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Spontaneous facial mimicry, liking and emotional contagion

Facial mimicry is a basic facet of social interaction, theorized to influence emotional contagion, rapport, and perception and interpretation of others' emotional facial expressions. Using EMG, two studies examined spontaneous mimicry of emotional facial expressions of live models over time, and whether the relationship between the model and observer moderated mimicry. Study 1 manipulated observers' liking of a confederate model; Study 2 compared friends with strangers. Observers mimicked brow and cheek movement. Observers who liked the models mimicked cheek movements more than those who did not like them. Study 2 demonstrated mimicry of natural, spontaneous expressions and found that observers' affect changed in association with the models'. People mimic live, dynamic facial expressions, likely more idiosyncratic and weaker than prototypes often used as stimuli, supporting the naturalistic importance of mimicry. Liking increases mimicry of smiles, indicating that mimicry is partially a consequence, not just a cause, of positive social relationships.

Keywords: facial mimicry, liking, emotional contagion, EMG

Mimicking expressions is a phylogenetically ancient and basic form of intraspecies communication (Brothers, 1990); it may have been evolutionarily adaptive because it helped humans communicate and foster relationships (Lakin, Jefferis, Cheng, & Chartrand, 2003). When an observer matches the facial expression of another, emotion-related thoughts and feelings may be modulated or initiated in the observer (McIntosh, 1996; McIntosh, Druckman, & Zajonc, 1994). Thus, mimicry appears to play a role in such intertwined and basic social processes as emotional contagion (Hatfield, Cacioppo, & Rapson, 1992; Lundquist & Dimberg, 1995; McIntosh et al., 1994; Vaughan & Lanzetta, 1981), dyadic rapport (Capella, 1993), behaviors such as helping and generosity (van Baaren, Holland, Kawakami, & van Knippenberg, 2004), and the perception and interpretation of facial expressions of emotion (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001). Moreover, mimicry appears

impaired in autism, a disorder of social-emotional functioning (McIntosh, Reichmann-Decker, Winkielman & Wilbarger, 2006), and some theorize that this deficit may cause some of the symptoms evident in autism (Moody & McIntosh, in press).

The importance of mimicry for interpersonal and emotional processes has generated significant work in recent years; however, basic issues such as the extent of mimicry of live (not photographed or videotaped) models and variables that moderate the extent of mimicry are relatively unexplored. The present studies address these questions. They focus on facial mimicry, as most investigations of mimicry have concentrated on the face (Hess, Philippot, & Blairy, 1998), and the best evidence for the role of mimicry in emotional contagion is associated with facial mimicry (Hatfield et al., 1992).

Numerous studies document that people mimic. For example, presentations of posed faces

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NOTES

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elicit zygomatic (muscle used to pull the corners of the lips back, as in a smile) activation when participants view a happy face and corrugator (muscle used to wrinkle the brows) activity when participants view an angry face (Dimberg, 1982, 1988; see also Hess et al., 1998). People mimic emotional facial expressions within 1000 ms, even in response to subliminally presented faces (Dimberg, Thunberg, & Elmehed, 2000).

Evidence for mimicry, however, is based largely on studies using pictures of intense, prototypical facial expressions. Live expressions, which have not been selected to be pure and clear expressions of classic emotions, are quicker, less dramatic, and more ambiguous than photographs of prototypical facial expressions. That they are dynamic means that there is more information, and reactions may tend to reflect relatively more on-line processes. Moreover, whereas most mimicry studies show participants face-shots of stimuli, in live interaction, the observer may also be observing the model's body or aspects of the surrounding room. Although mimicry of dynamic expressions has been found (Bush, Barr, McHugo, & Lanzetta, 1989; Gump & Kulik, 1997; Hess & Blairy, 2001; Vaughan & Lanzetta, 1980), evidence for both the presence of mimicry and its association with emotional contagion is weaker in more ecologically valid contexts (Hess & Blairy, 2001). Mimicry in such situations may differ from responses to static photographs. For example, in real-world contexts, mimicry of strangers' smiles may be more frequent than mimicry of their frowns (Hinsz & Tomhave, 1991). For mimicry to be an influential social process, it must occur not only in relation to static, prototypical faces, but also when people are looking at live, dynamic faces.

To address the question of whether mimicry of live models occurs, the present studies examined the extent of spontaneous facial mimicry of a live model over time. There is little other work examining mimicry of live models. One exception is the work of Gump and Kulik (1997). They videotaped dyads and timed how long each person smiled and frowned, and subtracted time frowning from time smiling. They found that there was a positive relation between the expressions of one member of the dyad and the other. One question with this work, however, is whether the expressions matched because of mimicry, intentional communication, or shared emotions. In a follow-up study, participants' matched the expressions of a confederate, also. This suggests that shared emotions were not the foundation of the matched facial expressions. Based on these findings, I expected to find mimicry, adding support to the contention that people mimic live facial expressions, which may be more idiosyn-

cratic and weaker than the prototypes often used as stimuli.

In addition to demonstrating that people measurably mimic in more ecologically valid circumstances, the use of live models allows for the investigation of relational moderators of facial mimicry. As evidence for the existence and importance of facial mimicry has grown, researchers have begun considering what factors might moderate the occurrence of mimicry. Identifying moderators of mimicry can point to mechanisms responsible for the phenomenon, and suggest underlying impairments in groups with mimicry deficits (Moody & McIntosh, *in press*). Both the emotional state of the observer and the relationship between the observer and the model have been considered. Niedenthal et al. (2001) suggest that the emotional state of the observer may influence the degree of mimicry such that observed expressions congruent with the perceiver's emotional state are more quickly and easily mimicked. Two studies suggest that relationship factors can influence mimicry. Gump and Kulik (1997) found more mimicry when people are confronting the same novel situation or when facing a threatening versus a non-threatening situation. Van Baaren, Maddux, Chartrand, de Bouter, and van Knippenberg (2003) report that when independent self-construals are primed, people mimic less than when interdependent self-construals are primed. This suggests that the relationship between the observer and the model may influence the amount of mimicry that occurs. Perhaps people mimic those with whom they feel connected or interdependent more than they mimic strangers. There are several reasons to expect that this would be the case. It may be more functional or adaptive to monitor and match the moods of individuals with whom one is in a relationship. Their emotions may be more diagnostic of the self-relevance of a situation, or their moods may be more likely to have an impact on one's own situation.

If social variables influence mimicry, then one of the most basic dimensions of social relationships – liking – should make a difference. The potential influence of liking on mimicry is virtually unexplored. Bush, McHugo, and Lanzetta (1986) showed participants silent videotapes of then U.S. President Reagan displaying anger, mild happiness, and intense happiness. Using electromyographic (EMG) readings over the brow, cheek, and lip, they found that individuals tended to mimic his facial displays. Further, they found that observers who did not support President Reagan manifested less zygomatic (cheek) activity and more corrugator (brow) activity than his supporters when viewing him display happiness. Although these data are suggestive, they do not

indicate whether changes in liking can alter mimicry. Perhaps those who disliked him tend to mimic smiles less in general, for example, or there is another individual difference that suppressed both mimicry and caused negative attitudes toward U.S. President Reagan. In addition, factors that influence mimicry of a political figure may differ from those affecting mimicry of individuals with whom one has an ongoing relationship.

Finally, one of the primary theorized consequences of mimicry of emotional facial expressions is emotional contagion. If liking influences mimicry, and mimicry causes emotional contagion, then liking should also influence contagion. There is some evidence that emotional contagion is affected by the relationship between people (McIntosh et al., 1994). For example, Krebs (1975) found that participants who believed they were similar to the model reported feeling worse and were more aroused while waiting for the model to receive a punishment than those who believed they were dissimilar. Zillman and Cantor (1977) found that in conditions in which children reported liking the protagonist of a stimulus film, they also reported feelings similar to his (see also Miller, 1987). Because mimicry is a potential route to contagion, these findings are consistent with the idea that relationship status moderates degree of mimicry.

The present studies

The present studies tested directly the predictions discussed above. First, I predicted that people would mimic brow and cheek activity of live models dynamically displaying emotions. Using EMG recordings of facial musculature action, the degree to which observers spontaneously mimicked the facial expressions of a model who is watching emotion-arousing stimuli was examined. Second, I predicted that the more the observer liked the model, the more he or she would mimic the model. One study tested this hypothesis using laboratory-induced relationships; the second compared mimicry between friends with mimicry between strangers. This first experimental study provided the opportunity to directly manipulate liking, the second study to examine if the effects occurred when the model's facial expression was truly spontaneous. Together, they provide converging evidence for the causal role of liking and the ecological validity of the phenomenon.

STUDY 1: Induced relationships and mimicry

A confederate-model produced emotional facial expressions while an observer (participant) watched. EMG recordings were made of cheek and brow movement of both. The liking of the observer for the model was manipulated into three liking conditions: positive, neutral, and negative. I predicted that observers would mimic the expressions of the models, and that observers in the positive (or "like") condition would mimic the most and those in the negative (or "dislike") condition would mimic least.

Method

Participants

Eighty-one undergraduates received course credit for participating. Data from nine were lost to equipment malfunction (3), movement artifact (2), experimenter error (2), or participant suspicion of the manipulation (2). Data from 35 men and 37 women were analyzed.

Measures

Mimicry. Facial musculature activity of both observer and model was measured using EMG. EMG was assessed using bipolar placements of Ag/AgCl 4mm surface electrodes, referenced to a ground electrode placed 3 cm below the ear. Electrode placements correspond to those customarily used to monitor cheek (zygomatic) and brow (corrugator) activity (Fridlund & Cacioppo, 1986) following guidelines given by Tassinari, Cacioppo, and Geen (1989). These sites tend to be active in emotional expression (e.g., Cacioppo, Petty, Losch, & Kim, 1986). One would expect more activity in the cheek (over the zygomatic, which pulls the corners of the lips back and up) when smiling and in the brow (over the corrugator, which pulls the brow together) when frowning.

The EMG signals were amplified, rectified and smoothed with Coulbourn bioamplifiers and contour-following integrators with a time constant of 400 msec. The resulting wave forms were sampled and digitized at 100 msec intervals. The digitized EMG readings were denoised in quadrature to facilitate comparison of EMG levels among channels and experimental sessions (Fridlund & Cacioppo, 1986).

Means and standard deviations of the EMG scores were proportional; thus the EMG levels were log-transformed before averaging, with scores between 0 μ V and 1 μ V set to equal 1 before they were transformed (Kirk, 1982). Averaged log-EMG activity during each 2-minute segment was calculated. Observer EMG activity during the neutral stimulus (no model facial movement) was

subtracted from activity during the positive segment (model displays smiles) and from mean activity during the negative segments (model displays sadness and disgust) to control for individual differences in baseline activity. These scores were compared separately for brow and cheek movement.

Self-report. Before and after the physiological measures were taken, participants completed a self-report questionnaire asking them to rate on a 10-point scale from 1 (extremely negative) to 10 (extremely positive) how they were feeling overall (to control for potential mood effects; see Niedenthal et al., 2001). These questions were embedded in a set of other questions regarding feelings and attitudes. The emotion questions asked before data collection were preceded by instructions indicating that, "Because your emotional state can influence the signals we record, we need to have you give us an idea of how you are feeling." After data collection, the instructions were, "In order to control for possible changes in emotions of both the control subject and the experimental subject, we need to have an idea of how you were feeling during each of the segments." Also on this self report form, the participants were asked after the liking manipulation "How much do you like the other subject?" as a manipulation check.

Procedure

Manipulation. Participants were randomly assigned to the like, neutral or dislike conditions. When a participant arrived, he or she met an undergraduate confederate, ostensibly another subject. Participants were told that involuntary electrical changes would be monitored to evaluate physical responses to stimuli. To further the manipulation, the experimenter asked the students about "factors that might influence responses to the stimulus tape and indicate usual baseline physical reactions." The students were then interviewed about a variety of topics seemingly related to how one would physiologically respond to visual and auditory stimuli. The topics included sleeping patterns, alcohol drinking, eating preferences, exercise practices, and tastes in art and music. The experimenter always asked the participant the question first; the confederate then responded appropriately to the experimenter's questions based on liking condition. In the positive condition, the confederate acted likable and friendly, and presented him or herself as similar to the subject in behavior and tastes (e.g., they drank roughly the same quantities of alcohol and enjoyed the same types of music). In the negative condition, the confederate acted cold and judgmental, presented him or herself as dissimilar to the subject (e.g., if the subject had a hamburger

for lunch, the confederate had tofu stir-fry), and made annoying noises while the participant was talking. In the *neutral* condition, the confederate did not initiate conversation, but was polite. At the end of the interview, the students were asked to complete the self-report questionnaire.

The participant and confederate were told that one of them would be the "experimental subject" who viewed the stimuli, and that the other would be a "control subject" and simply be in the room as a comparison for the experimental subject's reactions. After completing the self-report form, the students participated in a drawing rigged so that the participant was the "control subject." The confederate and participant were then separated and the "control subject" (i.e., the actual participant) was then told that the "real purpose of the study" was to examine the effects of being watched on the experimental subject's responses to the stimuli. The participant was recruited to watch the "experimental subject" while the latter was watching the stimuli.

Mimicry session. After the participant and confederate were reunited, the confederate-model was seated facing a video monitor. The observer sat 2.8 m away, facing the model at approximately a 33° angle. The observer could not see the screen of the monitor. The volume on the monitor was turned off so neither the confederate (who did not need to hear the segment to know when to express) or the participant could hear the sound.

The confederate watched a series of four 2-minute video segments, with 15-second breaks between each. Confederates had a scripted series of facial expressions they made at specific points in each segment. During the first, neutral segment, the confederates maintained a blank face. During the next segments, the confederates produced expressions of sadness (brought brows together, lowered corners of the mouth), disgust (wrinkled nose, lifted upper lip, slightly opened mouth, brought brows together), or happiness (corners of the mouth pulled up and back). The participant watched the confederate while EMG was recorded. Next, the participants and confederate completed the self-report questionnaire again, and the participant was debriefed, thanked, and excused.

Results

Manipulation checks

The manipulation had a significant effect on participants' reported liking of the confederate, $F(2, 60)=20.19, p<.001$. Follow-up tests revealed that those in the dislike condition liked the confederate significantly less ($M=5.46$) than those in the like ($M=8.19$) conditions. However, the neutral condition ($M=7.44$) was not unambiguously different from the positive and negative

conditions, so was not used in tests of the effect of liking on mimicry. (Including the neutral condition in the analyses did not change the pattern of results.) There was no effect of condition on mood. Regarding the facial stimuli the participants viewed, as scripted, confederates moved their cheeks more during the positive segment than during the negative segments, $F(1, 46)=477.78$, $p<.001$, and moved their brows more during the negative segment than during the positive segment, $F(1, 46)=61.06$, $p<.001$.

Differences in confederates' actions. Although confederates did not know the hypotheses of the study, because they were both the manipulation (changing behavior to alter liking) and the stimuli (making facial expressions), it is possible that the confederates acted differently during the mimicry phase of the study depending on condition. This was evaluated in two ways. First, facial EMG of the confederate was analyzed. There were no significant differences across condition in model brow or cheek movement. In addition, a group of naïve undergraduate raters (9 women, 10 men) watched a total of 36 (12 of each liking condition) randomly-selected sessions of the confederates' actions. After watching each nine-minute segment, raters indicated how expressive, likable, friendly, interesting, and watchable the confederate was during that segment. There were no effects or interactions for liking condition. These results suggest that any differences found in association with liking condition are not due to behavioral differences on the part of the confederates during the mimicry phase of the sessions.

Mimicry

If the participants mimicked the confederates, then their facial movements should differ depending on what type of emotional expression

the confederates were displaying. Further, if their liking for the model influenced mimicry, then liking should interact with the type of segment being viewed. The hypotheses were tested by comparing the difference in EMG activity from the neutral segment in 2 (liking) by 2 (valence of segment, within subjects) ANOVAs for cheek and brow. Observer cheek activity is displayed in Figure 1; the main effect for valence is significant, $F(1, 46)=25.45$, $p<.001$, indicating that observers' cheek movements were congruent with the content of the tape and the models' cheek movements. The condition-by-segment-valence interaction is marginally significant, $F(1, 46)=3.15$, $p<.08$, with a medium effect size (Cohen's $d=.54$; Cohen, 1992; Thalheimer & Cook, 2002). Observers in the like condition tended to respond more to the models' cheek movements than those in the dislike condition. These findings provide tentative evidence that the relationship between individuals influences the degree of mimicry of cheek activity, and, as described in the Study 2 Results section, combined with the second study show the liking-by-stimuli-valence interaction to be significant.

Observer brow activity is presented in Figure 2. The main effect for valence is significant, $F(1, 46)=22.15$, $p<.001$, indicating that observers mimicked model brow movement. Although the means are in the predicted direction, the interaction between liking and segment valence was not significant, $F(1, 46)=2.37$, $p=.13$. Observer liking for the model did not significantly influence mimicry of model brow movement.

Discussion

Mean levels of observer cheek and brow activity were congruent with the models' expressions, indicating that the participants mimicked

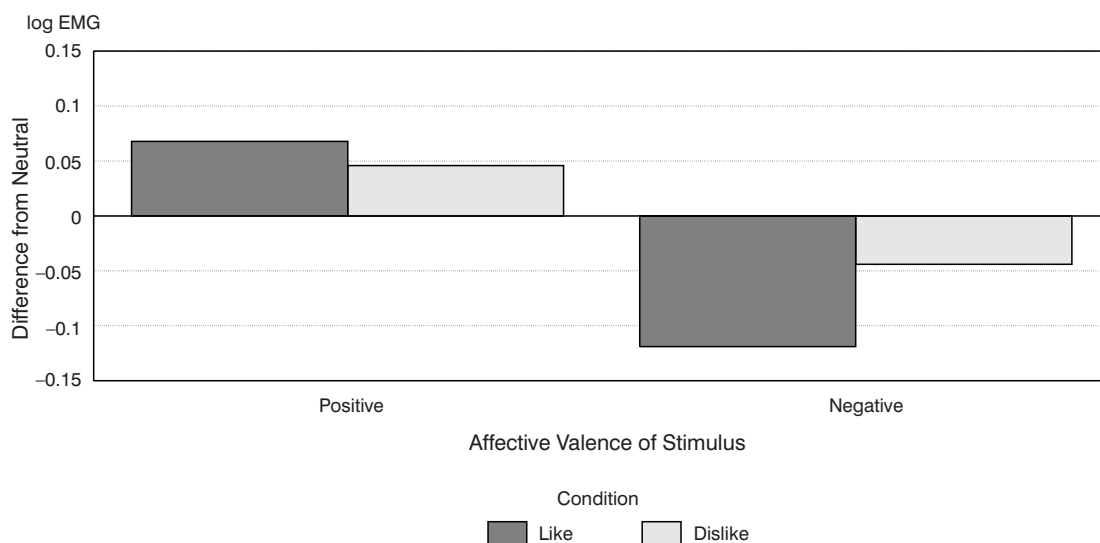


Figure 1. Observers' cheek activity in each liking condition during positive and negative affective stimuli in study 1: induced relationships

the live models' expressions. The hypothesis that observer liking for the model would influence mimicry for brow activity was not supported. However, there was marginally significant evidence that liking enhanced observer mimicry of cheek activity.

These data suggest that people may mimic the smiles of those they like more than the smiles of those they like less. The weak level of these findings may be because the general effect of relationship is small, the differences in positive or negative relationships created in the lab are too weak to cause marked differences, or both.

STUDY 2: Naturally occurring relationships and mimicry

The second study tested the mimicry and relationship hypotheses again, using a spontaneously expressing model, and comparing friends versus strangers. In addition, based on findings reviewed above suggesting that the relationship between individuals may affect emotional contagion (Krebs, 1975; McIntosh et al., 1994; Zillman & Cantor, 1977), Study 2 examined whether the model's emotions influence the emotions of the observer. Observers who were close friends with the model were predicted to mimic her more, and show greater shared emotional experience, than observers who had just met the model.

Method

Participants

To simplify the design of this study, only same-sex friends were used. The paid participants were recruited as pairs from the university community; all had a close friend also participating in the

study. One half participated in a session with a friend, one half participated with a stranger – someone else's close friend. Sixty-seven pairs were scheduled to participate. Two pairs were dropped because one or both participants failed to attend the scheduled session, three pairs were lost to equipment malfunction, nine due to irregularities during the experimental session (one observer fell asleep, two models made comic faces at their friends when the experimenters had left the room, six pairs giggled during the mimicry session), and two were found to be aware of the experimental hypotheses during the post-session debriefing. Thus, data from only 51 pairs of participants were analyzed. Sixty percent of the friends had lived together (48% currently); of those who had lived together, the median time of cohabitation was 40 weeks (range 1 week to 2.5 years). The median duration the friends reported knowing each other was 2.25 years (range 1 week to 17 years).

Stimuli

Four 2-minute film clips were presented to the model to elicit emotional facial expressions. They elicited *neutral* (flowers), *disgust* (facial surgery) *happy* (comedian) and *fear* (suspense film) expressions. The models listened to the soundtrack through earphones, preventing the observer from hearing the audio portion of the segments.

Measures

EMG was assessed using the same method described for Study 1, with the exception that the EMG signal was integrated with a more precise time-constant of 200 msec (not 400).

Participants indicated on scales ranging from 1 (extremely negative) to 10 (extremely positive) how they were feeling, overall, and how much they liked the other participant. They also

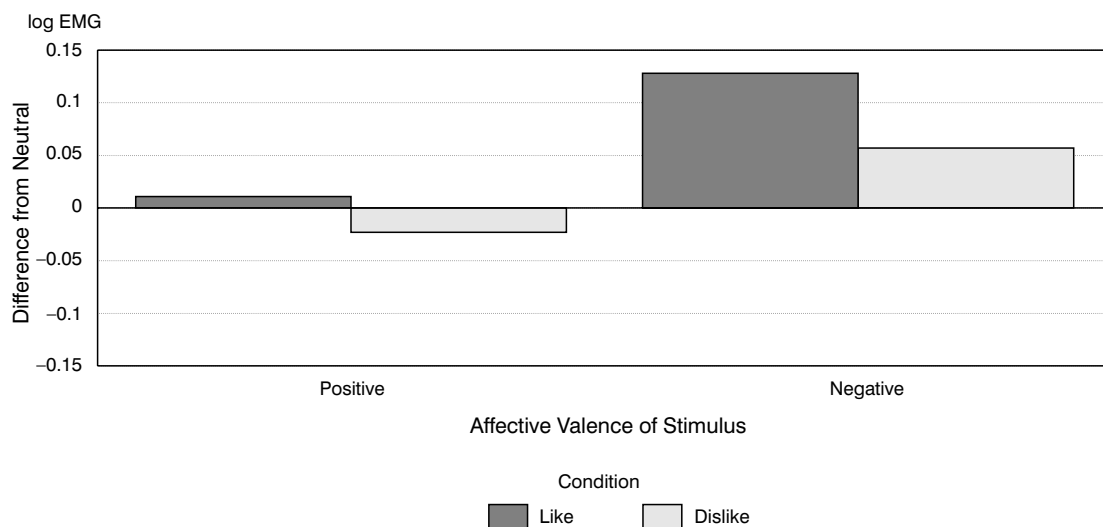


Figure 2. Observers' brow activity in each liking condition during positive and negative affective stimuli in study 1: induced relationships

indicated on a scale ranging from 1 (very weak) to 10 (very strong) how strong they believed the relationship was between them and the other participant. As with Study 1, all questions were embedded in a larger questionnaire.

In addition, before the video stimulus period, participants indicated the extent to which they were feeling happy, sad, angry, disgusted, fearful, and surprised on a scale ranging from 1 (not at all) to 7 (extremely). After the stimuli session, both participants were asked the degree to which they were feeling each of these six emotions during each video segment. These scales were combined by subtracting from the self-report of happiness the reports of sadness, anger, disgust, and fear to form an affect index for each trial (if happiness received a 7, and sadness, anger, disgust, and fear each received a 1, the affect index would be a three: $7 - 1 - 1 - 1 - 1 = 3$). Surprise was omitted from the index, as it is unclear whether it was a positive or negative reaction.

Procedure

Participants were recruited through fliers and an advertisement placed in the campus newspaper. Once both members of a friendship agreed to take part, they were assigned randomly to either participate with each other or to come in separately and participate with a stranger.

The laboratory procedure was identical to that of Study 1, with the addition that participants were told that we hypothesized that the “experimental subject” might react differently to the stimuli if the other person in the room is a friend versus a stranger. The model watched the four videos, with 15-second breaks between each segment. The first segment shown was always the neutral video.

After the stimuli session was finished, participants completed a second questionnaire,

indicating the degree to which they felt each of the six emotions during each of the four segments. The participants were then debriefed, thanked, paid, and excused.

Results

Preliminary analyses

Not surprisingly, friends liked each other more and reported stronger relationships than did strangers. There were no differences in mood across conditions. Because the models were in two different social situations, it was possible they would display different levels of activity in the two conditions (see Fridlund, 1991). However, there were no significant differences in model cheek and brow activity across liking conditions. Importantly, models displayed stimuli-consistent movement for the observers to mimic. Models' cheek movement was significantly greater during the positive segment than during the negative ones, $F(1, 49)=112.68, p<.001$, and their brow movement was significantly greater during the negative videos than during the positive, $F(1, 49)=114.24, p<.001$.

Mimicry

It was predicted that observers would mimic the models, and that their liking for the models would influence the amount of mimicry displayed. The analysis strategy used in Study 1 to evaluate whether observers' faces moved in association with the content of the models' stimuli, and whether the relationship between the model and the observer influenced this, was also used here. Two 2 (liking) by 2 (stimuli valence) ANOVAs were run on the difference of EMG activity from the neutral trials for the positive and negative stimuli. Cheek activity is displayed in Figure 3. The main

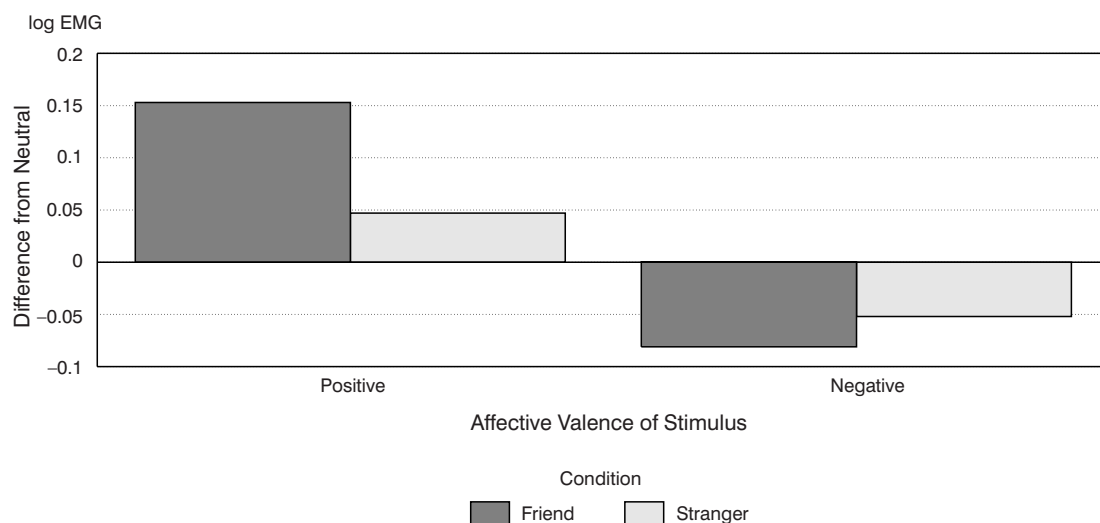


Figure 3. Observers' cheek activity in each relationship condition during positive and negative stimuli in study 2: natural relationships

effect for stimuli valence was significant, $F(1, 49)=19.39, p<.001$; observers moved their cheeks more while the model was watching the comic segment than when the model was watching the affectively negative segments. As in Study 1, the liking-by-stimuli-valence interaction was marginally significant, $F(1, 49)=3.19, p<.08$, with friends showing more cheek mimicry than strangers. As in Study 1, this interaction had a medium effect size (Cohen's $d=.51$; Cohen, 1992; Thalheimer & Cook, 2002). Because both studies found this interaction to be only marginally significant, I used the procedure described by Winer (1971) to determine if the studies, together, indicate that there is a significant effect. There is; the results together indicate that the liking-by-stimuli-valence interaction is significant across the two studies, $X^2(4)=10.10, p<.05$.

The observers' levels of brow activity are presented in Figure 4. The main effect for stimuli valence is significant, $F(1, 49)=4.17, p<.05$, with more brow activity evident during the models' negative stimuli than during the positive. Although the mean level of brow activity during the negative stimuli appears much greater in the friend condition than in the stranger condition, the liking-by-stimuli-valence interaction is not significant, $F(1, 49)<1$. The relationship between the model and the observer did not influence the degree of brow mimicry.

Self-report of emotion

Models and observers were asked their emotions before the stimuli, and afterwards, to indicate how they felt during each of the stimuli segments. If affect is contagious, then the observers' self-report of emotion should be consistent with the models'; if the relationship between the model and the observer influences emotional

contagion, then there should be an interaction of liking and stimuli valence, with observers who are friends with the model reporting more positive affect during the positive segment, and more negative affect during the negative ones. To test this, two 2 (liking) by 2 (stimuli valence) ANOVAs were run on the differences from neutral in self-reported affect. Positive numbers indicate affect became more positive, negative numbers indicate that affect became more negative.

For the models, there was a main effect for stimulus valence, $F(1, 49)=162.83, p<.001$; models reported experiencing a positive change from the neutral trials during the comic video ($M=2.16$) and a negative change from neutral during the negative ones ($M=-6.51$). There was no liking-by-stimuli-valence interaction, $F(1, 49)<1$; the model-observer relationship did not make a difference in the emotions reported by the model.

Observers also reported a positive change in affect from neutral during the positive video ($M=2.47$) and a negative change from neutral during the negative segments ($M=2.09$); this difference is significant, $F(1, 49)=34.11, p<.001$. The interaction was not significant, $F(1, 49)<1$. Observers' feelings were congruent with the models', but this was not influenced by the relationship between the model and the observer.

Discussion

I predicted that observers would spontaneously mimic the naturally-occurring facial movements of a dynamically-expressing live model. As expected, mean levels of observers' cheek and brow activity were congruent with the models' facial actions. The relationship between the model and the observer was hypothesized to influence the degree of spontaneous mimicry, with

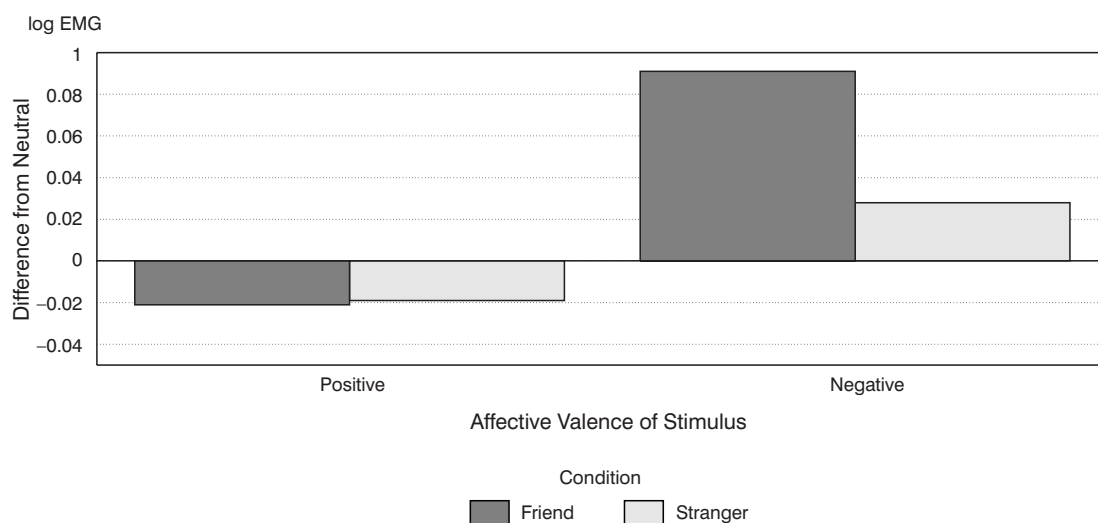


Figure 4. Observers' brow activity in each relationship condition during positive and negative stimuli in study 2: natural relationships

observers who were friends with the model mimicking more. Consistent with this prediction, there was a marginal difference suggesting that participants mimicked friends' smiles more so than smiles of strangers. Although the models displayed stimuli-consistent movement for the observers to mimic, it is likely that the participant-models in Study 2 displayed less clear modeling than the trained confederate-models in Study 1, perhaps weakening the results despite a potentially stronger social relationship between the model and the observer in this study.

In this study, emotional contagion was tested by asking both models and observers how they were feeling during each of the stimuli periods. As predicted, observers' affect tended to change in relation to what the model reported feeling. This finding is consistent with the position that mimicry of a model causes the observer to experience similar feelings. However, the direction of causality is indeterminate. The observers could have felt what the model was feeling, and this could have then caused a change in their expression. These data do not demonstrate that the expressions caused contagion. Further research should more closely examine the timeline of rapid facial responses to facial expressions, and consider the degree to which these expressions may reflect affective reactions to the faces, or be motor responses that may contribute to subsequent affect in the observer.

The congruence of observers' emotions with model's feelings was not moderated by the relationship between the model and the observer. Thus, no support is provided for the position that the relationship between the model and the observer influences emotional contagion. There are several possible reasons for its absence. First, of course, there may be no effect of relationship. Because previous studies have found some evidence for such a relationship (see Krebs, 1975; McIntosh et al., 1994; Zillman & Cantor, 1977), and because the current studies found that one possible mechanism for emotional contagion (mimicry) is at least somewhat associated with relationship, this conclusion would be premature. Second, the instrument used to assess emotional contagion may not have been sensitive enough to uncover any effect. The questionnaire was retrospective self-report and combined several emotions into an index of positive or negative affect. Future studies of both mimicry and the effects of relationships on emotional contagion should include more sensitive measures of emotion. Third, mimicry is not the only means by which relationships may influence emotional contagion. In the relatively impoverished situation in these studies – one person is simply watching another experience emotions – several factors that

make more positive relationships different from neutral or negative relationships (e.g., degree of shared experiences and meanings) could not easily operate. If this is the case, it might be difficult to find an effect for relationship examining only mimicry. Future studies should examine different possible mechanisms for emotional contagion that might be influenced by the relationship between the individuals.

General discussion

The patterns of results in the two studies are similar. As predicted, observers spontaneously mimicked the facial actions of the models. Mean levels of observer brow and cheek activity match those of the model. Together, these studies provide evidence that observers' facial movement is related to the facial actions of the person they are observing. Consistent with hypotheses and the findings of Gump and Kulik (1997), these studies show that mimicry is not limited to reactions to prototypical static faces or videotapes of individuals; mimicry occurs when one person is watching another person in the same room displaying relatively more idiosyncratic expressions. Moreover, in Study 2, the model was not posing expressions, but was reacting naturally to emotion-inducing stimuli. This study demonstrated that spontaneous mimicry of brow and cheek activity occurs in this more naturalistic circumstance. An additional contribution of these data is that they show that mimicry occurs when the individuals are not actually interacting – the model was attending to an emotional stimulus, not the observer. Thus, the presence of mimicry is not dependent on the attention (or gaze) of the model, suggesting that it is an innate or fairly automatized response and may not be solely a social-communicative process.

The presence of spontaneous facial mimicry of live models is consistent with the expanding body of work indicating that people automatically match behaviors of others in their social environment (Chartrand & Bargh, 1999; Hatfield et al., 1992; McIntosh et al., 1994; Niedenthal, Barsalou, Winkielman, Krauth-Gruber & Ric, 2005). These behavioral data parallel recent research on mirror neurons, which discharge when a similar action is executed and observed (Rizzolatti, Fadiga, Fogassi, & Gallese, 2002) and provide a neural mechanism for this class of behaviors (Carr et al., 2003). Such mimicry can be viewed as one example of embodied social and emotional processes (Niedenthal et al., 2005); moreover, the present data on affective contagion and the influence of relationships on this process underscores the interrelations of behavioral matching, shared emotions, and relationship

processes. Work investigating the influences on and psychological mechanisms of mimicry will enhance the field's understanding of how low-level processes influence broader social-emotional functioning (Moody & McIntosh, in press).

In Study 2, observers and models were asked to retrospectively indicate how they felt during each of the video segments. Observers' self reports tended to match the content of the segments and the affect the models reported feeling. This finding is consistent with prior work demonstrating emotional contagion (Hatfield et al., 1992; McIntosh et al., 1994), and is consistent with the notion that one person's mimicry of another can elicit the other's emotion in the first person. However, it is also consistent with the possibility that contagion caused similar facial expressions. Future work needs to untangle these alternatives to determine the degree to which mimicry causes congruent emotions and congruent emotions cause matched facial expressions.

Although the cover story for the study provided a rationale for asking both model and the observer how they were feeling, and these questions were embedded in a set of other questions, it is possible that there were demand characteristics that pushed the observers toward matching their expressions and self-reported feelings with the expressions they saw on the models' faces. However, during debriefing observers did not demonstrate knowledge of the hypothesis that their feelings should match the models'. Moreover, if participants were complying with experimental demand, it is hard to discern why they would conform to the relationship hypotheses for smiling but not frowning, and not the self-report hypothesis for relationship. More likely is that experimental demand may have worked against finding mimicry and relationship moderators of mimicry. A number of participants spontaneously mentioned during debriefing, before learning of the hypotheses, that they found themselves mimicking the model, and tried to suppress it because they were afraid it would influence the physiological readings being taken. Thus, the procedures of this might decrease observer mimicry and thus make it harder to find, and more difficult to discover subtle influences on it.

The influence of relationships

I predicted that observers who liked a model would mimic him or her more than those who disliked the model. Both studies found a marginal effect for liking in the mean levels of observer cheek activity, and when combined the interaction effect was statistically significant. In both studies, this interaction had a medium effect size. These

findings indicate that liking for a model influences the extent to which smiles are mimicked. During actual interactions the effect may be larger. In the laboratory setting, some reported trying to suppress facial movement so as not to disturb the physiological readings they believed were being taken. Further, in this study one person was reacting to an emotional stimulus whereas the other was reacting to that person; in a normal interaction, both are reacting to each other and there is more motivation for communication and rapport.

More liking is associated with more smiling. Because liking condition did not affect observer mood or movements of models, these do not provide plausible alternative explanations for the effects. There was no support for an effect of relationship on brow mimicry. This smile/frown asymmetry in influence of relationships is consistent with other studies examining the association of liking on mimicry. Recall that Bush et al. (1986) found that liking for Reagan influenced degree of mimicry of his smiles, but not his frowns; Hinsz and Tomhave (1991) found that mimicry of strangers' smiles may be more frequent than mimicry of their frowns. It is not clear why there would be this asymmetry. Possible reasons could focus on the mimetic response itself or on factors that influence rapid facial reactions to faces. For example, perhaps there is more variation in the degree to which people smile in responses to smiles; this increased variability would allow for more moderating influences – and liking may be one of those. Perhaps the emotional meaning of a frown is relatively stable across liked and disliked people (always threatening), whereas the smile of a friend is more consistently good but the smile of a stranger or enemy may be ambiguous – is it good or bad for your wellbeing? – and thus less likely to lead to a strong smile. A better understanding of the nature of rapid facial reactions will help provide a foundation for explaining the effect of liking, as well as other possible moderators. Similarly, understandings of moderators such as liking provide information that will help identify the nature of mimicry.

The smile/frown asymmetry does not necessarily mean that there is no relationship influence on brow mimicry; it only indicates that it is a weaker phenomenon. Thus, it is worth considering what processes may be responsible for any general influence of the relationship between people on the degree of mimicry. One possibility is gaze. People may simply look more at those they like (Rubin, 1970). The more one looks at a person, the more likely one might be to mimic that person. However, no differences in gaze between liking conditions was observable in the

present studies. Another possibility is that with individuals in a relationship, the communicative function of matching expressions has become automatic; if so, even when the person to whom the actor is communicating cannot see the actor, the actor matches the expression (see Bavelas, Black, Lemery, & Mullett, 1986; Fridlund, 1991). An observer may be more likely to do this with a person with whom he or she is used to communicating, or with a person with whom he or she wants to communicate more – that is, in both cases, a liked other. Another possibility is connected with the assumption that mimicry is a basic mammalian manner of communication. If emotional contagion prompts altruism (see Batson & Coke, 1983; Krebs, 1975), then a mechanism for this process may be sensitive to kin (or in-group) versus non-kin (or out-group) cues (see van Baaren, et al., 2004). Similarity and liking may serve as such cues, and thus people may be predisposed to respond more to the facial expressions of liked others. To the degree that being with a liked or out-group other primes different self-construals, the findings of van Baaren et al. (2003) regarding greater mimicry when interdependent self-construals are primed are consistent with this possibility. One interesting test would be examining mimicry of disliked others, or enemies. If gaze and attention drive mimicry, then these individuals may be mimicked more, because people may tend to pay close attention to the activities of threatening individuals. If communication or kin cues are responsible, then disliked people should be mimicked less.

A number of variables besides the valence of the relationship might influence spontaneous mimicry. In addition to mood (Niedenthal et al., 2001) and self-construals (van Baaren et al., 2003), the purpose of the interaction might have influence (e.g., a student may be more likely to mimic a teacher when watching the teacher give a lesson in a class than when the student sees the teacher talking with a friend). Hinsz and Tomhave (1991) mention the possibility of scripts for brief social encounters influencing mimetic responses.

To the extent that one person's mimicry of another person's smiles can cause positive affect in the first person, then the relationship between the people may influence how strong the contagion is. However, there is much work that needs to be done to clarify the finding. First, the actual effect of this difference in mimicry on the amount of emotional contagion is unknown. In Study 2, in fact, there was no evidence that affect was induced more in friends than in observers. Future work needs to establish the degree of the association between relationship influences on mimicry and such influences on emotional contagion, as well as

other social processes such as rapport and the perception and interpretation of facial expression of emotion. Moreover, more studies need to examine these phenomena in true social interaction. Gump and Kulik (1997) reflect that the absence of an association between facial mimicry and contagion in their research may be due to other nonverbal channels of communication available in a live interaction, making the contribution of facial mimicry negligible or absent.

Conclusion

Mimicry appears to play an important role in social situations. A complete understanding of the effects of mimicry in social processes necessitates an understanding of the situational moderators of mimicry. Here, mimicry of live models (Studies 1 and 2) displaying spontaneous expressions (Study 2) was demonstrated, supporting the naturalistic importance of mimicry. Moreover, mimicry of the smile was influenced by the relationship between the model and the observer. There are many issues for future research into mimicry and emotional contagion; the exploration of these should lead to a better understanding of social influences on social information processing and emotional experience.

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