Bodily Relativity: The body-specificity of language and thought

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Abstract

Do people with different kinds of bodies think differently? According to the *body-specificity hypothesis* (Casasanto 2009), they should. In this paper, I review evidence that right- and left-handers, who perform actions in systematically different ways, use correspondingly different areas of the brain for imagining actions and representing the meanings of action verbs. Beyond the concrete domain of action, the way people use their hands influences the way they represent abstract ideas with positive and negative emotional valence like "goodness," "honesty," and "intelligence," and how they communicate about them in spontaneous speech and gesture. Changing how people use their right and left hands can cause them to think differently, suggesting that handedness is not merely correlated with cognitive differences. Body-specific patterns of experience shape the way people think, feel, communicate, and make decisions.

Keywords: Action; Concepts; EEG; Emotion; fMRI; Handedness; Language; Metaphor; rTMS

Introduction

To the extent that the content of the mind depends on the structure of the body, people with different kinds of bodies should think differently, in predictable ways. This is the *body-specificity hypothesis* (Casasanto, 2009). When people interact with the physical environment, their perceptions and actions are constrained by their bodily attributes (e.g., Fischer, 2005; Linkenauger, et al., 2009). In this paper, I review research exploring ways in which people's words, thoughts, feelings, and judgments are also shaped by the particulars of their bodies.

Body-specificity of language and imagery

Initial tests of the body-specificity hypothesis used handedness as a testbed. Right- and left-handers perform the same actions differently. When people throw a ball, write a letter, or grasp a coffee mug they tend to use their dominant hand. Do differences in how people perform actions influence the way they imagine actions and process action language? To find out, we used functional magnetic resonance imaging (fMRI) to compare right- and left-handers' cortical motor activity during action imagery and action verb understanding.

Mental imagery of hand actions (but not other actions) corresponded to different patterns of motor activity in right- and left-handers. Left-hemisphere motor areas were activated in right-handers, but right-hemisphere motor areas were activated in left-handers (Willems, Toni, Hagoort, & Casasanto, 2009).

A similar pattern was found when people read words for actions they usually perform with their dominant hands (*scribble*, *toss*) and actions they perform with other parts of their bodies (*kneel*, *giggle*). When right-handers read words for hand actions, they activated areas of left premotor cortex used in planning actions with the right hand. Left-handers showed the opposite pattern, activating right premotor areas used for planning left-hand actions (Willems, Hagoort, & Casasanto, 2010).

Further fMRI experiments confirmed that activation during word reading was not due to conscious imagery of actions (Willems, Toni, Hagoort, & Casasanto, 2010). Although fMRI data are correlational, experimental interventions using theta-burst TMS showed that activity in premotor hand areas contralateral to the dominant hand is not epiphenomenal; rather, body-specific activation of the motor system plays a functional role in processing language about hand actions (Willems & Casasanto, 2011; Willems, Labruna, D'Esposito, Ivry, & Casasanto, 2011).

Body-specificity of emotion

Beyond the concrete domain of action, how might bodily experience shape mental representation of more abstract ideas like "good" and "bad," "victory" and "loss," "deceit" and "honesty"? Like many abstract concepts, these notions carry either positive or negative emotional valence. In language, good things are often associated with the top and bad things with the bottom of an imaginary vertical spatial continuum (Lakoff & Johnson, 1980); this spatial mapping has functional consequences for learning the meanings of valenced words (Casasanto & de Bruin, 2011) and for retrieving emotional memories (Casasanto & Dijkstra, 2010).

In addition to vertical metaphors, language also maps good and bad things to horizontal space, (e.g., *my right hand man*; *two left feet*). Implicitly, however, people's mental metaphors do not always reflect the good-is-right and bad-is-left conventions enshrined in language and culture. Rather, people's implicit mental metaphors are body-specific.

When asked to decide which of two products to buy, which of two job applicants to hire, or which of two alien creatures looks more trustworthy, right- and left-handers respond differently. Right-handers tend to prefer the prod-

uct, person, or creature presented on their right side but left-handers tend to prefer the one on their left (Casasanto, 2009). This pattern persists even when people make judgments orally, without using their hands to respond. Children as young as 5 years old already make evaluations according to handedness and spatial location, judging animals shown on their dominant side to be nicer and smarter than animals on their nondominant side (Casasanto & Henetz, 2011).

Beyond the laboratory, the association of "good" with the dominant side can be seen in left- and right-handers' spontaneous speech and gestures. In the final debates of the 2004 and 2008 US presidential elections, positive speech was more strongly associated with right-hand gestures and negative speech with left-hand gestures in the two right-handed candidates (Bush, Kerry), but the opposite association was found in the two left-handed candidates (McCain, Obama), whose gestures linked "positive" with "left" (Casasanto & Jasmin, 2010).

These patterns cannot be predicted or explained by conventions in language and culture, which consistently associate "good" with "right" and "bad" with "left". We proposed that, instead, implicit mental metaphors linking valence with left-right space are created as people interact with their physical environment. In general, greater motor fluency leads to more positive feelings and evaluations (e.g., Ping, Dhillon, & Beilock, 2009). Right-handers, who interact with their environment more fluently on the right side of space and less fluently on the left, come to implicitly associate "good" with "right" and "bad" with "left", whereas the opposite is true for left-handers (Casasanto, 2009).

This fluency-based explanation was validated in a study testing people whose dominant hand was handicapped, either in the long-term due to hemiparesis following unilateral stroke, or in the short-term due to motor training in the lab. After a period of acting more fluently with the left hand than the right, natural right-handers implicitly associated good with left, like natural left-handers (Casasanto & Chrysikou, 2011).

Body-specific patterns of action correspond to different emotion-related behaviors. Do they also lead to different neural organization for emotion? In right-handers, the left frontal lobe (which controls the dominant hand) is specialized for approach-motivational states, and the right frontal lobe (which controls the nondominant hand) for avoidance-motivational states. If brain areas that support affective motivation are functionally related to areas that support approach- and avoidance-related motor actions, then hemispheric specialization for motivation should covary with specialization for motor control. This prediction was supported in an electroencephalography (EEG) experiment showing opposite patterns of alpha-band power asymmetries in right- and left-handers. This anatomical covariation provides initial support for the functional link we proposed between the neural substrates of affective motivation and motor control (Brookshire & Casasanto, 2011).

Conclusions

The body is a ubiquitous part of the context in which people use their minds. The studies reviewed here show that even highly abstract thoughts depend, in part, on the ways people interact with the physical environment using their particular bodies. Like research on linguistic relativity and cultural relativity, investigations of *bodily relativity* can elucidate ways in which patterns of experience give rise to corresponding habits of thinking, feeling, communicating, and making decisions.

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