Acta Psychologica 153 (2014) 60–65

Contents lists available at ScienceDirect

Acta Psychologica

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

The effects of verbal cueing on implicit hand maps

Stefania Mattioni, Matthew R. Longo *

Department of Psychological Sciences, Birkbeck, University of London, United Kingdom

ARTICLE INFO

Article history:
Received 7 June 2014
Received in revised form 18 September 2014
Accepted 22 September 2014
Available online 9 October 2014

PsycINFO classification:
2320
2340

Keywords:
Body representation
Touch
Proprioception
Position sense

ABSTRACT

The use of position sense to perceive the external spatial location of the body requires that immediate proprioceptive afferent signals be combined with stored representations of body size and shape. Longo and Haggard (2010) developed a method to isolate and measure this representation in which participants judge the location of several landmarks on their occluded hand. The relative location of judgements is used to construct a perceptual map of hand shape. Studies using this paradigm have revealed large, and highly stereotyped, distortions of the hand, which is represented as wider than it actually is and with shortened fingers. Previous studies using this paradigm have cued participants to respond by giving verbal labels of the knuckles and fingertips. A recent study has shown differential effects of verbal and tactile cueing of localisation judgements about bodily landmarks (Cardinali et al., 2011). The present study therefore investigated implicit hand maps measuring through localisation judgements made in response to verbal labels and tactile stimuli applied to the same landmarks. The characteristic set of distortions of hand size and shape were clearly apparent in both conditions, indicating that the distortions reported previously are not an artefact of the use of verbal cues. However, there were also differences in the magnitude of distortions between conditions, suggesting that the use of verbal cues may alter the representation of the body underlying position sense.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Several forms of afferent signal provide information about the posture of the limbs, including receptors in joints, muscle spindles, and skin (Proske & Gandevia, 2012). Each of these signals provides information about the extent to which joints are flexed or extended, that is about body posture. In order to perceive the absolute location in external space, information about joint angles must be combined with information about the length of bodily segments between joints, information which is not specified by immediate afferent signals from the periphery. Thus, accurate position sense requires that immediate proprioceptive afferent signals be informed by a stored *body model* (Longo, Azañón, & Haggard, 2010).

Recently, we have developed a procedure to isolate and measure this body model in which participants are asked to indicate the perceived location of different landmarks on their occluded hand. By comparing the relative locations of judgements of different landmarks, implicit perceptual maps of hand shape can be constructed (Longo, 2014; Longo & Haggard, 2010, 2012a,b; Longo, Long, & Haggard, 2012). These studies have revealed that the body model of the hand is massively distorted, with several consistent patterns of distortion across people, including: (1) overall overestimation of hand width, (2) overall underestimation of finger length, and (3) a radio-ulnar gradient, with underestimation of finger length increasing from the thumb to little finger. In contrast, when asked to compare the perceive shape of their hand to a visual template, participants perform accurately (Longo & Haggard, 2010,b), suggesting that they have explicit awareness of the true shape of their hand. Longo and Haggard (2010) argued on the basis of this dissociation that the distorted body model is distinct from the conscious body image.

In the present paper we focus on one aspect of the procedure we used in previous studies with this paradigm, namely the fact that participants have been asked to localise bodily landmarks indicated by verbal labels. A large literature in neuropsychology has suggested that lexico-semantic knowledge about the body is a distinct domain, which can be doubly-dissociated from other aspects of semantic cognition (e.g., Coslett, Saffran, & Schwoebel, 2002; Goodglass, Klein, Carey, & Jones, 1966; Kemmerer & Tranel, 2008; Laiacona, Allamano, Lorenzi, & Capitani, 2006). The studies of Dennis (1976) and Suzuki, Yamadori, and Fujii (1997) both reported patients who were unable to point to parts of their own body when verbally labelled, but could point to body parts described functionally (e.g., 'with which organ do you see?') or by association to other objects (e.g., 'which parts do you put your socks on?'). Thus, the use of verbal labels to indicate landmarks may have important implications for the representations of the body involved in generating responses.

Cardinali et al. (2011) recently reported an intriguing difference between localisation of body part based on verbal versus tactile cues. They asked participants to indicate the location of their occluded right elbow, wrist, and middle fingertip, either by pointing with their left hand or by indicating the corresponding number on a ruler laid over their arm.

* Corresponding author at: Department of Psychological Sciences, Birkbeck, University of London, Malet Street, London WC1E 7HX, United Kingdom.
E-mail address: m.longo@bbk.ac.uk (M.R. Longo).

http://dx.doi.org/10.1016/j.actpsy.2014.09.009
0001-6918/© 2014 Elsevier B.V. All rights reserved.

When the location to be judged was cued by touching that part of the right arm, the authors replicated their previous finding (Cardinali et al., 2009) that the distance between the judged locations of the elbow and wrist increased following a period of tool use with the right arm. The authors interpreted this result as evidence that tool use induces functional updating of the body schema, leading to an elongation of the representation of the forearm. Critically, however, when participants were asked to indicate the location of the same body parts indicated by verbal labels, no such updating from tool use was found. Thus, while the manner in which the participant *responded* had no apparent effect, the manner in which body-part locations were *indicated* critically determined whether or not tool-use induced plasticity was obtained. Cardinali et al. (2011) interpret this dissociation as evidence that changing the sensory modality of the input (tactile or verbal) affects the degree of access of the body schema.

The dissociation localisation of bodily landmarks cued through touch versus vision reported by Cardinali et al. (2011) has important implications for understanding the nature of the distorted hand maps described above. Longo and Haggard (2010) argued that the distorted representation they described was distinct from the conscious body image since in a more overt measure of body image in which participants were asked to select from an array of hand images the one most like their own, they were on average unbiased. Nevertheless, it is true that all studies investigating these representations have used verbal cues to indicate which landmarks participants should localise (Ferrè, Vagnoni, & Haggard, 2013; Longo, 2014; Longo & Haggard, 2010, 2012a,b; Longo et al., 2012; Lopez, Schreyer, Preuss, & Mast, 2012). The results of Cardinali et al. (2011) indicate that this aspect of the procedure may have important consequences for which mental representations of the body are being measured.

It is thus a critical question whether the distorted representation underlying position sense reported in recent studies may result from activation of the conscious body image or lexico-semantic representations of the body resulting from the use of verbal cues. The present study addressed this issue by comparing distortions of implicit hand maps when participants were verbally cued to point to the knuckles and tips of their occluded left hand and when they were asked to point to the location of touches applied to those same landmarks. If the distortions reported by Longo and Haggard (2010) reflect access to the conscious body image, they should arise only when locations are verbally cued, and disappear when participants are asked to localise touch. In contrast, if the distortions reflect implicit body representations underlying position sense, they should appear regardless of the manner in which locations are cued.

2. Methods

2.1. Participants

Twenty healthy individuals (eleven female) between 18 and 73 years of age participated. All but two were right-handed as assessed by the Edinburgh Handedness Inventory (*M*: 63.56; range: −100 to 100).

2.2. Procedure

Procedures were similar to our previous studies using this paradigm (Longo, 2014; Longo & Haggard, 2010, 2012a,b; Longo et al., 2012). Participants placed their left palm-down on a table, aligned with their body midline (see Fig. 1). An occluding board (40 × 40 cm) was placed over the hand, resting on four pillars (6 cm high). A camera (Logitech Webcam Pro 9000 HD) suspended on a tripod above the occluding board (27 cm high) captured photographs (1600 × 1200 pixels) controlled by a custom Matlab (Mathworks, Natick, MA) script.

Participants used a long baton (35 cm length; 2 mm diameter) to indicate with their right hand the perceived location of several landmarks on their occluded left hand. Ten landmarks were used: the knuckles at the base of each finger and the tip of each finger. The critical difference between conditions was the manner in which participants were cued to each landmark. In the *Verbal* condition, participants were verbally instructed which landmark to localise, as in previous studies with this paradigm. In the *Tactile* condition, in contrast, the experimenter delivered unseen tactile stimuli to the same landmark using a von Frey hair (255 milliNewtons) applied for approximately one second. They were instructed to be precise in their judgements and avoid ballistic pointing or strategies such as tracing the outline of the hand. To ensure that they judged each landmark individually, participants moved the baton to a yellow dot at the edge of the board before the start of each trial. When the participants indicated their response, a photograph was taken and saved for offline coding.

There were four blocks of 30 trials: two blocks for the verbal condition and two blocks for the tactile condition. The two conditions were counterbalanced across the four blocks in ABBA fashion, with the first condition counterbalanced across participants. Each block included three mini-blocks of one trial of each landmark in random order. At the beginning and the end of each block a photograph of the participant's hand was taken to measure the true hand proportions and to check that the hand hadn't moved during the course of the block. To facilitate coding, a black mark was made on the centre of each knuckle with a non-permanent felt pen. A 10 cm ruler appeared in the photographs of the participant's hand and allowed conversion between pixel units and centimetres.

2.3. Analysis

The analysis was similar to our previous studies (Longo & Haggard, 2010, 2012a,b). The x–y pixel coordinates of each landmark on the images of actual hands and of all responses were coded using a custom Matlab script using Cogent Graphics (John Romaya, Wellcome Department of Imaging Neuroscience, University College London). Mean coordinates were then calculated for each landmark in each experimental block. The set of mean coordinates in each block comprises two maps, one reflecting actual hand shape, the other reflecting represented hand shape. Distances between mean pixel coordinates of the tip and knuckle of each finger and between pairs of knuckles were calculated and converted into cm.

We also used Generalised Procrustes Analysis (GPA) to compare the overall shape of hand maps. GPA aligns configurations of homologous landmarks, removing differences in location, rotation, and overall size to isolate differences in shape (Bookstein, 1991; Rohlf & Slice, 1990). Because the fingers are articulated structures, differences in posture could be confused with differences in shape (Adams, 1999). Although this will not affect analysis of distances between pairs of adjacent landmarks, it will affect analyses of overall hand shape, like GPA. We therefore rotated each finger to a common posture, defined for each finger as the angle formed by the intersection of the line running through the knuckles of the index and little fingers and the line running through the knuckle and tip of a particular finger. We used the same angles used in our original study (Longo & Haggard, 2010), namely 44.4°, 64.4°, 77.4°, 86.8°, and 106.1° for digits 1–5, respectively. For hand maps in each block, the tip of each finger was rotated so that the finger was at the appropriate angle, while preserving the distance between the knuckle and tip of each finger. This results in hand maps which have a common posture, allowing comparison of overall shape with GPA.

GPA was conducted using CoordGen software (Integrated Morphometrics Program, H. David Sheets, Canisius College, http://www3.canisius.edu/~sheets/morphsoft.html). Because there were two experimental blocks of each condition, maps of represented hand shape from the two blocks of each condition for a particular participant were first placed in GPA alignment with each other and the average hand shape calculated. Then a second, group-level, GPA was conducted to align maps of each condition across participants. The maps of actual

Download English Version:

https://daneshyari.com/en/article/919764

Download Persian Version:

https://daneshyari.com/article/919764

Daneshyari.com