cortex xxx (2016) 1–11

Available online at www.sciencedirect.com

ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex

Research report

Gender differences in non-standard mapping tasks: A kinematic study using pantomimed reach-to-grasp actions

Freya Copley-Mills, Jason D. Connolly and Cristiana Cavina-Pratesi*

Department of Psychology, Durham University, Durham, UK

ARTICLE INFO

Article history:
Received 23 September 2015
Reviewed 16 November 2015
Revised 5 March 2016
Accepted 10 June 2016
Action editor Georg Goldenberg
Published online xxx

Keywords:
Grasping
Pantomime
Sex-difference
Kinematics

ABSTRACT

Comparison between real and pantomimed actions is used in neuroscience to dissociate stimulus-driven (real) as compared to internally driven (pantomimed) visuomotor transformations, with the goal of testing models of vision (Milner & Goodale, 1995) and diagnosing neuropsychological deficits (apraxia syndrome). Real actions refer to an overt movement directed toward a visible target whereas pantomimed actions refer to an overt movement directed either toward an object that is no longer available. Although similar, real and pantomimed actions differ in their kinematic parameters and in their neural substrates. Pantomimed-reach-to-grasp-actions show reduced reaching velocities, higher wrist movements, and reduced grip apertures. In addition, seminal neuropsychological studies and recent neuroimaging findings confirmed that real and pantomimed actions are underpinned by separate brain networks. Although previous literature suggests differences in the praxis system between males and females, no research to date has investigated whether or not gender differences exist in the context of real versus pantomimed reach-to-grasp actions. We asked ten male and ten female participants to perform real and pantomimed reach-to-grasp actions toward objects of different sizes, either with or without visual feedback. During pantomimed actions participants were required to pick up an imaginary object slightly offset relative to the location of the real one (which was in turn the target of the real reach-to-grasp actions). Results demonstrate a significant difference between the kinematic parameters recorded in male and female participants performing pantomimed, but not real reach-to-grasp tasks, depending on the availability of visual feedback. With no feedback both males and females showed smaller grip aperture, slower movement velocity and lower reach height. Crucially, these same differences were abolished when visual feedback was available in male, but not in female participants. Our results suggest that male and female participants should be evaluated separately in the clinical environment and in future research in the field.

Crown Copyright © 2016 Published by Elsevier Ltd. All rights reserved.

* *Corresponding author*. Department of Psychology, Durham University, Durham, DH1 3LE, UK.

http://dx.doi.org/10.1016/j.cortex.2016.06.009

0010-9452/Crown Copyright © 2016 Published by Elsevier Ltd. All rights reserved.

UNCORRECTED PROOF

Please cite this article in press as: Copley-Mills, F., et al., Gender differences in non-standard mapping tasks: A kinematic study using pantomimed reach-to-grasp actions, Cortex (2016), http://dx.doi.org/10.1016/j.cortex.2016.06.009

1. Introduction

What makes a good mime artist seem to really be banging on an invisible wall? How does an actor in a film appear natural while fighting against a computer generated creature, and how does a magician convince us that a coin has been picked up and is about to 'vanish' for the next trick? What these people have in common is the ability to interact with imaginary objects, yet still produce movements that accurately portray, down to the fine details, the way we would expect to see someone move when the objects they are handling are actually there (Sito, 2013) These fine abilities of experts in action miming are quite surprising given that it is now well documented that humans move quite differently when asked to perform a real goal directed action, for example picking up an apple, as compared to its relative pantomimed action of picking up an imaginary apple.

Comparisons between performing real and pantomimed actions have been used in the field of neuroscience to dissociate stimulus driven (used in real action) as compared to internally driven (used in pantomimed action) visuomotor transformation with the goals (among others) of diagnosing neuropsychological disorders such as ideomotor apraxia (Sunderland & Shinner, 2007) and of testing models of vision (Milner & Goodale, 1995). In both instances, most studies used movements of the upper body, with a particular attention to grasping actions and tool use. The terms "pantomime" and "pantomimed action" is used in this context to describe actions performed toward 3-dimensional objects that are not actually physically present. This condition has been experimentally tested in different laboratories by using virtual representations (Santello, Flanders, & Soechting, 2002), mental images (Goodale, Jakobson, & Keillor, 1994), remembered items (Milner et al., 2001), or not-graspable two-dimensional images (Westwood, Danckert, Servos, & Goodale, 2002).

In neuropsychology, the ability to skillfully use tools – for example using a pair of scissors to cut a piece of paper – is clearly dissociated from the ability to pantomime the use of scissors: patients with lesions within the fronto-parietal network can perform the former task relatively well, but not the latter (Goldenberg, 2009; Goldenberg & Spatt, 2009). In this particular context, the use of pantomimed actions has suggested to neuropsychologists that the fronto-parietal brain areas usually lesioned in patients with ideomotor apraxia might play a key role in converting mental images of well learned actions into their corresponding motor execution. Behavioural studies (Hermsdorfer, Li, Randerath, Goldenberg, & Johannsen, 2012; Hermsdorfer, Li, Randerath, Roby-Brami, & Goldenberg, 2013) have demonstrated a high correlation between the kinematics parameters recorded while participants were performing pantomime tasks (reproducing the action of scooping with the hand) and demo tasks (reproducing the action of scooping using a spoon). Importantly, weak correlations were instead recorded when both pantomime and demonstration tasks were compared to actual use task (using a spoon to scoop soup for real). Interestingly, patients with apraxia behaved similarly to controls, with the difference that the former appeared to have more problems with specific movements such has wrist rotation. The severity of the deficit was seen to decrease along a gradient from pantomime, to demo, to use tasks (Hermsdorfer et al., 2013; Laimgruber, Goldenberg, & Hermsdorfer, 2005).

Differences between real and pantomimed grasping actions have also been used to support the theory that different pathways in the primate brain sustain vision for action and vision for perception (Goodale & Milner, 1992; Goodale & Westwood, 2004). According to this model, the ventral stream in the occipito-temporal cortex transforms visual information into durable perceptual representations enabling us to distinguish an apple from a cherry; whereas the dorsal stream, in the occipito-parietal cortex, extracts the moment-to-moment visual information necessary to enabling us to open our hands wider to grasp the apple rather than the cherry. Seminal evidence of such a division of labour came from patient D.F. (Goodale, Milner, Jakobson, & Carey, 1991), a woman who suffered visual form agnosia following a lesion to her occipital-temporal cortex in the ventral stream (James, Culham, Humphrey, Milner, & Goodale, 2003) D.F. could not recognize objects by relying on the sole information of shape. For example, when given a series of rectangular blocks of different sizes, she performed very poorly as compared to when asked to discriminate these same blocks by reproducing their size using her finger and thumb with the distance recorded between them not varying accordingly with object size. Surprisingly, however, when she was asked to grasp the same objects using the same finger and thumb in a precision grip, their distance was proportional to the size of the objects (Goodale et al., 1991)The fact that D.F. was able to use the shape of the blocks to guide her grasp, but not her perception, has been explained by suggesting: 1) that objects' visual processing for action and for perception engage separate brain pathways; and 2) the ventral stream in the occipito-temporal cortex, lesioned in D.F., guides vision for perception. A second patient, (R.V.) with a lesion in the parietal cortex (thus the dorsal stream) and suffering from Optic Ataxia (OA) was found to have the opposite problem. R.V. was very good at judging the size of the blocks, but she could not scale the opening of her fingers correctly when grasping (Jakobson, Archibald, Carey, & Goodale, 1991), suggesting that 3) the dorsal stream is responsible for vision for action. Within this context, real and pantomimed actions have been used as an additional tool to tap into the visual transformations housed across the two visual streams. If it is true that the dorsal stream is tuned to the visual feature of objects for on-line actions (grasping and reaching), then it should not be involved in processing the same visual features when actions are not performed on-line and are instead guided off-line by internal representations (for example, when the actions are delayed or guided toward an object that is no longer present). When form agnostic patient D.F. and OA patient I.G. were asked to perform either immediate or delayed grasps toward objects of different sizes, the above predictions were fulfilled. While D.F. (with an impaired ventral stream and a spared dorsal stream) could scale the opening of her fingers to the size of the object for immediate on-line as compared to delayed grasps, patient I.G. (with an impaired dorsal stream and a spared ventral stream) performed in the opposite manner by scaling her fingers to a better extent for the delayed as compared to the immediate grasp (Milner et al., 2001). D.F. was also tested in pantomime

Download English Version:

https://daneshyari.com/en/article/7312705

Download Persian Version:

https://daneshyari.com/article/7312705

Daneshyari.com