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CHAPTER 10

Mapping principles for conceptual metaphors

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Issues surrounding novel metaphor comprehension are not well understood. In order to address this problem, this paper proposes the Conceptual Mapping Model, which puts forward the idea that examining the linguistic mappings found in a particular source-target domain pairing allows hypotheses to be formulated regarding the underlying reason for this conceptual pairing. These hypotheses are formulated as Mapping Principles and allow for predictions regarding novel metaphor usage to be made. Four experimental studies on native Mandarin Chinese speakers demonstrate that novel metaphors that follow Mapping Principles receive significantly lower acceptability and interpretability ratings than conventional metaphors, as well as longer listening times when making these judgments. In addition, novel metaphors that do not follow Mapping Principles receive significantly lower acceptability and interpretability ratings than novel metaphors that do follow Mapping Principles, as well as longer listening times. In sum, the Conceptual Mapping Model proposes that a contrastive linguistic analysis of conventional conceptual metaphors can increase our understanding as to why conceptual domains are linked, which in turn will facilitate our ability to predict and model how conceptual metaphors are processed in both conventional and novel usages.

Keywords: conceptual metaphors, Mapping Principles, metaphor processing, ratings tasks, reaction time studies, Conceptual Mapping Model

1. Introduction

Increasing interest in real-world application and understanding of conceptual metaphors has heightened the need for a model of metaphor usage that can predict varying comprehension levels of metaphor among native speakers. Although Conceptual Metaphor Theory (Lakoff & Johnson, 1980, 1999; Lakoff, 1993) has deepened our understanding of the pervasiveness of metaphor in our language and cognitive system, the theory has focused on explaining the underlying conceptual

scenarios involved in conventional metaphors (cf. Lakoff, 1993:206). While doing so has greatly expanded our understanding of the cognitive basis of conceptual metaphors, it has also left the theory open to criticism that there is an 'anything goes' aspect to metaphor understanding and interpretation (Tsur, 1999). Researchers have proposed various models to account for the linguistic data more precisely (Clausner & Croft, 1997; Grady, 1997), yet these models fall short of predicting how conventional and novel metaphors will be comprehended by speakers.

Clausner and Croft's (1997) approach is to narrowly constrain the source domain so as to limit the mappings that may take place between two domains. They propose that specifying a metaphor at its appropriate level of schematicity, and carefully describing the semantic structure, can constrain the concepts that can correspond between a source and a target domain. For example, they argue that the metaphor AN ARGUMENT IS A BULIDING is too broad and should instead be AN ARGUMENT IS THE STRUCTURAL INTEGRITY OF A BUILDING. The revised conceptual metaphor predicts that concepts such as 'foundation' would be used in the metaphor, but concepts such as 'chimney' and 'plumbing' would not, because they are not part of the structural integrity of a building. It is not clear, however, how to determine the source domain in this approach, nor how to avoid postulating too narrow a source domain.

Grady (1997) takes a different approach and suggests that THEORIES ARE BUILDINGS is instead a compound metaphor made up of two primary metaphors: ORGANIZATION IS A PHYSICAL STRUCTURE and PERSISTING IS REMAINING ERECT. When the compound metaphor is decomposed into primary metaphors, the gaps in the examples of THEORIES ARE BUILDINGS (i.e. possible instances of the metaphor that do not occur) are considered to be "predictable consequences of the underlying structure" (Grady, 1997:280). Furthermore, novel extensions are no longer considered to be capricious or defined in terms of token frequency, but instead can be "defined in a principled manner" (Grady, 1997:280).

While I will expand upon the idea that novel extensions of conventional conceptual metaphors can be defined in a principled manner, doing so through primary metaphors is problematic for the purposes of examining how speakers process conceptual metaphors on-line. That is, while there may be valid theoretical reasons to break compound metaphors into primary metaphors, there are empirical advantages to using basic-level conceptual categories in terms of analyzing native speaker intuitions, running corpora-based analyses, and running psycholinguistic experiments. In addition, I depart from Grady's (1997) assumptions that native speaker evidence is 'inconclusive' and that corpora-based evidence is 'merely' statistical and not essential to theoretical analyses (Grady, 1997:281). Although Grady (1997) makes a valid point about how a decompositional account is an improvement to Conceptual Metaphor Theory, and can capture relationships

between different metaphors, I would like to suggest here that in order to understand how metaphors are processed, it is also necessary to have a variety of empirical methods available to determine what metaphors can be considered novel and what metaphors can be considered conventional, in order to be able to either falsify or replicate one's findings. This is especially important, since such distinctions are fundamental to understanding language processing issues related to conceptual metaphors.[1]

One reason that distinctions concerning conventionality and novelty are important is because work within the broad framework of Conceptual Metaphor Theory has come under attack by researchers who argue that it cannot explain the psycholinguistic data (i.e. Glucksberg & Keysar, 1993; Glucksberg, McGlone & Manfredi, 1997; Glucksberg & McGlone, 1999; Keysar, Shen, Glucksberg, & Horton, 2000; McGlone, 1996, 2007; Murphy, 1996). McGlone (1996), for example, tested the validity of conceptual metaphors in a series of off-line psycholinguistic studies and argued that there was no evidence that native speakers use the knowledge mapping that conceptual metaphors provide. Instead, he proposes that the attributive categorization hypothesis better accounts for the data. This model says that metaphors are category-inclusion statements of the form (*X is a Y*).[2] The attributive categorization view explicitly argues against a set of pre-existing correspondences between two domains, instead arguing that when a metaphor arises, the source domain provides properties that are then attributed to the target domain. One flaw in studies that show evidence for the attributive categorization view is that they do not distinguish between novel metaphors and conventional metaphors in their linguistic stimuli. It is quite possible that these researchers did not find evidence to support Conceptual Metaphor Theory because they were not testing conventional conceptual metaphors.[3] Thus, it becomes incumbent on researchers supporting Conceptual Metaphor Theory to give criteria to distinguish between novel and conventional conceptual metaphors, as well as to distinguish between metaphors that syntactically constrain a categorization interpretation (of the type *X* is a *Y*) and those that do not.

In what follows, I will present the Conceptual Mapping Model and examine its limitations. Next, I will discuss the processing predictions suggested by this model and present off-line and on-line experimental data that support these predictions.

2. The Conceptual Mapping Model

The Conceptual Mapping Model is designed to operationally define a method to determine the underlying reasons for the source-target domain pairings of a conceptual metaphor. These reasons, called Mapping Principles, can be tested

experimentally in both off-line and on-line studies. The main idea is that the lexemes involved in the conceptual metaphor must be identified and the associated groupings analyzed.[4] Once the lexemes that map for a certain conceptual metaphor have been analyzed, the underlying reason why a particular target has selected a particular source domain will be able to be postulated. This underlying reason will be stated in terms of a Mapping Principle. A six-step paradigm is used to collect and analyze the data, and is demonstrated for IDEA IS BUILDING in Mandarin Chinese below, in order to facilitate comparison with previous work done on this metaphor in English (Clausner & Croft, 1997; Grady, 1997). These steps were used to aid in determining the Mapping Principles for all conceptual metaphors used in the experimental studies that follow. All steps were completed by a group of five linguistically-trained native speakers who then met to discuss their answers. Step four required unanimous agreement (regarding conventionality); all other steps required four out of five members to agree. Ten additional linguistically-trained native speakers later verified these analyses.[5]

In the first step, native speakers generate as many metaphorical examples as they can think of within a proposed target domain, in this case IDEA. Second, each speaker evaluates each example generated and groups it according to its source domains, such as BUILDING, FOOD, COMMODITY or INFANT. The groupings are then discussed and modified if necessary (i.e., should the source domain be referred to as 'BABY' or 'INFANT'?). At this point, conceptual metaphors, such as IDEA IS A BUILDING are postulated. Third, three questions are asked concerning what is known about each source domain in terms of real world knowledge. This real world knowledge is conceptual. However, this conceptual knowledge is able to be expressed through the (meta) linguistic expressions as used below in (1).

(1) *Real world knowledge* [*about buildings*]
Q1. What entities does the source domain have?
[foundation, structure, base, model, layout, cement, brick, steel bar, sandstone, (bamboo) scaffolding, roof, wall, worker, window, door, plumbing, decoration]
Q2. What qualities does the source domain (or the entities in the source domain) have?
[shaky, high, short, strong, weak, flimsy]
Q3a. What does the source domain do?
[to protect, to shield, to shelter]
b. What can someone do to (or in) the source domain?
[to live in, to build, to construct, to tear down]

The fourth step involves determining whether the linguistic expressions that hav been generated are conventional or novel through group discussion. If any mem ber of the group feels the metaphor is unusual, it is not included in the group ' conventional conceptual metaphors. The examples in (2) below are all considere conventional. The entities that correspond between the source and target domair are *jiagou* 'frame' (2a), *genji* 'base' (2b), *moxing* 'model' (2c), *cuxing* 'miniatur (2c), and *ge ju* 'layout' (2d), while the quality that corresponds between the sourc and target domains is *songsan* 'loose' as in (2a).

(2a) *zhege lilun jiagou hen songsan*
this theory frame very loose
'The framework of this theory is loose.'

(2b) *nide lundian genji shi sheme*
your argument base be what
'What is the foundation of your argument?'

(2c) *wode zhege xiangfa zhi shao you moxing/cuxing*
my this idea just slightly have model/miniature
'My idea is only beginning to take shape.'

(2d) *zhege xiangfa de geju tai xiao le*
this idea de layout too small ASPECT-PARTICLE
'The layout of this idea is too small.'

The functions that correspond between the source and target domains are *jiango* 'build' (2e), *chengxing* 'take shape' (2f), and *dongyao* 'shake' (2g).

(2e) *zhe qun wenren zheng nuli jiangou i tao lilun*
This group scholar at the present work hard build one set theory
'This group of scholars is working hard at constructing a theory.'

(2f) *tade sixiang jiagou kuan cheng xing le*
his thought framework soon taking shape ASPECT-PARTICLE
'His thought's framework is taking shape.'

(2g) *tade xiangfa kaishi dongyao*
his idea begin shake
'His idea has begun to waver.'

The fifth step involves analyzing the examples for the linguistic expressions tha occur in these conceptual metaphors (3). These actual mappings are a subset o the correspondences that exist in the real world.

(3) *Actual mappings/correspondences that exist between* IDEA *and* BUILDING

Q1. What entities does the source domain have that are mapped to the target domain?
[framework, foundation, model, layout, e.g. (2a), (2b), (2c) & (2d)]

Q2. What qualities does the source domain or the entity in the source domain have that are mapped to the target domain?
[loose, shaky, e.g. (2a)]

Q3a. What does the source domain do that is mapped to the target domain?
[shake, e.g. (2g)]

b. What can someone do to (or in) the source domain that is mapped to the target domain?
[to construct, to take shape, e.g. (2e), (2f)]

Sixth, once the actual mappings have been analyzed, the correspondences that have been mapped are compared with what could have been mapped (i.e. in the case of real world knowledge). From the analysis in (3) above, it can be seen that expressions relating to the concepts of *foundation*, *stability* and *construction* were mapped. Concepts relating to the position of the building, internal wiring and plumbing, the exterior of the building, windows and doors were not mapped. Thus, the target domain of IDEA uses the source domain of BUILDING in order to emphasize the concept of structure. Buildings can stand because of a foundation and a well-built stable structure. Ideas are deemed worthy if they also have a solid basis and structure. Thus, when people talk about ideas and want to express positive notions concerning organization, they may use the source domain of BUILDING to express this idea. The Mapping Principle in this case is therefore the following:

Mapping Principle for IDEA IS BUILDING
Ideas are understood as buildings, in that **buildings involve a (physical) structure and ideas involve an (abstract) organization.**

The result for IDEA IS BUILDING in Mandarin Chinese is similar to the results found in English, since the fundamental mapping relates to structure (Clausner & Croft, 1997; Grady, 1997).

The steps as formulated above are not uncontroversial. They rely a good deal upon consensus being reached by native speakers at each point. However, recent advances have been made since these steps were first postulated (in early 2000) in terms of analyzing metaphors in large-scale corpora (Ahrens, Chung, & Huang, 2003, 2004; Chung, Huang, & Ahrens, 2003; Chung, Ahrens, & Huang, 2004, 2005; Huang, Chung, & Ahrens, 2006). For example, when running step one on a

corpus, a particular lexeme, such as 'idea' is chosen, and all metaphorical instances are manually selected. This narrowing of the target domain is advantageous when dealing with large amounts of data and allows for additional related lexical items, such as 'theory', to be independently analyzed. The results for both lexemes may then be compared in terms of their respective mappings and postulated mapping principles. The second step, grouping into source domains, can be handled computationally through either top-down or bottom-up methods (Chung, 2007). This step can also be verified by using categorization tasks with native speakers. For example, in two pre-tests discussed below, participants are asked (a) to decide if a lexical item postulated to be from a particular source domain in fact belongs in that source domain, or (b) to rate how strongly it belongs in a particular source domain. Step three involves making decisions about core versus peripheral knowledge, while step four involves decisions about which expressions are novel and which ones are conventional. Both steps require native speaker intuitions. In step five, actual mappings need to be compared to what could be mapped – again, this judgment is made by a group of native speakers. Step six is currently based on a comparison between steps five and three. While all these steps currently rely on consensus among native speakers, recent work on corpora (Huang et al., 2006) has demonstrated that mapping principles derived in this way are supported by frequency data. That is, the most frequently occurring lexical item in a source-target domain pairing is postulated to correspond to the mapping principle. In addition, I will show below that the linguistic stimuli that are created based on mapping principles derived in this way also show statistically significant differences between experimental conditions – differences that we would not expect to see if this method was substantially flawed.

The Conceptual Mapping Model predicts that there will be two different kinds of novel metaphors: novel metaphors that follow mapping principles and novel metaphors that do not follow mapping principles. Thus, under the Conceptual Mapping Model, metaphors can be grouped into four kinds ranging from most conventional to most novel: (1) conventional metaphors, (2) novel metaphors that follow the mapping principle, (3) novel metaphors that do not follow the mapping principle, and (4) anomalous metaphors, i.e. novel metaphors that use a source-target domain pairing that rarely, if ever, occur in the language, such as BELIEFS ARE MACHINES in Mandarin Chinese.[6] Clausner and Croft's (1997) approach, on the other hand, only distinguishes two kinds: (1) metaphors that fall inside the scope of the source domain, and (2) those that fall outside the scope of the source domain. The attributive categorization hypothesis, on the other hand, predicts that there will be no discernible differences between the comprehension of conventional and novel uses of metaphor. Lastly, hypothetical predictions cannot be formulated for Grady's (1997) approach since, when the conceptual metaphors

are broken down into primary metaphors, there are multiple conceptual mappings involved for each primary metaphor. Since these are conceptual mappings, there is no way to ascertain through either native speaker intuitions, or through frequency-based data from corpora, which particular mapping is most salient. In what follows, I will present experimental evidence for the Mapping Principles that are formulated within the Conceptual Mapping Model.

3. Psycholinguistic experiments

The predictions of the Conceptual Mapping Model for the first three kinds of metaphors mentioned above are as follows: conventional conceptual metaphors (i.e. exemplars that follow the mapping principle and are common in the language) will be treated on par with literal language (Stewart & Heredia, 2002). Next, metaphors that follow the mapping principle but are novel usages will receive slightly lower acceptability and interpretability ratings and slightly higher processing times when making acceptability and interpretability decisions. Lastly, novel metaphors that do not follow the mapping principle will involve even lower acceptability and interpretability ratings and even higher processing times.

Using both on-line and off-line experimental methods has the advantage of testing one aspect of what Gibbs, this volume, calls a real-world approach to metaphor. In particular, he points out in this chapter and in Gibbs (1994) that researchers need to differentiate between four different types of metaphoric understanding: metaphor processing, metaphor interpretation, metaphor recognition, and metaphor appreciation. Of these four, the first two types are examined here as the two on-line studies in Sections 6 and 7 look at metaphor processing, which Gibbs defines as "the fast, mostly unconscious process that lead to metaphor comprehension in real-time listening and reading". Sections 4 and 5 look at metaphor interpretation, which involves the reflective processes that can be found in off-line acceptability and interpretability judgment tasks.

4. Off-line acceptability ratings of metaphors

a. Participants

132 National Taiwan University (NTU) undergraduate student volunteers from four different classes participated in this study. Participants were native speakers of Mandarin. They had to rate their general proficiency of Mandarin as being 5 or above (on a scale of 1 to 7) to qualify for the experiment.

b. Materials

Eighteen metaphors were used in the experiment. Each metaphor was first analyzed and its mapping principle determined by five linguists trained in the Conceptual Mapping Model. Then each analysis and mapping principle was presented to a group of ten linguists from the Chinese Knowledge Information Processing Group. Conceptual metaphors found in Mandarin Chinese (i.e. LOVE IS A PLANT) were used in this experiment only when the analyses and mapping principles were agreed upon by this latter group.

Each metaphor contains six types of sentence, as given in (4) below. The examples are derived from the conceptual metaphor LOVE IS BAGGAGE.

Example (4a) is a conventional metaphor, while (4b) is a 'literal match' to the conventional metaphor example, as it replaces the word 'love' with 'baggage', which then allows for a straightforward literal interpretation of the sentence. In the next set, (4c) is an example of a novel metaphor that follows the mapping principle, while (4d) is its literal match (i.e. the only difference between these two examples is that in (4c) 'love' is the subject of the sentence and in (4d) 'baggage' is the subject. In the last set, (4e) is a novel metaphor that does not follow the mapping principle, while (4f) is a literal match to (4e). In each metaphorical sentence the source domain is shaded, and the target domain is underlined.

Conventional conceptual metaphor

(4a) *zhe aiqing zhen jiaoren wu fa fuhe*
the love really make people no way carry
'People have no way to carry this love.'

Literal match to the conventional conceptual metaphor

(4b) *zhe baofu zhen jiaoren wu fa fuhe*
the baggage really make people no way carry
'People have no way to carry this baggage.'

Novel metaphor that follows the Mapping Principle

(4c) *zhe aiqing zhen jiaoren wu fa beifu*
the love really make people no way bear
'People have no way to bear this love.'

Literal match to the novel metaphor that follows the Mapping Principle

(4d) *zhe baofu zhen jiaoren wu fa beifu*
the baggage really make people no way bear
'People have no way to bear this baggage.'

Novel metaphor that does not follow the Mapping Principle

(4e) *zhe aiqing zhen jiaoren wu fa dakai*
the love really make people no way open
'People have no way to open this love.'

Literal match to the novel metaphor that does not follow the Mapping Principle

(4f) *zhe baofu zhen jiaoren wu fa dakai*
the baggage really make people no way open
'People have no way to open this baggage.'

Based on an *a priori* analysis of the metaphor LOVE IS BAGGAGE, the proposed Mapping Principle is: Love is understood as baggage, in that *baggage involves carrying a physical weight and love involves carrying an emotional burden*. (4a) is an example of a conventional usage of this metaphor, while (4c) is a novel usage, since 'beifu' is not used to talk about love conventionally. However, the novel example in (4c) does follow the mapping principle for this source-target domain pairing, since the meaning of 'beifu' still has to do with carrying a weight. (4f) is an example of a novel metaphor that does not follow the mapping principle for this particular source-target domain pairing, since opening a suitcase is not usually related to how much it weighs.

In addition, before the acceptability experiment was run, several conditions had to be met. First, all the metaphorical terms (such as *fuhe* 'carry', *beifu* 'bear' and *dakai* 'to open') had to be considered as being in the source domain (in this case BAGGAGE) by a group of native speakers. Thus, the following two pretests were run: a source domain rating test, and a yes-no source domain test. 31 National Taiwan University (NTU) undergraduate students participated in the source domain rating tests and 20 NTU undergraduates participated in the source domain yes/no test. All participants had to meet the language requirements described previously. The participants were given the source domain and were asked if the word next to it was related to it. On the rating task, they were asked to rate the strength of the relationship from 1 to 7, with 7 being highly related. In the yes-no task, they were simply asked to circle yes or no. Items were only included in the acceptability experiment that both had (a) a mean over all participants of 4.9 or above on the ratings test, and (b) a mean of .7 or above for the yes/no test.

Moreover, it was also ascertained that key words in (4a) and (4b) (i.e. *fuehe* 'carry'), (4c) and (4d) (i.e. *beifu* 'bear'), and (4e)–(4f) (i.e *dakai* 'open') did not differ in terms of frequency of lexical items. The frequency norms are based on CKIP (1993). The means of the groups are 11667, 11767, and 9996 with an SD of 9354, 8936, 6276 respectively; $F(2,47) = .231$, $p = .795$).

The prediction for the Conceptual Mapping model is that the literal sentences should be equally acceptable (i.e., b = d = f). In addition, the conventional conceptual metaphors (a) should be ranked as equally acceptable to the literal sentences. However, both kinds of novel metaphor should be ranked lower in acceptability than their literal counterparts (i.e., (c) < (d), (e) < (f)), and there also should be a gradation in the ranking of all metaphorical sentences, such that (a) > (c) > (e), since conventional conceptual metaphors should be processed automatically, and novel metaphors that follow mapping principles should involve additional processing resources when compared with the conventional conceptual metaphors. Furthermore, these resources should be less when compared with novel metaphors that do not follow mapping principles, since this last kind requires the listener to make a new connection between the source and target domains, while the novel metaphors that follow mapping principles require only the activation of an underlying connection.

Clausner and Croft's model, on the other hand, predicts that (a) and (c) should not differ in acceptability because (c) in their model would still fall under the constrained source domain. Furthermore, the attributive categorization hypothesis predicts no difference between (a) and (c) and (e), since in this model, each metaphorical mapping is a unique event that is dealt with individually.

c. Procedure

The 108 experimental sentences were divided into six booklets with 18 examples each using a counter-balanced design, so that no participant saw a sentence from any one of the conceptual metaphors more than once. The participants were randomly given one booklet containing a set of instructions. They were instructed to rate the sentences according their acceptability. If they felt the sentence to be not strange at all and acceptable, then they were instructed to give a rating of 7. If the sentence was strange and unacceptable, then they were instructed to give the sentence a rating of 1. If they felt that the acceptability was in between acceptable and unacceptable, then they were to choose from 2 to 6 depending on the level of acceptability. Two practice examples were given before they started to rate the acceptability of experimental sentences.

d. Results

The data from 132 participants were tallied and the means were calculated across all participants for the six sentence conditions. The means and standard deviation for each sentential condition are given in Table 1.

Table 1. Means for acceptability ratings of literal and metaphorical sentences

Sentence type	Mean	SD
A (conventional conceptual metaphors)	6.0	1.7
B (literal matches to A)	6.0	1.7
C (novel metaphors that followed mapping principle)	5.0	2.1
D (literal matches to C)	6.0	1.5
E (novel metaphors that did not follow mapping principles)	4.0	2.2
F (literal matches to E)	5.4	1.9

For the overall analysis of variance, which consisted of the between-participant variables of booklets (6) and within-participants variable of Sentence type (metaphorical (A, C, E) versus literal (B,D,F)), a significant effect main effect of Sentence Type was found over participants ($F(5,630) = 112.5$, $MSe = .782$, $p < .05$) and over items ($F(5,72) = 11.4$, $MSe = 1.052$, $p < .05$). Of major importance to the hypothesis under investigation, *a priori* planned comparisons were performed on the metaphorical sentences and their associated literal matches. The conventional metaphorical sentences (A) did not differ significantly from their literal matches (B), $t = .28$, $p = 1.0$. The novel metaphors that followed mapping principles (C) did however differ significantly from their literal sentence matches (D), $t = 8.9$, $p < .05$. In addition, the novel metaphors that did not follow mapping principles (E) also differed significantly from their literal sentence matches (F), $t = 13.12$, $p < .05$.

Moreover, further planned comparisons of the three metaphorical sentences show that the difference in ratings between the conventional metaphorical sentences (A) and the novel metaphorical sentences that followed mapping principles (C) was significant, $t = 9.6$, $p < .05$. Furthermore, the difference in ratings between the novel metaphorical sentences that followed mapping principles (C) and the novel metaphorical sentences that did not follow mapping principles (E) was also significant, $t = 9.5$, $p < .05$.

5. Off-line interpretability ratings on metaphors

Interpretability ratings for these sets of sentences were also examined, since theories that treat grammatical judgments and semantic interpretation as distinct modules would postulate that there might be different patterns involved. For example, if interpretability is the question under study, it might be the case that the novel forms are equally uninterpretable, even though there were gradations in the differences of their acceptability. However, if the critical issue is the mapping principles involved, and not the semanticality or grammaticality decision, then there should be a gradation in interpretability ratings between the three sets of

a. Participants

An additional 132 participants from NTU were tested in the off-line interpretability experiment. The materials and design were exactly the same as in the previous experiment, except that participants were instructed to rate the sentences according to their interpretability, following similar instructions to those given above.

b. Results

The data from 132 participants were tallied and the means were calculated across all participants for the six sentence conditions. The means for each sentential condition and its related standard deviation are given in Table 2.

Table 2. Means for interpretability ratings of literal & metaphorical sentences

Sentence type	Mean	SD
A (conventional conceptual metaphors)	6.5	1.1
B (literal matches to A)	6.5	1.2
C (novel metaphors that followed mapping principle)	5.6	1.8
D (literal matches to C)	6.6	1.1
E (novel metaphors that did not follow mapping principles)	4.6	2.2
F (literal match to E)	6.2	1.5

For the overall analysis of variance, which consisted of the between-participant variables of booklets (6) and within-participants variable of Sentence Type (metaphorical (A, C, E) versus literal (B, D, F)), a significant effect main effect of Sentence type was found over participants ($F(5,630) = 108.7$, $MSe = .748$, $p < .05$) and over items ($F(5,72) = 24$, $MSe = .462$, $p < .05$). Of major importance to the hypothesis under investigation, *a priori* planned comparisons were performed on the metaphorical sentences and their associated literal matches. The conventional metaphorical sentences (A) did not differ significantly from their literal matches (B), $t = .07$, $p = 1.0$. The novel metaphors that followed mapping principles (C) did differ significantly from their literal sentence matches (D), $t = 9.6$, $p < .05$. The novel metaphors that did not follow mapping principles (E) also differed significantly from their literal sentence matches (F), $t = 15.27$, $p < .05$.

In addition, further planned comparisons of the three metaphorical sentences showed that the difference in ratings between the conventional metaphorical sentences (A) and the novel metaphorical sentences that followed mapping principles (C) was significant, $t = 8.6$, $p < .05$. Furthermore, the difference in ratings between the novel metaphorical sentences that followed mapping principles (C) and the novel metaphorical sentences that did not follow mapping principles (E) was also significant, $t = 9.4$, $p < .05$

6. On-line acceptability decision experiment

The two previous experiments involved off-line (untimed) ratings, and demonstrated that participants ranked metaphors differently depending on what degree of novelty was involved: conventional conceptual metaphors (i.e., no novelty was involved), novel metaphors that followed mapping principles (i.e., some degree of novelty was involved, as the mapping principle had to be activated to interpret the new lexical usage), or novel metaphors that did not follow mapping principles (i.e., a large degree of novelty was involved as the metaphor did not fit in with the mapping principle associated with this source-target domain pairing and a new connection and interpretation had to be created.) McGlone (1996) and Glucksberg et al. (1993) have pointed out, however, that conceptual metaphors are not necessarily accessed in on-line reaction time studies. Under this assumption, one would not expect to see a gradation in reaction time between conventional conceptual metaphors, novel metaphors that follow mapping principles, and novel metaphors that do not follow mapping principles, as predicted by the Conceptual Mapping Model. Such a finding would falsify the mapping principle hypothesis and instead lend support to the attributive categorization view. The following two on-line experiments for acceptability and interpretability test this possibility.

a. Participants and materials

92 National Taiwan University undergraduate students participated in this study for NT$100. All were native speakers of Mandarin as determined by the previously discussed criteria. They had not participated previously in any related experiments. The materials included the original 18 sets of stimuli and six additional sets that underwent similar pre-testing and frequency controls to those described above.

b. Apparatus

The 144 sentences (24 sets of stimuli multiplied by six conditions in each set) were recorded by a female speaker to the hard drive of an IBM-compatible Pentium computer with the aid of the Creative Wave sound card using the Creative Wave program. They were counter-balanced over six lists. An internal dedicated CPU in the button box measured the time from the auditory presentation of the sentence until a response was made on the button box or 3 seconds had passed, whichever was earlier. The measurements were made to the nearest millisecond. The sentences occurred in random order, and there was a three-second delay between sentences.

c. Procedure

Participants sat in front of a computer monitor in a soundproof room and listened to instructions read aloud by a native speaker. These instructions explained that the participants were taking part in an experiment about how language is comprehended and that there were no tricks involved. They were then asked to listen to the sentences on the headphones and to decide if the sentence was acceptable or unacceptable. The participants made this binary decision with a two-button button box specifically designed for this purpose. Participants pressed one button with their index finger if the sentence was unacceptable and pressed the other button with their other pointer finger if it was acceptable. Half the participants were assigned to press the right-hand button for 'acceptable' and the left hand button for 'unacceptable' and vice versa. The participants were asked to keep their fingers on the buttons at all times and to respond as fast and accurately as possible. The computer screen was covered with a piece of dark gray cardboard so that participants' attention would be focused on listening to the auditory stimuli. Although participants were not given a definition of what was acceptable and what was not acceptable, they were given the opportunity to practice making this decision before the experiment began as a practice experiment with eight sentences was run to familiarize participants with the procedure, and if they inquired as to what 'acceptable' meant (and only a few did), they were told that they should use their own judgment.

d. Results

After screening for participants who did not respond more than 15% of the time (2 participants), there were 90 participants with reliable data, 15 participants for each list. The outliers from the RT data were trimmed by excluding outliers above and below two standard deviations from the mean, which resulted in excluding 5.82% of the data.

Table 3 below presents the mean reaction times of all responses in each condition, as well as the percent considered acceptable for each condition.

A one-way ANOVA was run on individual participants' data employing Lists (4) as a between-participants factor (materials counterbalancing factors). An overall significant main effect of Sentence Type (metaphor versus literal) was found for participants (F_1 (5,420) = 27.40, MS*e* = 25067, $p < .05$) and for items ($F_2(5, 138) = 6.842$, MS*e* = 28650, $p < .05$). There was also no effect of List ($F(5, 84) = .378$, MS*e* = 407652, $p = .862$). Of major importance to the hypothesis under investigation, *a priori* one-tailed planned comparisons were performed on

Table 3. RT means & percent considered acceptable for literal and metaphorical sentences

Sentence types	RT mean (in ms)	Percent considered acceptable
A (conventional conceptual metaphors)	544	85%
B (literal matches to A)	580	82%
C (novel metaphors that followed mapping principle)	691	59%
D (literal matches to C)	616	83%
E (novel metaphors that did not follow mapping principles)	788	40%
F (literal matches to E)	640	77%

the metaphorical sentences and their associated literal matches. As predicted, the conventional metaphorical sentences (A) did not differ significantly from their literal matches (B) in terms of reaction time ($t(178) = -1.0$, $p = .159$) or acceptability level ($t(178) = 1.032$, $p = .152$). However, the novel metaphors that followed mapping principles (C) did differ significantly from their literal sentence matches (D) in terms of reaction time ($t(178) = 1.657$, $p < .05$) and acceptability percentage ($t(178) = 6.667$, $p < .05$). Novel metaphors that did not follow mapping principles (E) also differed significantly from their literal sentence matches (F) in terms of reaction time ($t(178) = 2.907$, $p < .05$) and acceptability percentage ($t(178) = 10.000$, $p < .05$).

In addition, further planned comparisons of the three metaphorical sentences show that the difference in reaction times and acceptability percentages between the conventional metaphorical sentences (A) and the novel metaphorical sentences that followed mapping principles (C) was significant, $t(178) = 3.555$, $p < .05$, and $t(178) = 7.565$, $p < .05$, respectively. Furthermore, the difference in ratings between novel metaphorical sentences that followed mapping principles (C) and novel metaphorical sentences that didn't follow mapping principles (E) was also significant in terms of mean reaction time, $t(178) = 1.949$, $p < .05$ as well as in terms of acceptability percentage $t(178) = 4.773$, $p < .05$.

7. On-line interpretability ratings of metaphors

a. Participants and materials

96 National Taiwan University undergraduate students who fitted our language criteria participated in this study for NT$100. They had not participated previously in any related experiments. The materials and apparatus were the same as those used in the previous on-line experiment.

b. Procedure

The procedure was the same as in the previous on-line experiment except that in this experiment they were asked to make a decision as to whether the sentences they heard were interpretable or not.

c. Results

After screening for participants who were interrupted during the experiment (2 participants), or who had 15% or more of 'no' responses (4 participants), there were 90 participants with reliable data and 15 participants for each list. The outliers from the RT data were trimmed by excluding outliers above and below two standard deviations from the mean, which resulted in excluding 6.34% of the data.

Table 4 below presents the mean reaction times of all responses in each condition, as well as the percent considered interpretable for each condition.

Table 4. RT means and percent considered interpretable for literal and metaphorical sentences

Sentence types	RT mean (in ms)	Percent considered interpretable
A (conventional conceptual metaphors)	382	95%
B (literal matches to A)	402	94%
C (novel metaphors that followed mapping principles)	489	81%
D (literal matches to C)	399	95%
E (novel metaphors that did not follow mapping principles)	575	63%
F (literal matches to E)	416	91%

A one-way ANOVA was run on individual participants' data employing Lists (4) as a between-participants factor (materials counterbalancing factors). An overall significant main effect of Sentence Type (metaphor versus literal) was found for participants ($F_1(5,420) = 30.84$, $MSe = 16162$, $p < .05$) and for items ($F_2(5, 138) = 6.767$, $MSe = 22030$, $p < .05$). There was also no effect of List ($F(5, 84) = 1.432$, $MSe = 163299$, $p = .221$). Of major importance to the hypothesis under investigation, *a priori* one-tailed planned comparisons were performed on the metaphorical sentences and their associated literal matches. As predicted, the conventional metaphorical sentences (A) did not differ significantly from their literal matches (B) in terms of reaction time ($t(178) = -.735$, $p = .232$) or interpretability level ($t(178) = .515$, $p = .304$). However, the novel metaphors that followed mapping principles (C) did differ significantly from their literal sentence matches (D) in terms of reaction time ($t(178) = 2.825$, $p < .05$) and interpretability percentage ($t(178) = 5.217$,

$p < .05$). Novel metaphors that did not follow mapping principles (E) also differed significantly from their literal sentence matches (F) in terms of reaction time ($t(178) = 4.849$, $p < .05$) and interpretability percentage ($t(178) = 7.298$, $p < .05$).

In addition, further planned comparisons of the three metaphorical sentences showed that the difference in reaction times and interpretability percentages between the conventional metaphorical sentences (A) and the novel metaphorical sentences that followed mapping principles (C) was significant, $t(178) = 3.330$, $p < .05$, and $t(178) = 5.390$, $p < .05$, respectively. Furthermore, the difference in ratings between the novel metaphorical sentences that followed mapping principles (C) and the novel metaphorical sentences that did not follow mapping principles (E) was also significant in terms of mean reaction time, $t(178) = 2.319$, $p < .05$ and in terms of interpretability percentage $t(178) = 4.475$, $p < .05$.

8. Discussion and conclusion

The findings in the off-line and on-line experiments for acceptability and interpretability verified the predictions of the Conceptual Mapping Model. In particular, conventional conceptual metaphors were rated as being equally acceptable and interpretable to literal expressions, and were rated higher than novel metaphors. Furthermore, conventional conceptual metaphors were rated more highly than novel metaphors that followed the postulated mapping principles. In addition, novel metaphors that followed the mapping principles were rated more highly than novel metaphors that involved the same source domain, but did not follow the mapping principle.[7] In addition, contrary to views that conceptual metaphors might not be accessed on-line, listening times were faster for conventional metaphors as compared with novel metaphors that followed mapping principles when participants were making acceptability and interpretability judgments. Moreover, listening times were faster for novel metaphors that followed mapping principles as compared with novel metaphors that didn't follow mapping principles when participants were making these same judgments.[8]

These findings, along with the fact that the stimuli were tightly controlled in terms of syntactic structure and lexical frequency, suggest that speakers do access mapping principles when making interpretability and acceptability judgments about sentences that contain conceptual metaphors. Sentences with conventional conceptual metaphors require no additional processing time when compared with literal sentences, but novel metaphors that follow mapping principles require more processing time as compared to literal sentences, and novel metaphors that do not follow mapping principles require even more time. Although similar processing times do not necessarily indicate that similar processing resources

were used, as in the case of the conventional versus literal examples (cf. Ahrens et al., 2007), the longer processing times do indicate that there was an increased processing load depending upon whether or not the novel metaphors followed the mapping principles postulated.

While Clausner and Croft's (1997) model might predict a difference between conventional and novel metaphors based simply on frequency (or perhaps on the related concept of familiarity), they would not predict a difference between conventional metaphors and novel metaphors that follow mapping principles, since in their theory novel metaphors that follow mapping principles and the conventional metaphors are both part of the same constrained source domain. The Attributive Category Hypothesis, moreover, predicted that there should be no difference in acceptability between any of the three kinds of metaphor (unless they also invoke either frequency or familiarity for the conventional metaphors) since under these models, there is no coherent system of conceptual correspondences and each metaphoric mapping is unique. In addition, even if frequency or familiarity is invoked to account for the conventional metaphors, their model runs up against the same constraints as Clausner and Croft's model since it cannot explain the differences between the two kinds of novel metaphors, as both these kinds never occur in the language and are equally unfamiliar.

However, what Clausner and Croft's (1997) model, Grady's (1997) model, and the Conceptual Mapping Model have in common is the assumption that conceptual metaphors reflect systematic mappings between source and target domains. While each model chooses to represent this systematicity in different ways, all three differ fundamentally from the attributive categorization view, which proposes that a source domain provides properties that are attributed to the target domain on the fly. The main contribution of the Conceptual Mapping Model is that it sets up criteria for evaluating, based on native speaker intuition, corpus data, and psycholinguistic experiments, how this systematicity is represented in the language and dealt with from a processing point of view.

This is not to say, however, that any of the above models should be discarded. As discussed in endnote 1, metaphor as a linguistic phenomenon is so complex that it may be the case that more than one theory is needed to account for how it is processed (Gibbs, 2006). Gibbs also mentions this in this volume where he notes that one of the key challenges for the future is to examine whether researchers who embrace different theoretical positions are perhaps looking at different types of metaphorical language. That is, it is plausible to think that in cases where there are no pre-existing conceptual mappings, statements of the type 'X is a Y' may in fact be dealt with as class-inclusion statements as suggested by the attributive categorization view. These class-inclusion statement metaphors may be processed in a different manner from conceptual metaphors which occur in more varied

types of syntactic construction (cf. Grady's (1999) discussion of resemblance versus correlational metaphors). Thus, it is suggested that many factors need to be taken into consideration when testing a model's processing claims, including the syntactic frame involved, the metaphor type, the degree of conventionality of the metaphor, and the task type.

In sum, the Conceptual Mapping Model proposes that by delimiting the source and target domain to conceptually coherent categories (such that participants can make judgments about whether an item belongs in, or is related to, that category or not), and by examining the linguistic evidence (i.e. the entities, qualities, and functions that map between the source and target domains) or the corpus evidence for the frequency of mappings, a mapping principle can be formulated which will explicate the underlying reason for the existing correspondences between these two structured knowledge domains. The model postulates that it is the mapping principle that constrains the possibilities for novel metaphor extensions, and that it may be the mapping principle that is activated during judgment tasks. Recent research has also demonstrated mapping principles *are* activated in on-going integration of sentences into discourse (Gong & Ahrens, 2007), and further research will examine if the two kinds of novel metaphor proposed here (novel metaphors that follow mapping principles and novel metaphors that do not follow mapping principles) show differing areas of brain activation, in order to further understand how novel language is comprehended and integrated in on-going language processing.

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Notes

1. In fact, as Gibbs (2006) points out, "the complexity of metaphoric language makes it unlikely...that any single theory will be capable of explaining how verbal metaphors come into being, and how they are ordinarily produced and interpreted" (p. 435). Thus, the model being proposed in this paper should be viewed as one complementary account to both Grady's decompositional account and Clausner and Croft's domain-based account. All three accounts have as their starting point the idea that Conceptual Metaphor Theory needs to be better constrained in order to make more relevant linguistic predictions about conceptual metaphor use.

2. Grady (1999) suggests that primary metaphors are understood in terms of a correlation between concepts, while other metaphors, such as those of the type 'X is a Y', can be dealt with in terms of a resemblance model. In this paper, I will focus on what Grady calls correlation-based metaphors, although the conceptual metaphors I discuss are not necessarily primary metaphors as Grady defines them.

3. Other reasons might involve whether the experimental tasks are conducive to accessing the processes involved in understanding conceptual metaphors. For example, Gong and Ahrens (2007) have noted that line-by-line presentation does not allow context to influence decisions about the appropriateness of conceptual metaphors, while paragraph presentation does. This would explain, for example, why Glucksberg et al. (1993) did not find evidence of conceptual metaphor activation in on-line processing, since their presentation method was line-by-line.

4. This notion of a mapping principle is different from the general principles that Lakoff (1993) postulates, since he hypothesizes that these general principles are part of the conceptual system, but not part of the grammar or lexicon. However, I am suggesting here that linguistic correspondences can and should be identified in order to identify mapping principles (cf. Ahrens, 2002; Huang et al. 2006).

5. As the native speakers who generate the stimuli are all studying for their master's degrees at National Taiwan University, it is reasonable to assume that the decision as to what constitutes a conventional or novel metaphorical usage is valid for educated Mandarin speakers in Taiwan in their 20's.

6. Ahrens et al. (2007) ran a functional Magnetic Resonance Imaging (fMRI) study to look at the haemodynamic response when contrasting literal sentences with conventional metaphorical sentences and anomalous metaphorical sentences. They found that anomalous metaphorical sentences use extensive additional right and left hemisphere resources, as compared with conventional metaphorical sentences or literal sentences, indicating that this kind of metaphor was using additional processing mechanisms to understand and interpret this never-before-seen source-target domain pairing.

7. One reviewer notes that participants might be baffled by an unconventional formulation of the metaphor rather than by an unconventional mapping. However, if participants were simply baffled by an unconventional formulation of a metaphor, they would have produced similar results for both kinds of novel metaphor, which was not the case.

8. Note that visual iconicity as discussed in Hiraga (2005) is not apt to influence the four experiments discussed here, as the latter two are listening experiments in which no characters

are involved, and the former two are reading experiments in which participants are reading at a natural speed and not analyzing the semantic structure of the characters they are reading. Furthermore, all four experiments show the same patterns with regard to the degree of novelty of the metaphors, which also suggests that the participants were not spending additional resources trying to analyze iconicity of the characters when they were reading the sentences in the first two experiments.

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