Acta Psychologica 185 (2018) 203–218

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy

Truth is in the head. A nod and shake compatibility effect

Stefania Moretti, Alberto Greco*

Lab. of Psychology and Cognitive Sciences, COGNILAB-DISFOR, University of Genova, Italy

ARTICLE INFO

Keywords:
Head nod
Head shake
Truth-value processing
Embodiment effect
Motor compatibility

ABSTRACT

Studies from the embodiment perspective on language processing have shown facilitation or interference effects depending on the compatibility between verbal contents, concrete or abstract, and the motion of various parts of the body. The aim of the present study was to test whether such compatibility effects can be found when a higher cognitive process like truth evaluation is accomplished with head movements. Since nodding is a vertical head gesture typically performed with positive and affirmative responses, and shaking is a horizontal head gesture associated with negative and dissenting contents, faster response times can be expected when true information is evaluated by making a vertical head movement and false information by making a horizontal head movement.

Three experiments were designed in order to test this motor compatibility effect. In the first experiment a series of very simple sentences were asked to be evaluated as true or false by dragging them vertically and horizontally with the head. It resulted that truth-value was assessed faster when it was compatible with the direction of the head movement, compared to when it was incompatible. In the second experiment participants were asked to evaluate the same sentences as the first experiment but by moving them with the mouse. In the third experiment, a non-evaluative classification task was given, where sentences concerning animals or objects were to be dragged by vertical and horizontal head movements. In the second and third experiment no compatibility effect was observed. Overall results support the hypothesis of an embodiment effect between the abstract processing of truth evaluation and the direction of the two head movements of nodding and shaking. Cultural aspects, cognitive implications, and the limits of these findings are discussed.

1. Introduction

The body plays a crucial role in human communication and activity. In everyday social interactions, nonverbal behavior serves as an important cue that facilitates understanding what is expressed verbally. Mental contents like beliefs, feelings, and intentions are often better revealed by body movements like gestures, facial expressions and bodily postures rather than by explicit communication and this is why their nature has always fascinated scholars in very different fields of knowledge, from linguistics to social psychology.

Head nods and shakes are among the first bodily expressions acquired by infants (Darwin, 1872; Guidetti, 2005). These gestures are of particular interest because they are mostly used to communicate agreement and disagreement: the vertical movement of nodding is typically used in Western culture to communicate agreement or acceptance, while the horizontal movement of shaking is commonly used to communicate dissent or denial (Ekman, 1979; Jakobson, 1972; Morris, 1979). This communication can occur without speaking, by simply moving the head up and down or left and right, but these movements are also often performed accompanying positive and affirmative or dissenting and negative verbal expressions. According to this kind of communicative function, such gestures interact with language, and their habitual use since early communication makes these two head movements physically embodied habits (Andonova & Taylor, 2012; Horstmann & Ansorge, 2011).

In general, the relationships between gestures and language have been much studied in the literature. Several models and different explanations of this relationship have been proposed. For example, the well-known facilitation effects of gestures on speech production (Krauss, 1998; Krauss, Chen, & Chawla, 1996; McNeill, 1992) and comprehension (Clark, 1996; Kelly, Barr, Church, & Lynch, 1999; McNeil, Alibali, & Evans, 2000), are explained because they can help speakers to express ideas that are hard to capture, by spatially simulating the meaning or by simplifying the access to words in memory.

Most of the models concerning the relationship between gestures and speech agree with the idea that language processing is closely tied to the body (Goldin-Meadow, 2003; Hostetter & Alibali, 2008; Kita & Özyürek, 2003; Krauss, Chen, & Gotfexnum, 2000; Pouw, De Nooijer, Van Gog, Zwaan, & Paas, 2014). Therefore, gestures have been considered to constitute valid evidence for the embodiment approach,

* Corresponding author.
E-mail addresses: stefania.moretti@edu.unige.it (S. Moretti), greco@unige.it (A. Greco).

https://doi.org/10.1016/j.actpsy.2018.02.010
Received 30 January 2018; Received in revised form 14 February 2018; Accepted 19 February 2018
Available online 16 March 2018
0001-6918/

which places the body increasingly central to the study of cognition (Alibali, Boncoddo, & Hostetter, 2014; Dijkstra & Post, 2015; Zwaan, 2014).

The line of research pursued by the embodiment approach, indeed, has shown evidence that language understanding, and even higher cognitive processes like judgment and planning, are founded on sensorimotor mechanisms, which lead to partial simulations of sensory, motor, and affective states (Barsalou, 1999, 2003, 2008; Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Dominey et al., 2015; Gibbs Jr, 2005; Glenberg, 1997; Goldstone & Barsalou, 1998; Iran-Nejad & Irannejad, 2017; Johnson, 2015; Mahon & Caramazza, 2008; Meteyard, Cuadrado, Bahrami, & Vigliocco, 2012; Niedenthal, 2007; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Reimann et al., 2012; Soylu, 2016; Wilson, 2002; Zwaan & Madden, 2005; Zwaan, Madden, Yaxley, & Aveyard, 2004). These simulations are based on previously acquired information and are considered to be the result of the evolution of mechanisms which originally allowed individuals to make inferences and represent information in the absence of physical stimuli. Thus, the effects of this grounding are considered to occur even when cognition is disconnected from the environment in which the sensorimotor patterns were acquired or activated (Körner, Topolinski, & Strack, 2015; Niedenthal et al., 2005), and it has been shown that these effects generally show up as a facilitation or interference in cognitive processing and motor responses, based on whether bodily activity and cognitive states are compatible or not.

According to this perspective, actions that people perform (both physical and simulated) can thus affect cognitive processing and vice versa (Barsalou, 2010; Glenberg, Witt, & Metcalfe, 2013; Kaschak, Jones, Carranza, & Fox, 2014; Körner et al., 2015). In this view, hence, gestures, as a special form of action deriving from sensorimotor simulations (Hostetter & Alibali, 2008, 2010), are deemed to interact with cognitive processing.

In line with this hypothesis, the goal of the present study was to test the presence of an interaction between the two vertical and horizontal head movements, involved in nodding and shaking gestures, and the truth-value processing of verbal expressions. Our main expectation was to find a motor compatibility effect when stimuli evaluated as true are moved with the head vertically, the movement typically performed with positive/affirmative verbal expressions, and when sentences evaluated as false are moved horizontally, the movement performed with negative/dissenting verbal expressions.

1.1. Basic distinctions about compatibility

The "compatibility" relationship between body and mind is a central concept in embodied cognition approaches. However, compatibility is a complex and multifaceted phenomenon and several aspects of it have been investigated with different experimental designs, stimuli, and instructions. Considering that the aim of the present work was to test a specific motor compatibility effect, some distinctions are needed.

First, two general kinds of stimuli have been used in the literature: objectively understandable and subjectively evaluable verbal expressions. In the first case, the focus is on the relationship between a bodily state or action and the mere understanding of the meaning of words or sentences. In the second case, the relationship is with the evaluation processing (judging affective meaning, pleasantness, value, etc…) of polarized and valenced words or sentences. In our research, we have chosen to study a peculiar kind of evaluation, the objective assessment of the truth-value of a statement, which has yet to be investigated in the perspective of embodiment.

As regards stimulus presentation and response modality, two kinds of compatibility effects have been investigated: spatial and motor. For the first type of effect, embodiment accounts postulate that language comprehension is based on spatial schemas. Thus, schematic spatial representations and spatial dimensions of meaning have been considered for both concrete or implicit location words (Barsalou, 2008; Zwaan & Yaxley, 2003; Pecher, Van Dantzig, Boot, Zanolie, & Huber, 2010; Estes, Verges, & Barsalou, 2008; Šetić & Domijan, 2007) and for abstract concepts or valenced words (Glenberg et al., 2008; Barsalou, Niedenthal, et al., 2003; Barsalou, Simmons, Barbey, & Wilson, 2003; Lakoff & Johnson, 1999, 1980; Chasteen, Burdzy, & Pratt, 2010; Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007; Meier & Robinson, 2004; Proctor & Cho, 2006; Hall, Coats, & Smith LeBeau, 2005; Schubert, 2005). Hence, even with stimuli not having any concrete spatial position in reality nor a directional dimension, like abstract or valenced concepts, spatial effects have been found for the "left-right" dimension (e.g., Casasanto, 2009; Casasanto & Chrysikou, 2011; Chasteen et al., 2010; Maass & Russo, 2003) and for the "up-down" dimension (e.g., Dudschig, de la Vega, De Filippis, & Kaup, 2014; Meier et al., 2007; Meier & Robinson, 2004; Meteyard, Bahrami, & Vigliocco, 2007). Considering the first kind of stimuli, objectively understandable, when the location of a word on the screen was congruent with the typical perceived location of its referent in space (e.g., 'bird' at the top of the computer screen) faster processing was observed. Similarly, faster detection times were found when words expressing positive concepts (e.g., happy, good, heaven, god) were located in the upper part of a computer screen and vice versa when negative ones (e.g., sad, bad, hell, devil) were in the lower part. Sometimes, conflicting predictions of spatial effects among implicit location words, motion verbs, and valenced words (e.g. contradicting concepts with the same spatialization) can be found in the literature, due to the task specificity (de la Vega, De Filippis, Lachmair, Dudschig, & Kaup, 2012; Dudschig, de la Vega, & Kaup, 2015; Hurtienne et al., 2010) or the body specificity (Casasanto, 2009; Casasanto & Chrysikou, 2011; Casasanto & Jasmin, 2010).

In studies concerning spatial compatibility, the stimulus location is manipulated but no motor action is requested. When motor compatibility is investigated, by contrast, the interaction between a stimulus and a bodily action is tested within motor response paradigms. In these studies the effect occurs with both concrete (Borghi, Glenberg, & Kaschak, 2004; Glenberg, 1997; Glenberg & Kaschak, 2002; Kaschak et al., 2005; Richardson, Spivey, Barsalou, & McRae, 2003; Zwaan & Yaxley, 2003) and abstract or valenced materials (Cacioppo, Priester, & Bernston, 1993; Carraro, Castelli, & Negri, 2016; Chen & Bargh, 1999; Förster & Strack, 1998; Guan, Meng, Yao, & Glenberg, 2013; Neumann & Strack, 2000; Solarz, 1960; Strack & Deutsch, 2004; Wentura, Rothermund, & Bak, 2000). For example, Glenberg and Kaschak (2002) observed what they have called the "Action-Sentence Compatibility Effect" or ACE, that is, faster response times when the arm movement to be executed was in the same direction as the concrete action expressed by a sentence. Similar effects occurred with the evaluation of valenced stimuli (e.g. Chen & Bargh, 1999): the response to a positive stimulus was faster when the direction of the movement to make in order to evaluate it was an approach movement (arm flexion toward the body), and vice versa an avoidance movement (arm extension away from the body) when stimuli were negatively valenced.

Finally, a fundamental distinction regards the notion of motor compatibility. Since embodiment can function both as a response and as a stimulus (Barsalou, 2003), two kinds of motor compatibility can be found in literature: (a) when the processing of a content automatically activates the simulation of a compatible action (the action is a response) and (b) when an induced action subsequently influences the processing of a content (the action is a stimulus).

The first type of motor compatibility has been investigated in tasks requiring to process stimuli while executing actions (mostly with arm movements) (e.g. Borghi & Cimatti, 2009; Fischer & Zwaan, 2008; Gallese & Lakoff, 2005; Gibbs, 2006; Glenberg & Kaschak, 2002; Kaschak et al., 2014; Zwaan, 2004). In this case, actions are facilitated when they match the simulated actions and hindered when there is a mismatch between the two (Dijkstra & Post, 2015). Compatibility occurs because the affected cognitive processing entails a mental simulation that reactivates the same neuronal paths that were active while experiencing the situation expressed verbally (Zwaan & Madden, 2005;