Available online at www.sciencedirect.com
ScienceDirect
Cognition 104 (2007) 1–18
COGNITION
www.elsevier.com/locate/COGNIT

Spontaneous facial mimicry in response to dynamic facial expressions ☆

Wataru Sato [a,*], Sakiko Yoshikawa [b]

[a] *Department of Psychology, Graduate School of Letters, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8501, Japan*

[b] *Department of Cognitive Psychology in Education, Graduate School of Education, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8501, Japan*

Received 4 January 2006; revised 3 May 2006; accepted 5 May 2006

Abstract

Based on previous neuroscientific evidence indicating activation of the mirror neuron system in response to dynamic facial actions, we hypothesized that facial mimicry would occur while subjects viewed dynamic facial expressions. To test this hypothesis, dynamic/static facial expressions of anger/happiness were presented using computer-morphing (Experiment 1) and videos (Experiment 2). The subjects' facial actions were unobtrusively videotaped and blindly coded using Facial Action Coding System [FACS; Ekman, P., & Friesen, W. V. (1978). *Facial action coding system.* Palo Alto, CA: Consulting Psychologist]. In the dynamic presentations common to both experiments, brow lowering, a prototypical action in angry expressions, occurred more frequently in response to angry expressions than to happy expressions. The pulling of lip corners, a prototypical action in happy expressions, occurred more frequently in response to happy expressions than to angry expressions in dynamic presentations. Additionally, the mean latency of these actions was less than 900 ms after the onset of dynamic changes in facial expression. Naive raters recognized the subjects' facial reactions as emotional expressions, with the valence corresponding to the dynamic facial expressions that the subjects were viewing. These results indicate that dynamic facial expressions elicit spontaneous and

☆ This manuscript was accepted under the editorship of Jacques Mehler.

* Corresponding author. Tel./fax: +81 75 771 2896.
E-mail address: L50158@sakura.kudpc.kyoto-u.ac.jp (W. Sato).

doi:10.1016/j.cognition.2006.05.001

rapid facial mimicry, which functions both as a form of intra-individual processing and as inter-individual communication.

Keywords: Facial mimicry; Dynamic facial expressions; Mirror neuron

1. Introduction

Communication through facial expressions of emotion plays an important role in social coordination (Keltner & Kring, 1998). Through the evolutionary process, facial expressions would have helped humans take collective actions during danger and forming intimate relationships with other individuals. Consistent with this idea, psychophysiological studies using facial electromyography (EMG) indicate that facial expressions elicit facial muscular activity congruent with the presented facial expressions. For example, Dimberg (1982) showed that mere photographic presentations of angry and happy facial expressions induced spontaneous corrugator supercilii muscle activity (brow lowering actions, prototypical in angry facial expressions) and zygomatic major muscle activity (lip corner pulling actions, prototypical in happy facial expressions), respectively. This facial muscular activity may be interpretable as mimicking behavior or "facial mimicry" (Hess, Philippot, & Blairy, 1999). Dimberg, Thunberg, and Elmehed (2000) reported that facial EMG activity occurred even without awareness of the specific facial expression, confirming the spontaneous nature of the responses. This facial reaction occurs rapidly; Dimberg and Thunberg (1998) showed that facial EMG activity occurred after only 500 ms of exposure to the facial pictures. These data imply that facial muscle activity that may relate to facial mimicry occurs spontaneously and rapidly in response to facial expressions.

However, there is little evidence as to whether the facial muscle activity revealed by EMG recordings is externally visible as facial mimicry. This point is crucial because if overt facial mimicking occurs when perceiving facial expressions of emotion, then this facial motor activity could function not only in intra-individual processing, such as empathic understanding, but also in inter-individual communication. Although developmental studies have demonstrated that neonates exhibit overt facial mimicry of adult facial expressions (Meltzoff & Moore, 1977; Field, Woodson, Greenberg, & Cohen, 1982), the visibility of facial activity has not been explicitly measured in EMG studies with adult subjects. As these facial EMG amplitude changes are very subtle (a few microvolts), facial muscle activities may not be visible (cf. Cacioppo, Petty, Losch, & Kim, 1986).

With regard to the mechanism of facial mimicry, recent neuroscientific evidence provides the clue, pointing to the involvement of motor-related brain areas in social communication. Single-unit recording studies in monkeys have revealed that specific neurons in the ventral premotor cortex (area F5) discharge both when the monkey performs specific hand actions and when it observes experimenters performing similar actions; These neurons have been named "mirror neurons" (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). A recent