CORTEX 70 (2015) 49–67

Available online at www.sciencedirect.com

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

Special issue: Research report

Distinct neural processes are engaged in the modulation of mimicry by social group-membership and emotional expressions

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ARTICLE INFO

Article history:
Received 30 September 2014
Reviewed 18 November 2014
Revised 22 January 2015
Accepted 4 March 2015
Published online 20 March 2015

Keywords:
Imitation
Mimicry
Chameleon effect
Emotional expressions
Affiliation

ABSTRACT

People often spontaneously engage in copying each other's postures and mannerisms, a phenomenon referred to as behavioral mimicry. Social psychology experiments indicate that mimicry denotes an implicit affiliative signal flexibly regulated in response to social requirements. Yet, the mediating processes and neural underpinnings of such regulation are largely unexplored. The present functional magnetic resonance imaging (fMRI) study examined mimicry regulation by combining an automatic imitation task with facial stimuli, varied on two social-affective dimensions: emotional expression (angry *vs* happy) and ethnic group membership (in- *vs* out-group). Behavioral data revealed increased mimicry when happy and when out-group faces were shown. Imaging results revealed that mimicry regulation in response to happy faces was associated with increased activation in the right temporo-parietal junction (TPJ), right dorsal premotor cortex (dPMC), and right superior parietal lobule (SPL). Mimicry regulation in response to out-group faces was related to increased activation in the left ventral premotor cortex (vPMC) and inferior parietal lobule (IPL), bilateral anterior insula, and mid-cingulate cortex (MCC). We suggest that mimicry in response to happy and to out-group faces is driven by distinct affiliative goals, and that mimicry regulation to attain these goals is mediated by distinct neuro-cognitive processes. Higher mimicry in response to happy faces seems to denote reciprocation of an affiliative signal. Higher mimicry in response to out-group faces, reflects an appeasement attempt towards an interaction partner perceived as threatening (an interpretation supported by implicit measures showing that out-group members are more strongly associated with threat). Our findings show that subtle social cues can result in the implicit regulation of mimicry. This regulation serves to achieve distinct affiliative goals, is

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http://dx.doi.org/10.1016/j.cortex.2015.03.007

mediated by different regulatory processes, and relies on distinct parts of an overarching network of task-related brain areas. Our findings shed new light on the neural mechanisms underlying the interplay between implicit action control and social cognition.

1. Introduction

Imagine yourself in a conversation with a friend, or even somebody you have just met. You laugh and have a good time and then you might come to notice that you're sitting in the same position: you both have your legs crossed and lean forward in your chair. In many social interactions, individuals unconsciously align their body postures or mannerisms to each other. This engagement in behavioral mimicry has been termed the Chameleon effect (Chartrand & Bargh, 1999), referring to the chameleon-like way in which interaction partners "merge" with their social surroundings (Chartrand & Bargh, 1999; Chartrand & Lakin, 2013; Heyes, 2011; Lakin & Chartrand, 2003). The Chameleon effect has been ascribed multiple socially beneficial functions, such as affiliating and bonding with others (Lakin & Chartrand, 2003; Lakin, Jefferis, Cheng, & Chartrand, 2003; Stel & Vonk, 2010), stabilizing group cohesiveness (Lakin, et al., 2003), and enhancing prosocial behavior (Van Baaren, Holland, Kawakami, & Knippenberg, 2004; Van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009). Moreover, contextual factors such as liking of the interaction partner (Stel et al., 2010), or the goal to affiliate with him or her (Lakin & Chartrand, 2003), have been shown to enhance behavioral mimicry. Conversely, decreased mimicry has been observed in situations in which it is advantageous to inhibit mimicry (Brass, Zysset, & von Cramon, 2001; Spengler, von Cramon, & Brass, 2009), such as disliking an interaction partner (Stel, et al., 2010) or not wanting to affiliate with him or her (Johnston, 2002).

Mimicry thus seems to be regulated in a versatile fashion to different affiliative motives. The present study aimed to identify the (neural) processes engaged in such a flexible regulation of mimicry, in order to gain a better understanding of the role of mimicry in the implicit regulation of social interaction. To this end, we investigated whether and how mimicry of arbitrary finger lifting movements is modulated by salient social signals, i.e., the emotional expressions (happy *vs* angry) and group-membership (in- *vs* out-group) of putative interaction partners.

However, behavioral mimicry has thus far mostly been studied by social psychologist, using naturalistic paradigms, which usually manipulated or measured the frequency of mimicking acts in interactions between a participant and a confederate (Chartrand & Bargh, 1999; Lakin, Chartrand, & Arkin, 2008; Stel, et al., 2010; Stel & Vonk, 2010; Van Baaren, et al., 2004; Van Baaren, et al., 2009). While such naturalistic paradigms have high ecological validity, they suffer from a number of limitations. For one, they are limited in their ability to experimentally control social cues relevant for social interactions, such as emotion displays or eye contact. Secondly, measuring the frequency of mimicry provides only a crude quantification of the extent of behavioral mimicry. Also, behavioral measures alone are limited in identifying the underlying processes regulating mimicry. While neural measures would be more informative in this respect, naturalistic paradigms are hardly suitable for use in neuroimaging experiments, which usually require repeated trials, and whose measurement constraints mostly preclude the investigation of naturalistic social interaction.

Automatic imitation paradigms have therefore been proposed as laboratory models of mimicry (Heyes, 2011), providing an intriguing possibility to study the neural bases of chameleon-like mimicry effects to varying social cues (Heyes, 2011; Klapper, Ramsey, Wigboldus, & Cross, 2014; Wang & Hamilton, 2012, 2014, 2015; Wang, Newport, & Hamilton, 2011; Wang, Ramsey, & Hamilton, 2011). Central to automatic imitation paradigms is the notion that the mere observation of a movement triggers motor resonance processes that facilitate the execution of this very movement (Brass, Bekkering, Wohlschläger, & Prinz, 2000). The label "automatic", in this context, refers to the fact that the perception-action link operates independently of the explicit intentions of the individual exerting it, as participants are instructed to respond to a number cue (e.g., with a finger-lifting movement (Brass et al., 2000)), but are "automatically" influenced by a simultaneously displayed movement (e.g., a congruent or incongruent finger-lifting movement) acting as a distractor irrelevant to the task at hand (Heyes, 2011).

Notably, there is consistent evidence that situational and contextual variables implicitly modify automatic imitation (Grecucci, Koch, & Rumiati, 2011; Klapper et al., 2014; Leighton, Bird, Orsini, & Heyes, 2010; Wang & Hamilton, 2012, 2014, 2015; Wang, Newport, et al., 2011; Wang, Ramsey, et al., 2011). For instance, automatic imitation has been shown to be modulated by pro-versus antisocial primes (Leighton, et al., 2010; Wang & Hamilton, 2015), the social status of the interaction partner (Wang & Hamilton, 2012), or the occurrence of direct eye-contact (Wang, Newport, et al., 2011; Wang, Ramsey, et al., 2011). Studies by Losin, Iacoboni, Martin, Cross, and Dapretto (2012) & Losin, Cross, Iacoboni, and Dapretto (2014) have investigated the modulation of conscious imitation (i.e., instructed imitation of gestures) by group-membership. Importantly, the results suggest that it is the implicit perception of the out-group's social status and not ethnic[1] similarity per se which modulates conscious imitation and underlying

[1] Note that although the term "racial" has been mostly used in previous work, this term and its use has some problematic connotations in its public use (for instance motivating measures against certain racial groups based on their presumed "biologically determined" inferiority). We therefore prefer to use the term "ethnicity" as a more neutral description of what we are dealing with – i.e., differences between individuals in socio-cultural and physical, but not in biological-genetic terms (AAPA, 1996; see also (Lamm & Majdandžić, 2015; Riečanský, Paul, Kölble, Stieger, & Lamm, 2014).