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Metaphor priming in sentence production: Concrete pictures affect abstract language production

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ABSTRACT

People speak metaphorically about abstract concepts—for instance, a person can be "full of love" or "have a lot of love to give." Over the past decade, research has begun to focus on how metaphors are processed during language comprehension. Much of this work suggests that understanding a metaphorical expression involves activating brain and body systems involved in perception and motor control. However, no research to date has asked whether the same is true while speakers **produce** language. We address this gap using a sentence production task. Its results demonstrate that visually activating a concrete source domain can trigger the use of metaphorical language drawn from that same concrete domain, even in sentences that are thematically unrelated to the primes, a **metaphorical priming effect**. This effect suggests that conceptual metaphors play a part in language production. It also shows that activation in the perceptual system that is not part of an intended message can nevertheless influence sentence formulation.

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1. Introduction

Much of human language is about abstract concepts like *love* that are invisible and intangible. Yet the words used to describe them often characterize them as though they were visible and tangible. It's conventional to say that one is *searching for love* or *finding satisfaction*, as though love and satisfaction were objects. But when we speak about abstract concepts concretely, are we also thinking about them concretely? Theoretical work in the Conceptual Metaphor framework (Lakoff, 1993; Lakoff & Johnson, 1980) argues that we are. If an abstract concept like LOVE can be systematically described as *exchanged*, *stolen*, or *shown* just like a physical object, then perhaps abstract concepts are not only described in terms of concrete concepts like physical objects; maybe these abstract target domains are also conceived of in terms of concrete source domains (as suggested by Johnson, 1987; Lakoff, 1987; Lakoff & Johnson, 1999; Lakoff & Turner, 1989). This might be a way in which the conceptual system grounds abstract concepts in terms of more perceptually, motorically, or physically concrete concepts.

Experimental research has begun to investigate whether and when people access such cross-domain mappings during language use, focusing mostly on reasoning and language comprehension. With respect to reasoning, Boroditsky (2000) found that subjects primed with an object-moving spatial image (depicting objects moving in one direction along a line) were more likely to reason about time as a moving object, while perceiving an ego-moving scenario (where a person is moving relative to objects) made subjects more likely to reason about time as a stationary object that the experiencer moves past. In other words, activation of a concrete domain (in this case, SPACE) influences how people frame a metaphorically related abstract domain (TIME). Other experiments have shown that reasoning about crime policy is influenced by the metaphor used to describe it (Thibodeau & Boroditsky, 2013).

Sentence comprehension studies have similarly shown that processing utterances about abstract concepts subsequently activates representations of concrete source domains. Measures of source-domain activation include forced-choice and free-form drawing tasks (Richardson, Spivey, Edelman, & Naples, 2001), visual discrimination tasks (Richardson, Spivey, Barsalou, & McRae, 2003), sensibility judgments (Kaschak et al., 2005), categorical judgments (Santiago, Lupiáñez, Pérez, & Jesús Funes, 2007), and real or imagined motion (Gibbs, 2013). There's also work taking the reverse tack—showing that prior activation of source domain concepts influences subsequent abstract language comprehension (Boroditsky, 2001; Gibbs, 1992, 1994; Torralbo, Santiago, & Lupiáñez, 2006). For instance, physical engagement or experiences (in source domains) automatically influences comprehenders' interpretations of ambiguous sentences (Boroditsky & Ramscar, 2002), their preference for abstract near-synonyms (Tseng, Hu, Han, & Bergen, 2007), and processing speed for metaphorical

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language (Wilson & Gibbs, 2007). Moreover, some work shows that experiences of physical temperature affect interpersonal judgments (Williams & Bargh, 2008) and estimates of social proximity (IJzerman & Semin, 2009). In sum, there are now numerous results from comprehension-oriented studies suggesting that (1) comprehending metaphorical language activates concrete source domain concepts, and that (2) activating particular concrete perceptual or motor knowledge affects subsequent reasoning and language comprehension about a metaphorically connected abstract domain.

However, questions remain about the exact processes engaged during metaphor comprehension and how to best account for variability in empirical results (e.g., McGlone, 2007; Steen, 2008; see Gibbs, 2013 for a recent review). For example, McGlone (2007) has suggested that conceptual mappings might only be activated in metalinguistic activities such as appropriateness rating tasks and has pointed out the need for a richer array of converging evidence, especially for the type of metaphor investigated in the study presented below, and Gibbs (2013) has likewise argued for the importance of studying metaphor across a range of language configurations. Other approaches to metaphor have argued that novel metaphors are processed differently from more conventionalized ones, suggesting an increasingly limited role for concrete source domains as a metaphor becomes more familiar, as well as revisiting the possibility that the comprehension of some metaphorical expressions involves prior or parallel activation of the literal interpretation of the expression (Bowdle & Gentner, 2005; Desai, Binder, Conant, Mano, & Seidenberg, 2011). Current psycholinguistic models draw heavily on the notion of parallel activation of alternatives (e.g., MacDonald, Pearlmutter, & Seidenberg, 1994), which further supports the possibility of simultaneous activation of literal and metaphorical interpretations during sentence comprehension. Under such a scenario, evidence for concrete source activation during metaphor comprehension could be linked to literal activations, instead of being a necessary component of the comprehension of the metaphorical meaning.

Investigating metaphor via language production provides a new way to assess theories of metaphor, expanding on data from introspection and comprehension paradigms. It is highly unlikely that a speaker producing a metaphorical expression is also activating a competing literal version of that expression. Nor should we find effects of concrete source activation on metaphor production if the metaphor has become so conventionalized that it is no longer associated with that source domain. Thus, if we find that exposure to a concrete source domain increases the likelihood of drawing from that domain to produce metaphorical language, we will have converging evidence for a causal role of conceptual metaphor in language use. No experimental research to date has addressed the question of conceptual metaphor activation in language production. Yet this is a critical issue if we want to understand the choices people make in using metaphor. Therefore, the work presented here takes a first step in exploring the role of concrete source domains in metaphor production.

Existing language production models view speakers as going through three primary processes: message formulation, grammatical encoding, and phonological encoding (Bock, 1995; Bock & Levelt, 1994; Ferreira & Slevc, 2007). Although specific production models propose different explanations of how non-linguistic concepts are connected to subsequent grammatical and phonological encoding processes, the underlying assumption across all models is that production begins when speakers formulate a prelinguistic version of (the beginning of) their intended message (Bock, 1995; Bock & Levelt, 1994; Bock & Loebell, 1990; Ferreira & Slevc, 2007; Levelt, 1989). In other words, existing production models primarily regard speakers' messages as emerging from their own intention. A rich body of literature has shown that the exact form that is produced can be influenced by previous experience, including a previously activated syntactic form (Bock, 1995; Pickering & Ferreira, 2008; Pickering & Garrod, 2013) or an entity in a to-be-described picture that is made more salient through attentional capture (e.g., Gleitman, January, Nappa, & Trueswell, 2007; van de Velde, Meyer, & Konopka, 2014). These findings fit into a more general picture of production in which more accessible concepts and linguistic forms are favored. However, observed effects on the deeper content of the produced message have been limited to cases such as the construal of events with alternative perspective predicates, such as *chase* versus *flee*, in response to attentional capture (Gleitman et al., 2007) or the use of adjectives to mark contrasts made salient to the speaker in the discourse situation (Heller & Chambers, 2014; Lane, Groisman, & Ferreira, 2006). In the experiment described below, we asked whether the activation of concrete domain concepts influences the conceptualization phase of message formulation and thus ultimately affects the metaphorical description of abstract concepts in sentence production. Abstract concepts can often be expressed in a variety of ways, including different metaphorical means. For instance, LOVE can be described either as an object (it is something that can be *found*, *shared*, *shown*, etc.) or as a container (one can be *in love* or *fall out of love*). If mappings from concrete source domains to abstract target domains play a role in sentence production, then, we hypothesized, choice of a conceptual metaphor to describe an abstract target domain should be affected by prior activation of the relevant source domain concept.

We tested this through a production experiment. We first chose a set of 30 abstract concepts that can be described in terms of either of two concrete concepts: CONTAINMENT or POSSESSION. We then primed these concrete concepts through images. On each critical trial, participants saw two prime images, which both depicted a concrete configuration, either CONTAINMENT or POSSESSION. Critically, participants were not required to name or describe these pictures. Previous research on picture perception indicates that participants rapidly recognize the objects or scenes that are depicted in simple displays (Intraub, 1979; Potter, Staub, & O'Connor, 2004) but do not covertly name the pictured objects, even when their task is to click as quickly as possible on whichever object is named aloud (e.g., Dahan & Tanenhaus, 2005). We therefore reasoned that participants would activate the holistic concepts of CONTAINMENT or POSSESSION, but would not reliably activate linguistic descriptions of the pictures (although see below for further discussion of this possibility). Following the picture displays, participants were presented with a name (like *Mary*) and a word pertaining to an abstract domain that is metaphorically describable in terms of either CONTAINMENT or POSSESSION (like *love*). Participants had to formulate a sentence using the name and the abstract word. If abstract domains are not only talked about but also conceptualized in terms of concrete domains, then activating a specific concrete domain through picture perception should result in greater activation for the primed conceptual mapping, relative to alternative ways to conceive of the abstract domain. This should in turn increase the likelihood that people will subsequently activate and produce metaphorical language about the abstract concept using that same concrete source domain. In other words, we should observe metaphor priming.

2. Experiment

Participants saw concrete picture primes followed by linguistic prompts, and then quasi-spontaneously produced sentences using the linguistic prompts. In each trial of the experiment, subjects saw two consecutive pictures, both depicting either CONTAINMENT (e.g., an apple in a box), POSSESSION (e.g., a boy holding an apple), or neither relation (e.g., a boy using a computer; hereafter: "NEUTRAL" relations). The sequence of two pictures was followed by a linguistic prompt: a person's name and an abstract word (e.g., "Sally, trouble"). All of the abstract words could be metaphorically described in terms of multiple concrete source domains, critically including CONTAINMENT and POSSESSION, but were otherwise unrelated to the picture primes. Based on each linguistic prompt, subjects produced a simple sentence. We classified these resulting sentences as using CONTAINMENT metaphors, POSSESSION metaphors, or neither, using strictly linguistic

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