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Automatic facial responses to near-threshold presented facial displays of emotion: Imitation or evaluation?

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ABSTRACT

Automatic facial reactions to near-threshold presented facial displays of emotion can be due to motor-mimicry or evaluation. To examine the mechanisms underlying such automatic facial responses we presented facial displays of joy, anger, and disgust for 16.67 ms with a backwards masking technique and assessed electromyographic activity over the zygomaticus major, the levator labii, and the corrugator supercilii. As expected, we found that participants responded to displays of joy with contractions of the zygomaticus major and to expressions of anger with contractions of the corrugator supercilii. Critically, facial displays of disgust automatically activated the corrugator supercilii rather than the levator labii. This supports the notion that evaluative processes mediate facial responses to near-threshold presented facial displays of emotion rather than direct mimicry of emotional facial features.

1. Introduction

Facial expressions of emotions are highly significant social signals. Given the frequency of exposure in everyday life, it is not surprising that facial displays of emotion can be processed automatically. A fascinating finding demonstrated that congruent automatic facial responses occur even to subliminally presented facial displays of emotion (Dimberg, Thunberg, & Elmehead, 2000). In their study, participants' electromyographic (EMG) facial responses to subliminal presentations of angry, smiling, or neutral facial displays evoked congruent muscle responses in the viewer; the zygomaticus was activated by happy, the corrugator muscle by angry faces even though these faces were not consciously perceived. In the current research we focus on the mechanisms by which these congruent facial responses to subliminally presented facial displays occur. We will compare two alternative explanations that may account for such facial responses under such limited information processing conditions.

2. Motor-mimicry

One mechanism that might account for congruent facial responses to subliminally presented facial displays of emotion is the tendency to spontaneously mimic these behaviors. The tendency to unintentionally imitate the behavior of observed others is seen as a basis for various forms of social behavior such as affiliation, rapport, emotional contagion or pro-social behavior (Preston & de Waal, 2002). Lipps (1907) was among the first to propose that empathy hinges on unintentional imitation of others. There is a growing interest in imitation which is often also referred to as motor-mimicry (Bavelas, Black, Lemery, & Mullet, 1987). It has been suggested, that such automatic motor-mimicry is mediated by a common process underlying both, decoding of the perceived stimuli and the generation of the motor response. Interestingly, motor-mimicry is seen as an outflow action control system insofar as the representational format of perception and generation of behavior overlaps (Prinz, 1990). Importantly, such a common representational format of stimulus and response would suggest that specific perceptions would specifically trigger corresponding motor responses, that is, perceiving discrete emotions (such as a display of disgust) should result in emotion specific motor-mimicry (such as an expression of disgust).

On a neuronal level, so called mirror neurons that are activated by one's own performance of an action and the observation of that action are seen as a prerequisite for motor-mimicry (Rizzolatti

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& Craighereo, 2004). In a similar vein, so called embodiment approaches (Barsalou, 1999; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005) argue that concepts are represented amodal, so that bodily reactions and sensations are partly reenacted when the respective concept is activated. This reenactment helps to understand for example the facial display of someone else. According to Gallese (2001) actions, emotions and sensations experienced by others become meaningful to us because we share them with them.

3. Evaluative processes

Another mechanism that might account for congruent facial responses to subliminally presented facial displays of emotion is fast automatic evaluative processes. From this point of view, the subliminal angry or smiling faces in the Dimberg et al. (2000) study may have automatically activated evaluative processes which in turn may have activated corresponding muscle responses. From our point of view, this account is more plausible than the motor-mimicry assumption: First, it is consistent with the view that the evaluative content of subliminally presented information is processed automatically (Murphy & Zajonc, 1993). Second, it is more parsimonious and it can account for responses to masked presentations of facial displays and to abstract concepts such as words. It has been shown with affective priming (Fazio, 2001) that attitudes can automatically activate congruent evaluative responses. Moreover, there is evidence that automatic evaluative processes can initiate action tendencies such as approach or avoidance (Lang, Bradley, & Cuthbert, 1990). In line with this view, a recent review indicated that only few studies show mimicry of discrete emotions and concludes that extant evidence rather supports valence-based mimicry (Hess & Fischer, 2013).

Based on these arguments we suggest that very brief masked presentations of facial displays of emotions are automatically analyzed according to their valence. Motor-mimicry would require a more extensive analysis of the presented prime stimuli which is prevented by the brief masked presentation. Thus, all positive expressions should entail activation of the zygomaticus major whereas all negative expressions are expected to activate the corrugator supercilii. Note that we do not doubt that perceivers are able to differentiate between emotional expressions at a more specific level than just positive versus negative emotions. The most interesting question in the current context however is, if a masked presentation of a facial expression is sufficient to trigger motor-mimicry or if evaluative processes are triggered under such limited conditions. Apparently, at very short stimulus presentation durations, participants are still able to detect the valence of the stimulus although they are unable to detect the semantic content, or differentiate between specific emotions of the same valence (Bargh, Litt, Pratto, & Spielman, 1989). At the same time, there is evidence that valence is extracted from subliminally presented facial expressions (Murphy & Zajonc, 1993) and even from words (Greenwald, Klinger, & Schuh, 1995). Based on these findings we suggest that very briefly presented facial displays of disgust activate the corrugator supercilii muscle in the viewer rather than the levator labii muscle. More specifically, briefly presented facial displays of disgust automatically trigger a negative evaluation which in turn leads to an activation of the corrugator supercilii muscle.

4. Responses to facial disgust

One way to find an answer to the question if mimicry or evaluative responses mediate the influence of subliminally presented facial expressions of emotion might be to employ a facial expression that encompasses emotion specific muscle contractions. In this respect, the facial expression of disgust may be particularly interesting because this emotional expression includes the activation of facial muscles that are unique as well as facial muscle that also occur in other negative emotions. Research revealed that facial responses to disgust are characterized by contractions of the corrugator supercilii and the orbicularis oculi that are also part of other negative emotional expressions (de Jong, Peter, & Vanderhallen, 2002; Vrana, 1993; Wolf et al., 2005). Unique to the facial expression of disgust, however, is the wrinkling of the nose which requires contractions of the levator labii muscle (de Jong et al., 2002; Vrana, 1993; Wolf et al., 2005; Yartz & Hawk, 2002). Interestingly, the levator labii muscle is not only activated in response to disgust stimuli but also in response to facial expressions of disgust in others. For example, Blairy, Herrera, and Hess (1999) exposed participants to supraliminally presented facial expressions of disgust, happiness, anger, sadness and fear. In two studies, mimicry effects were observed for all target expressions except of the fear expression. Most interestingly, for the decoding of the disgust expression, higher levator labii alleque nasii than both orbicularis oculi and corrugator supercili were obtained. Similarly, Lundqvist (1995) observed that the levator labii is activated in response to the sight of a facial expression of disgust. Oberman, Winkielman, and Ramachandran (2007) observed that blocking mimicry of cheek and mouth regions impairs explicit recognition of happiness and disgust. This research supports the idea that one function of mimicry is to facilitate the recognition of other persons' emotions.

Taken together, these findings show that the levator labii is activated in response to both disgust stimuli and facial expressions of disgust. Apparently, the fact that disgust stimuli and facial expression of disgust trigger the same facial response in the viewer might be due to the fact the anterior insula is a common substrate that can by activated by both kinds of stimuli (Wicker et al., 2003).

5. Overview

In order to examine the mechanisms of automatic facial responses to facial displays of emotion in more detail, we closely followed the experimental design of Dimberg et al. (2000), with five exceptions: First of all, instead of a condition with neutral facial expressions, we included a condition with facial displays of disgust. The rationale was that the contraction of the levator labii is highly specific for the expression of disgust which has been shown in previous research (de Jong et al., 2002; Vrana, 1993; Wolf et al., 2005). Thus, if spontaneous facial responses to facial displays of emotion were due to mimicry, backward-masked facial displays of disgust should be sufficient to activate the levator labii in observers. On the other hand, if backward-masked facial displays primarily trigger evaluative processes, the presentation of a disgust expression should trigger a negative evaluation leading to the activation of the corrugator supercilii muscle. According to the Facial Action Coding System the corrugator supercilii is part of the facial display of sadness, fear and anger (Ekman & Friesen, 1978). In all other conditions we expect to replicate the findings of Dimberg et al. (2000).

A second difference to the Dimberg et al. (2000) study is that we manipulated the facial expressions used as primes within subjects. Moreover, we used a randomized presentation order of the primes because we considered this to be a more crucial test of our hypothesis. Notably, this helps canceling out potential carry-over effects from one trial to the next due to expectations formed based on rudimentary perception of emotional cues. In order to further decrease possible carry-over effects between trials, we also increased the presentation duration of the masks (11,000 ms) compared to the Dimberg et al. study.