Emotion
2011, Vol. 11, No. 3, 687–690

1528-3542/11/$12.00 DOI: 10.1037/a0023163

BRIEF REPORT

When Does Mimicry Affect Evaluative Judgment?

Francesco Foroni and Gün R. Semin
Utrecht University

We investigated the effect of subliminally presented happy or angry faces on evaluative judgments when the facial muscles of participants were free to mimic or blocked. We hypothesized and showed that subliminally presented happy expressions lead to more positive judgments of cartoons compared to angry expressions *only* when facial muscles were not blocked. These results reveal the influence of *socially* driven embodied processes on affective judgments and have also potential implications for phenomena such as emotional contagion.

Keywords: emotion contagion, embodied cognition, emotion mimicry

What happens when you see somebody smiling? Earlier research has demonstrated that the *repeated* pairing of a target cartoon figure with subliminally presented positive (or negative) emotional expressions (Niedenthal, 1990) or the *repeated* association of a neutral stimulus with affect-arousing photos (Krosnick, Betz, Jussim, & Lynn, 1992) induces, respectively, a positive (or negative) impression of the neutral stimulus and leads to the formation of an attitude toward the stimulus. These research findings can be seen as instances of evaluative conditioning where the repeated pairing of an otherwise neutral stimulus with one that is evaluatively loaded produces a change in evaluation (e.g., De Houwer, in press). The focus of the current research is on *how* and *why* being exposed to a single positive or negative emotional expression shapes the evaluation of a novel stimulus.

A well-known, robust phenomenon is that people mimic facial expressions of anger or happiness, even when such photos are presented subliminally (e.g., Dimberg, Thunberg, & Elmehed, 2000; Dimberg, Thunberg, & Grunedal, 2002). However, the implications of such mimicry have not been investigated. Recently, Winkielman and his colleagues (Winkielman, Berridge, & Wilbarger, 2005) have shown that the subliminal presentation of emotional faces may influence consequential behavior toward a product (e.g., amount of drinking when we are thirsty). More important, we know from earlier research by Strack, Martin, and Stepper (1988) that the *mechanical inducement* of a smile (i.e., zygomatic major) by means of a pen held between one's teeth influences judgments of how funny a cartoon is. These two research strands, namely mimicry and the consequences of facial feedback, inspired the current research. The question we addressed is: does exposure to a subliminally presented facial expression of a happy (or angry) face, known to induce activation of the same facial muscles in a perceiver, influence a perceiver's judgments of a novel stimulus in a manner comparable to the mechanical activation of a smile? This formulation focuses on a social-influence process driven by the symmetry of facial expression of emotion between producer and perceiver. The resonance of the perceiver's facial muscles to the expressions displayed by the producer is assumed to provide the *proprioceptive feedback* influencing evaluative judgments. This conclusion is further strengthened by recent research showing that subcutaneous injections of botulinum toxic-A (BTX) paralyzing specific facial muscles (e.g., corrugator supercilii) slowed down reading sentences that would normally require the paralyzed muscle for their expression: namely, sentences involving frowning (Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010).

There is by now a considerable literature showing mimicry and contagion effects in humans and other primates, often without any conscious awareness or control by the individuals involved (see Hatfield, Cacioppo, & Rapson, 1994). Recent research on the perception of emotional expressions (Niedenthal, Winkelman, Mondillon, & Vermeulen, 2009) suggests that the processing of emotional expressions entails the reactivation of those neural states that are involved in their production. Although earlier research had not specified the neurophysiological mechanisms underlying these effects, current research suggests that observers of people experiencing different emotions recruit the neural processes activated during the experience of these emotions. Briefly, the findings suggest that observing facial expressions of disgust and feelings of disgust activate similar sites in the anterior insula and anterior cingulate cortex (e.g., Wicker et al., 2003), a neurally driven process referred to as "empathy" (e.g., Decety, 2005; Jabbi, Swart, & Keysers, 2007). Human experiments with single neuron recordings have revealed that the observation of pain and its experience activate the same neurons (Hutchison, Davis, Lozano, Tasker, & Dostrovsky, 1999). The argument developed by a number of researchers (e.g., Adolphs, 2006; Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Decety, & Grèzes, 2006) on emotional "mir-

Francesco Foroni and Gün R. Semin, Faculty of Social and Behavioral Sciences, Utrecht University, Utrecht, the Netherlands.

This research was supported by the Royal Netherlands Academy of Arts and Sciences (ISK/4583/PAH to Gün R. Semin).

Correspondence concerning this article should be addressed to Francesco Foroni, Faculty of Social and Behavioral Sciences, Utrecht University, Heidelberglaan, 1 - 3584 CS Utrecht, the Netherlands. E-mail: F.Foroni@uu.nl

roring" suggests a neurally driven "empathy" process in observers. Cumulatively, this research suggests that "mirroring" first noted for actions is also applicable to emotion (cf. Adolphs, 2006).

Although the evidence for a symmetry between production and perception of emotion in general and emotional expressions in particular is strong, there is, to date, no evidence showing that observing or perceiving another's facial expression influences an observer's online evaluative judgments via motor resonance. The aim of the current research was to examine whether exposure to facial expressions of emotion (i.e., smiling and frowning faces) known to induce resonance of facial muscles between producer and perceivers tune perceivers' evaluative judgments and whether blocking resonance inhibits these judgmental consequences.

Overview

We examined whether subliminal exposure to happy (and angry) faces influences observers' evaluative judgments of cartoons, and whether this is due to observer's facial muscles resonating to observed facial expressions of emotion. To this end, cartoons were judged after subliminal exposure to happy and angry faces under two different conditions. In the first condition, participants' facial smiling muscles (zygomatic major) were not inhibited (no-blocking condition) while in another condition participants' facial muscles were mechanically inhibited (blocking condition) by getting participants to hold a pen between their lips (see below for details).

We predicted that the subliminal presentation of faces with emotional expressions (happy vs. angry) would influence judgments of how funny a cartoon is, whereby smiling faces were expected to produce higher funniness ratings than frowning faces. Moreover, we expected that this effect would be present only when participants' facial muscles are not blocked, thus permitting facial muscles to resonate to the emotional expression of the target. One might argue for a priming account for the predicted effects suggesting that positive facial expressions as primes enhance a positive evaluation, whereas negative faces as primes enhance a negative evaluation. However, if this was the case, then one would expect no differences between the blocking and no-blocking conditions.

The differential pattern of results we predict would for the first time directly confirm that the simulation of the facial expressions displayed by a target is responsible for shaping the evaluative judgments of the observer. The resulting design was a two factorial with emotional expression (happy vs. angry) and muscle condition (no-blocking vs. blocking) as the two between-participant variables.

Method

Participants and Stimuli

One hundred twenty-seven students (82 females; mean age: 21.1) participated in this experiment on a paid voluntary basis. Two sets of stimulus material were used. The first consisted of 24 cartoons, selected on the basis of a pretest from a larger pool with funniness ratings that were around scale midpoint. The second set contained photos of three men and three women (from KDEF face database: Lundqvist, Flykt, & Öhman, 1998). Two photos of each stimulus person were used (one with a smiling and the other with a frowning expression). This set contained a total of 12 different photos.[1]

Procedure

Upon arrival, participants were led to individual cubicles where the experiment was presented as a computer-administered investigation on the relationship between humor and cognitive processes. Participants were instructed to rate on a 9-point scale from 1 (not funny at all) to 9 (extremely funny) the degree to which a set of cartoons was funny. Participants were also informed that they were to perform a simple reaction-time task intermixed with the main task of rating the cartoon. Participants assigned to the blocking condition were also informed that they had a secondary coordination task, namely, holding a pen in their mouths. The experimenter explained and demonstrated how the pen should be held (with the lips in a "kiss-like" position and the pen straight out of the mouth)[2] and then ascertained that the participant understood how the pen should be held.

The cartoon-rating phase consisted of 12 trials. For each trial, a cartoon was selected randomly from a set of 24 cartoons and was then randomly paired with one of the six faces (depending on the experimental condition, these were either only happy or only angry faces). Each trial started with a fixation point. After a variable interval (between 500 and 1,500 ms), a face appeared (for 30 ms) forward- and backward-masked by a scrambled neutral picture (both masks were presented for 30 ms). Participants were instructed to press the space bar as soon as they saw a flash on the screen (i.e., the reaction-time task). Then, the cartoon appeared and stayed on the screen until the participant read the caption and entered a funniness rating. During the 12 trials, the participants in the blocking condition hold the pen in their mouth as instructed. At the end of the experiment, participants were debriefed via an increasingly direct and explicit set of questions. The debriefing revealed that participants did not infer the purpose of the experiment.

Results and Discussion

Funniness ratings for the 12 cartoons were aggregated to yield a funniness score.[3] An analysis of variance of the funniness ratings was

[1] These 12 photos (six happy and six angry expressions) were piloted with an independent sample of participants. Participants were exposed to the pictures one at the time while their facial electromyography (EMG) was recorded on their zygomatic major and corrugator supercilii muscle regions. This set of pictures induced somatic facial muscle mimicry comparable to those obtained in earlier research (e.g., Dimberg et al., 2000).

[2] This position has been used earlier (e.g., Foroni & Semin, 2009; Strack et al., 1988) and is known to inhibit muscle activation. This position requires strong, continuous muscle activation, which prevents any differential muscle responses during perception. Thus, by inducing irrelevant and constant activation (i.e., muscular noise), the possibility of mimicry is excluded. Oberman et al. (2007) used two different blocking manipulations and showed that only constant and irrelevant muscle activation prevents differential muscle responses during perception.

[3] To ensure the use of only those trials where participants were attending to the subliminal presented facial stimulus, ratings for which the reaction time (RT) on the reaction-time task were too slow (RTs $>$ 1,500 ms), indicating no attention to the subliminal stimulus was excluded as done in other research (e.g., Foroni & Semin, 2009; excluded trials in total: 10.7%). Results including those trials show similar pattern of results, but slightly reduced power probably because the trials where the face was not attended show no modulation on the consequent rating.

performed with emotional expression (happy vs. angry), muscle condition (no-blocking vs. blocking), and participant gender as predictors. As predicted by the main hypothesis, the expected two-way interaction between emotional expression and muscle condition (see Figure 1) was significant, $F(1, 119) = 3.89$, $p = .05$. Further analyses revealed that (again, as predicted) participants in the no-blocking condition rated the cartoons as significantly funnier when presented with smiling ($M = 4.96$, $SD = 1.06$) than with frowning faces ($M = 4.10$, $SD = 1.57$), $t(55) = 2.55$, $p = .01$. In contrast and again as predicted, the blocking condition showed no systematic tendency, $t(61) < 1$.

Additionally, there were some effects of less theoretical interest, such as the main effect for emotional expression, indicating that smiling faces produced higher funniness ratings ($M = 4.62$, $SD = 1.20$) than frowning faces ($M = 4.24$, $SD = 1.34$), $F(1, 119) = 6.25$, $p = .01$. Moreover, participant gender showed a significant effect, $F(1, 119) = 6.06$, $p = .02$. Male participants rated the cartoons as funnier ($M = 4.77$, $SD = 1.40$) than female participants ($M = 4.26$, $SD = 1.18$). The two-way interaction between gender and emotional expression was also significant, showing that male participants, relative to female, showed a larger difference in their ratings as a function of the emotional expression condition (happy vs. angry faces), $F(1, 119) = 5.23$, $p = .02$.

The chief results that were predicted reveal that participants' funniness judgments were affected, despite the fact that they were unaware of being exposed to faces expressing happiness or anger. Further, and most important, this data pattern was obtained only in the no-blocking condition and not in the blocking condition.

General Discussion

The study presented here was designed to test whether spontaneous and automatic muscle mimicry induced by subliminal exposure to happy and angry faces tunes our judgments. The results show that subliminal exposure to facial expressions influences evaluative judgments of cartoons. When participants are subliminally exposed to happy faces, they rate cartoons as funnier than when they are exposed to angry faces. We argued that this difference is due to observers' muscles resonating to the observed facial expression on the photo and not to an evaluative difference between positive and negative stimuli (happy vs. angry) or to mere priming effects. In order to exclude this alternative possibilities, we manipulated the presence or absence of muscle resonance by mechanically blocking the activation of the zygomatic major (Winkielman, Niedenthal, & Oberman, 2008). This manipulation inhibits mimicry by inducing continuous facial muscle activation that is irrelevant to the task (cf. Oberman et al., 2007). The reported results confirmed that the presentation of facial expressions (e.g., smiling and frowning) shapes evaluative judgments only when participants' muscles are free to resonate with a target's facial expression (no-blocking condition). This clearly excludes alternative explanations (e.g., priming effects), and supports the hypothesis that the operation of a spontaneous automatic muscle mimicry process, that we know is induced by the simple exposure to facial expressions (e.g., Dimberg et al., 2000), shapes our judgments.

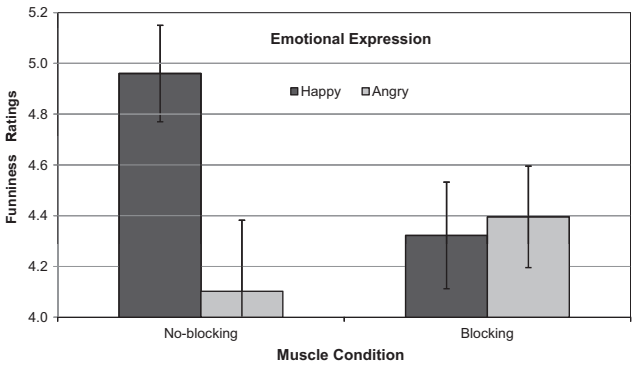

Figure 1. Funniness ratings as a function of emotional expression and muscle condition (means and standard error).

An alternative argument that can be put forward is whether holding a pen creates a situation introducing more effort or more distraction relative to the no-blocking condition. That this is not the case is evident for two reasons. First, as earlier research has shown, holding a pen *per se* does not inhibit mimicry; what is important is whether the position prevents any differential muscle responses during perception (see footnote 2 and Oberman et al., 2007). Second, to exclude the potential argument that the pen may introduce extra attentional demands and thus have a distracting effect, we analyzed the reaction times of the participants' responses to indicate that there was a flash on the monitor (the subliminal face presentation). An analysis of these data (design: 2 muscle condition $\times$ 2 emotion expression $\times$ 2 gender) revealed no main effects or interactions (all Fs < 1.0). These data suggest that there was no difference in difficulty or effort between the two critical muscle conditions.

In conclusion, it appears that the resonance process suggested here shapes evaluative judgments by providing proprioceptive feedback (Strack et al., 1988) influencing the judgment stage and guiding the understanding of our own emotional states (e.g., Gallese, 2005; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). The current results are also in line with embodied theories (Barsalou, 2008) and embodied accounts of emotional perception (Niedenthal et al., 2009). Further, they also provide an embodied account for phenomena such as emotional contagion (e.g., Lundqvist & Dimberg, 1995) or even "canned laughter." Seeing someone smiling induces muscle simulation in a perceiver (e.g., Dimberg et al., 2000), and this in turn enhances the likelihood of inducing a smiling and a positive evaluative response.

Finally, we argue that the effect of muscle mimicry should apply to a range of emotions associated with distinct facial expressions, and future research should test this prediction. Because the effect on judgment is shown here to be a byproduct of the muscle mimicry, then the absence of mimicry or reduced degree of mimicry (e.g., Lanzetta & Englis, 1989; McHugo, Lanzetta, & Bush, 1991) should lead to no or reduced effects. A second important implication of these arguments is that if the somatosensory system is busy with the execution of an action, or is immobilized (blocked) as in this research, or temporarily paralyzed as in the cosmetic use of BTX (Havas et al., 2010), the effect on judgment should not be present. This could also be the case for individuals with autism spectrum disorders that do not show spontaneous facial mimicry (e.g., McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006). These patients show, among others, impairment in understanding other people's emotional states (Oberman et

al., 2007), and the lack of facial mimicry could be one of the reasons. Notably, what is proposed here is not an individual-centered process as in earlier research (e.g., Strack et al., 1988), but a *social* one (Semin & Cacioppo, 2008): seeing somebody smiling induces a simulation of the smiling muscles for an observer and thereby provides internal information that shapes the observer's evaluative judgment of a novel stimulus in the field.

References

Adolphs, R. (2006). How do we know the minds of others? Domain specificity, simulation, and enactive social cognition. *Brain Research, 1079,* 25–35.

Barsalou, L. H. (2008). Grounded cognition. *Annual Review of Psychology, 59,* 647–672.

Carr, L., Iacoboni, M., Dubeau, M.-C., Mazziotta, J. C., & Lenzi, G. L. (2003). Neural mechanisms of empathy in humans: A relay from neural systems for imitation to limbic areas. *Proceedings of the National Academy of Sciences, USA, 100,* 5497–5502.

Decety, J., & Grèzes, J. (2006). Multiple perspectives on the psychological and neural bases of understanding other people's behavior. *Brain Research, 1079,* 4–14.

Decety, L. (2005). Perspective taking as the royal avenue to empathy. In B. F. Malle & S. D. Hodges (Eds.), *Other minds: How humans bridge the divide between self and other*. New York: Guilford.

De Houwer, J. (in press). Evaluative conditioning: A review of procedure knowledge and mental process theories. In T. R. Schachtman & S. Reilly (Eds.), *Application of learning and conditioning*. Oxford, United Kingdom: Oxford University Press.

Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science, 11*, 86–89.

Dimberg, U., Thunberg, M., & Grunedal, S. (2002). Facial reactions to emotional stimuli: Automatically controlled emotional responses. *Cognition & Emotion, 16*, 449–472.

Foroni, F., & Semin, G. R. (2009). Language that puts you in touch with your bodily feelings: The multimodal responsiveness of affective expressions. *Psychological Science, 20,* 974–980.

Gallese, V. (2005). "Being like me": Self-other identity, mirror neurons, and empathy. In S. Hurley & N. Chater (Eds.), *Perspectives on imitation: From neuroscience to social science: Vol. 1: Mechanisms of imitation and imitation in animals*. Cambridge, MA: MIT Press.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). *Emotional contagion*. New York: Cambridge University Press.

Havas, D., Glenberg, A., Gutowski, K., Lucarelli, M., & Davidson, R. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. *Psychological Science, 21,* 895–900.

Hutchison, W. D., Davis, K. D., Lozano, A. M., Tasker, R. R., & Dostrovsky, J. O. (1999). Pain-related neurons in the human cingulate cortex. *Nature-Neuroscience, 2,* 403–405.

Jabbi, M., Swart, M., & Keysers, C. (2007). Empathy for positive and negative emotions in the gustatory cortex, *Neuroimage, 34,* 1744–1753.

Krosnick, J. A., Betz, A. L., Jussim, L. J., & Lynn, A. R. (1992). Subliminal conditioning of attitudes. *Personality and Social Psychology Bulletin, 18,* 152–162.

Lanzetta, J. T., & Englis, B. G. (1989). Expectations of cooperation and competition and their effects on observers' vicarious emotional responses. *Journal of Personality and Social Psychology, 33,* 354–370.

Lundqvist, D., Flykt, A., & Öhman, A. (1998). *The Karolinska directed emotional faces—KDEF* [CD-ROM]. Stockholm: Department of Clinical Neuroscience, Karolinska Institute.

Lundqvist, L. O., & Dimberg, U. (1995). Facial expressions are contagious. *International Journal of Psychophysiology, 9,* 203–211.

McHugo, G. J., Lanzetta, J. T., & Bush, L. K. (1991). The effect of attitudes on emotional reactions to expressive displays of political leaders. *Nonverbal Behavior, 15,* 19–41.

McIntosh, D. N., Reichmann-Decker, A., Winkielman, P., & Wilbarger, J. L. (2006). When the social mirror breaks: Deficits in automatic, but not voluntary mimicry of emotional facial expressions in autism. *Developmental Science, 9,* 295–302.

Niedenthal, P. M. (1990). Implicit perception of affective information. *Journal of Experimental Social Psychology, 26,* 505–527.

Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, and emotion. *Personality and Social Psychology Review, 9*, 184–211.

Niedenthal, P. M., Winkielman, P., Mondillon, L., & Vermeulen, N. (2009). Embodiment of emotion concepts: Evidence from EMG measures. *Journal of Personality and Social Psychology, 96,* 1120–1136.

Oberman, L., Winkielman, P., & Ramachandran, S. (2007). Face to face: Blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience, 2,* 167–178.

Semin, G. R., & Cacioppo, J. T. (2008). Grounding social cognition: Synchronization, entrainment, and coordination. In G. R. Semin & E. R. Smith (Eds.), *Embodied grounding: Social, cognitive, affective, and neuroscientific approaches* (pp. 119–148). New York: Cambridge University Press.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile - a nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology, 54*, 768–777.

Wicker, B., Keysers, C., Plailly, J., Royet, J.-P., Gallese, V., & Rizzolatti, G. (2003). Both of us disgusted in my insula: The common neural basis of seeing and feeling disgust. *Neuron, 40,* 655–664.

Winkielman, P., Berridge, K. C., & Wilbarger, J. L. (2005). Unconscious affective reactions to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin, 31,* 121–135.

Winkielman, P., Niedenthal, P. M., & Oberman, L. (2008). The embodied emotional mind. In G. R. Semin & E. M. Smith (Eds.), *Embodied grounding: Social, cognitive, affective, and neuroscientific approaches*. New York: Cambridge University Press.

Received December 17, 2008
Revision received May 4, 2010
Accepted January 2, 2011 ■