Making Metaphors: A Quantitative Analysis of Metaphor Production and Interpretation in Japanese Using a Multimodal Task

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Abstract

Two key features of Conceptual Metaphor Theory are that metaphors appear in multiple modes of communication from language to gestures to pictures and that metaphors scaffold our understanding of abstract concepts by grounding them in embodied, physically experienced concepts. In an exploratory study, we investigated metaphor production and interpretation using cross modal stimuli (verbal and pictorial). Native Japanese participants viewed an abstract word in the textual mode, in the form of an incomplete copula metaphor (Friendship is ...), and then saw six images of concrete entities (castle, heater, colored pencils, etc.). They chose one of these image concepts to complete the copula metaphor and then provided an interpretation of it. In this paper, we first analyze these choice selections using descriptive statistics. Results indicate that there is a wide amount of variability among these selected responses. Secondly, we analyze the interpretations, which use (1) external or systemic properties of the pictorial entity; (2) situational functions or actions performed on the entity; or (3) some form of introspection related to the entity.

1 Introduction

Metaphor describes one thing (often referred to as the topic) in terms of another (the source or vehicle), as in "Hope is the thing with feathers" (from a poem by Emily Dickinson). In this case, "hope" is the topic and in this sentence it's correlated to the source, "the thing with feathers", which one might presume to be a bird. This is considered a nominal metaphor (e.g., X <copula> Y), consisting of two parts, the topic, which tends to be more abstract, and the source, which tends to be a physical or concrete entity. This combinatorial ability is paramount for communication and is widespread in everyday language use, not just in poetry. Moreover, metaphor is not only used for verbal communication, but also nonverbal communication through gestures (Cienki and Müller, 2008), pictures (Forceville and Urios-Aparisi, 2009) and music (Zbikowski, 2008). Under this perspective, metaphor is viewed as being only derivatively part of language and in fact, conceptual in nature (commonly referred to as, Conceptual Metaphor Theory; see Lakoff, 1987; Lakoff and Turner, 1980).

In this paper, we first provide some theoretical background on the differing processes of concrete and abstract concepts, focusing initially on Dual Coding Model and then on embodied theories of cognition. Specifically, our review addresses abstract concepts and the role of metaphor, affect, and language. Finally, we argue for an approach to abstract metaphor construction as a dynamic process that highlights the fluidity, flexibility, and variability of concepts. Then we discuss a unique exploratory study that utilized both verbal and pictorial stimuli for a metaphor production and interpretation task. Moreover, we investigate the chosen sources by the participants to complete the

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metaphors and what semantic features they used to interpret them. This study thus sheds light on the tight combinatorial and entrenched networks between some concepts, as well as the ad hoc process to interpret newly formed and unfamiliar combinations.

2 Constructing Meaning: The Dual Coding Model

The Dual Coding Model (Paivio, 1971, 2007) claims that word meanings are represented in two different systems – one for nonverbal codes called "imagens" and the other for verbal codes called "logogens". The nonverbal system relies on multimodal representations (tactile, visual, olfactory) of the concepts while the verbal system is based on a linguistic system of knowledge for the concept and associative networks (curiosity – wandering). According to this theory, concrete concepts recruit equally from both imagery and verbal processes, but for abstract language, verbal processes predominate (Paivio, 2007). Therefore, concrete concepts have an advantage since they receive dual-content, which has been called a *concreteness effect,* or the effect that we tend to process concrete words faster and remember them better than abstract words. This model highlighted the importance of sensorimotor systems for processing concrete concepts, but on the other hand, claimed that abstract concepts are purely part of the verbal system. This model foreshadowed a growing movement within the cognitive sciences towards a greater awareness of the body for meaning construction.

3 Embodied Theories of Meaning Construction

Over the past couple decades, the field of cognitive science has gone through a major paradigm shift from the traditional computational theory of mental processes, as algorithmic operations on abstract symbols, to one where concepts, objects, or events are grounded in sensorimotor, perceptual and emotional systems, commonly referred to as embodied cognition (Barsalou, 2008; Gibbs, 2005; Pecher and Zwaan, 2005). As opposed to earlier amodal or disembodied perspectives, an embodied perspective views meaning to be grounded in knowledge of action and objects. In an early theoretical approach to embodiment, Barsalou (1999, 2017) proposed that when processing a word like *guitar*, aggregated information from perception, action, and internal states are recruited, which results in a simulation of that object. This may include the shape, texture, sound, how it's played, and past interactions with it. These simulations or reactivated perceptual input provide linguistic meaning to the concept. Barsalou (1999) labeled this theory as perceptual symbol systems.

Studies using fMRI provided evidence for embodiment by showing that when one reads action verbs (e.g., *lick, pick, or kick*) corresponding to certain body parts (e.g., *face, arms, legs* respectively), adjacent or overlapping areas were activated in the motor and premotor cortex for that action (Hauk, Johnsrude, and Pulvermüller. 2004). In another study, Buccino et al. (2005) also found similar results. In their study, they found that when participants listened to verbal language corresponding to a body part (foot/leg; hand/arm), this modulated the activity of the motor system for the effector involved in that listening activity. Such results suggest that action verbs are coded into the same premotor and motor cortices used when one actually performs the action (for a review of the role of the motor system in language comprehension see Fischer and Zwaan, 2008). Evidence goes beyond action words to include the sensory modes. For instance, odor-related words (e.g., cinnamon) have been shown to elicit increased activity in olfactory regions compared to neutral words (Gonzalez et al., 2006). In sum, there is a considerable amount of accumulating evidence that supports an embodied view for language comprehension, especially in regards to concrete concepts.

However, a common criticism of embodied theories is that they have difficulty in explaining abstract concepts (since they are commonly viewed as not deriving from sensorimotor or perceptual content) and the creation of novel concepts that also lack an experiential basis (Borghi et al., 2017; Dove, 2011). In the next section, we review two possible explanations for abstract concepts: (1) they are grounded in metaphors, which has been called a strong version of embodiment (Meteyard et al., 2012), and (2) abstract concepts are both linguistic and embodied (Dove, 2009, 2011; Vigliocco et al., 2009) and are grounded in emotional and interoceptive states (Kousta et al.,

2011), as well as events and situations (Barsalou and Wiemer-Hastings, 2005).

3.1 A Strong Version: Metaphor as a Bridge

A strong version of embodied cognition argues that not only concrete concepts rely on sensorimotor simulation, but abstracts concepts, too (Gallese and Lakoff, 2005, Gibbs, 2006) and metaphors act as a "bridge" between embodiment and abstraction (Jamrozik et al., 2016).

Grady (1997) theorized that some associations between topic and source are so deeply entrenched, common, and found across multiple languages that he called them primary metaphors (e.g., DIFFICULTY IS HEAVY; POWER IS UP; INTIMACY IS CLOSENESS). So, the physical concepts, which are experienced through the sensorimotor systems (i.e., heaviness), map in a unitary direction onto non-sensory abstract concepts (i.e., difficulty). Lakoff and Johnson (1999) suggest that these types of metaphor are obligatorily learned during cognitive development. For instance, for AFFECTION IS WARMTH, the child conflates the affection of the caregiver with the sensation of bodily warmth. Thus, affection, as an abstract psychological feeling, becomes fused with the sensory bodily experience of warmth. These experientially motivated primary metaphors are widespread and have been shown to take place at the conceptual level. For instance, a situation of difficulty may include some type of burden like harboring a secret. Slepian et al. (2012) found that when people recalled or suppressed an important secret like infidelity, they estimated hills to be steeper and distances to be farther. The researchers interpreted this as evidence showing that harboring a secret physically weighs people down and thus influences their perception.

This co-activation of the topic-source concepts is automatic and unconscious. Accordingly, when one thinks of a difficult situation or an intimate relationship, one also conceptualizes a physical weight or spatial closeness respectively. Yet these sources may map onto multiple and varying abstract concepts. For instance, weight is also mapped onto importance due to repeated experiences with heavy objects, which require more effort, in terms of physical strength or cognitive planning, as compared with lighter objects (Jostmann, Lakens, and Shubert, 2009).

There is also empirical support in the field of neuroscience for the metaphor as a "bridge" view. For instance, in an fMRI study that specifically examined the grounding of metaphor in sensorimotor systems found that textural metaphors (e.g., *she had a rough day*) activated texture-selective somatosensory cortex, compared to literal matched sentences (e.g., *she had a bad day*) (Lacey, Stilla, and Sathian, 2012). Despite this widespread support for the metaphor view for explaining abstract word meaning comprehension (e.g., Jamrozik et al., 2016), its explanatory power is limited to abstract concepts that have clear sources (e.g., bad – rough; burden – weight; intimacy – closeness), which are numerous, but not exhaustive of all abstract concepts.

3.2 Abstract Knowledge Grounded in Affect, Events, and Situations

In a weaker version of embodied cognition, Vigliocco et al. (2009) proposed that experiential (sensorimotor and affective), as well as linguistic (verbal, associative networks) information contribute to the representation of all concepts. In this view, concrete word meanings have preponderance for experiential information, but abstract ones for affective and linguistic information. This emphasizes the importance of emotion for abstract meaning construction and how abstract words also have an experiential basis, but also how emotion allows for "learning, or bootstrapping, of abstract knowledge" (Meteyard et al., 2012 p. 800).

Another approach that falls under a weaker version of embodied cognition proposes that abstract concepts are fundamentally different from concrete ones for they simulate concrete situations and introspective experiences (Barsalou and Wiemer-Hastings, 2005). More specifically concrete concepts have a focus object (e.g., guitar), but abstract ones are more diffuse, are used in a wider variety of contexts, and are more complex. Developing this model, Barsalou et al. (2008) proposed what they called LASS or Language And Situated Simulation framework, which claims that linguistic and situated simulations are continuously interacting with each other. The linguistic is involved with more superficial processing of word meanings whereas deeper processing involves sensorimotor simulations.

In sum, abstract concepts are highly heterogeneous. Some abstract concepts may recruit entrenched metaphorical mappings onto concrete concepts while others have high affective associations and still others activate a scene that simulates one to mentally run a situation.

4 Dynamic Concepts: Flexibility, Fluidity, and Variability

Another important issue for metaphor production research is the flexibility of concepts. There is growing evidence suggesting that the architecture of the semantic system is experientially based (or at least partially for abstract concepts, as presented in the previous section) and moreover variable across timescales and contexts, as well as individual processing preferences and abilities (Yee and Thompson-Schill, 2016). That is to say, concepts don't necessarily have conceptual cores nor are they static. Variability is far more common than often assumed and even entrenched features of concepts are not always automatically activated (Lebois, Wilson-Mendenhall, and Barsalou 2015). In addition, Yee et al. (2016) argue that there is never a "no context" or "neutral context" situation for even the goal of the task can influence conceptual activation. This approach aims to move away from seeing *concepts* in the head, as static objects, to an an approach that emphasizes the dynamic process of making meaning by way of *conceptualizing*, as an active process (Casasanto and Lupyan, 2015).

Reconstructing the meaning of words is highly modulated by the individual's personal experiences with such words. This is especially the case with abstract nouns since they span a wide range of contexts and thus subjective experiences are crucial for their representations (Wiemer-Hastings and Xu, 2005). Some researchers even contend based on the dynamic influences of numerous variables such as the body, the environment, past experiences, and relevant goals that you can never represent the same concept twice (Connell and Lynott, 2014).

5 Overview of the Study

In this current study, we aim to investigate whether or not some abstract concepts (LOVE, ANGER), are more commonly combined with some physical and concrete source concepts and if this shows up across a large group of individuals. The other possibility is that topic/source combinations vary widely when individuals are confronted with a decision task like a metaphor completion task. For instance, when asked to think about the concept of LOVE, one likely activates long-term memory and recent experiences with this abstract concept. This may include people, such as family (house) or the performance of lovers (masks). For others, this abstract concept might simply evoke an explosive emotion. Still for others, they might consider LOVE as requiring time to grow (forest) or in contrast leading to entrapment (spider web). The point here is that when primed to complete a metaphor for this abstract concept from a set of six corresponding possible sources, which are presented in the pictorial mode, these concurrent contextual cues from the images activate certain features of LOVE. If the two concepts were indeed fused by an entrenched metaphorical mapping, one would assume based on the participants desire to reduce the cognitive load of the task, this entrenched source would be frequently selected to complete the metaphor.

5.1 Research Questions

1. Do subjects show any preference for certain source stimuli to complete the metaphors?
2. What selected features or properties of the selected source concepts do the subjects use to interpret the metaphors?

6 Method

6.1 Participants

97 native Japanese speakers took part in this study (36 female, M_{age} = 20, SD_{age} = 1.07). Participants were recruited from 1st year Liberal Arts courses at the university.

6.2 Material

The material developed for this study consisted of two parts: a list of abstract concepts (metaphor topics) and six corresponding images (potential sources to complete the metaphor). In total, there were 20 abstract concepts used in this study, collated from a list of common and familiar abstract nouns, as well as previous research that have similarly used abstract topics as a prompt for a copula metaphor production task (see Shibata et

al., 2007; Terai et al., 2015) (e.g., 好奇心, kōkishin 'CURIOSITY'; see Appendix A for the full list),. Each abstract noun (e.g., 友情 yūjō 'FRIENDSHIP') had a unique set of six corresponding images that represented concrete physical entities (e.g., space heater, castle, colored pencils, etc.). These images were selected as having potential semantic features that could be mapped onto the topic (e.g., warmth, protection, variety). In addition, we had conducted a previous study with these images where we interviewed participants afterwards about the images and subsequently removed ones, they had deemed confusing or difficult to understand. One strategy for compiling these sets of images for each abstract topic was to do a search for the abstract word on Google and then look at images that appeared in this list. We also aimed at using pictures that were simplistic and had only one primary entity visible in the image. The material was inputted into a Google Form.

6.3 Procedure

Students individually sat at computers in a language lab. First, they signed a consent form that explained the purpose of the study and then opened up the Google Form and saw an example that explained the steps to complete the metaphor task. Specifically, the participant first saw an abstract topic concept in the format of an incomplete metaphor in the textual mode (愛情・・・だ *aijō* ... da 'LOVE IS ...') and then six corresponding images (see Figure 1). Beneath the images, there was an input box where they completed the metaphor by choosing one of the images as the source and then there was a second input box where they provided an interpretation of it. They did this for each of the 20 abstract concept/image sets.

Figure 1: The 6 images to complete the metaphor for 愛情 *aijō* 'LOVE'

7 Results and Discussion

The first step in analyzing the data involved a descriptive analysis for the source selections for each of the topics (see Table 1). The distribution of selected sources across all six images highlights the flexibility of conceptual combination and the possibility of fusing an abstract concept to numerous physical entities. For instance, one would presume under a conceptual metaphor model that FRIENDSHIP (as an abstract concept closely related to intimacy) would activate the physical sensation of "warmth", which is a salient feature of a heater, but this was one of the lower selected sources by the respondents.

TOPIC	% of Selected SOURCES (Images)		
FRIENDSHIP 友情 *yūjō*	*Colored Pencils* 26%	*Medicine* 22%	*Battery* 16%
	Shoes 15%	*Heater* 8%	*Castle* 7%
LOVE 愛情 *aijō*	*Masks* 22%	*Forest* 10%	*House* 20%
	Spider Web 16%	*Explosion* 24%	*Suitcase* 3%
ANXIETY 不安 *fuan*	*Storm* 33%	*Tangled knot* 32%	*Crutches* 12%
	Cliff 11%	*Hotpot* 8%	*Blender* 0%
CURIOSITY 好奇心 *kōkishin*	*Dandelion* 29%	*Lighter* 24 %	*Map* 21%
	Paintbrush 11%	*Grass* 6 %	*Forest Path* 2 %
EDUCATION 教育 *kyōiku*	*Opened Door* 26%	*Key* 29%	*Globe* 8%
	Construction 14%	*Hammer* 2%	*Dumbbell* 18%

Table 1: Five TOPICS and corresponding selected SOURCES (see Appendix A for the full list)

This variability was widespread and occurred in 16 of the 20 topics where no one source accounted for more than 40% of the responses. So, in answer to our first research question, only 20% of the topics appear to elicit a preferential source. These topics likely have strong associative connections to these concrete concepts (MIND – *sponge*), as they appeared across a large population of participants.

TOPIC	% of Selected SOURCES (Images)		
HOPE 希望 *kibō*	*Rainbow* 55%	*Birds* 15%	*Stoplights* 12%
	Stethoscope 5%	*Merry-go-round* 3%	*Leaf* 3%

HONESTY 正直 *shōjiki*	*Sword* 50%	*Straight Road* 20%	*Magnifying Glass* 10%
	Handshake 8%	*Mountaintop* 4%	*Watering Can* 0%
MIND 心 *kokoro*	*Sponge* 46%	*Space* 22%	*Flowering Vase* 14%
	Window 10%	*Computer* 2%	*Rug* 2%
CULTURE 文化 *bunka*	*Tree (roots)* 43%	*Salad* 14 %	*Handcuffs* 14%
	Fence 11%	*Computer Network* 6%	*Pillars* 5%

Table 2: TOPICS with high percentages of single SOURCE selections

Despite one source being heavily weighed in the above four topics, there was still rich diversity among the responses, which shows the idiosyncrasies and emotional valence of these abstract concepts. For instance, CULTURE was widely associated with a *tree*, which has positive meaning, but in contrast, 14% of the respondents chose a source with negative meaning (*handcuffs*).

The second goal of this research was to investigate the semantic features used by the participants to interpret their newly constructed metaphors. In order to do this, we used the coding scheme developed by Wu and Barsalou (2009). Table 2 shows the analysis for the topic, FRIENDSHIP. This topic constrained and provided context to these six images, which forced the participants to look for features that could be used to provide some semantic structure to their newly created metaphors. Through this analysis, we can observe the wide range of conceptual content that is projected from the sources onto this abstract concept. For instance, those who selected *colored pencils* tended to describe FRIENDSHIP as being diverse. This property comes from the systemic property of colored pencils, as in the fact, that these pencils come in many different colors. In contrast, others provided an introspective property of this entity by describing how *colored pencils* enable one to live a more enriching life. That is to say, these *colored pencils* provide one the tools to live a more meaningful life, which likely refers to their intrinsic property for making art. Another commonly chosen source was *medicine*, whereby the participants focused on the healing power of FRIENDSHIP. Moreover, those who chose *battery* focused on how relationships between friends occasionally need to be recharged or can even become dangerous if they are overused. Another salient systemic property of batteries is that they alter between being fully charged and weakly charged and again participants used this feature to map onto the topic and how friendships similarly oscillate in strength and weakness. Unexpectedly, 15% of the participants selected *shoes* to complete the metaphor and the interpretations highlighted many different properties of *shoes* ranging from the physical attribute of *shoes*, such as they come in pairs (the image of two) to relational meaning, as in, *shoes* are used to travel through life with, similar to a FRIENDSHIP. Surprisingly only a small percent chose a *heater* and as expected they interpreted this metaphor by describing how FRIENDSHIP makes one feel warm. Finally, for *castle*, which was least selected source image, participants tended to focus on the systemic property of *castles*, as in being strong and unbreakable. In contrast, other respondents focused on the situation of people working together to build a *castle*, which relates to how FRIENDSHIP is a building process.

TOPIC: FRIENDSHIP IS …	
Image SOURCES	Coding Scheme of Interpretations
1. *Colored Pencils* (26%)	**E_{sys}** variation /diversity **S_F** draw colorful pictures **I_c** colorful pictures *enables* one to live a more enriching life
2. *Medicine* (22%)	**S_F** helps one overcome pain; gives one energy **S_F** possibility of addiction; makes one crazy; possibility of overdoes
3. *Battery* (16%)	**E_{sys}** sometimes weak sometimes strong **I_c** relationship *requires* occasional recharging **I_c** dangerous *if* overused
4. *Shoes* (15%)	**E_{CE}** they come in pairs; not alone **S_F** walk together in life with
5. *Heater* (8%)	**E_{sys}** warmth
6. *Castle* (7%)	**E_{sys}** strength, unbreakable **S_A** takes time to build up, but after it's built one knows all the details **I_R** fun, a remarkable symbol

Table 3: Image SOURCES and interpretations (see Appendix B for the coding scheme)

A second example, CURIOSITY (see Table 4), also illustrates the great diversity of representation of this abstract concept based on the selected sources. For instance, those who selected a *dandelion* considered the situation and how the wind or an agent (such as a friend) performs an action upon this object by blowing it, causing the seeds to spread and eventually fall to the ground and germinate, which results in the budding of a new flower. So, using this source, the participants viewed curiosity as something that takes a long temporal timeframe, as compared to those who chose a *lighter*. Using this source, the participants saw the temporariness of CURIOSITY, as something short-lived like a flickering flame. Moreover, a number of the respondents who selected *lighter* as the source also included the potential danger of this entity (i.e., "curiosity killed the cat"). This did not show up in any of the other selected sources. Also, in contrast to the before mentioned examples, those who selected a *map* focused on the situational function of this object, in that it acts as a guide for one to move through unknown territories. The fourth most commonly selected image was the *paintbrush*. Again, some participants focused on the perceptual property of this entity and viewed CURIOSITY as being colorful. Others recalled some situation of a *paintbrush* and the freedom it provides one to paint as one wants to paint or a more specific situation of one throwing the paints onto the ground in search of a color, which highlights the exploratory nature of CURIOSITY. A few selected the *grass* picture, as the image to complete the metaphor and primarily interpreted this with systemic properties of *grass*. Interestingly of all the entity properties of *grass*, they tended to focus on its strength to grow anywhere, even in difficult places, and its persistence and expansiveness. These interpretations focus on the grittiness of CURIOSITY and how it often requires one to overcome difficulties, which might include resistance from others or society, and its need for commitment and endurance. Again, this contrasts considerably with a *lighter*, which associated CURIOSITY with a certain amount of fleetingness. Finally, a couple participants chose the image source, a *forest path*, and one interpretation pointed out introspectively how CURIOSITY moves you along a path into the future. This closely relates to the conceptual metaphor, LIFE IS A JOURNEY, and CURIOSITY is the trigger that helps you to move forward.

TOPIC: CURIOSITY IS …	
Image SOURCES	Coding Scheme of Interpretations
1. *Dandelion* (29%)	**E_{CE}** seeds > **S_A** a friend (or wind) blows the seeds > **E_B** seeds fall and take root (and flower)
2. *Lighter* (24%)	**E_{sys}** fleetingness **S_F** potentially dangerous
3. *Map* (21%)	**S_F** takes you to places; guides you in the unknown **I_O** maps expand your mind
4. *Paintbrush* (11%)	**E_{CE}** colorful **S_A** freedom to paint; dumping the colors onto the floor **I_R** exciting
5. *Grass* (6%)	**E_{sys}** grows anywhere; expansive; persistent; strong; casually grows; grows in difficult places **S_A** searching for a bug in a grassy place (an unforgettable experience)
6. *Forest Path* (2%)	**E_{sys}** continuous **I_O** moves you along the path towards the future

Table 4: Image SOURCES and interpretations

In summary, to answer our second research question, participants used different techniques to interpret the metaphors. For instance, sometimes they focused on the properties of the entity. This may include external components such as the fact that dandelions have seeds or a systemic property such as the flame of a lighter is a momentary flicker. Another strategy commonly used is to focus on some action property and this often involves simulating some situation related to the entity (as in, a map guides you through the unknown). Finally, some participants used an introspective property of the entity to interpret the metaphor. In this case, they have learned that maps are used for exploring new areas and thus provide a tool for expanding one's knowledge structures and it is then this feature that is mapped onto the topic, CURIOSITY. At the same time, certain salient properties of the entity were not used by the participants like a *map* is made of paper or that a *lighter* is commonly used for cooking or lighting a cigarette or that a *dandelion* is a plant.

8 Conclusion

In this paper, we describe an exploratory study that investigated metaphor production across two different modes (textual, pictorial). Providing the participants with a visual concrete image for the source activated a nonverbal, multimodal code, independent of linguistic content. The participants had to associate an abstract topic with one of these images. The data presented here shows a wide range of selected sources for a majority of the topics, which highlights the flexibility of thought, as well as the looseness of abstract conceptual content. One can view CULTURE as a *tree*, which grows and provides a group of people the roots or structure to live. At the same, another views CULTURE as confining and restrictive and thus associates it with *handcuffs* or a *fence*. This study highlights that when one is presented with an abstract concept and then six images, one does not retrieve static conceptual features, but conceptualizes, which is an active process of meaning making. This is likely dependent on a number of variables, ranging form past knowledge structures to emotions to salient thoughts that exact moment when the subjects were completing the task.

Another important point that this paper raises has to do with automatic activation of conceptual metaphors. To return to one of our examples, FRIENDSHIP, what was most revealing to us is the fact that few participants (8%) selected the heater. Those who did select this source mapped, as expected, the most salient property of a heater, warmth, onto the abstract concept, FRIENDSHIP. For us, we had predicted this source selection would be the strongest since it touches on a very conventional conceptual metaphor, yet this was not the case. This questions whether or not the conceptual structure of such an entrenched metaphor is indeed obligatorily accessed, especially when it crosses over into a different mode (pictorial).

As abstract concepts have been notably difficult to explain from an embodied perspective, future research needs to continue to look at this dynamic process. One area that could be investigated in future studies is to look at how stable these generated metaphors are at the individual level. Would participants' metaphors change over time? This would involve a longitudinal study that would ask participants to complete the metaphor tasks in this study twice, separated by a specific length of time, and then compare their response selections. Since abstract concepts are a key element to human societies and the cognitive architecture of humans, it is highly relevant to explore research methods that provide greater insight into our understanding of them.

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Appendix A. Complete list of metaphor topics and selected sources

Metaphor Topic	Metaphor Source (6 images - nonverbal)
LOVE 愛情 *aijō*	Explosion (24%), Masks (22%), House (20%), Spider web (16%), Forest (10%), Suitcase (3%)
FRIENDSHIP 友情 *yūjō*	Colored Pencils (26%), Medicine (22%), Battery (16%), Shoes (15%), Heater (8%), Castle (7%)
CURIOSITY 好奇心 *kōkishin*	Dandelion (seeds) (29%), Lighter (24%), Map (21%), Paintbrush (11%), Grass (6%), Forest Path (2%)
LONELINESS 孤独 *kōdoku*	Desert (27%), Hole (20%), Rain cloud (19%), Barbed Wire (11%), Wall (10%), Desert (sunset focus) (5%), Pliers (3%)
AN IDEA アイディア *aidia*	Tree (37%), Butterfly (14%), Light Bulb (14%), Sailboat (12%), Bathtub (11%), Passport (4%)
MOTIVATION 動機付け *dōkizuke*	Seedling (35%), Fire (23%), Alarm Clock (12%), Racecar (12%), Cupcake (8%) Coffee Cup (6%)
DISAPPOINTMENT 失望 *shitsubō*	Crevice (31%), Downward Escalator (23%), Sinking Ship (18%), Birdcage (15%), Fly (insect) (3%), Jump Rope (chord) (3%)
THE ECONOMY 経済 *keizai*	Rollercoaster (38%), Scale (21%), Tightrope Walking (19%), The Tides (18%), Plant (3%), Slot Machine (2%),
JEALOUSY 嫉妬 *shitto*	Shark (27%), Sickness (26%), Stove top (24%), Wrench (9%), Megaphone (7%), Coffee Press (4%),
OLD AGE 老年 *rōnen*	Autumn Leaves (28%), Wine (25%), Blank Notebook (18%), Rocking Chair (18%), Fossilized shell (7%) Bridge (4%),
ANGER 怒り *ikari*	Volcano (39%), Bomb (25%), Lightning (16%), Octopus (7%), Fried Eggs and Bacon (5%), Lit Matches (3%)
FREEDOM 自由 *jiyū*	Wings (22%), Bicycle (21%), Paper Airplane (21%), Notebook (11%), Rocket (space) (7%), Swing (3%)
ANXIETY 不安 *fuan*	Storm (33%), Tangled Knot (32%), Crutches (12%), Cliff (11%), Hotpot (8%), Blender (0%),
SYMPATHY 同情 *dōjō*	Umbrella (rain) (18%), Heart (15%), Pillow (12%), Glasses (12%), Compass (8%), Sunshine (7%)
SUCCESS 成功 *seikō*	Ladder (25%), Money (24%), Diamond (16%), Star (12%), Fireworks (7%), Darts (6%)
HONESTY 正直 *shōjiki*	Sword (50%), Straight Road (20%), Magnifying Glass (10%), Handshake (8%), Mountaintop (4%), Watering Can (0%)
CULTURE 文化 *bunka*	Tree (roots) (43%), Handcuffs (14%), Salad (14%), Fence (11%), Computer Network (6%), Pillars (5%),
THE MIND 心 *kokoro*	Sponge (46%), Space (22%), Flower Vase (14%), Window (10%), Computer (2%), Rug (2%),
HOPE 希望 *kibō*	Rainbow (55%), Birds (15%), Stoplights (12%), Stethoscope (5%) Merry-go-round (3%), Leaf (3%)
EDUCATION 教育 *kyōiku*	Key (29%), Opened Door (26%), Dumbbell (18%), Construction (14%), Globe (8%), Hammer (2%),

Note: The totals do not always add up to 100% due to some responses not being able to be categorized for not following instructions (i.e., Love is love).

Appendix B. Coding of interpretations

The coding used in this study was adapted from Wu and Barsalou (2009).

Entity Properties: $\mathbf{E_{sys}}$ a global systemic property of the entity *(states, conditions, abilities, traits)*; $\mathbf{E_{CE}}$ an external component of the entity; $\mathbf{E_B}$ an action that is characteristic of an entity's behavior

Situation Properties: $\mathbf{S_F}$ the function or role the entity serves for the individual; $\mathbf{S_A}$ an action that a participant performs in a situation;

Introspective Properties: $\mathbf{I_c}$ contingency between two or more aspects of a situation *(if, enable, cause, because, depends, requires)* $\mathbf{I_R}$ representational state in the mind of a situational participant *(beliefs, ideas)* $\mathbf{I_O}$ an operation on a cognitive state *(retrieval, learning)*