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Modulation of facial mimicry by attitudes

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Abstract

The current experiment explored the influence of attitude on facial reactions to emotional faces. The participants' attitudes (positive, neutral, negative) towards three types of characters were manipulated by written reports. Afterwards participants saw happy, neutral and sad facial expressions of the respective characters while their facial muscular reactions (*M. Corrugator supercilii* and *M. Zygomaticus major*) were recorded electromyografically. Results revealed facial mimicry reactions to happy and sad faces of positive characters, but less and even incongruent facial muscular reactions to happy and sad faces of negative characters. Overall, the results show that attitudes, formed in a few minutes, and only by reports and not by own experiences, can moderate automatic nonverbal social behavior, i.e. facial mimicry.

keywords: facial mimicry, attitudes, interpersonal relationships, emotion

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Modulation of facial mimicry by attitudes

Humans have the tendency to react with congruent facial expressions when looking at an emotional face (e.g. Dimberg, 1982; Dimberg & Thunberg, 1998). This phenomenon of *facial mimicry* is a relevant aspect of non-verbal communication (Dimberg & Thunberg, 1998). Facial mimicry appears to be an automatic and unconscious reaction, because it occurs without awareness or conscious control, cannot be completely suppressed (Dimberg, Thunberg, & Grunedal, 2002) and even occurs in response to subliminally presented emotional expressions (Dimberg, Thunberg, & Elmehed, 2000).

Facial mimicry and mimicry in general create and reinforce smooth and harmonious interactions and strengthen social bonds and relationships (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003). Mirroring the emotional facial display of an interaction partner creates rapport and liking by communicating attention and understanding (Lakin, Jefferis, Cheng, & Chartrand, 2003). But the link between mimicry and the quality of a present relationship is not unidirectional. According to a review by Hess (2001), facial mimicry should only occur in situations where individuals already have a positive or at least neutral relationship. This is because past relationship quality influences the expectations and goals one has for future relationship quality, as well as expectations concerning the goals of the interaction partner. Furthermore, past mimicry behavior should also directly predict future mimicry behavior (Ajzen, 1991). McIntosh (2006) manipulated relationship quality by confronting participants in an interview situation with either a friendly acting confederate with similar habits and tastes or with an annoying confederate with dissimilar habits and tastes. He found that after this episode, the friendly confederate's happy facial expressions were mimicked more than those of the annoying one; whereas no difference could be observed for other emotional expressions.

Furthermore, Hess (2001) also talks about mimicry as a *means* to creating positive relationships. Therefore, a goal to approach or affiliate should lead to more mimicry, and a

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goal to avoid or compete to less mimicry. This has been shown by Lakin and Chartrand (2003) who found that priming participants explicitly or implicitly with a need for affiliation significantly amplified behavioral mimicry of a confederate. Conversely, explicitly inducing a goal to compete reduced congruent facial muscular reactions in a study by Lanzetta and Englis, (1989), and Weyers, Mühlberger, Kund and Pauli (2006) could show reduced patterns of facial mimicry after nonconscious competition priming.

Because affiliation or cooperative goals are most often pursued vis-à-vis persons one likes, a direct link between positive attitudes toward an interaction partner and enhancement of mimicry should have been built. Conversely, goals to avoid further contact and to compete are often pursued vis-à-vis persons one dislikes, thus a link between negative attitudes and suppression of mimicry should have been built. Importantly, according to this rationale, attitude serves as a signal directly influencing behavior – mimicry – even in the absence of explicit or implicit goals with regard to the counterpart. This is the central prediction of the present paper.

Evidence supporting the assumption of a direct link between attitudes and mimicry behavior comes from two different research areas. Studies focusing on motivational orientations showed that evaluative processes in response to attitude objects automatically activate approach and avoidance tendencies and behaviors. For example Solarz (1960) had participants move cards with positive and negative words either towards or away from themselves. He found that participants were faster at moving cards with positive words towards themselves (approach behavior) and cards with negative words away (avoidance behavior) than vice versa. In a similar study, Chen and Bargh (1999) demonstrated that these tendencies can also be activated automatically, i.e. without conscious evaluation of the respective words. Further research affirmed this link between positive attitudes and approach behaviors as well as between negative attitudes and avoidance tendencies for both social and non-social attitude objects (Neumann & Strack, 2000; Neumann, Hülsenbeck, & Seibt, 2004;

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Seibt, Neumann, Nussinson, & Strack, in press). To conclude, the available evidence suggests that positive attitudes automatically instigate approach behavior towards objects and people, and that negative attitudes automatically instigate avoidance behavior. Accordingly, liking of a person should lead to an approach orientation towards her and hence enhanced mimicry, and disliking should lead to an avoidance orientation and hence reduced mimicry.

However, although the impact of mimicry on attitudes is well-studied (e.g., Bavelas, Black, Lemery, & Mullett, 1986; Chartrand & Bargh, 1999), only a few studies focused on the other direction of this relationship – from attitudes to mimicry. In a study using a cross-leg panel technique LaFrance (1979) assessed rapport and posture sharing at two points in time. She found a significant correlation between rapport at time 1 and mimicry at time 2 (r = .58), although the correlation between mimicry at time 1 and rapport at time 2 (r = .77) was significant, too, and even higher. Thus, these data do not allow a clear conclusion whether liking breeds mimicry or whether mimicry breeds liking.

Furthermore, Herrera, Bourgeois and Hess (1998) found that negative racial attitudes towards members of an ethnic out-group result in reduced facial mimicry to pictures of out-group members: French Canadians did not mimic the emotional facial expressions displayed by Japanese actors, although they had no deficits in decoding them. Moreover, the more negative their racial attitudes towards the outgroup members were, the more they showed *incongruent facial reactions*, i.e. an activation pattern contrary to common mimicry reactions. They smiled at expressions of sadness and frowned at expressions of happiness. Further on, Yabar, Johnston, Miles and Peace (2006) could show more behavioral mimicry (touching the face) towards ingroup as compared to outgroup members. In another study designed to investigate the influence of attitudes on facial mimicry, McHugo, Lanzetta and Bush (1991) had participants watch video sequences showing emotional displays of two prominent politicians and found that negative attitudes towards one of the politicians resulted in less congruent facial reactions to this speaker's happy expressions.

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These previous studies, however, did not manipulate attitudes. The results in Herrera et al. (1998) and Yabar et al. (2006) can also be due to shared and non-shared group identity. Shared group identity leads to behavioral assimilation, non-shared identity to contrast (Schubert & Häfner, 2003; Spears, Gordijn, Dijksterhuis, & Stapel, 2004). The results in McHugo et al. (1991) can also be due to shared and non-shared goals. Thus, there is no clear evidence showing that attitudes affect facial mimicry. We predict that facial muscular reactions in response to facial emotional expressions can be modified by experimentally induced explicit attitudes towards the respective sender. Positive attitudes toward a person should cause stronger mimicry of facial expressions of emotions by that person, as compared to neutral and negative attitudes. For the latter, we expect, based on Herrera et al. (1998), incongruent facial muscular expressions. Representing the direct opposite of mimicry, such facial reactions will signal a discouragement of creating a positive relationship and so serve as appropriate means to avoid further contact. Specifically, we expect an increase in *M. Zygomaticus major* (the muscle involved in smiling) activity in response to happy facial expressions with increasing character valence. No differential reactions to neutral or negative faces are expected. For the *M. Corrugator supercilii* (the muscle responsible for frowning), we expect an increase in activity in response to sad faces of positive and neutral characters. Furthermore for negative characters we even expect incongruent facial muscular reactions, i.e. a decrease in *M. Corrugator supercilii* activity in response to sad faces. No differential reactions to happy or neutral faces are expected.

Method

Design and Participants

The design was a 2 (muscle: *M. Corrugator supercilii* vs. *M. Zygomaticus major*) x 3 (emotion: happy vs. neutral vs. sad) x 3 (type of character: positive vs. neutral vs. negative) within-subjects design. A total of twenty-eight female university students participated in the experiment. They were recruited on campus and received 10 € for compensation. Recruitment

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was limited to female subjects because of earlier findings (Dimberg & Lundqvist, 1990) indicating that females show more pronounced, but not qualitatively different mimicry effects than male subjects. Data from 3 participants had to be excluded from analyses due to non-compliance with the instructions. Analyses are based on the remaining sample of 25 females, aged between 19 and 27 years (M = 21.46, SD = 2.24).

Stimuli and Apparatus

Avatar emotional facial expressions. Instead of pictures of humans we used avatar facial emotional expressions to trigger facial mimicry. Avatars (i.e. virtual persons or graphic substitutes for real persons) provide a useful tool for research in emotion and social interactions (Blascovich, Loomis, Beall, Swinth, Hoyt, & Bailenson, 2002), because they allow full control over the facial expression and its dynamics, e.g. its intensity and temporal course (cf. Krumhuber & Kappas, 2005). Furthermore, due to the possibility to use the same prototypical faces for all types of characters there is no need to control for differences in liking and attractiveness between the conditions and a reduced amount of error variance can be assumed. How successfully an avatar can be used as a research tool for studying interactions has recently been demonstrated by Bailenson and Yee (2005). Subjects rated a digital chameleon, i.e. an avatar which mimics behavior, more favorably even though they were not aware of the mimicry. Thus, an avatar's mimicry created liking comparable to real individuals (Chartrand & Bargh, 1999).

Stimuli were created with *Poser* software (*Curious Labs*, Santa Cruz, CA) and the software extension offered by Spencer-Smith, Wild, Innes-Ker, Townsend, Duffy, Edwards, Ervin, Merritt and Paik (2001) to manipulate action units separately according to the facial action coding system (Ekman & Friesen, 1978). Notably, Spencer-Smith et al. (2001) could show that ratings of quality and intensity of the avatar emotional expressions were comparable to those of human expressions from the *Pictures of Facial Affect* (Ekman & Friesen, 1976).

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The facial stimuli were presented on a computer screen one meter in front of the participants with a picture size of about 19 x 25 cm. Three emotional facial expressions were created from a prototypic female and a prototypic male face: a neutral, a happy, and a sad expression (for details see Spencer-Smith et al., 2001). We chose happiness and sadness as emotional facial expressions due to their affiliating function in social interactions and relationships and to their contagiousness (Jakobs, Fischer, & Manstead, 1997). Each male and female emotional expression was then combined with three types of hairstyles (blond, brown, and black hair), resulting in eighteen stimuli (for examples see Figure 1). The three types of characters were created by assigning the three character descriptions (positive, neutral or negative – see below) to the three different types of avatars (blond, brown or black). Assignments of hairstyle to the specific character as well as order of introduction of the three character types were both counter-balanced.

Attitude manipulation. The attitude manipulation at the beginning of the session was covered as an introduction to different types of avatar characters designed to occur in computer games. In order to ensure a motivated and systematic processing of the given information, participants had to memorize the avatar characters with their specific traits for a later recall-task. The positive avatars were introduced as *kind* (FREUNDLICH), *nice* (NETT), *likeable* (SYMPATHISCH) and *self-confident* (SELBSTBEWUSST). The traits of the neutral avatar characters were *reserved* (DISTANZIERT), *serious* (ERNST), *calm* (RUHIG) and *neat* (ORDENTLICH) and the negative characters were described as *malicious* (BOSHAFT), *aggressive* (AGGRESSIV), *egoistic* (EGOISTISCH) and *deceitful* (HINTERLISTIG). All traits and combinations of traits had been pre-tested to affirm their distinct positive, neutral, and negative nature.

Facial EMG. Activity of the *M. Zygomaticus major* (the muscle involved in smiling) and the *M. Corrugator supercilii* (the muscle responsible for frowning) was recorded on the left side of the face using bipolar placements of 13/7 mm Ag/AgCl surface-electrodes

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according to the guidelines established by Fridlund & Cacioppo (1986). In order to cover the recording of muscular activity participants were told that skin conductance would be recorded (see e.g. Dimberg et al., 2000). The EMG raw signal was measured with a BrainAmp MR amplifier (Brain Products Inc.), digitalized by a 16-bit analogue-to-digital converter, and stored on a personal computer with a sampling frequency of 1000 Hz. Raw data were rectified offline and filtered with a 30 Hz low cutoff filter, a 500 Hz high cutoff filter, a 50 Hz notch filter, and a 125 ms moving average filter. The EMG scores are expressed as change in activity from the pre-stimulus level, defined as the mean activity during the last second before stimulus onset. Trials with an EMG activity above 8 μV during the baseline period and above 30 μV during the stimuli presentation were excluded (less than 5 %). Before statistical analysis, EMG data were collapsed over the 6 trials with the same emotional expression of a specific character, and reactions were averaged over the 6 seconds of stimulus exposure.

Individual difference measures. Since there is evidence that high empathic or high extraverted subjects tend to show stronger facial reactions (Sonnby-Borgström, Jönsson, & Svensson, 2003) *Empathy* was assessed with the SPF (Paulus, 2000) and *Extraversion* with the EPQ-RK (Ruch, 1999). Furthermore, the BFNE (Brief Fear of Negative Evaluation Questionnaire, Leary, 1983; German adaptation: Vormbrock & Neuser, 1983) was applied because Dimberg (1997) found differences in facial reactions of subjects high and low in social fear.

Manipulation Check. At the end of the experiment, participants answered three questions about each avatar's happy, neutral and sad facial expression concerning valence, arousal and liking on 9-point Likert scales. The specific questions were "How negative/positive do you find the picture?", "How arousing do you find the picture?", and "How much do you like the displayed person?". Negative characters were expected to be rated as less positive and liked less than positive characters, with the neutral characters falling in between. No differences were expected for arousal ratings.

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Procedure

Participants were tested individually in a laboratory room. They were told that they would complete several computer tasks designed to study the suitability and memorability of certain avatars for an upcoming computer game. After signing the consent form the EMG electrodes were placed. Participants were then asked to start the computer task. At the beginning of this task they were introduced to three different types of characters. For each type of character, the neutral expressions of the two avatars (one male, one female) of the same hairstyle were presented on the screen followed by their respective positive, neutral or negative traits. The fact that the hairstyle was the only feature in which the three characters differed was not explicitly mentioned to the participants but should have been obvious.

After the introduction of the three types of characters participants completed a recall task. The neutral expression of one of the six avatars was presented on the screen, and participants were asked to press one out of three buttons to indicate its character (positive, neutral or negative). To ensure that participants remember the traits of the three character types throughout the study they were further informed that they will have to complete this recall task again right after the next part of the study.

This next task for the participants was to look through the emotional facial expressions. For each participant three blocks of stimuli were presented with each block containing all the 18 facial expressions in random order, resulting in 54 picture presentation. Each picture was presented 6 seconds, preceded by a warning pitch tone and a fixation cross appearing in the center of the screen three seconds before picture onset. Inter-trial-intervals varied from 19 to 23 seconds. To ensure that participants paid attention to the stimuli they were told that they will be asked about the pictures later. During picture presentation, *M. Zygomaticus major* and *M. Corrugator supercilii* activity were recorded electromyografically.

Afterwards, the recall task was administered again, and the manipulation check and the questionnaires were completed. Finally, participants were asked about their ideas

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regarding the true purpose of the experiment. None was aware of the hypotheses, and none suspected that facial muscular reactions were measured.

Results

Manipulation Check

For liking, valence and arousal ratings three separate repeated measures analyses of variance with the within-subject factors Character (positive vs. neutral vs. negative) and avatar's Emotion (happy vs. neutral vs. sad) were computed. The interaction of character and emotion did not gain significance for any rating, all $p > .37$. However, analyses revealed a significant main effect of character for liking ratings, $F(2, 23) = 6.0$, $p = .010$, $\eta_p^2 = .199$. Following *t*-tests revealed that positive characters ($M = 5.69$, $SD = 1.03$) were liked more than negative characters ($M = 4.73$, $SD = 1.50$), $t(24) = 2.58$, $p = .016$. Neutral characters ($M = 5.54$, $SD = 1.43$) were also liked more than negative characters, $t(24) = 3.44$, $p = .002$, but not less than positive ones, $t(24) = .54$, $p = .592$. These results confirm that indeed different explicit attitudes had been formed towards the negative versus the positive and neutral characters. No main effects of character for valence (positive characters: $M = 5.36$, $SD = 1.10$; neutral characters: $M = 5.40$, $SD = 1.03$; negative characters: $M = 5.08$, $SD = 0.98$) or arousal (positive characters: $M = 4.72$, $SD = 1.22$; neutral characters: $M = 4.34$, $SD = 1.57$; negative characters: $M = 4.12$, $SD = 1.34$) ratings could be observed, both ps $> .11$.

Recall Task

Analyses of the first recall task following the attitude manipulation revealed that no participant made more than two errors in the six classification trials (3 participants showed two errors, 2 participants showed one error). At the second recall task right after the presentation of the emotional stimuli none of the participants showed any error. Thus, all data were used for further analyses.

Facial Reactions

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EMG data were analyzed with a repeated measures analysis of covariance with the within-subject factors Muscle (*M. Corrugator supercilii* vs. *M. Zygomaticus major*), avatar's Emotion (happy vs. neutral vs. sad) and avatar's Character (positive vs. neutral vs. negative). Empathy, extraversion and social fear were entered as covariates to control for potential side effects due to individual differences. Analyses returned a significant effect of Empathy on the Muscle x Emotion x Character interaction, $F(4, 40) = 5.2$, $p = .003$, $\eta_p^2 = .213$, but no effects of extraversion or social fear on any of the effects, all *p*s > .20. Therefore, further analyses were computed with empathy as covariate.

A significant Muscle x Emotion x Character interaction was observed, $F(4, 40) = 4.5$, $p = .006$, $\eta_p^2 = .193$, indicating different emotion specific facial reactions to positive, neutral and negative characters. No other main effect or interaction gained significance, all *p*s > .46. To further specify this interaction, separate follow up ANCOVAs for the *M. Zygomaticus major* and the *M. Corrugator supercilii* were calculated.

M. Zygomaticus major. As prediced, activity in *M. Zygomaticus major* to happy faces increased with character valence, whereas no difference could be observed for neutral or sad faces (see Figure 2). This was verified by a significant Emotion x Character interaction, $F(4, 44) = 2.8$, $p = .044$, $\eta_p^2 = .119$. Simple comparisons revealed a significant difference between *M. Zygomaticus major* reactions to happy faces of positive characters ($M = .61$) as compared to neutral ($M = .29$) and negative characters ($M = .18$), $p = .017$ and $p = .014$, respectively, but not between neutral and negative, $p = .222$. No effects were observed for neutral or sad facial expressions, all *p*s > .18.

Additionally, one-sample *t*-tests against zero revealed only for positive and neutral characters a significant increase in *M. Zygomaticus major* activity in response to happy facial expressions, $t(24) = 3.0$, $p = .006$ and $t(24) = 2.6$, $p = .016$, respectively. For negative characters the activation was only marginally different from zero, $t(24) = 1.9$, $p = .072$. Thus, happy faces of positive and neutral, but not of negative characters evoked a smiling response.

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M. Corrugator supercilii. As predicted for the *M. Corrugator supercilii*, congruent muscle reactions to sad facial expressions of positive characters were found, whereas in response to negative characters incongruent facial muscular reactions could be observed (see Figure 3). This was verified by a significant Emotion x Character interaction, $F(4, 40) = 3.0$, $p = .044$, $\eta_p^2 = .132$. Simple comparisons revealed significantly stronger reactions to sad faces of positive characters ($M = .19$) as compared to sad faces of neutral ($M = .03$) and negative characters ($M = -.11$), $p = .020$ and $p = .005$. Reactions to sad faces of neutral and negative characters differed, too, $p = .051$.

Notably, the specific reaction to sad faces of negative characters was a significant *inhibition* of *M. Corrugator supercilii* activity, as a one-sample *t*-test against zero could confirm, $t(24) = 2.1$, $p = .044$. Further *t*-tests against zero revealed a significant increase in *M. Corrugator supercilii* activity in response to sad faces of positive characters, $t(24) = 2.1$, $p = .049$, but no significant change as compared to baseline for neutral characters, $t(24) = 0.1$, $p = .947$.

Discussion

In line with our expectations the EMG data revealed that the manipulation of the participants' attitudes towards the avatars caused changes in the observed amount of facial mimicry. Whereas happy and sad faces of positive characters evoked congruent facial muscular reactions, i.e. facial mimicry, happy and sad faces of negative characters evoked less or even *incongruent* reactions. Specifically, the activity of *M. Zygomaticus major* (the smiling muscle) in response to happy faces was reduced if the face belonged to a negative character as compared to a positive character. For *M. Corrugator supercilii* (the frowning muscle) a quite similar and even more pronounced pattern was observed: sad faces of positive characters evoked the strongest contraction, and sad faces of negative characters evoked a relaxation of that muscle, the latter indicating not only less congruent facial muscular reactions but even *incongruent* reactions.

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The manipulation check revealed an unexpected lack of differences in valence ratings. However, the expected difference in liking ratings between positive and negative characters gained significance. The neutral characters did not differ significantly from the positive ones but only from the negative ones indicating a slight positivity of the neutral characters.

It can be concluded that negative characters elicit less mimicry to happy and even incongruent reactions to sad facial expressions both compared to the equivalent reactions to positive characters. These results are the first to demonstrate in a controlled, experimental fashion that facial responses to facial emotional displays can be influenced by actual attitudes, i.e. when a specific affective position to the sender is held. They are further in line with the results reported by Herrera et al. (1998) and McHugo et al. (1991) who both found with a quasi-experimental design less congruent or incongruent reactions in response to disliked politicians and ethnic outgroups.

The results fit well with the assumed functionality of mimicry to create empathy and liking and to facilitate social contacts (Hess, 2001; Lakin et al., 2003). Thus, faced with a positive character, a pleasant and smooth interaction in order to create a positive relationship seems desirable and therefore mimicry is shown. But when confronted with a negative person, one might not be interested in being perceived as likeable and one might desire to avoid future contacts. Therefore a decrease in mimicry towards negative characters makes perfect sense. Importantly, the present results were obtained in a context that was only minimally social with no actual or implied interaction. Thus, the modulation of emotional facial mimicry by attitudes may have evolved due to its functionality for social goals or needs, but it seems to occur rather automatically even in the absence of a current functionality.

We believe that attitudes are not the only moderator of mimicry. Other characteristics that are closely correlated with the goal to approach or avoid a person should also acquire the ability to influence mimicry independently. Furthermore, personality differences can moderate the amount of mimicry. For example, van Baaren, Maddux, Chartrand, de Bouter

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and van Knippenberg (2003) showed that an interdependent self-construal leads to more behavioral mimicry than an independent self-construal. Reasons for this can be that interdependents pay more attention to others, relate more easily to others, and have a more interrelated self-concept. Finally, there is reason to believe that group-membership influences mimicry independently of attitudes. Schubert and Häfner (2003) asked participants to think about an outgroup and found behavioral assimilation, unless they had simultaneously primed the self in which case behavioral contrast resulted. These results are in line with models by Stapel (Stapel & Koomen, 2001; Stapel, 2007) who argues that behavioral assimilation is the more likely outcome, unless comparison is instigated. We believe that a similar process can occur in facial mimicry: Outgroup members are mimicked as long as they are not categorized as belonging to a different group, independent of the attitude towards that group.

However, given the pervasive evidence for the effects of group identity on mimicry (Herrera et al., 1998; Yabar et al., 2006), the possibility that attitudes affect mimicry through influencing group identity should also be considered. For example, individuals might be more inclined to accept nice persons as members of their group and to exclude nasty persons from their group. This process is likely to happen when several categorizations are possible, or when the category is fuzzy enough to allow flexible inclusion and exclusion. However, in the present study we minimized the possibility for such processes by using almost identical avatars. Also, if group identity played a role, we might have expected to find a moderation of the results by target gender such that positive females provoke the most mimicry and negative males the least, which we did not. Another possible mediator of attitude effects on mimicry is attention: paying more attention to a face should enhance facial mimicry. However, the available evidence suggests a preferential attention to negative as opposed to positive or neutral attitude objects (Dijksterhuis & Aarts, 2003; Öhman, Lundqvist & Esterves, 2001). Thus, attention cannot explain why negative characters were mimicked *less* than positive or

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neutral ones. The attention guiding effect of attitudes in general (Roskos-Ewoldsen & Fazio, 1992) might, however, explain why neutral characters provoked less mimicry.

According to a functionality approach, incongruent facial muscular reactions, in our study a decrease in *M. Corrugator supercilii* activity in response to the sad face of a negative person, can be interpreted as a discouragement of further contact. But the relaxation of the *M. Corrugator supercilii*, which is normally a response to happy facial expressions (see our results for positive characters), could also be a sign of schadenfreude – a positive emotional response triggered by a negative event happening to a disliked, negative character. This is because here we examined and observed *emotional* mimicry, which means that the mimicker's facial display is a function of both the goals pursued in the social situation as well as of the inner state of the person. Conversely, in behavioral *non-emotional* mimicry (e.g., Lakin & Chartrand, 2003), the behavior is only a function of the goal pursued. Furthermore, only emotional mimicry can lead to emotional contagion or counter-contagion through facial feedback processes. Thus, further research should study the mechanisms involved in these two kinds of mimicry separately, both for congruent and incongruent muscular reactions.

Given that our sample consisted only of women, it still has to be shown whether the results are generalizable to men. But since none of the above mentioned studies on the effects of attitudes on approach and avoidance tendencies (Chen & Bargh, 1999; Neumann & Strack, 2000; Neumann, Hülsenbeck, Seibt, 2004; Seibt, Neumann, Nussinson & Strack, in press; Solarz, 1960) and on the effects of affiliation and competition goals on mimicry (Lakin & Chartrand, 2003; Lanzetta & Englis, 1989) found any gender differences, we expect no differential effects of this kind of attitude manipulation. Nevertheless, further studies are needed to replicate the results with differing samples.

In the above mentioned study by Yabar et al. (2006) on behavioral mimicry in response to in- and out-group members a positive correlation between mimicry and implicit liking but a negative correlation between mimicry and explicit liking was observed. At first

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view, this negative correlation with explicit attitudes seems to contradict our results. In the current literature, two different systems underlying the formation (and change) of explicit and implicit attitudes are postulated (e.g. Rydell, McConnell, Mackie, & Strain, 2006; Rydell & McConnel, 2006; Strack & Deutsch, 2004; Smith & DeCoster, 2000). In the approach introduced by Rydell et al. (2006), explicit attitudes, which refer to conscious knowledge and beliefs (Strack & Deutsch, 2004), are supposed to be formed quickly and flexibly in a non-associative but rather abstract and conscious manner via a so called fast-learning system. In contrast, implicit attitudes, which are based on associative structures to which people do not have conscious access (Strack & Deutsch, 2004), are assumed to be formed via a slow-learning system, strengthening associations in memory step by step. However, in a recent study Gregg, Seibt and Banaji (2006) found that implicit attitudes could even be formed through abstract supposition. This suggests that in the present study, where attitudes have been formed by reports of others, implicit attitudes might have been manipulated as well. Furthermore, given the abstract nature of our avatar stimuli and the lack of possibilities to gain experiences with the characters, it seems very unlikely that our participants had any contradicting implicit and explicit attitudes.

In sum, our results show that facial mimicry can be modified by experimentally manipulated attitudes. Together with the results by Herrera et al. (1998) and McHugo et al. (1991) they provide evidence that recently formed attitudes lead to a change in automatic and non-conscious social behavior like facial mimicry. In light of the results by Yabar et al. (2006) and of Gregg et al. (2006), who showed that implicit attitudes were resistant to change through either slow learning or abstract supposition, it can be predicted that even after revising our explicit attitudes towards someone, our mimicry reaction or lack thereof would still persist and tend to perpetuate a certain relationship status.

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Figure captions

Figure 1. Examples of avatars with different emotional facial expressions.

Figure 2. Mean EMG change in μV for *M. Zygomaticus major* in response to happy, neutral and sad faces for positive, neutral and negative characters. Error bars indicate standard errors of the means.

Figure 3. Mean EMG change in μV for *M. Corrugator supercilii* in response to happy, neutral and sad faces for positive, neutral and negative characters. Error bars indicate standard errors of the means.

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Figure 1

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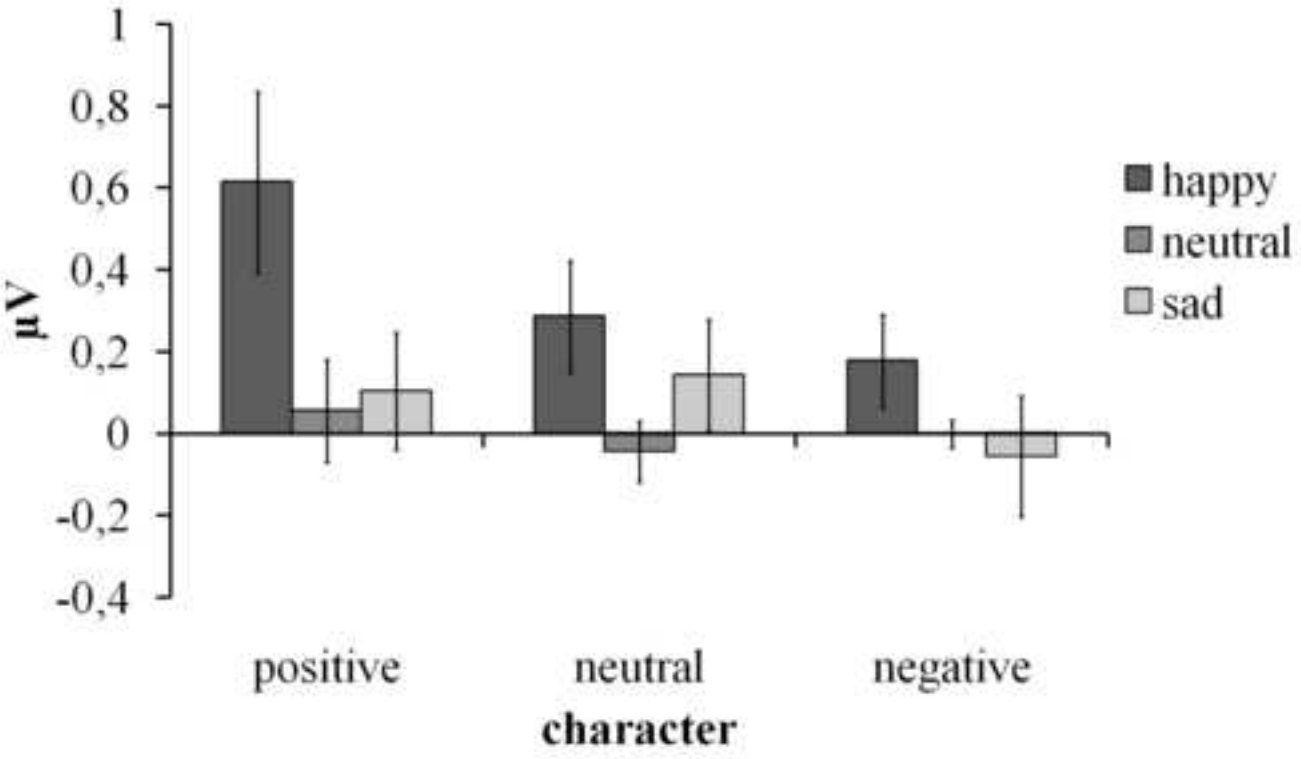
Figure 2



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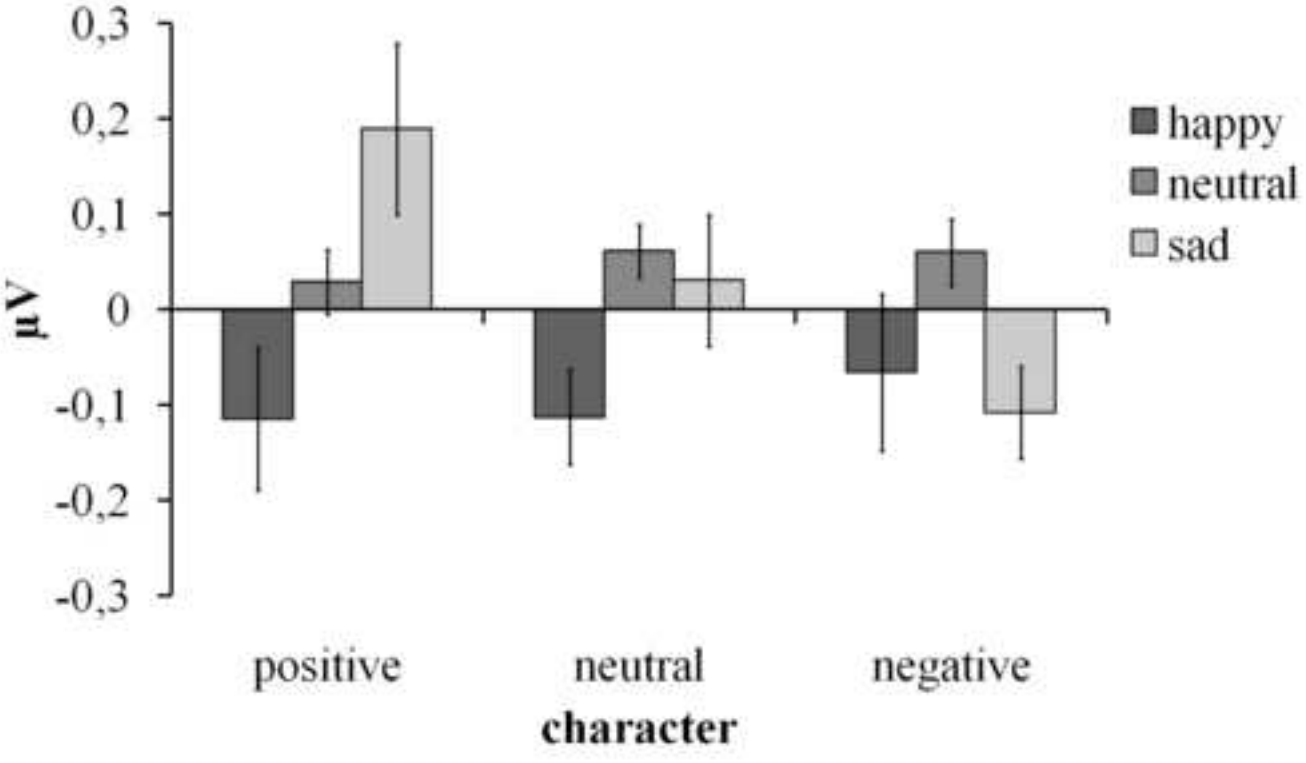
Figure 3