Indirect Categorization as a Process of Predicative Metaphor Comprehension

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In this article, we address the problem of how people understand predicative metaphors such as “The rumor flew through the office,” and argue that predicative metaphors are understood as indirect (or two-stage) categorizations. In the indirect categorization process, the verb (e.g., fly) of a predicative metaphor evokes an intermediate entity, which in turn evokes a metaphoric category of actions or states (e.g., “to spread rapidly and soon disappear”) to be attributed to the target noun (e.g., rumor), rather than directly evoking a metaphoric category as argued by Glucksberg’s (2001) categorization theory. We test our argument using two experiments, namely, offline comprehension and online priming. The offline comprehension experiment showed that interpretation of predicative metaphors had greater overlap with words indirectly associated with the verb than those directly associated with the verb. The online priming experiment demonstrated that indirectly associated words were activated during predicative metaphor comprehension, but directly associated words were not. These results provide convergent evidence for our argument, and thus the psychological validity of two-stage categorization as a process of predicative metaphor comprehension was confirmed.

Predicative metaphors are figurative expressions that involve the metaphorical use of a verb, such as “The rumor flew through the office” and “His fame echoes throughout the world.” Despite their frequent use in everyday communication, predicative metaphors have been paid little attention in metaphor research. Particularly, the cognitive mechanism underlying predicative metaphor comprehension has never been examined, although a considerable number of studies have been made on the comprehension mechanism of nominal metaphors such as “My job is a jail” (e.g., Bowdle & Gentner, 2005; Glucksberg, 2001; Jones & Estes, 2006; Pierce & Chiappe, 2009; Utsumi, 2007). Predicative metaphors and nominal metaphors differ in what is being processed metaphorically; actions, events, or states are described figuratively using predicative metaphors, while objects are figuratively referred to by nominal metaphors. Indeed, Chen, Widick, and Chatterjee (2008) have recently provided neuroanatomical evidence that predicative and nominal metaphors may be processed differently. Taken together, it is obviously crucial to explore the cognitive mechanism of predicative metaphor comprehension.

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Cognitive linguists may argue that the cognitive linguistics research on metaphor (e.g., Kövecses, 2002; Lakoff & Johnson, 1980) has addressed predicative metaphors as manifestations of the conventionalized, conceptual metaphors. However, these studies do not provide a general mechanism of how the conceptual metaphors are constructed, in other words, how a set of correspondences or mappings is made between the source domain and the target domain. The recent development has tried to explain the mechanism of metaphorical mappings using blending (Grady, 2005) or neural computation (Lakoff, 2008), but their explanation is not general enough to specify psychological processes involved in the construction of complex conceptual metaphors. This problem becomes more serious when we consider how people comprehend novel predicative metaphors.

Glucksberg (2001, 2003) argues that people comprehend predicative metaphors via a categorization process as they do for nominal metaphors. Just as nominal metaphors use the source concepts that epitomize certain categories of objects or situations, predicative metaphors use verbs that epitomize certain metaphoric categories of actions (e.g., the category of speedy travel evoked by the verb fly). However, no clear empirical evidence has been provided for his argument. Although Torreano, Cacciari, and Glucksberg (2005) demonstrated that the level of abstraction of a verb’s referent was related to the metaphoricity of a predicative metaphor, their finding does not necessarily imply that the verb directly evokes a metaphoric category in metaphor comprehension.

In this article, we propose indirect categorization as a comprehension process of predicative metaphors. Indirect categorization is a two-stage process of categorization in which evocation (or creation) of metaphoric categories is indirect and mediated by intermediate entities, rather than direct as predicted by the categorization theory. In comprehending a predicative metaphor (e.g., “The rumor flew through the office”), the verb (e.g., fly) evokes an intermediate entity, which in turn evokes a metaphoric category of actions or states (e.g., “to spread rapidly and soon disappear”) to be attributed to the target noun (e.g., rumor).

To obtain empirical evidence for our indirect categorization theory, we conducted two psychological experiments, namely, an offline comprehension experiment and an online priming experiment. In the offline comprehension experiment (i.e., Experiment 1), we examined what proportion of interpretations of predicative metaphors were derived directly from the verb and what proportion were indirectly associated with the verb. For this purpose, we assessed a concordance rate between words listed as metaphorical interpretation and those associated with the verb or associated with the verb associates. In the online priming experiment (i.e., Experiment 2), we used a priming paradigm to assess the online availability of direct and indirect categories for predicative metaphor comprehension. In this experiment, a metaphorical sentence was presented as a prime and its effect on the speed of lexical decision about a subsequent target word was measured. The target conditions were a word related to the metaphorical meaning, a word directly associated with the verb, a word indirectly associated with the verb, and a control word unrelated to the metaphor. In addition, we manipulated the aptness and vehicle conventionality of predicative metaphors in these experiments. This is because recent metaphor studies (e.g., Bowdle & Gentner, 2005; Glucksberg & Haught, 2006; Jones & Estes, 2006) have demonstrated that these metaphor properties play an important role in comprehension of nominal metaphors. By doing so, we can examine whether the process of predicative metaphor comprehension (or indirect categorization) is affected by these metaphor properties.
DIRECT VERSUS INDIRECT CATEGORIZATION

As we mentioned above, Glucksberg’s (2001, 2003) categorization theory argues that people understand predicative metaphors as direct categorizations. The categorization theory addresses mainly nominal metaphors and argues that people understand nominal metaphors by seeing the topic (or the target concept) as belonging to the superordinate metaphorical category exemplified by the vehicle (or the source concept). It goes on to argue that predicative metaphors function very much as do nominal metaphors; just as nominal metaphors use vehicles that epitomize certain categories of objects or situations, predicative metaphors use verbs that epitomize certain categories of actions. According to the categorization theory, for example, the predicative metaphor “The rumor flew through the office” is comprehended so that the verb fly evokes a superordinate category of an action to travel fast and such the action is attributed to the target rumor, as illustrated in Figure 1(a).

However, it is doubtful that predicative metaphors are processed in the same way as nominal metaphors. The primary reason for this doubt is that many empirical findings on semantic representation demonstrate that the semantic structure of verbs, which refer to events or actions, differs in many respects from that of nouns, which refer to objects. First, the hierarchical organization for objects and events is different; event categories are represented by fewer levels (generally two) and with fewer distinctions at the superordinate level than object categories (Vigliocco & Vinson, 2007). Second, the hierarchical relation (or hyponymy) between verbs is also qualitatively different from that between nouns (Fellbaum, 1998). The hyponymic relation for verbs involves many kinds of semantic elaborations and can be appropriately expressed by “To V1 is to V2 in some particular manner” (e.g., “To mumble is to talk indistinctly in a low voice”), although noun hyponymy is based only on class inclusion “A N1 is a N2” (e.g., “A horse is a mammal”). Third, the role of hierarchical relations differs between

![Diagram](image-url)

**FIGURE 1** An illustration of direct and indirect categorization for the metaphor “The rumor flew through the office.”
nouns and verbs. For nouns, the most important roles are played by the hierarchical relations including superordination and coordination, whereas the dominant relations for verbs are nonhierarchical ones such as antonymy, entailment, and causation. Some evidence compatible with the different role of hierarchical relations is provided by the analysis of semantic substitution errors. Garrett (1992) reported that for nouns the large majority of substitutions involve category coordinates (i.e., words in the same level of the hierarchical structure), while for verbs the preferred semantic relationship between target and intruding words is opposition (e.g., go/come). In addition, a neuroanatomical difference appears to exist between nouns and verbs (Shapiro & Caramazza, 2004; Vigliocco & Vinson, 2007) and between nominal metaphors and predicative metaphors (Chen et al., 2008). These findings indicate that hierarchical relations are less activated in the processing of verbs, and thus it is less likely that verbs directly evoke superordinate categories of events or actions; this contradicts Glucksberg’s categorization theory.

Another reason for doubting the categorization theory is that it does not address the richness of the metaphorical meanings expressed by predicative metaphors. For example, people can derive more meanings from the metaphor “The rumor flew through the office” than supposed in the categorization theory (e.g., to travel fast); the rumor spreads rapidly and suddenly, the rumor is dispersed or disseminated, the rumor disappears or is forgotten very soon, and so on. These rich interpretations are unlikely to be derived directly from the verb fly, given that the semantic structure of verbs is hierarchically less rich. In addition, the verb fly of “The rumor flew through the office” does not refer to the superordinate category of fast travel, which the categorization theory assumes as a metaphorical meaning. It is reasonable to assume that the verb fly refers to a more specified meaning, namely the category of rapid spread, which is a subordinate to the category of fast travel.

To overcome the difficulties of the categorization theory of predicative metaphors, we propose an indirect categorization theory. The intuitive idea behind indirect categorization is that a correspondence between the actions or events literally expressed by the verb and the actions or events to be attributed to the target noun would be indirect, rather than direct as predicted by the categorization theory; constructing a correspondence is mediated by an intermediate entity. As illustrated in Figure 1(b), in the case of the “fly” metaphor, the verb fly first evokes some sort of intermediate entity and the intermediate entity then evokes a final abstract category of “to spread rapidly and soon disappear,” which is attributed to the target rumor being described.

One important question that arises here is what kind of entities are involved in the intermediate step. Two possible answers can be provided: (i) abstract actions or states produced by abstraction of the verb, and (ii) things or objects produced by instantiation of the verb’s arguments (e.g., prototypical agents, experiencers, or themes of the verb’s action). Figure 2 illustrates these two possibilities for the fly metaphor. When comprehending “The rumor flew through the office,” people may think of a very abstract action to travel fast by abstracting the verb fly, and this abstract intermediate entity is then specified to refer to rumor spreading. A perhaps more likely explanation is that people may consider a set of prototypical members of “things that fly” or “flying objects,” which contains airplanes, birds, and insects, by instantiating the argument of the verb fly. Some actions or events that are relevant to both flying objects and the target rumor are then extracted to refer to rumor spreading. These two types of intermediate entities may be activated simultaneously during comprehension, rather than
selectively. Which one is more activated or preferred may be determined depending on the difficulty in deriving an abstract category from a verb. For example, it is difficult to imagine a more abstract superordinate category of eating up in the metaphor “The girl ate up the story,” which may be understood on the basis of things that are eaten up, whereas in the case of the metaphor “The single man picked up the woman,” the superordinate of picking up (e.g., acquiring) comes readily to mind and thus it is less necessary to enumerate things that are typically picked up.

**EXPERIMENT 1**

In Experiment 1, we tested our indirect categorization theory by comparing people’s interpretations of predicative metaphors (i.e., $I(M)$ in Figure 3), with words or phrases associated directly or indirectly with the verb of predicative metaphors (i.e., $A(w_v)$ or $A(S)$ in Figure 3). If a metaphoric category is evoked indirectly in predicative metaphor comprehension,
the interpretation of predicative metaphors $I(M)$ would have greater overlap with indirectly associated words $A(S)$ than with directly associated words $A(w_v)$. If a metaphoric category is evoked directly from the verb, the percentage of overlap between the metaphorical interpretation $I(M)$ and directly associated words $A(w_v)$ would be greater than the percentage of overlap between the interpretation and indirectly associated words $A(S)$.

Our indirect categorization view therefore predicts that, regardless of metaphor aptness and vehicle conventionality, the interpretation of predicative metaphors has greater overlap with indirectly associated words $A(S)$. On the other hand, Glucksberg’s categorization view predicts that, regardless of vehicle conventionality, the interpretation of predicative metaphors (in particular apt metaphors) has greater overlap with directly associated words $A(w_v)$.1

Method

Participants. Eighty-eight people (78 undergraduate and graduate students and 10 working persons) participated as volunteers. All participants were native speakers of Japanese.

Materials. Forty Japanese predicative metaphors were used for the experiment. (See the appendix for the 40 predicative metaphors.) These metaphors were selected from 80 metaphors in a pilot study.

Pilot study. For a pilot study, we used 80 Japanese predicative metaphors. They included 20 intransitive verbs (e.g., go moldy [kabiru in Japanese],2 or echo [hibiku in Japanese]) and each verb was paired with four abstract nouns (e.g., “Technology goes moldy” [“Gijutsu ga kabiru”], “One’s fame echoes” [“Meisei ga hibiku”]).3 In order to eliminate the possibility that the target sentences were interpreted as personification metaphors, in which the subject of the sentence, rather than the verb, was used metaphorically, we did not use verbs that literally refer to human actions or experiences.

In this pilot study, we collected the aptness and conventionality ratings to select 40 metaphors used in the main study. Because the conventionality rating task requires the salient meaning of predicative metaphors, the pilot study was conducted separately in two parts. In the first part of the pilot study, 50 participants were assigned 40 metaphors such that each metaphor was assigned to 25 participants. They were asked to write down at least three interpretations of each metaphor and to rate the aptness of the metaphor on a 7-point scale (1 = not at all apt, 7 = extremely apt). A list of generated interpretations for each metaphor was used as a set $I(M)$. In the second part, 15 participants were given a list of verbs used in the 80 metaphors with the most salient meaning of the metaphors. The most salient meaning was determined to be the word or phrase listed by the largest number of participants in the first part of the pilot study. They

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1The prediction about the relation between metaphor aptness and direct categorization is based on the findings on nominal metaphors that metaphor aptness facilitates the process of categorization (Glucksberg & Haught, 2006; Jones & Estes, 2006).

2Note that the original Japanese verb “kabiru” is a verb, although its English translation “go moldy” is a verb phrase.

3The combination of abstract nouns and specific verbs was found to be more metaphorical than other combinations (Torreano et al., 2005). This finding indicates that the predicative metaphors used in the experiment are appropriate for our purposes.
were asked to rate how conventional each meaning was as an alternative sense of the verb on a 7-point scale of 1 (very novel) to 7 (very conventional). For example, because the meaning being obsolete was listed by the largest number of participants for “Technology goes moldy,” the participants of the conventionality rating task were asked the following question: “When we say that something (X) goes moldy, how conventional is the interpretation that something (X) is obsolete?”

After the pilot study, we chose 40 metaphors for the main study in the following way. First, we calculated the mean aptness rating and the mean conventionality rating for each metaphor. We then classified the 80 metaphors into four groups—conventional and high apt, conventional and low apt, novel and high apt, and novel and low apt—according to whether the mean aptness or conventionality for each metaphor was more than the midpoint 4. Finally, we chose 10 metaphors from each group such that metaphors in the same group had as different verbs as possible and their variance of aptness and conventionality was as low as possible.

Procedure. In the experiment, we collected words or phrases associated directly or indirectly with the verb. The experiment was conducted separately in two parts because direct verb associates \( A(w_v) \) were required for substituted sentences, from which indirect verb associates \( A(S) \) were collected, as shown in Figure 3.

In the first part of the experiment, 12 participants were assigned all 16 verbs which were used in the 40 chosen metaphors, and asked to list at least two words or phrases that they associated with each verb. A list of generated words for each verb was used as a set \( A(w_v) \) of direct verb associates.

The second part was performed by other 11 participants. They were assigned 40 substituted sentences and asked to list at least two words or phrases that they thought were involved in the interpretation of substituted sentences. A list of generated words for the substituted sentences was used as a set \( A(S) \) of indirect verb associates. Substituted sentences were generated by substituting three words in \( A(w_v) \) listed by the largest number of participants for the verb \( w_v \) of the metaphor.

For example, when three words dirty (kitanai), cheese (chizu), and get old (furuku-naru) were listed by the largest number of participants for a verb go moldy, the substituted sentence of a predicative metaphor “Technology goes moldy” was “Technology is dirty,” “Technology is cheese,” and “Technology gets old.”

After the experiment, we generated three sets of words for each metaphor, namely \( I(M) \), \( A(w_v) \), and \( A(S) \) in the following way. First, closely related words or phrases were accepted as the same word if they belonged to the same deeper category of a Japanese thesaurus. After that, any word that was mentioned by only one participant was eliminated from the set of words.

Results and Discussion

As shown in Figure 3, in order to assess the degree of overlap between the metaphorical interpretation and the direct or indirect verb associates, we calculated the direct concordance rate \( CR_{dir} \) and the indirect concordance rate \( CR_{ind} \) for each metaphor \( M \):

\[
CR_{dir} = \frac{\sum_{x \in I(M) \cap A(w_v)} n_I(x) + n_A(x)}{\sum_{x \in I(M)} n_I(x) + \sum_{x \in A(w_v)} n_A(x)}
\]
where \( n^I (x), n^A (x) \) and \( n^S (x) \) respectively denote the number of participants who listed a word \( x \) as a metaphorical interpretation, a verb associate, and an associate of the substituted sentences. (The numbers in parentheses in Figure 3 denote these values.) The direct concordance rate \( CR_{dir} \) defined by Equation 1 evaluates the degree of overlap between metaphorical interpretation and direct verb association, while the indirect concordance rate \( CR_{ind} \) defined by Equation 2 evaluates the degree of overlap between metaphorical interpretation and indirect association. For example, the direct concordance rate of the example shown in Figure 3 is calculated as

\[
CR_{dir} = \frac{(4 + 3)}{((10 + 4 + 3 + 2) + (5 + 3 + 3 + 2))} = \frac{7}{32} = 0.219
\]

and the indirect concordance rate is calculated as

\[
CR_{ind} = \frac{(10 + 2) + (3 + 2) + (2 + 4)}{((10 + 4 + 3 + 2) + (4 + 2 + 2 + 2))} = \frac{23}{29} = 0.793.
\]

Table 1 shows the mean concordance rates for direct and indirect categorization. Overall, as shown in the last row of Table 1, the mean indirect concordance rate \( CR_{ind} = .380 \) across the 40 metaphors was higher than the mean direct concordance rate \( CR_{dir} = .189 \). This result is consistent with our indirect categorization theory and inconsistent with Glucksberg’s categorization theory.

To confirm this difference statistically, we conducted a three-way ANOVA of Categorization (direct or indirect) × Conventionality (conventional or novel) × Aptness (high or low). In the analysis, the data were analyzed only by items (\( F_i \)) because the concordance rates could not be calculated for each participant. The factor of Categorization was within items and other two factors were between items. The predicted difference between the direct and indirect concordance rates was confirmed; the main effect of Categorization was significant, \( F_i (1, 36) = 22.19, p < .001 \). None of the other main effects and interactions were significant. These results support the indirect categorization theory and indicate that predicative metaphor comprehension is not affected by metaphor aptness and conventionality.

**TABLE 1**

Means (\( M \)) and Standard Deviations (\( SD \)) of Concordance Rates between Metaphor Interpretation and Direct or Indirect Verb Associates

<table>
<thead>
<tr>
<th>Metaphor Group</th>
<th>( CR_{dir} ) (Direct)</th>
<th>( M )</th>
<th>( SD )</th>
<th>( CR_{ind} ) (Indirect)</th>
<th>( M )</th>
<th>( SD )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional, High-apt</td>
<td>.256</td>
<td>.202</td>
<td>.391</td>
<td>.279</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional, Low-apt</td>
<td>.172</td>
<td>.135</td>
<td>.408</td>
<td>.318</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel, High-apt</td>
<td>.201</td>
<td>.171</td>
<td>.354</td>
<td>.240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel, Low-apt</td>
<td>.125</td>
<td>.103</td>
<td>.368</td>
<td>.167</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>.189</td>
<td>.159</td>
<td>.380</td>
<td>.248</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXPERIMENT 2

In Experiment 2, we tested the indirect categorization view using a priming paradigm, in which a metaphorical sentence was presented first and the task was to make a lexical decision about a target word presented after the metaphorical sentence. The target conditions were a word related to the metaphorical meaning, metaphor target (MT); a word directly associated with the verb, direct associate target (DAT); a word associated with the substituted sentence, indirect associate target (IAT); and a control target (CNT) unrelated to the metaphor.

Faster lexical decisions in comparison with the CNT indicate line activation. If predicative metaphors are comprehended by the direct categorization process, the DAT would be faster to make a lexical decision than the CNT, but the IAT would not be faster. Hence, Glucksberg’s categorization theory predicts facilitation of the DAT and no facilitation of the IAT. On the other hand, if predicative metaphors are comprehended by the indirect categorization process, the IAT would be faster than the CNT. Hence, our indirect categorization theory predicts facilitation of the IAT. The DAT may also be activated, but to a lesser degree than the IAT. Concerning the MT, both theories predict facilitation of the MT.

Method

Participants. Forty-five undergraduate and graduate students participated as volunteers. All participants were native speakers of Japanese.

Materials. The 39 predicative metaphors used in Experiment 1 were employed as prime sentences. One metaphor “An effect is crushed.” (“Kouka ga tsubureru”) was excluded from Experiment 2 because no indirectly associated words could be selected as IAT according to the target selection procedure mentioned below. The other 40 metaphors that were not selected in the pilot study of Experiment 1 were used as filler sentences for nonword targets.

For each prime metaphor, the MT, DAT, and IAT were selected from among the set of metaphorical interpretations I(M), the set of direct verb associates A(wv), and the set of indirect verb associates A(S) respectively. For an MT, we selected the word in I(M) that was listed by the largest number of participants. For a DAT and an IAT, we selected the word that was listed by the largest number of participants in A(wv) or A(S), excluding the MT word. The CNT was selected randomly from a dictionary such that it was not related to the metaphor. For example, the metaphor “Technology goes moldy” was combined with obsolete (furuku-naru) as the MT, dirty (kitanai) as the DAT, get worse (waruku-naru) as the IDT, or vanish (toozakaru) as the CNT.

Procedure. A within-participants design was used with each participant comprehending all the 79 metaphors under all conditions. Participants, who were run individually, were seated in front of a computer screen. They were first given an overall instruction of the experiment and then presented with six practice trials followed by the 79 experimental trials presented in a random order. On each trial, they were presented with a predicative metaphor as a prime in the center of the screen for 3000 ms and asked to interpret the metaphor. A target word (MT, DAT, IAT, CNT, or nonword) was then presented 500 ms after the offset of the predicative metaphor. Participants were asked to decide whether the target word was a word or a nonword as quickly as possible;
they indicated decision by pressing the appropriate key on the keyboard. Reaction times were measured from the onset of the target word until the appropriate key was pressed.

**Results and Discussion**

A total of seven participants were eliminated from the analysis because they did not reach the decision error criterion of 90% correct. Only reaction times of correct decision were used in the analysis. Following metaphor priming research (Blasko & Connine, 1993), reaction times greater than 1750ms were eliminated from the analysis. This elimination caused the further elimination of two participants’ data because the data of some conditions were missing.

Table 2 shows mean lexical decision times and standard deviations for the correct “yes” responses. The time difference (DIF) from the CNT indicates the extent of the priming effect. Although the pattern of DIF differs depending on conventionality and aptness, the overall result was that the IAT produced the greatest priming effect (42.8 ms faster than the CNT), but the DAT showed the smallest priming effect (only 14.6 ms faster). The MT showed a moderate priming effect (19.8 ms faster). This result is consistent with the indirect categorization theory and inconsistent with the direct categorization theory.

A three-way ANOVA of Target (MT, DAT, IAT, or CNT) × Conventionality (conventional or novel) × Aptness (high or low) was conducted on lexical decision times. In the analysis, the data were analyzed by participants (F_p) and by items (F_i). The factor of Target was within participants and within items, while other two factors were within participants and between items. The main effect of Target was significant by the participant analysis, F_p(3, 105) = 2.79, p < .05, although it was not significant by the item analysis, F_i(3, 105) = 1.35, p = .26. Post-hoc pairwise comparisons (p < .05) revealed that the IAT (M = 800.3 ms) was significantly faster than the CNT (M = 843.1 ms); this indicates a significant activation of indirectly associated meanings during metaphor comprehension. In addition, the difference between the IAT and the DAT (M = 828.5 ms) was marginally significant (p = .06). Again, the result is consistent with the indirect categorization theory but inconsistent with the direct categorization theory; predicative metaphors are understood via the indirect categorization process, in which constructing the correspondence between the actions or events literally expressed by the verb and those expressed metaphorically is mediated by intermediate entities. A little surprisingly, the priming effect of the MT was not statistically significant.

In addition, the main effect of conventionality was significant, F_p(1, 35) = 7.04, p < .05; F_i(1, 35) = 5.28, p < .05. Mean decision times to all targets were shorter for conventional metaphor primes (M = 808.3 ms) than for novel metaphor primes (M = 839.2 ms). On the other hand, the main effect of aptness was not significant, and no significant interactions were observed.

These results suggest that vehicle conventionality facilitates comprehension of predicative metaphors, but the comprehension process remains unchanged.

**GENERAL DISCUSSION**

The offline comprehension experiment (Experiment 1) demonstrated that interpretation of predicative metaphors had greater overlap with words indirectly associated with the verb than those directly evoked from the verb. The online priming experiment (Experiment 2) demonstrated that
<table>
<thead>
<tr>
<th>Metaphor Type</th>
<th>MT (Metaphor)</th>
<th>DAT (Direct Associate)</th>
<th>IAT (Indirect Associate)</th>
<th>CNT (Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>DIF</td>
<td>M</td>
</tr>
<tr>
<td>Conventional, High-apt</td>
<td>799.3</td>
<td>210.2</td>
<td>50.1</td>
<td>781.6</td>
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<tr>
<td>Conventional, Low-apt</td>
<td>818.9</td>
<td>235.2</td>
<td>-14.2</td>
<td>840.2</td>
</tr>
<tr>
<td>Novel, High-apt</td>
<td>864.1</td>
<td>203.2</td>
<td>10.4</td>
<td>859.7</td>
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<tr>
<td>Novel, Low-apt</td>
<td>810.7</td>
<td>233.8</td>
<td>31.9</td>
<td>832.4</td>
</tr>
<tr>
<td>All</td>
<td>823.3</td>
<td>181.7</td>
<td>19.8</td>
<td>828.5</td>
</tr>
</tbody>
</table>

*Note. DIF = difference from control target.*
indirectly associated words were activated during predicative metaphor comprehension, while directly associated words were not activated. These findings provide some support in favor of the proposed view that predicative metaphors are understood as indirect categorizations. These experiments also showed that metaphor aptness and vehicle conventionality had no significant influence on the results, suggesting that the same mechanism (i.e., indirect categorization) governs the comprehension of predicative metaphors regardless of these metaphor properties.

As we mentioned previously, the most important issue concerns the intermediate entity involved in the indirect categorization process. We provide two possible answers, namely abstract actions obtained by abstracting the verb, and things that typically perform or undergo the action literally referred to by the verb. The experiments reported in this article could not reveal what are involved in the intermediate step, but we point out that entities that typically perform or undergo the verb’s action are really involved in predicative metaphor comprehension. For example, consider the following metaphorical sentence.

“Float like a butterfly, sting like a bee.”

These are the words of Muhammad Ali, a famous American boxer who won World Heavyweight Champion three times. This sentence is a predicative metaphor that expresses Ali’s boxing style describing his swift footwork as *to float* and his lightning-quick punch as *to sting*. These metaphorical meanings are not likely to be evoked directly by these verbs. For example, it is difficult to imagine that the action of moving to evade a punch is derived through the abstraction of the verb *float*. Furthermore this metaphor also conveys a kind of gorgeousness and sharpness in his behavior, which cannot be derived solely from the verbs. It is more likely that such the interpretation would be derived when people call to mind “things that float” and “things that sting” as an intermediate entity, and in the case of this metaphor they are verbalized in the simile form such as “like a butterfly” and “like a bee.” Simile phrases such as these are often attached to predicative metaphors (e.g., “Time flies like an arrow”). These examples suggest that predicative metaphors are comprehended on the basis of prototypical entities that perform or undergo the action literally expressed by the verb.

The importance of objects typically having the property expressed by the predicate in comprehending predicative metaphors is made clearer when we consider adjective metaphors such as “The taste is red” or “red taste,” which involve the metaphorical use of adjective or modifier. Because the semantic structure of adjectives is not at all hierarchical (Miller, 1998), it is impossible to imagine that, according to the direct categorization view, adjectives evoke a superordinate or abstract category of property. We have therefore argued that the indirect categorization theory explains adjective metaphor comprehension (Utsumi & Sakamoto, 2007). According to the indirect categorization theory, the adjective metaphor “red taste” is comprehended so that properties referred to metaphorically are created only from objects typically characterized by the adjective red. Specifically, the adjective red first evokes an intermediate category “red things” to which chili pepper, cherry, blood, and fire typically belong. Then exemplars relevant to the target “taste” such as chili and cherry are selected and they evoke a final abstract category of properties spicy, hot and tart. We have provided some empirical evidence of involvement of intermediate objects in comprehending adjective metaphors; Nakamura, Sakamoto, and Utsumi (2010) empirically found that a significantly large number of metaphorical meanings listed for adjective metaphors were derived from scenes or events that were relevant to both the adjective (e.g., red) and the topic (e.g., taste). This finding suggests that, when comprehending adjective
metaphors, people may imagine a specific scene that includes an object typically characterized by the adjective (e.g., red objects).

Research on fictive motion (e.g., Matlock, 2004; Matlock, Ramscar, & Boroditsky, 2005) is also related to our study because a fictive motion sentence, which involves the metaphorical use of a motion verb such as “The road goes through the desert,” is a kind of predicative metaphor. A number of studies on fictive motion have demonstrated that when trying to understand fictive motion sentences people simulate motion or visual scanning although these sentences express no explicit motion (Matlock, 2004; Richardson & Matlock, 2007) and such the mental simulation of motion influences thought about time (Matlock et al., 2005). The mentally simulated motion is so concrete that its effects on thought about time vary according to the amount and direction of motion (Ramscar, Matlock, & Boroditsky, 2010). These findings are consistent with our indirect categorization view. Mental simulation of motion implies an imaginary scene that includes concrete motion and mobile entities. These entities can be regarded as intermediate entities evoked in the indirect categorization process. On the other hand, these findings appear incompatible with Glucksberg’s categorization theory because simply evoking a superordinate category from a motion verb may not be able to invite such the mental simulation.

To conclude, the findings reported in this article suggest that predicative metaphors are understood as indirect categorizations. People understand predicative metaphors differently from nominal metaphors; they understand predicative metaphors via the multi-stage process of categorization, not by the simple abstraction of the verb. It would be vital for future research to explore in more detail the internal process of indirect categorization when predicative metaphors are comprehended.

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REFERENCES

APPENDIX : PREDICATIVE METAPHORS USED IN EXPERIMENTS 1 AND 2

<table>
<thead>
<tr>
<th>Conventional, High-apt</th>
</tr>
</thead>
<tbody>
<tr>
<td>A difference echoes. (Sa ga hibiku.)</td>
</tr>
<tr>
<td>One’s personality twists. (Seikaku ga nejireru.)</td>
</tr>
<tr>
<td>An opportunity is crushed. (Kikai ga tsubureru.)</td>
</tr>
<tr>
<td>The country gets wet. (Kuni ga uruou.)</td>
</tr>
<tr>
<td>One’s existence floats. (Sonzai ga uku.)</td>
</tr>
<tr>
<td>Love burns. (Ai ga moeru.)</td>
</tr>
<tr>
<td>One’s motion freezes. (Dousa ga kooru.)</td>
</tr>
<tr>
<td>One’s power is shaded. (Chikara ga kageru.)</td>
</tr>
<tr>
<td>The meaning fades. (Imi ga aseru.)</td>
</tr>
<tr>
<td>Technology goes moldy. (Gijutsu ga kabiru.)</td>
</tr>
</tbody>
</table>
Conventional, Low-apt

A rumor echoes. (Uwasa ga hibiku.)
Sound twists. (Oto ga nejireru.)
An effect is crushed. (Kouka ga tsubureru.)
Impatience burns. (Aseri ga moeru.)
An image freezes. (Imeji ga kooru.)
One’s hate is shaded. (Zouo ga kageru.)
A taste goes moldy. (Aji ga kabiru.)
Progress stagnates. (Shinpo ga yodomu.)
A show goes rotten. (Shibai ga kusaru.)
An idea flows. (Shisou ga nagareru.)

Novel, High-apt

One’s fame echoes. (Meisei ga hibiku.)
An expression twists. (Hyogen ga nejireru.)
Sound floats. (Koe ga uku.)
Misunderstandings are buried. (Gokai ga umaru.)
Prices loosen. (Bukka ga yurumu.)
Memory stagnates. (Kioku ga yodomu.)
Human civilization creaks. (Bunmei ga kishimu.)
Unity creaks. (Danketsu ga kishimu.)
One’s honor goes rotten. (Meiyo ga kusaru.)
One’s body flows. (Shintai ga nagareru.)

Novel, Low-apt

Complaints echo. (Monku ga hibiku.)
Justice twists. (Seigi ga nejireru.)
Sound gets wet. (Oto ga uruou.)
Fear burns. (Kyofu ga moeru.)
Anger freezes. (Ikari ga kooru.)
Difficulties fade. (Konnan ga aseru.)
A promise goes moldy. (Yakusoku ga kabiru.)
One’s charm is buried. (Miryoku ga umaru.)
One’s status loosens. (Chii ga yurumu.)
An influence stagnates. (Eikyou ga yodomu.)