Brain and Cognition 78 (2012) 50–58

Contents lists available at SciVerse ScienceDirect

Brain and Cognition

journal homepage: www.elsevier.com/locate/b&c

Mighty metaphors: Behavioral and ERP evidence that power shifts attention on a vertical dimension

Kiki Zanolie [a,*], Saskia van Dantzig [a,b], Inge Boot [a], Jasper Wijnen [c], Thomas W. Schubert [d], Steffen R. Giessner [a], Diane Pecher [a]

[a] Erasmus University Rotterdam, Institute for Psychology, The Netherlands
[b] Leiden University, Institute for Psychological Research, The Netherlands
[c] University of Amsterdam, Department of Psychology, The Netherlands
[d] Instituto Universitário de Lisboa (ISCTE-IUL), Centro de Investigação e Intervenção Social, Lisboa, Portugal

ARTICLE INFO

Article history:
Accepted 11 October 2011
Available online 15 November 2011

Keywords:
Visual spatial attention
Grounded cognition
Embodied cognition
Concept representation
Abstract concepts
Conceptual Metaphor Theory
P1
N1

ABSTRACT

Thinking about the abstract concept *power* may automatically activate the spatial up–down image schema (*powerful up*; *powerless down*) and consequently direct spatial attention to the image schema-congruent location. Participants indicated whether a word represented a powerful or powerless person (e.g. 'king' or 'servant'). Following each decision, they identified a target at the top or bottom of the visual field. In Experiment 1 participants identified the target faster when their spatial position was congruent with the perceived power of the preceding word than when it was incongruent. In Experiment 2 ERPs showed a higher N1 amplitude for congruent spatial positions. These results support the view that attention is driven to the image schema congruent location of a power word. Thus, *power* is partially understood in terms of vertical space, which demonstrates that abstract concepts are grounded in sensory-motor processing.

1. Introduction

A very important question within the domain of cognitive psychology is how we represent abstract concepts. In the grounded cognition framework, researchers have proposed that the mental representation of concepts involves the simulation of actual sensory-motor experiences (e.g., Barsalou, 1999, 2008a; Glenberg, 1997). On this account action, perception, and mental representation share processing mechanisms. When someone represents a concept, previously stored information of the sensory-motor experience is partially reactivated to form a simulation of this sensory-motor experience. There is ample evidence that concrete concepts are grounded in sensory-motor representations (Barsalou, 2008b). However, the question remains whether and how abstract concepts can be represented in a grounded fashion (Pecher, Boot, & Van Dantzig, 2011). For instance, how would abstract concepts such as *power* and *love*, that have far less direct reference in the physical world than concrete concepts such as *apple* or *hammer*, be grounded? A proposal is that metaphors play a role in the representation of abstract concepts.

The idea that abstract concepts are represented by metaphors was described by the Conceptual Metaphor Theory (Gibbs, 1994; Lakoff & Johnson, 1980, 1999). According to this theory, metaphors provide grounding for abstract concepts by connecting them to more concrete representations. Evidence for this idea originates from metaphorical expressions. For example, the concept *war* may be used as a metaphor for the abstract concept *argument*, as in the sentence *He attacked every weak point in my argument*. By means of this metaphorical connection, the structure inherently present in a concrete concept (the *source domain*) is mapped onto the abstract concept (the *target domain*). The concrete concepts in turn take their structure from image schemas (e.g. Hampe & Grady, 2005; Johnson, 1987), which are dynamic patterns of multi-modal activation that emerge from recurring perceptual and action experiences. Lakoff and Johnson (1980, 1999) argue that metaphors are not merely a linguistic phenomenon but also serve a representational goal.

Conceptual Metaphor Theory is not the only theory of how abstract concepts are grounded. Other accounts of abstract concepts have proposed that abstract concepts are represented by concrete situations and introspective experiences (Barsalou & Wiemer-Hastings, 2005) or by affective and linguistic information (Andrews, Vigliocco, & Vinson, 2009; Kousta, Vigliocco, Vinson, Andrews, & Del Campo, 2011). Whereas Conceptual Metaphor Theory assumes only basic image schemas as a way of grounding,

* Corresponding author. Address: Institute for Psychology, T13-08, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Fax: +31 10 4089009.
E-mail address: zanolie@fsw.eur.nl (K. Zanolie).

0278-2626/$ - see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.bandc.2011.10.006

these other accounts may provide richer sensory-motor representations (Pecher et al., 2011). In the present study we investigated the role of image schemas as proposed by the Conceptual Metaphor Theory. For a complete account of how abstract concepts are grounded, however, other accounts would also need to be considered.

There is now increasing evidence for the interplay between image schemas and abstract concepts (e.g., Casasanto & Boroditsky, 2008; Giessner & Schubert, 2007; Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007; Schubert, 2005). Schubert (2005) showed that power judgments can be affected by vertical dimensions. He presented pairs of related stimuli with a clear difference in power, such as *master-servant*, simultaneously, one above the other. The participants were instructed to detect the powerful or powerless member of the pair as quickly as possible. Participants were faster to identify the powerful member when it was presented at the top location and faster to identify the powerless member when presented at the bottom location. In another experiment, single words referring to powerful or powerless people were presented either at the top or at the bottom of the computer screen. Participants made a power-decision; they decided whether the word represented a powerful or powerless person. An interaction between stimulus position and power was found, such that participants were faster to respond to powerful targets when they appeared at the top position, whereas responses to powerless targets were faster when they were presented at the bottom position.

Although the results of Schubert (2005) and other similar results (e.g. Giessner & Schubert, 2007; Meier & Robinson, 2004) have been explained in terms of people understanding *power* metaphorically by activating the up–down (verticality) image schema, it still remains unclear whether this activation is an automatic process that is part of the concept's representation. An alternative explanation might be that the paradigm that was used, namely the manipulation of the vertical location of the power-words themselves, induced strategic use of spatial location. If participants noticed the relation between the concept of power and the spatial location, they might have had a bias to respond in an image schema-congruent way. For example, they may have had a bias to respond 'powerful' to stimuli at the top of the screen and 'powerless' to stimuli at the bottom of the screen. Such a bias or strategy does not necessarily show that the image schema is needed or used to represent the concept itself. Rather, the results could merely show that the concept *power* and spatial up–down schema were activated, and participants noticed the relation *power is up* only after both had been activated.

Spatial attention as an alternative dependent variable could be crucial to show that the activation of an image schema is independent of strategic concerns. More direct symbolic and social cues can orient attention to an implied spatial location. For instance, visual targets are identified faster when their spatial location is cued by a preceding arrow (e.g. Posner, Snyder, & Davidson, 1980; Tipples, 2002), direction words such as *left* or *right* (Hommel, Pratt, Colzato, & Godijn, 2001), a head facing toward a certain location (Langton, Watt, & Bruce, 2000) or gazing eyes (e.g. Driver et al., 1999; Friesen & Kingstone, 1998; Kingstone, Smilek, Ristic, Friesen, & Eastwood, 2003). Even the perception of numbers can induce a shift of attention (e.g. Fischer, Castel, Dodd, & Pratt, 2003; but see Pecher & Boot, 2011; Zanolie & Pecher, 2011). Fischer et al. found that numbers high in magnitude (e.g. 9) induced a shift of attention to the right visual field and low numbers (e.g. 1) induced a shift of attention to the left visual field. These types of directional cues do orient attention, even when targets are distributed equally across cued and uncued locations. Since the Conceptual Metaphor Theory predicts that the image schema is inherent to the concept's representation it should affect spatial attention in an automatic manner. Therefore, it might be possible that attention can be directed automatically to congruent spatial locations (e.g., up for a powerful word).

Meier and Robinson (2004) designed a paradigm that is particularly suited to investigate the automatic activation of image schemas because congruency effects in this task (e.g. faster reaction times for targets in an up position after a powerful or positive word and vice versa) cannot be explained by a response bias. Meier and Robinson studied the metaphor *good is up*, *bad is down*. In their paradigm participants were asked to evaluate positive and negative words presented at the center of the screen. After the evaluation, participants performed a spatial identification task where the target stimulus (a *p* or *q*) was presented either at the top or bottom of the screen. Congruent with the metaphorical mapping, discriminations at the top of the screen were faster after participants made a positive evaluation (*good* is *up*); in contrast, discriminations at the bottom of the screen were faster after participants made a negative evaluation (*bad* is *down*). It is unlikely that these results are caused by a response bias, because the identity of the target letter was completely unrelated to its position or evaluation of the valence of the word. Thus, even if participants noticed the metaphorical relation, it would not have made them more accurate in discriminating between a *p* or a *q*.

Could it be that thinking of power can induce a shift of attention to the upper or lower visual field? When the up–down image schema plays a central role in the representation of *power*, one would expect that attention is directed to the location that is congruent with this image schema. It is crucial to present a task in which the spatial information assumed to be embedded in the concept cannot be used strategically by the participant to improve performance.

Therefore, we adopted the paradigm used by Meier and Robinson (2004) to address two important questions, namely whether thinking about *power* automatically activates a spatial image schema and whether thinking about *power* directs spatial attention. Experiment 1 was a behavioral study in which participants made power decisions to words denoting powerful or powerless people (e.g. *king* or *servant*), presented centrally. Following each decision, a target letter was presented in the upper or lower visual field. Participants were required to identify the target letter as quickly and accurate as possible. If the up–down image schema is activated automatically, as Meier and Robinson found in the domain of valence, we should find an interaction between power and the spatial location of the visual target. Participants should be faster to identify a target presented at the top of the screen when it is preceded by a *powerful* word, whereas they should be faster to identify a target at the bottom of the screen when it is preceded by a *powerless* word. Importantly, such a result would show that thinking about the concept *power* automatically activates an underlying vertical spatial image schema, as Meier and Robinson found in a different target domain.

A spatial attention shift can be observed not just behaviorally by faster reaction times to targets presented in a spatial location congruent with the up–down image schema, but also by using electrophysiological measures, such as event-related potentials (ERPs). In Experiment 2 we measured ERPs time-locked to target presentation to investigate components that are typically modulated by spatial attention. By measuring ERPs we gain important insight in the allocation of visuospatial attention, allowing a detailed observation of the time course of cognitive processes after making a power decision. Mainly two components (P1 and N1) are modulated at target onset as a function of previous cueing. The first component, the P1 component, is a positive deflection occurring at 80–130 ms after target presentation over posterior, occipital scalp regions. This component is enhanced as a function of attention allocated to the visual target. Targets presented at attended locations elicit a larger P1 amplitude than targets at non-attended locations (Hillyard, Mangun, Woldorff, & Luck, 1995; Mangun,