variants of the comparison theory (see Gentner, 1983; Ortony, 1979; Tversky, 1977). The most developed comparison model is structure-mapping, which posits that metaphor is primarily a comparison (mapping) of the similarities between topic and vehicle domains (Gentner, 1983; Gentner & Bowdle, 2008). In structure-mapping, comparing the topic and vehicle domains uncovers their shared commonalities. This comparison is presumed to occur in two stages, an alignment stage and a projection stage. The alignment stage is where topics and vehicles are juxtaposed, and the projection stage is where more inferences from the vehicle are

projected to the topic. Furthermore, these commonalities can be of two types; attributes and relations. Attributes refer to one thing (e.g., colourful) whereas relations refer to two or more things (e.g., eclipse). Structure-mapping holds that metaphor, like analogy, posits that a relation in one domain (the vehicle) also applies in another (the topic); therefore, figurative meaning (e.g., metaphor, analogy, and simile) is reached primarily from relational rather than attributional structures (Gentner, 1983). Wolff and Gentner (2011) illustrate this with a comparison of two typically unrelated concepts, SOME SUBURBS ARE PARASITES. Such a comparison would result in the relational mapping of BENEFITTING FROM AND HARMING HOST; both the suburb and parasite benefit and harm the host city or host organism respectively. The specific attributes of the suburbs (e.g., their location) and parasites (e.g., their type) are not the primary structures important in the interpretation of figurative language, but the relational features are.

The theoretical inferences of structure-mapping have been observed in experimental settings. For instance, Gentner (1988) found that adults produce more relational interpretations of metaphors than attributional interpretations, whereas children rely more on attributional comparisons for comprehension. This developmental difference suggests that the capacity for comprehending relational structure is acquired after a preference for attributional structure. Also, Aisenman (1999) found that people prefer word pairs in the metaphor form (rather than the simile form) when such pairs share relational features rather than attributional features. Thus, structure-mapping is the comparison of structures inherent in two unrelated domains, and in metaphors, relational rather than attributional structures appear to be the primary linkage (see Gentner, 1983, Gentner & Bowdle, 2008; Wolff & Gentner, 2011).

Categorization

The alternative to the comparison model is the categorization model (Glucksberg, 2008; Glucksberg & Keysar, 1990). Categorization theorists posit that metaphors are processed as class-inclusion statements much like literal statements. This view holds that the linguistic form of metaphors, namely, A IS B, resembles the grammatical structure of literal categorical, or class-inclusion, statements (e.g., A ROBIN IS A BIRD). Therefore, a figurative statement such as MY JOB IS A JAIL, according to the categorization view, does not involve a comparison or feature mapping process, such as structure-mapping. Rather, it involves categorizing the topic, MY JOB, into the superordinate category, JAIL. This is achieved by *dual reference*; in this metaphor, the word JAIL can refer to a literal jail *or* to an abstract, nonconventional category of which the vehicle belongs (i.e., unpleasant situation). This dual reference mechanism is at work in many words (e.g., KLEENEX refers to both a brand of facial tissue along with any generic facial tissue) (Glucksberg, 2003). Furthermore, categorization theorists claim that the grammatical order of topics and vehicles (i.e., topic is always before the vehicle), is not adequately considered in comparison theories. That is, MY JOB IS A JAIL, when reversed to MY JAIL IS A JOB, becomes nonsensical even though their similar features remain the same (Glucksberg & Keysar, 1990).

In categorization, the topic and vehicle play different roles. The vehicle provides properties that are attributed to the topic whereas the topic constrains which types of vehicle properties may be attributed (Glucksberg, McGlone, & Manfredi, 1997). For example, in the metaphor, MY LAWYER IS A SHARK, the topic, LAWYER, relates to skills or attributes needed to practice law, and not to things that are unrelated to law such

as physical appearance, thus constraining the types of properties that can be assigned to it; LAWYER is an example of a high constraint topic, whereas MAN is an example of a low constraint topic (Glucksberg, McGlone & Manfredi, 1997). The vehicle SHARK is unambiguous in its reference to predation and viciousness; SHARK is an example of an unambiguous vehicle whereas ORGANISM is an example of an ambiguous vehicle. Both high-constraint and unambiguous vehicles are specific whereas low-constraint topics and ambiguous vehicles are vague. Therefore, a constraining topic paired with an unambiguous vehicle provides an effective means for property attribution.

Evidence for the categorization model and its position on constraint and property attribution in metaphor comes from priming studies (e.g., Glucksberg, McGlone & Manfredi, 1997; McGlone & Manfredi, 2001). Priming is a method in experimental psychology where an additional, tangential stimulus (the prime) is presented before the onset of another stimulus, the target stimulus. Doing so can affect the processing of the target stimulus. For example, seeing the prime DOCTOR allows readers to recognize the word NURSE faster than they would without seeing the prime (Meyer & Schvaneveldt, 1971). Glucksberg et al. (1997) presented subjects with metaphors composed of constraining topics (e.g., SOME PLASTIC SURGEONS ARE BUTCHERS), non-constraining topics (e.g., HIS LIFE IS A SOAP OPERA) unambiguous vehicles (e.g., SOME LECTURES ARE SLEEPING PILLS) and ambiguous vehicles (e.g., SOME DREAMS ARE RIVERS). These metaphors were preceded by priming their respective topics or vehicles. The researchers found that reading times for metaphors decreased (or, reading was facilitated) as a result of topic or vehicle primes only for the high-constraint topic metaphors and the unambiguous vehicle metaphors. In other words, priming the

topic or vehicles of metaphors is only favourable when those primes aid in the property attribution process. Conversely, the property attribution process can be inhibited; McGlone & Manfredi (2001) found that priming irrelevant properties of the vehicle category (e.g., literal properties like SHARKS CAN SWIM) slows down reading time whereas other primes (topic, and relevant vehicle properties, such as SHARKS ARE VICIOUS) can speed up reading time. Thus, because the vehicle in the metaphor refers to a superordinate category and not to the literal shark, priming literal shark properties will inhibit processing. Gernsbacher, Keysar, Robertson and Werner (2001) explored further how priming can enhance or suppress the processing of metaphors. Participants were instructed to determine if sentences presented on the computer monitor made sense or not. When metaphors (e.g. THAT DEFENSE LAWYER IS A SHARK.) precede target sentences that reflect the super-ordinate category of sharks (e.g. SHARKS ARE TENACIOUS), the time participants take to determine if the target sentences make sense is lower than if the metaphor precedes a target sentence that reflects the literal aspects of sharks (e.g. SHARKS ARE GOOD SWIMMERS.). The researchers argue that the metaphors enhance processing superordinate target sentences because both statements refer to the superordinate representation of SHARK whereas the metaphors suppress processing literal target statements because the metaphor calls upon the superordinate representation but the literal target statement calls upon the basic representation of SHARK, so processing the literal SHARK after reading about the superordinate SHARK takes extra time.

Hybrid Theories

In recognition of evidence for both comparison and categorization, some

contemporary theories account for both processes rather than one single process. For example, Gentner and Wolff (1997) presented subjects with novel metaphors on a computer screen, which were primed by the topic, the vehicle, both topic and vehicle, or by neither. The authors predicted that if metaphors were categorizations, then only the vehicle prime should have a facilitative effect (with lower reading times) because seeing the vehicle first would induce processing its superordinate category (as predicted by the categorization model). On the basis of the resulting data these researchers, however, concluded that only the condition that facilitated reading times happened when both the topic and vehicle were primed. However, the authors replicated this task with conventional (frequently used) metaphors and found a processing advantage for vehicle primes. To account for this, the authors proposed that novel metaphors are processed as comparisons whereas conventional metaphors can be processed as either comparison or categorizations. The processing type is determined by the vehicle's dual reference (i.e. literal word or superordinate category). If the vehicle refers to the literal word, then metaphors are processed as comparisons; on the other hand, if the vehicle refers to a superordinate category then metaphors are processed as categorizations. For Gentner and her colleagues (Bowdle & Gentner, 2005; Gentner & Bowdle, 2001; Gentner & Wolff, 1997) this finding implies that as metaphors become more familiar, the vehicle acts like a superordinate category; this view is called the *career of metaphor hypothesis*.

The career of metaphor hypothesis gained further support from contrasts between metaphors and similes (Bowdle & Gentner, 2005). Similes differ from metaphors by including the word *like* (or sometimes *as*) in the statement. Both the comparison and categorization camps hold that the grammatical form of similes invites comparison

processing, whereas the grammatical form of metaphors invites categorization (Gentner & Bowdle, 2001; Glucksberg & Keysar, 1990). However, both camps believe that those invitations are ignored for their favoured processing type (i.e. comparison or categorization). In other words, comparison theorists hold that even though metaphors are written like categorizations, they are processed as comparisons (Gentner & Bowdle, 2008; Gentner & Wolff, 1997); similarly, categorization theorists hold that even though similes are written like comparisons, they are processed as categorizations (Glucksberg, 2008; Glucksberg & Keysar, 1990). Importantly, ignoring the processing demands inherent in linguistic format adds additional processing effort that translates into additional time, errors, or change in preference in psycholinguistic tasks.

Based on their understanding of the difference between metaphors and similes, Bowdle and Gentner (2005) asked participants to rate their preference for novel and conventional metaphors and their simile counterparts. In experiment 1, participants rated novel figurative statements higher in comprehension in the simile form (i.e. comparison form) than the metaphor (i.e. categorization) and conventional figurative statements in the metaphor form (i.e. categorization form). In experiment 2 subjects read novel figurative statements faster as similes than as metaphors and conventional figurative statements faster as metaphors than as similes. In experiment 3, subjects were given pairs of similes containing the same vehicle (e.g. AN ACROBAT IS LIKE A BUTTERFLY; A FIGURE SKATER IS LIKE A BUTTERFLY) and a statement with a blank topic (e.g. _____ IS LIKE A BUTTERFLY) to complete. Participants studied these similes and provided topics that would result in the completed statements having a similar meaning to the previous two statements. In another phase, participants rated those

statements in simile and metaphor form. They preferred the metaphor form for the previously studied items rather than the simile form. This implies that comparison processing of similes gives way to categorization processing after frequent use. In other words, after becoming familiar with a figurative statement, the participant no longer only understands the vehicle as a literal word, but now also understands its reference to a superordinate category (e.g., the superordinate category of BUTTERFLY in this case may refer to something that moves in an agile, elegant fashion). As such, the career of metaphor hypothesis suggests that all novel pairings of topics and vehicles, whether simile or metaphor, are processed as comparisons whereas conventional statements can be processed as categorizations because the familiar vehicle term has been repeatedly used and can *now* refer to a superordinate category. Metaphors begin their "career" as comparisons and after frequent usage, can become categorizations (Bowdle & Gentner, 2005; Gentner & Bowdle, 2001; Gentner & Wolff, 1997).

Unlike the career of metaphor hypothesis, the *quality of metaphor hypothesis* argues that metaphor *aptness* is the contributing variable that distinguishes comparison and categorization (Glucksberg & Haught, 2006). Aptness is defined as "the quality of being appropriate or suitable" (Oxford Dictionaries, n.d.). After controlling for aptness, in a series of experiments, Haught (2013) showed that novel metaphors (not just conventional metaphors) are sometimes processed as categorizations. For instance, subjects were asked to match metaphors (SOME LAWYERS ARE SHARKS) and similes (SOME LAWYERS ARE LIKE SHARKS) to interpretations which either referenced properties of a literal vehicle (SOME LAWYERS ARE VICIOUS) or an emergent property from the vehicle's superordinate category (SOME LAWYERS ARE

GREEDY). In experiment 1, Haught found that subjects matched metaphors to interpretations containing emergent properties whereas the similes were matched to interpretations containing literal properties. Moreover, Haught modified conventional metaphors to become novel by including an adjective that applied to the topic (i.e. SOME LAWYERS ARE WELL PAID SHARKS); an adjective that applied to the literal vehicle (i.e. SOME LAWYERS ARE RAZOR TOOTHED SHARKS); an adjective that applied to both topic and vehicle (i.e. SOME LAWYERS ARE OLD SHARKS); and no adjective (SOME LAWYERS ARE SHARKS). The prediction was that topic-applicable statements should be preferred in metaphor form because their adjective (WELL PAID) is a reference to the metaphorical shark whereas the vehicle-applicable adjective (RAZORTOOTHED) is a reference to the literal shark. Indeed, subjects rated the topic modified metaphors higher than similes in aptness (experiment 2) and comprehensibility (experiment 3) and took less time to read than the topic modified similes (experiment 4). In another study, Haught (2014) demonstrated that, contrary to the comparison view that metaphors and similes are interchangeable, people interpret metaphors and similes made up of the same topic-vehicle combination differently. Participants were provided with novel metaphors (e.g., THE LAWYER WAS AN OLD SHARK) and their simile counterparts (e.g., THE LAWYER WAS LIKE AN OLD SHARK) along with interpretations that reflected the categorization process (e.g., THE LAWYER WAS SHREWED, EXPERIENCED AND WELL VERSED) and interpretations that reflected the comparison process (e.g., THE LAWYER WAS WEAK, TIRED, AND LESS AGGRESSIVE). Participants rated category interpretations higher for metaphors than similes and comparison interpretations higher for similes than metaphors, implying that

metaphors and similes, even with the same topic-vehicle construction, mean different things. Haught (2014) suggests that, contrary to the career of metaphor hypothesis, metaphors cannot shift from comparison to categorization as a result of familiarity without a change in meaning. Importantly, the quality of metaphor hypothesis implies that categorization processing is indicative of higher quality; that is, a metaphor processed by comparison will be less apt than a metaphor processed by categorization.

Based on the evidence to date, it appears that metaphors are not processed in a single predetermined way as was proposed by earlier models (Gentner, 1983; Glucksberg & Keysar, 1990; Glucksberg et. al, 1997, McGlone & Manfredi, 2001; Ortony, 1979; Tversky, 1977). What we can take away from the contrasts of earlier models is that the processes of both categorization and comparison must be considered in metaphor comprehension research. Another important consideration is the word level properties upon which these processes occur (Kintsch, 2000). The following section discusses that aspect of metaphor research.

Semantic Variables in Metaphor Comprehension

Semantic Memory

One major limitation with metaphor processing models is that they do not describe what topic and vehicle properties are involved in the comprehension of a metaphor (Gibbs & Colston, 2012; Kintsch, 2000). For example, the categorization view does not objectively describe what a superordinate category is (Kintsch, 2000). For that reason, Kintsch (2000, 2008) argues that if metaphor comprehension is a "semantic problem", we must consider the general knowledge structure or, *semantic memory*, and couple this variable with comprehension processes described in psychological models.

Semantic memory can be operationalized in a number ways, but recent models are based on word co-occurrences. In these models, semantic similarity between words is inferred from their usage in natural language (see Landauer & Dumais, 1997 for an example of one of these models).

Kintsch (2000) has found that semantic memory models are an important tool in metaphor comprehension. His computational model, known as the predication algorithm, compares the similarity between a metaphor and the words that are thought to be relevant with the meaning of said metaphor. This model uses Latent Semantic Analysis (LSA) to compute the similarity in meaning between words. LSA creates a semantic space that is reflective of how words are used in natural language. Words are represented as vectors and their arrangement reflects their co-occurrence in natural language, and in turn, semantic distances between vectors can be calculated as cosines; words that share meaning are closer to each other than words that do not, and as a result, form semantic neighbourhoods (Lanauer & Dumais, 1997). The predication model is based on the categorization view and its property attribution process and determines which properties are involved in deriving the meaning of a metaphor (Kintsch, 2000). It computes metaphoric meaning by first selecting semantic neighbours that are related to the vehicle, and then from this set, selects neighbours that are also related to the topic. The result is a vector that is the centroid of the topic, vehicle, and the semantic neighbours related to them. This vector, which represents the meaning of a metaphor in semantic space, can be compared with the vectors of other words that one would expect to be related to the metaphor. For example, the vector of the metaphor, MY LAWYER IS A SHARK is highly related to the vector of the word LAWYER, less related to the vectors of the

words SHARK and FISH, and is more related to the vector of the word VICIOUS than the vector of the word LAWYER is. Therefore, the metaphor introduces viciousness to the concept of lawyer because in the metaphor this word is related to both LAWYER and SHARK (Kintsch, 2000, 2001). The predication model has also been tested with human interpretations; and can predict interpretations that participants provide (Kintsch & Bowles, 2002).

Concreteness

An influential variable in metaphor comprehension is concreteness, or the capacity for a word to be sensed or visualized. It has been suggested that metaphors are a necessary component of our conceptual system and that their function is to partially structure abstract entities in delineated, concrete domains (Lakoff & Johnson, 1980). Indeed, many metaphors employ a concrete vehicle, and an abstract topic (e.g., Gentner, 1983; Katz, 1989; Kintsch, 2000; Wolff & Gentner, 2011; Xu, 2010, but see Gibb and Wales (1990) for a non-replicated counter example). Katz (1989) found that when participants are asked to provide vehicles to topics they chose concrete vehicles that were of moderate semantic distance from the topic. Xu (2010) found that topic-vehicle word pairs yield more similarities when the topic is abstract and the vehicle is concrete than if both terms are concrete. Kintsch reasoned that concrete predicates, or vehicles, may create more apt metaphors because they are semantically rich; “What strong metaphors seem to have in common is that the predicate is a concrete term, rich in imagery and many potential associations…” (Kintsch, 2000, pg. 261).

Although semantic memory and concreteness have been shown to be important in metaphor comprehension, few studies have considered their interactive effects. Al-Azary

and Buchanan (2012) examined the effects of semantic memory and concreteness in novel metaphor comprehension using Windsor Improved Norms of Distance and Similarity of Representations of Semantics (WINDSORS), a model of semantic memory similar to LSA. WINDSORS however, arguably captures more nuances of semantic memory than LSA because it is a measure of semantic neighbourhood *density* (SND), which describes how many *near* semantic neighbours a word has (Durda & Buchanan, 2008). Moreover, WINDSORS controls for word frequency in its calculation of semantic similarity; that is, some high frequency words may appear near each other by chance rather than shared meaning; thus, WINDSORS is an updated model of lexical co-occurence (Durda & Buchanan, 2008).

WINDSORS measure of semantic neighbourhood density has been recently tested in some psycholinguistic tasks. For instance, Danguecan (2011) found an inhibitory effect from near neighbours in a lexical decision task; words from dense semantic spaces, or high SND words, were processed slower than words from sparse semantic spaces, or low SND words. MacDonald (2013) replicated the inhibitory effect in both young (18 – 25 years old) and older (60 – 80 years old) adults. Lastly, McHugh (2009) found that WINDSORS semantic distances reflect the dominant and subordinate meanings of homographic words. In the WINDSORS database, a target word such as DEPRESSION is more closely related to its dominant meaning, such as SADNESS than its subordinate meaning such as HOLE. Importantly, priming the dominant meaning (e.g., SADNESS) of a target word (e.g., DEPRESSION) resulted in faster recognition than priming the subordinate meaning (e.g., HOLE) of the same target word. In summary, the previous studies that used semantic characteristics derived from the WINDSORS model all found

that the model characterizes semantic density in a way that is consistent with our current understanding of semantic processing.

In a metaphor comprehension task, participants rated novel metaphors made up of words with low semantic neighbourhood densities as more comprehensible than high SND counterparts. Furthermore, metaphors with abstract topics were rated as more comprehensible than those with concrete topics but only for high SND metaphors. This interaction demonstrates that the abstract topics employed in many metaphors, and the abstract advantage reported by Xu (2010) may be limited to high SND metaphors. The results further suggest that metaphors from semantically sparser neighbourhoods were more comprehensible. In other words, metaphors with topics and vehicles from semantically dense neighbourhoods were not rated as highly comprehensible as were metaphors with words from less dense neighbourhoods. If a dense semantic space represents the many potential associations that Kintsch is in favour of, then the Al-Azary and Buchanan (2012) results are at odds with his description of "strong metaphors". However, a large but sparse semantic neighbourhood could be what Kintsch had in mind.

Research Objectives

It is unclear why Al-Azary and Buchanan's (2012) metaphors made up of high SND words were judged to be less comprehensible than their metaphors made up of low SND words. However, metaphor processing theories may be able to explain this. Recall that categorization theory posits that metaphors are processed by including the topic in the category referenced by the vehicle. Also, Kintsch (2000) has argued that such superordinate categories can be operationalized as semantic neighbourhoods.

To account for the results obtained by Al-Azary & Buchanan (2012), the *semantic*

neighbourhood density hypothesis is proposed. This hypothesis is related to Kintsch's (2000) Predication Algorithm in that it assumes the semantic neighbourhood of words affects metaphor comprehension, and is also consistent with the categorization view of metaphor (Glucksberg & Keysar, 1990; Glucksberg, 2008). However, it differs from the previous models because it can explain differences in comprehension between high and low quality metaphors. That is, it can describe why a metaphor is apt or inapt. If a topic is placed in a semantic neighbourhood, then a dense neighbourhood may have *too* many associations and not enough room to assimilate a new word. On the other hand, sparse semantic spaces would have the room to assimilate a new word. Concreteness would also play a role; dense semantic spaces would presumably assimilate abstract words better than concrete words because the former have fewer physical attributes than the latter (Rosch, Mervis, & Gray, 1976). If concrete words have more attributes than abstract words, then categorizing concrete words would be more difficult in a dense neighbourhood because there are many close neighbours that must cohere with the concrete word and its features. For example, consider two high SND metaphors, A PEN IS A SWORD and CENSORSHIP IS A FILTER. The latter may be more comprehensible than the former because the lack of concrete features in CENSORSHIP allows it to categorize by being assimilated into a dense neighbourhood. On the other hand, PEN has many concrete features that impede categorizing it in the semantic neighbourhood of SWORD. In sparse spaces however, concreteness is not such an issue; abstract and concrete topics should have equal or near equal assimilation. Notice that the semantic neighbourhood density hypothesis would explain the Al-Azary and Buchanan (2012) results; low SND metaphors would be more comprehensible than high SND metaphors

because the semantic space of the vehicle in the former is sparse and can accommodate a new word. Similarly, high SND metaphors would be less comprehensible than low SND because the semantic space of the vehicle in the former is dense and cannot accommodate a new word, but if that new word is abstract, its lack of concrete features can facilitate the categorization; thus, there is an abstract topic advantage only for high SND metaphors.

The above model sounds plausible, but it must be empirically tested. A recent study has shown that the online processing, or time course, of metaphors is characterized in two stages. Wolff and Gentner (2011) provided metaphors (e.g., SOME SUBURBS ARE PARASITES) as well as reversed metaphors (e.g., SOME PARASITES ARE SUBURBS) for 600 and 1600 millisecond (ms) deadlines. Participants rated the statements as comprehensible or non-comprehensible. Metaphors in the reversed form were just as comprehensible as their forward counterparts at the early deadline which indicated a symmetrical processing stage. In other words, at 600 ms, people do not have a preference for the orientation of metaphors; forward (SOME SUBURBS ARE PARASITES) and backward metaphors (SOME PARASITES ARE SUBURBS) are equally comprehensible. Conversely, the later deadline showed that forward metaphors increased in comprehension whereas reversed metaphors decreased in comprehension. That is, the directionality of metaphors does not occur until after a symmetric stage at 600 ms. Recall that categorization theory holds metaphors are directional, categorical statements. Wolff and Gentner's (2011) results, therefore, illustrate that if directional processing takes place, it occurs sometime after 600 ms and before 1600 ms.

To tease apart the SND by concreteness interaction, the Al-Azary and Buchanan (2012) study should be replicated with the inclusion of the timing manipulation used by

Wolff and Gentner (2011). This would allow for isolated, symmetrical processing at an early deadline, and asymmetrical processing at a later deadline. It is predicted that metaphors will not differ in comprehension rating at the early deadline (600 ms). This is due to the nature of processing at this period; namely, symmetrical processing, as discovered by Wolff and Gentner (2011). However, in the later period (1600 ms), it is expected low SND metaphors will proceed to the second stage of directional processing and will therefore increase in comprehension. Concrete, high SND metaphors on the other hand will not reach this directional stage because the dense semantic space of the vehicle contains no association room for a concrete word. Abstract words will have less difficulty entering a dense semantic space, so abstract, high SND metaphors will undergo directional processing as well, but will not be as comprehensible as low SND metaphors. If the predictions are met, both the semantic neighbourhood density hypothesis and the quality of the metaphor hypothesis will gain support because only comprehensible metaphors are processed as directional (categorical) statements whereas less comprehensible metaphors are not. The crucial assumption in the present study is that metaphors are processed symmetrically at 600 ms and are later processed as categorizations at 1600 ms. Comparison and categorization processes can be inferred from these processing deadlines; if metaphors do not increase in comprehension by the 1600 ms processing deadline then they are comparisons; conversely, if metaphors increase in comprehension by the 1600 ms processing deadline then they are categorizations.

CHAPTER II

DESIGN AND METHODOLOGY

Stimulus Development

The items used in this experiment were the same ones used by Al-Azary and Buchanan (2012). These items were, when possible, taken from other studies such as Katz et al. (1988) and Xu (2010). Furthermore, metaphors were also inspired from Danguecan's (2011) stimulus set of words which were manipulated on concreteness and SND. The current items varied in the concreteness of the topic and the SND of both topics and vehicles. Concreteness was operationalized in the same way as Danguecan (2011) had done, with concrete words referring to physical objects that can be sensually experienced and abstract words referring to words that cannot be sensually experienced. For example, *pencil* is a concrete word, but *education* is not.

Half of the metaphors were composed of abstract topics whereas half were composed of concrete topics. SND measures were retrieved from the WINDSORS database. Words with a SND measure of less than .36 were considered to be low SND whereas words with a SND measure of more than .36 were considered to be high SND. This cut off is taken from Danguecan and Buchanan's (2012) study that showed that the resulting semantic neighbourhoods produced the effects in psycholinguistic tasks. Half of the metaphors were made up of high SND words whereas half of the metaphors were made up low SND words. This resulted in four conditions: abstract topic, concrete vehicle, high SND (abstract high SND); abstract topic, concrete vehicle, low SND (abstract low SND); concrete topic, concrete vehicle, high SND (concrete high SND) and concrete topic, concrete vehicle, low SND (concrete low SND). There were 12 metaphors

in each condition, which results in 48 metaphors used in the experiment. See Appendix A for experimental metaphors.

Nonsense fillers were used in order to compare their comprehension relative to the metaphors. Such statements were matched to the metaphor condition in concreteness and SND. The only difference is that during their construction, they were intended to be meaningless. Literal statement fillers were also included. However, their concreteness was not manipulated as creating an abstract-concrete literal statement proved to be a difficult task. See Appendix A for filler items. Fifteen practice metaphors along with 15 nonsense statements and 15 literal statements were also employed in a practice sessions. These were not subject to any statistical analysis. See Appendix B for these items.

The manipulations for this experiment are therefore two levels of concreteness (abstract topics vs. concrete topics), two levels of SND (high SND vs. low SND), two levels of processing deadline (early vs. late) and three levels of statement type (nonsense vs. metaphoric vs. literal), all of which are within-subjects variables. This results in 240 experimental trials.

Participants

Fifty people participated for partial course credit. Recruitment was through the University of Windsor Psychology Participant Pool. Participants were 18 years of age or older and had normal or corrected-to normal-vision.

Procedure

After providing informed consent, participants were directed to a Windows XP computer running Direct RT software (Jarvis, 2006) and a purpose-built 9-button response bar. Only the two buttons on opposing ends were active for the experiment.

Participants were provided with instructions on the screen (see Appendix C) and orally briefed on the experimental task and were informed that they would be quickly judging the comprehensibility of statements presented on the screen. Instructions were also presented on the screen. Participants were encouraged to dedicate their left hand for the button on the left side and their right hand for the button on the right side. The button on the left was to be pressed if a statement was incomprehensible; conversely, the button on the right was to be pressed if a statement was comprehensible.

A practice session was initiated to orient the participants to the buttons and their corresponding representations. This practice session consisted of presenting the words "comprehensible" and "incomprehensible". Word presentations were preceded by a 300 millisecond presentation of pound signals which matched the number of letters in each word. The words were presented on the screen for both, 600 and 1600 millisecond deadlines. A question mark followed each presentation. In short, the stimulus presentation schedule was pound signals for 300 milliseconds, replaced by the word for 600 or 1600 milliseconds, replaced by a question mark that remained on the screen until a response was made. Participants were instructed to make a response at the sight of the question mark and were told that they only had a limited amount of time to respond. An error message reading "Please try to respond faster!" appeared after any trial in which a response was made after the 400 millisecond response duration. In total, this practice session had 20 trials. Half of the trials had the word "comprehensible" presented at both presentation durations whereas the other half had the word "incomprehensible" presented at both presentation durations. The correct response for the "comprehensible" words was the right button pushed within 400 milliseconds of the presentation of the question mark.

Further, the correct response for the “incomprehensible” words was the left button pushed within 400 milliseconds of the presentation of the question mark. Participants were supervised and feedback was provided during this session.

At the conclusion of this practice session, another practice session was initiated. This practice session was identical in its stimulus presentation schedule; however, statements (nonsense, metaphor, and literal) were used in place of the single words. Participants were instructed to press the button on the right if the statement was comprehensible and the button on the left if the statement was incomprehensible. In total, this practice session involved 90 trials. See Appendix B for practice items. After this session, the experimenter left the testing room and the testing session was initiated with 240 experimental trials. Participants finished the entire study in less than 30 minutes.

CHAPTER III

ANALYSIS OF RESULTS

Data Cleanup

Following Wolff and Gentner's (2011) data cleanup procedure, any responses made after 400 milliseconds were removed from the data analysis. This was to ensure that all participants remained on task and that they had an equal amount of time to make their response after the stimuli were presented at their given deadlines. This resulted in the removal of 17.3% of the trials. See Table 1 for a breakdown of data cleanup for each condition.

Table 1

Percentage of responses removed from data analysis for Experiment 1

Condition	Metaphor	Nonsense Statement	Literal Statement
Abstract, High SND, Early	31%	28%	-
Abstract, High SND, Late	12%	7%	-
Abstract, Low SND, Early	27%	30%	-
Abstract, Low SND, Late	11%	8%	-
Concrete, High SND, Early	28%	24%	20%
Concrete, High SND, Late	8%	5%	6%
Concrete, Low SND, Early	31%	28%	22%
Concrete, Low SND, Late	9%	9%	6%

Statement Comprehension

Before the main analysis, the effect of statement type was examined at both deadlines to ensure that participants were interpreting metaphors as more comprehensible than nonsense statements and less comprehensible than literal statements. This was achieved by a statement (nonsense vs. metaphor vs. literal) by deadline (early vs. late)

repeated-measures ANOVA. A main effect of statement was obtained, $F(2, 98) = 498.12$, $p = < .001$, $\eta^2 = .91$ as well as a main effect of deadline, $F(1, 49) = 15.50$, $p = <.001$, $\eta^2 = .24$. Pairwise comparisons indicate that metaphors ($M = .46$, $SE = .03$) were more comprehensible than non-sense statements ($M = .13$, $SE = .02$) and less comprehensible than literal statements ($M = 0.90$, $SE = .011$). Moreover, a statement by deadline interaction was obtained, $F (2, 98) = 76.48$, $p = <.001$, $\eta^2 = .61$. See figure 1 for this interaction. Bonferonni adjusted *t* tests revealed a significant difference between metaphors and literals at the early deadline, $t (49) = 13.21$, $p = <.001$, and the later deadline, $t (49) = 17.78$, $p = <.001$. This was also true for metaphors and nonsense statements at the early deadline, $t (49) = 10.27$, $p = <.001$, and the late deadline, $t (49) = 17.22$, $p = <.001$.

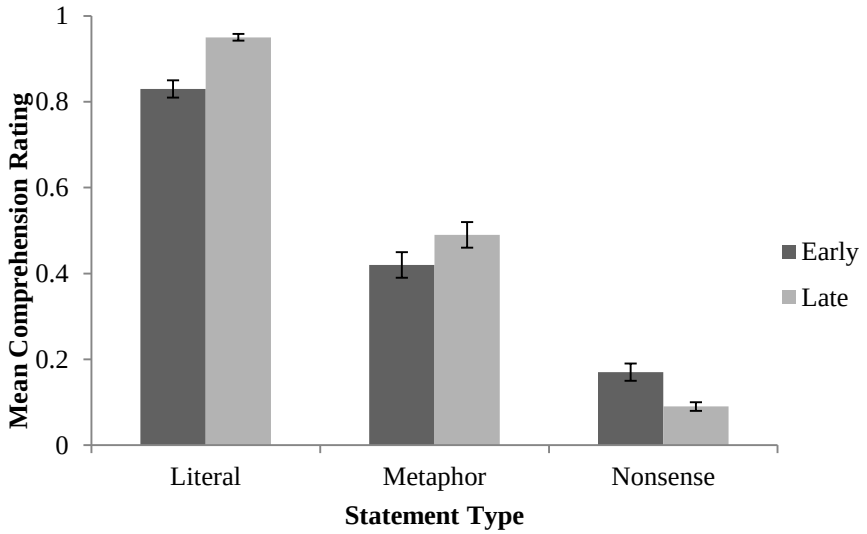

Figure 1. Statement by deadline interaction. Error bars represent standard error of the mean.

These results confirm that participants recognized novel metaphors as more meaningful than nonsense statements but less meaningful than literal statements. Further,

participants were not simply guessing when making their comprehension judgements because guessing should result in even comprehension ratings for each statement type at each processing deadline.

Main Analysis of Metaphors

A concreteness by SND by deadline repeated-measures ANOVA revealed a main effect of concreteness, F (1, 49) = 7.83, p = .007, η^2 = .14. Overall, metaphors made up of abstract topics (M = .48, SE = .039) were more comprehensible than those made up of concrete topics (M = .43, SE = .028). A main effect of SND was obtained, F (1, 49) = 52.78, p = < .001, η^2 = .52. Metaphors made up of low SND words (M = *.50, SE = .02)* were more comprehensible than their high SND counterparts (M = .45, SE = .02). Lastly, a main effect of deadline was obtained, F = (1, 49) = 16.06, p = .001, η^2 = .25. Overall, metaphors presented at the later processing stage (M = .49, SE = .01) were more comprehensible than metaphors presented at the early processing stage (M = .46, SE = .02).

Several interaction effects were revealed, including a concreteness by SND interaction, F (1, 49) = 39.00, p = < .001, η^2 = .44; the effect of SND on comprehension varied across levels of concreteness. Figure 2 shows that the difference in comprehension as a result of SND is greater for metaphors that contain a concrete topic than metaphors that contain an abstract topic.

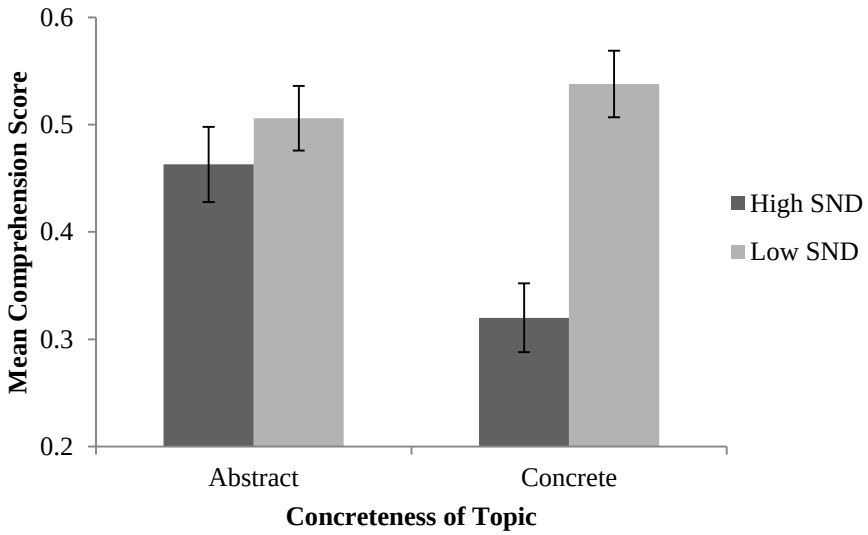

Figure 2. Concreteness by SND interaction. Error bars represent standard error of the mean.

Furthermore, a concreteness by deadline interaction was obtained, F (1, 49) = 5.17, p = .027, η^2 = .10; the effects of concreteness on comprehension varied between early and late deadlines. Figure 3 shows that the difference in comprehension as a result of deadline was greater for abstract metaphors than it was for concrete metaphors. In other words abstract metaphors increased in comprehension at the later stage of processing more than concrete metaphors did.

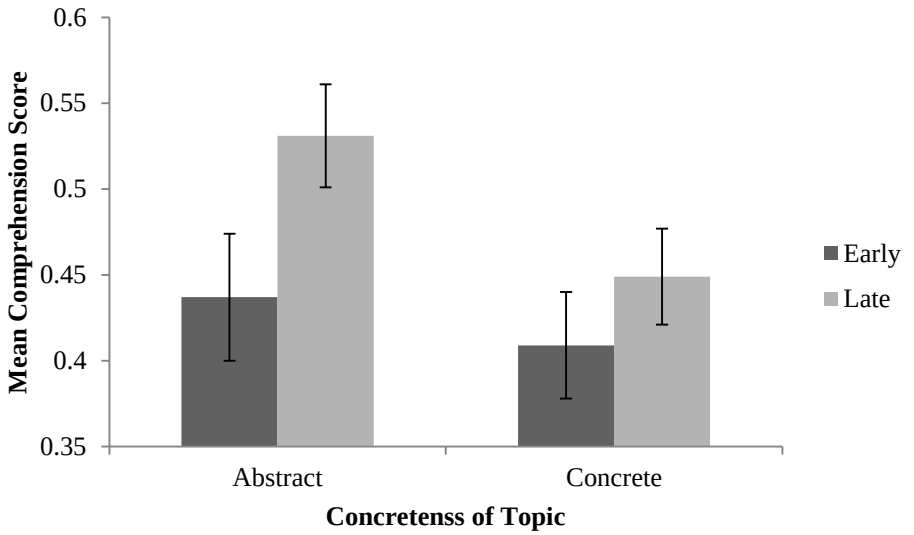

Figure 3. Concreteness by Deadline Interaction. Error bars represent standard error of the mean.

Lastly, a semantic neighborhood density by deadline interaction was obtained, $F = (1, 49) = 17.55$, $p = <.001$, $\eta^2 = .26$. The effects of SND on comprehension varied across levels of deadline. Figure 4 shows that the effects of processing deadline are greater in metaphors made up of low semantic neighbourhood densities than high SND counterparts. In other words, low SND metaphors increased in comprehension at the later processing stage more than high SND metaphors.

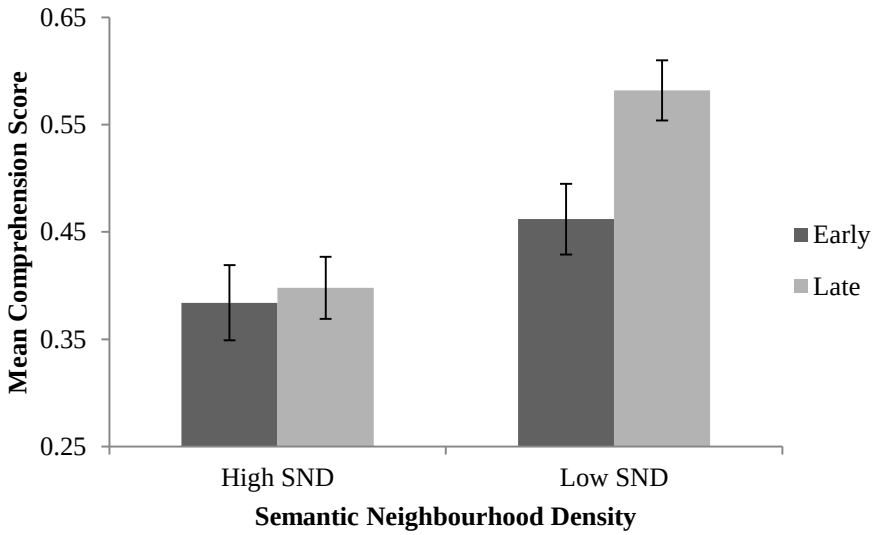

Figure 4. SND by Deadline interaction. Error bars represent standard error of the mean.

A three way interaction was non-significant, $F(1,49) = 1.17$, $p = .46$, $\eta^2 = .01$. Bonferroni adjusted *t*-tests revealed a non-significant difference between abstract high SND metaphors at the early and late processing stages $t(49) = -1.68$, $p = .099$ but there was a difference between abstract low SND and abstract-concrete high SND metaphors at the late processing stage, $t(49) = 3.46$, $p = 0.001$. At the early processing stage, concrete, high SND metaphors were rated as less comprehensible than abstract, high SND metaphors, $t(49) = 3.099$, $p = .003$. Figure 5 shows each of the condition means at both processing deadlines. Metaphors made up of low SND words increase the most from later processing deadlines. Concrete-high SND metaphors do not increase in comprehension at the later stage of processing; moreover, the difference between abstract-high SND metaphors at both deadlines is greater than the difference between concrete-high SND metaphors at both deadlines.

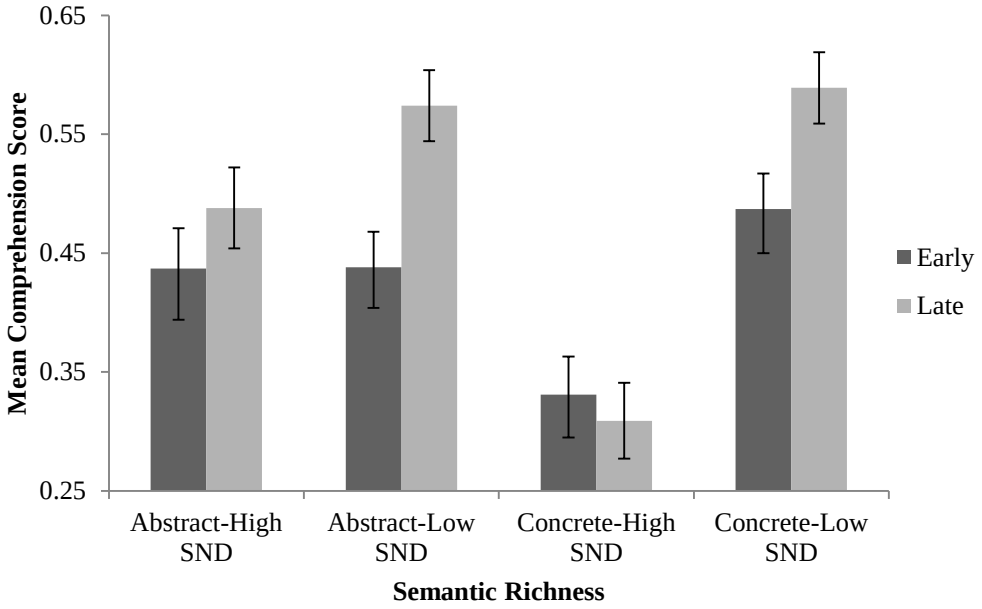

Figure 5. Mean Comprehension Score for each of the metaphoric conditions at both processing deadlines. Error bars represent standard error of the mean.

Discussion

Metaphors were more comprehensible at the later processing stage than the early processing stage. This is expected considering that the one second difference between the early and late processing deadlines allows for more processing time and a shift in processing from symmetrical alignment to directional projection as first demonstrated by Wolff and Gentner (2011). One striking difference between the current set of results and Wolff and Gentner's (2011) is that at the early processing stage, concrete-high SND metaphors were distinguishable from the other conditions, as shown by their lower ratings. Recall that Wolff and Gentner (2011) found the early processing stage of 600 milliseconds to be too short for participants to distinguish between forward or reversed metaphors. The fact that the current stimulus set yields a comprehension difference among metaphor types at 600 milliseconds of processing time is surprising and is a

testament to the robust effects of SND and concreteness. The obtained interactions however, were predicted by the proposed semantic neighbourhood density hypothesis. It seems that metaphors are more meaningful if they are composed of words from sparse semantic spaces, and this is due to their ability to enter the later stage of directional processing. When words in metaphors are from dense spaces, an abstract topic can be more facilitative than a concrete topic when metaphors are composed of words from sparse semantic spaces; they are more comprehensible than metaphors composed of words from dense semantic spaces. The processing advantage for low SND metaphors arises because by the late deadline they increase in comprehension more than high SND metaphors. Further, the results do not show this processing advantage for concrete high SND metaphors; such metaphors are as comprehensible in the late stage as they were in the early stage. Abstract high SND metaphors increase in comprehension more than their concrete counterparts in the late stage.

There is, however, a potential confound in the experimental design that needs to be addressed. Recall that this was a repeated measures design so participants were exposed to each metaphor at both deadlines. Although the re-occurrence of each metaphor was random, there is, nonetheless, a potential response bias whereby participants base a proportion of their responses to metaphors presented the second time in the list on their earlier exposure to them the first time on the list. Experiment 2 eliminates this potential bias by replicating Experiment 1 with deadline as a between participants variable.

Experiment 2

Procedure

Seventy one people participated for partial course credit. Recruitment was through the University of Windsor Psychology Participant Pool. Participants were 18 years of age or older and had normal or corrected to normal vision. The experimental procedures and stimuli were identical to Experiment 1. The only procedural difference was that in Experiment 1 the participants saw the same metaphors at both the early and late presentations whereas in Experiment 2 deadline was implemented as a between participant variable; 37 participants viewed stimuli for 600 ms whereas 34 participants viewed stimuli for 1600 ms.

Results

Data removal followed the same procedures as outlined in Experiment 1; this resulted in the removal of 17.8% of the data. See table 2 for a breakdown of trials removed by condition. One participant from the 1600 ms condition was removed from data analysis because they failed to respond within 400 ms in all of the statements of a given condition. Therefore, data was analyzed from 70 participants; 37 participants viewed stimuli for 600 ms and 33 participants viewed stimuli for 1600 ms.

Table 2

Percentage of responses removed from data analysis for Experiment 2

Condition	Metaphor	Nonsense Statement	Literal Statement
Abstract, High SND, Early	24%	23%	-
Abstract, High SND, Late	15%	12%	-
Abstract, Low SND, Early	23%	20%	-
Abstract, Low SND, Late	17%	16%	-
Concrete, High SND, Early	23%	18%	18%
Concrete, High SND, Late	15%	13%	10%
Concrete, Low SND, Early	22%	22%	18%
Concrete, Low SND, Late	17%	14%	10%

Statement Comprehension

As in Experiment 1, a statement (nonsense vs metaphoric vs literal) by deadline (early vs late) mixed design ANOVA was run (with Greenhouse-Geisser correction). A main effect of statement was again obtained, $F(2, 122.77) = 699.35$, p = <.001, $\eta^2 = .91$. Comparisons revealed that concrete metaphors ($M = .48$, $SE = .02$) were less comprehensible than literal concrete statements ($M = .85$ $SE = .01$) but more comprehensible than nonsense statements ($M = .19$ $SE = .01$). A main effect of deadline approached significance; $F(1, 68) = 3.96$, $p = .051$, $\eta^2 = .06$. A statement by deadline interaction was obtained, $F(1.8, 122.77) = 699.35$, $p = <.001$, $\eta^2 = .50$. See figure 6 for this interaction.

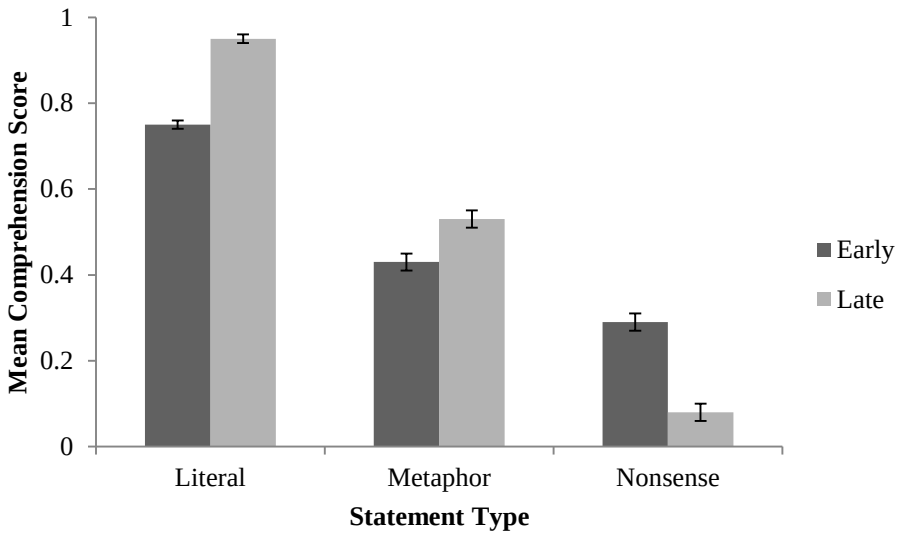

Figure 6. Statement by deadline interaction. Error bars represent standard error of the mean.

Contrasts revealed that the increase in comprehension by the late deadline was greater for metaphors than for nonsense statements, $F(1, 68) = 77.37$, $p = <.001$, $\eta^2 = .53$. Also, the increase in comprehension by the late deadline for literals was greater than for metaphors, $F(1,68) = 7.31$, $p = .009$, $\eta^2 = .097$.

Main Analysis and Discussion

As in Experiment 1, only the metaphoric statements were subject to further analysis. A concreteness by SND by deadline mixed design ANOVA revealed a main effect of concreteness F (1, 68) = 17.32, $p = <.001$, $\eta^2 = .20$. Metaphors containing abstract topics ($M = .52$, $SE = .03$) were rated higher than metaphors containing concrete topics ($M = .44$, $SE = .02$), which is consistent with Experiment 1. Moreover, a main effect of SND was obtained, F (1, 68) = 76.24, $p = <.001$, $\eta^2 = .53$, and this is also consistent with Experiment 1. Metaphors made up of low SND words ($M = .56$ $SE = .02$) were more comprehensible than metaphors made up of high SND words ($M = .40$ $SE =$

.02). A between subjects effect of deadline, was obtained, F (1, 68) = 4.20, p = .044, η^2 = .06. Metaphors presented at the early processing deadline of 600 milliseconds (M = .434, SE = .031) were less comprehensible than those presented at the later deadline of 1600 milliseconds (M = .53, SE = .03).

The same interaction effects as those found in Experiment 1 were obtained. A concreteness by deadline interaction was significant, F(1, 68) = 4.81, p = .032, η^2 = .07 as was the SND by deadline interaction, F(1, 68) = 9.86, p = .003, η^2 = .13; this interaction was in the same direction as Experiment 1. Furthermore, a concreteness by SND interaction was also obtained, F(1,68) = 31.54, p = < .001, η^2 = .32. This interaction was also in the same direction as Experiment 1. Figure 7 shows each of the condition means at both processing deadlines. As can be seen, metaphors made up of low SND words appear to benefit from later processing deadlines. Metaphors made up of high SND words and with concrete topics do not result in increased comprehension ratings as a result of later processing deadlines. Bonferonni adjusted t tests again reveal a difference between abstract high SND and concrete high SND metaphors at the early stage; t (36) = 2.92, p = .006 but this was not true for abstract low SND and concrete low SND metaphors at the early stage; t (36) = -1.44, p = .160. At the late deadline, abstract low SND metaphors were more comprehensible than their high SND counterparts, t (32) = -3.03, p = .005. To summarize, this replication of Experiment 1 resulted in the same pattern of findings and rules out the possibility that response bias or stimulus familiarity could have produced the effects of interest.

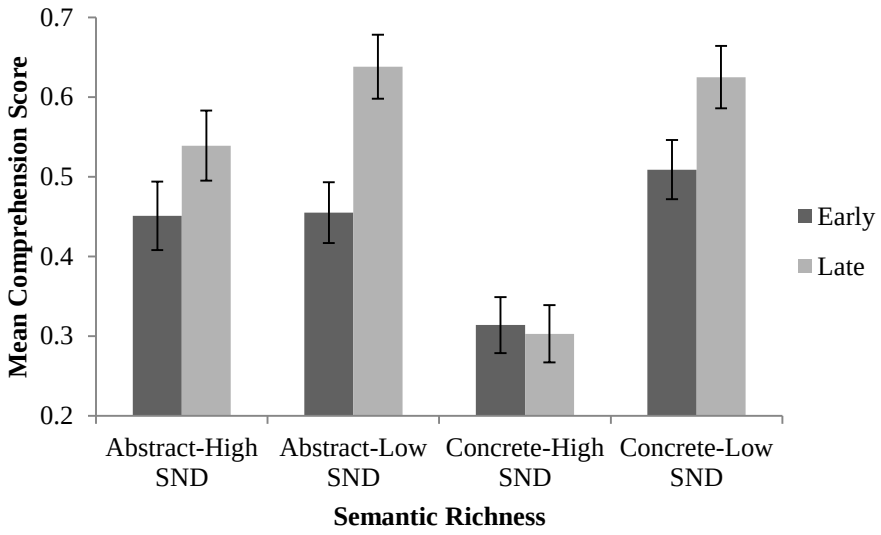

Figure 7. Mean Comprehension Score for each of the metaphoric conditions at both processing deadlines for Experiment 2. Error bars represent standard error of the mean.

Chapter IV

General Discussion

Two processing deadlines thought to reveal symmetrical and directional processes (Wolff & Gentner, 2011) were used to determine how concreteness and SND interact in metaphor comprehension. As expected both abstract and concrete, low SND metaphors increased in comprehension at the later processing stage. Concrete high SND metaphors did not increase in comprehension at the later processing stage, whereas abstract high SND metaphors demonstrated a similar pattern to low SND metaphors. At the very least this data suggests that, contrary to Wolff and Gentner's (2011) findings, metaphors are not fundamentally processed by two stages; a symmetric alignment stage and an asymmetric, directional stage which they showed by comparing comprehension at two processing deadlines. This was the case for low SND metaphors along with abstract high SND metaphors, but not so for concrete high SND metaphors. Although the directionality of metaphors was not directly manipulated, the results may suggest that concrete, high SND metaphors are not directional metaphors. This is because they did not increase in comprehension at the 1600 ms processing deadline, and this deadline is associated with directionality (recall that Wolff and Gentner (2011) only found forward metaphors and not reversed metaphors to be comprehensible at these processing deadlines). The increase in comprehension from 600 to 1600 ms seems to suggest that meaningful metaphors consolidate by the later stage and less meaningful metaphors do not.

Comparison theories, such as the previously discussed structure-mapping theory (Gentner, 1983; Gentner & Bowdle, 2008; Wolff & Gentner, 2011), to my knowledge, cannot account for the finding that concrete high SND metaphors did not increase in

comprehension by the later processing deadline. Structure-mapping holds that common features of the topic and vehicle are automatically accessed for comprehension; however, there is no theoretical reason for why the semantic richness of concrete high SND metaphors would inhibit the structure-mapping process.

On the other hand, the categorization view can better explain why concrete high SND metaphors did not increase in comprehension after one second of processing. Recall that in this model, metaphors categorize the topic in the category that the vehicle belongs to (Glucksberg, 2008; Glucksberg & Keysar, 1990). In high SND metaphors, this category is a dense neighbourhood with many near neighbours. It seems that a concrete topic may have more difficulty penetrating such dense spaces than do their abstract counterparts. However, even at 600 ms, abstract high SND metaphors were more comprehensible than their concrete counterparts. Thus, although concrete high SND metaphors do not increase in comprehension at the later stage of processing, their initial lack of comprehension was not expected and is not accounted for by categorization processes alone.

The data is best interpreted through hybrid models (e.g., Bowdle & Gentner, 2005; Glucksberg & Haught, 2006) that account for comparison and categorization processes, rather than the structure-mapping (Gentner, 1983; Gentner & Bowdle, 2008; Wolff & Gentner, 2011) or categorization models (Glucksberg, 2008; Glucksberg & Keysar, 1990; Glucksberg et. al., 1997; McGlone & Manfredi, 2001) that claim singular processing. Recall that the career of metaphor hypothesis (Bowdle & Gentner, 2005) states that novel metaphors are comparisons whereas conventional metaphors can be categorizations. The data presented above cannot be accommodated by this hypothesis

because all of the stimuli were novel, yet low SND metaphors increased in comprehension in a way analogous to directional metaphors. Rather, the quality of metaphor hypothesis (Glucksberg & Haught, 2006) does a better job accommodating the data; poorer metaphors (as measured by comprehension) were processed as comparisons whereas richer metaphors reached a directional stage that characterizes categorization. However, the quality of metaphor hypothesis does not describe *why* apt metaphors are processed as categorizations whereas inapt metaphors are processed as comparisons. To that end, the semantic neighbourhood density hypothesis was proposed. This hypothesis states that low SND metaphors are more comprehensible than high SND metaphors because the former are processed as categorizations whereas the latter are processed as comparisons. Moreover, abstract topics are advantageous for high SND metaphors because they have no concrete features or attributes to clash with the near neighbours of the dense semantic space.

The mean comprehension scores at the later deadline replicate the Al-Azary and Buchanan (2012) results; low SND metaphors were rated as more comprehensible than high SND metaphors, and abstract-high SND metaphors were rated as more comprehensible than concrete-high SND metaphors. To examine why these differences were found, I turned to metaphor processing theories and isolated the processing stages of metaphors. Based on my understanding of these theories and previous findings I predicted that SND and concreteness would interact with processing deadlines and hypothesized that if metaphors are processed by directional, topic-to-vehicle domain projection, then low SND metaphors would increase in comprehension at this later stage whereas high SND metaphors would not. However, an abstract topic would categorize

better than a concrete topic only in high SND metaphors. The proposed semantic neighbourhood density hypothesis therefore is based on the premise that a novel metaphor introduces a new semantic neighbour to a semantic neighbourhood. The new semantic neighbour is the topic, and the semantic neighbourhood is that of the vehicle. If the semantic neighbourhood of the vehicle is dense, it is difficult to find a meaningful relationship between it and the topic. Kintsch's (2000) predication algorithm selects semantic neighbours of the vehicle in its computation of the metaphor vector. Following the proposed view the algorithm would have some difficulty in selecting the nearest neighbours of the vehicle if there are many neighbours (i.e. they form a dense neighbourhood).

One can make predictions based on the current hypothesis. For example, concrete-high SND metaphors do not appear to reach directional processing, and this implies that topics and vehicles are at most, symmetrically aligned. Therefore we can predict that reversing the topics and vehicles of concrete-high SND metaphors will not affect their comprehension ratings. Campbell and Katz (2006) provided reversed metaphors along with a supporting context to participants to rate and read. Participants rated comprehension for reversed metaphors just as high as forward metaphors when the former were fitted in a context that supported the reversed metaphor's meaning (experiment 1) and read reversed metaphors just as fast as forward metaphors when provided in a supportive context (experiment 2). Concrete high SND metaphors may be better than abstract high SND or low SND metaphors for topic-vehicle reversal.

The results obtained in this study encourage many follow up studies. If similes invite comparison processes whereas metaphors invite categorization processes (Gentner

& Bowdle, 2001; Glucksberg & Keysar, 1990) then, converting the current stimulus set to similes should result in concrete high SND statements to become more comprehensible in simile than metaphor; abstract high SND and low SND statements should be preferred in the metaphor format. One can replicate Haught's (2013) study with our stimuli to examine this possibility.

Recall that the career of metaphor hypothesis holds that after figurative statements are repeatedly used, they become conventionalized and can be preferred more in the grammatical form of metaphors (A IS B) than the grammatical form of similes (A IS LIKE B). The question arises then, are some metaphors more prone to be conventionalized than others? The semantic neighbourhood density hypothesis, would predict that low SND metaphors are more likely to conventionalize than high SND metaphors. This is because a sparse semantic space has room for new semantic neighbours. The conventionalization of novel metaphors can be induced in experimental settings (see Bowdle & Gentner, 2005), and should be attempted with the current stimulus set in a future study.

In sum, there are a myriad of tasks that examine metaphor and simile differences, metaphor conventionalization and metaphor generation, among others. Such tasks can be useful in assessing the current model's limitations. Our model is based on previous models that stress directional processing. However, our stimuli are composed of words with the same SND values. It is necessary to replicate our work with metaphors made up of mixed SND values. For example, will the same effects be observed with low SND topics and high SND vehicles? Our model currently ignores variations of metaphors that most likely exist, and is therefore limited to metaphors with topics and vehicles of the

same SND values. Nonetheless, by manipulating two distinct semantic variables the current stimulus set has provided very revealing results that allow us to test and to flesh out details of existing models and has provided suggestions upon which future studies can be developed.

Appendix A

Metaphors			
Abstract High SND	**Abstract Low SND**	**Concrete High SND**	**Concrete Low SND**
Civilization is a Crust	Censorship is a Filter	A Pen is a Sword	A Library is a Sanctuary
Language is a Bridge	Indecision is a Whirlpool	A Museum is a Cemetery	A Politician is a Broom
Superstition is a Disease	Austerity is a Remedy	A Beach is a Grill	A Scarecrow is a Guardian
Cynicism is an Undertaker	Daydream is a Trip	Embroidery is Ink	A Surfer is a Swan
Addiction is Paste	Destiny is a Story	A Tadpole is a Seed	Veins are Roots
Justice is a Net	Digestion is a Bulldozer	A Mosquito is a Vampire	Lipstick is a Marker
Revolution is an Earthquake	Responsibility is a Chain	A Cigarette is a Syringe	A Pond is a Mirror
Heaven is Dessert	The Unconscious is a Factory	A Cactus is a Bottle	A Woodpecker is a Lumberjack
Passion is a Storm	Debate is a Pendulum	A Crab is an Anchor	A Heart is a Motor
Ignorance is Blindness	Joy is Warmth	Money is Medicine	Darkness is a Cover
Revelation is Rain	Departure is a Sunset	A Forest is a Harmonica	A Cloud is a Curtain
Sarcasm is a Knife	Discovery is a Sunrise	A Zebra is a Piano	A Star is a Sign

Appendix A (continued)

Nonsense Statements			
Abstract High SND	**Abstract Low SND**	**Concrete High SND**	**Concrete Low SND**
Depression is a Party	Imagination is a Square	A Table is a Fox	A University is a Spa
Destruction is a Coat	Shelter is a Nose	A Television is a Spear	A Bug is a Coin
Veneration is a Pickle	Patriotism is a Leaf	A Theatre is a Bookshop	A Wallet is a Handkerchief
Philosophy is an Insect	Addition is a Beak	A Boot is a Brick	A Trunk is a Gear
Religion is Snow	Tribute is a Stick	A Cake is a Wrench	A Shell is a Sidewalk
Argument is Paint	Depth is a Firework	A Kayak is a Spy	A Tooth is an Egg
Crime is a Raven	Confusion is an Alligator	A Bulldog is a Cherry	A Circus is a Pool
Belief is a Reptile	Arrival is a Shoestring	A Satellite is a Lightbulb	A Toe is a Coach
Calculation is a Dinosaur	Exercise is a Roommate	A Rabbit is a Pitcher	A Coast is a Tube
Deception is a Cello	Sensation is a Suitcase	A Lizard is a Raindrop	A Napkin is Candy
Evaluation is a Lamp	Suitability is a Donkey	A Fork is a Planet	A Staple is a Shelf
Espionage is a Rock	Art is a Kitten	A Ladder is a Sailboat	An Armchair is a Script

Appendix A (continued)

Literal Statements	
High SND	**Low SND**
A Bus is a Vehicle	Leather is a Material
A Necklace is Jewellery	A Screwdriver is a Tool
Banana is a Fruit	Chicken is a Meat
A Whale is a Mammal	Juice is a Liquid
A Frog is an Amphibian	A Crocodile is a Predator
Violet is a Colour	A Hamburger is Food
The Bible is Scripture	Cheddar is a Cheese
A Gorilla is an Ape	An Apartment is a Structure
A Collie is a Pet	A Turtle is a Structure
A Couch is Furniture	Gasoline is a Fuel
A Beard is Hair	A Cannonball is a Sphere
A Poppy is a Flower	A Mouse is a Rodent

Appendix B

Practice Statements		
Literal Statements	**Metaphors**	**Nonsense Statements**
A House is a Building	Adoration is Lightning	A Bar is a Wire
A Snake is Venomous	An Ambassador is a Peacock	A Tree is a Rocket
A Vegetable is Healthy	A Butterfly is a Flower	A Balloon is a Monkey
Facebook is a Website	A Dream is an Eclipse	A Stream is a Mountain
Golf is a Sport	Sleep is an Ocean	A Bug is an Orange
Chess is a Game	A Gene is a Blueprint	A Friend is a Scientist
A Skyscraper is Tall	Alcohol is a Crutch	A Battery is a Wrench
A Liver is an Organ	Lust is Anarchy	Grass is a Beaker
A Mammoth is Extinct	The Wind is an Arrow	Paper is a Trampoline
A Femur is a Bone	Cocaine is a Joyride	A Trailer is a Cup
Vision is a Sense	Truth is a Labyrinth	A Pear is an Animal
Spring is a Season	Happiness is Gold	A Sandwich is a Sauce
A Mushroom is a Fungus	Depression is a Ditch	A Feather is a Twig
Oak is a Wood	A Shadow is a Stalker	A Motorcycle is a Reptile
A Berry is a Fruit	A Baby is an Angel	A Park is a Jail

Appendix C

On-screen instructions:

Your task will be to rate how comprehensible statements are. The statements will either be nonsensical, literal, or figurative. For example, A Sheep is a Hill is a nonsensical statement; A Circle is a Shape is a literal statement; Love is a Journey is a figurative statement. Treat metaphors, or figurative statements as comprehensible. Use the button on the far right if the statement is comprehensible and the button on the far left if the statement is incomprehensible. Please wait until the statement disappears and a ? appears before making your response. Statements will be presented quickly, so please act as quickly and accurately as possible. The practice session will first involve the words comprehensible and incomprehensible. For comprehensible, press the button on the far right and for incomprehsenible press the button on the far left. Press the space bar to begin.

On-screen instructions for practice session #2:

Now you will do the same task but in response to statements. If the statement is comprehensible, press the button on the far right. If the statement is incomprehensible, press the button on the far left. Remember to react as quickly and accurately as possible. Press the spacebar to begin.

On-screen instructions for experimental session:

Now you will do the testing phase. Remember to respond as soon as you see the ?. Please press the space bar when you are ready.

References

Aptness. (n.d.). In *Oxford Dictionaries online dictionary*. Retrieved August 07, 2014, from http://www.oxforddictionaries.com/definition/english/aptness

Aisenman, R. (1999). Structure-Mapping and the Simile--Metaphor Preference. *Metaphor and Symbol, 14* , 45-52.

Al-Azary, H., & Buchanan, L. (2012, October). *Effects of semantic neighbourhood density and concreteness on novel metaphor comprehension*. Poster presented at the Eighth International Conference on the Mental Lexicon, Montreal, QC.

Bowdle, B. F., & Gentner, D. (2005). The career of metaphor. *Psychological Review*, *112*(1), 193–216.

Campbell, J., & Katz, A. (2006). On reversing the topics and vehicles of metaphor. *Metaphor and Symbol ,21*, 22-59.

Danguecan, A. (2011). *The effects of concreteness and semantic neighbourhood density on visual word recognition.* (unpublished master's thesis). University of Windsor, Windsor, ON.

Danguecan, A.N., & Buchanan, L. (2012, October). *Semantic effects in word recognition tasks.* Poster presented at the Eighth International Conference on the Mental Lexicon, Montreal, QC.

Durda, K., & Buchanan, L. (2008). WINDSOR: Windsor improved norms of distance and similarity of representations of semantics. *Behavior Research Methods, 40,* 705–712.

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science*, *7*(2), 155–170.

Gentner, D. (1988). Metaphor as Structure Mapping: The Relational Shift. *Child Development*, *59*, 47-59.

Gentner, D., & Bowdle, B. F. (2001). Convention, Form, and Figurative Language Processing. *Metaphor and Symbol*, *16*, 223–247.

Gentner, D., & Bowdle, B.F. (2008). Metaphor as structure-mapping. In R. W. Gibbs, Jr. (Ed.), The Cambridge handbook of metaphor and thought (pp. 109–128). Cambridge, UK: Cambridge University Press

Gentner, D., & Wolff, P. (1997). Alignment in the processing of metaphor. *Journal of Memory and Language*, *37*, 331–355.

Gernsbacher, M. A., Keysar, B., Robertson, R.R.W. & Werner, N.K. (2001). The role of suppression and enhancement in understanding metaphors. *Journal of Memory and Language, 45,* 433 – 450.

Gibb, H., & Wales, R. (1990). Metaphor or simile: Psychological determinants of the differential use of each sentence form. *Metaphor and Symbolic Activity, 5(4),* 199 - 213.

Gibbs, R. W., & Colston, H. L. (2012). *Interpreting figurative meaning*. Cambridge: Cambridge University Press

Glucksberg, S. (2008). How metaphors create categories—quickly. In R. W. Gibbs, Jr. (Ed.), The Cambridge handbook of metaphor and thought (pp. 67–83). Cambridge, UK: Cambridge University Press

Glucksberg, S. (2003). The psycholinguistics of metaphor. *Trends in Cognitive Sciences, 7*(2), 92–96.

Glucksberg, S., & Haught, C. (2006). On the relation between metaphor and simile: When comparison fails. *Mind & Language, 21,*360 - 378.

Glucksberg, S., & Keysar, B., (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review, 97,* 3 – 18.

Glucksberg, Sam, McGlone, Matthew, S. Manfredi, D. (1997). Property Attribution in Metaphor Comprehension. *Journal of Memory and Language, 67*(36), 50–67.

Haught, C. (2013). A Tale of Two Tropes: How Metaphor and Simile Differ. *Metaphor and Symbol*, *28*(4), 254–274.

Haught, C. (2014). Spain is Not Greece: How Metaphors are Understood. *Journal of Psycholinguistic Research*, *43*(4), 351–6.

Jarvis, B. G., (2006). DirectRT (Version.2006.2.0.28. [Computer Software]. New York, NY: Empirisoft Corporation.

Katz, A. N. (1989). On choosing the vehicles of metaphors: Referential concreteness, semantic distances, and individual differences. *Journal of Memory and Language, 28*(4), 486–499.

Katz, A.N, Paivio, A, Marschark, M & Clark, J.M (1988). Norms for 204 literary and 260 nonliterary metaphors on 10 psychological dimensions. *Metaphor and Symbolic Activity,3,* 191-214.

Kintsch, W. (2008). How the mind computes the meaning of metaphor. In R. W. Gibbs, Jr. (Ed.), The Cambridge handbook of metaphor and thought (pp. 129–142). Cambridge, UK: Cambridge University Press

Kintsch, W. (2000). Metaphor comprehension: A computational theory. *Psychonomic Bulletin & Review*, *7*(2), 257–266.

Kintsch, W. (2001). Predication. *Cognitive Science, 25*(2), 173–202.

Kintsch, W., & Bowles, A. R. (2002). Metaphor Comprehension: What Makes a Metaphor Difficult to Understand? *Metaphor and Symbol*, *17*(4), 249–262.

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

Landauer, T., & Dumais, S. (1997). A solution to Plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. *Psychological Review, 1*(2), 211–240.

Macdonald, G. (2013) *Aging and semantic processing* (unpublished doctoral disseration). University of Windsor, Windsor, Ontario, Canada

McGlone, M. S., & Manfredi, D. a. (2001). Topic-vehicle interaction in metaphor comprehension. *Memory & Cognition*, *29*(8), 1209–19.

McHugh, T. (2009). *Support for the right hemisphere hypothesis of language processing: An investigation of amiguous word resolution in puns* (unpublished doctoral disseration). University of Windsor, Windsor, Ontario, Canada.

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, *90*, 227–234.

Ortony, A. (1979). Beyond literal similarity. *Psychological Review*, *86*, 161–180.

Rosch, E., Mervis, C., & Gray, W. (1976). Basic objects in natural categories. *Cognitive Psychology*, *8*, 382–439.

Tversky, A. (1977). Feature of similarity. *Psychological Review*, *85*, 327 – 352.

Wolff, P., & Gentner, D. (2011). Structure-mapping in metaphor comprehension. *Cognitive Science*, *35*(8), 1456–88.

Xu, X. (2010). The relationship between the content and the form of metaphorical statements. *Journal of Psycholinguistic Research*, *39*(2), 165–78.

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