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Facial mimicry and emotional contagion to dynamic emotional facial expressions and their influence on decoding accuracy

Ursula Hess[a,*], Sylvie Blairy[b]

[a]*Department of Psychology, University of Quebec at Montreal, P.O. Box 8888, Station Centre-Ville, Montreal, QC, Canada H3C 3P8*

[b]*Free University of Brussels, ERASME Hospital, Brussels, Belgium*

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Abstract

The present study had the goal to assess whether individuals mimic and show emotional contagion in response to relatively weak and idiosyncratic dynamic facial expressions of emotions similar to those encountered in everyday life. Furthermore, the question of whether mimicry leads to emotional contagion and in turn facilitates emotion recognition was addressed. Forty-one female participants rated a series of short video clips of stimulus persons expressing anger, sadness, disgust, and happiness regarding the emotions expressed. An unobtrusive measure of emotional contagion was taken. Evidence for mimicry was found for all types of expressions. Furthermore, evidence for emotional contagion of happiness and sadness was found. Mediational analyses could not confirm any relation between mimicry and emotional contagion nor between mimicry and emotion recognition. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Facial mimicry; Emotional contagion; Emotion recognition

1. Introduction

It has been suggested that mimicry — the imitation of others' non-verbal displays by an observer — plays an important role in the communication of affective states [e.g. Freud, 1921, based on a theory by Lipps, 1907; Bavelas et al., 1986]. For example, Rogers (1957) saw the imitation of a client's non-verbal behavior as a means to communicate empathy and some schools of therapy (see, e.g. Siegel, 1995) advocate imitation as a means of understanding the client's internal state.

Facial mimicry in this context is usually concep-

* Corresponding author.
E-mail address: hess.ursula@uqam.ca (U. Hess).

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tualized as an automatic, reflex-like process (see, e.g. Lipps, 1907; Hoffmann, 1984; Hatfield et al., 1993), with the observer's facial expression matching the observed facial expression. Emotional contagion is a closely related concept that is sometimes defined in overlapping terms (e.g. Hatfield et al., 1993). It is therefore useful to define the specific use of the two terms in the framework of the present study. Specifically, we consider as mimicry the congruent facial reactions to the emotional facial displays of others. That is, mimicry is defined exclusively as an expressive component. In contrast, we define emotional contagion as an affective state that matches the other's emotional display.

In a recent review, Hess et al. (1999) conclude that evidence from studies on both adults and infants strongly suggests that, in general, people adopt facial, postural, and vocal behaviors that are congruent with the displays they observe, and that these displays often represent mimicry (see also Dimberg, 1990). However, some examples of counter-mimicry effects (e.g. Lanzetta and Englis, 1989; Hess, 1998) have also been reported. Specifically, Lanzetta and Englis (1989) found mimicry in a collaborative task situation but counter-mimicry in a competitive task situation. This, and evidence that mimicry may depend on the type of task the participant is engaged in (Hess et al., 1998), suggests that mimicry may not be an automatic, reflex-like mechanism. Furthermore, a number of studies suggest that individuals tend to report emotional states that match the facial emotion displays to which they have been exposed (see, e.g. Hatfield et al., 1993; Strayer, 1993; Laird et al., 1994; Schneider et al., 1994; Lundqvist and Dimberg, 1995).

The two processes, mimicry and emotional contagion, have been suggested to be causally elated. This idea goes back to Lipps (1907) who suggested that the imitated expression leads — via a feedback process — to emotional contagion. As regards the influence of emotional contagion on empathy (the capacity to recognize the emotional state of others), Lipps (1907) as well as Hoffmann (1984) imply that emotional contagion should in turn facilitate emotion recognition. Related ideas have more recently been expressed by Hatfield et al. (1993). Similarly, Cappella (1993), based on evidence in favor of the facial feedback hypothesis (FFH) in particular, proposes that facial feedback from mimicry causes contagion.

However, evidence is accumulating that emotional contagion may not be causally related to mimicry (Gump and Kulik, 1996; Blairy et al., 1999). Also, in their review of the literature, Hess et al. (1999) could not find any consistent evidence that mimicry facilitates emotion recognition. Together, these findings throw doubt on the notion that emotion recognition is related to a reflex-like mimicry process via contagion.

So why do people mimic at all since this process seems to not be related to either emotional contagion or emotion recognition accuracy? Before answering this question a second look at the evidence reported above is necessary. First, despite the evidence for facial mimicry reported above, it is not clear whether individuals mimic the type of expressions they are likely to encounter in real life. This, because evidence for mimicry in adults is largely based on studies that employed very intense, prototypical facial expressions presented as still photographs. For example, the extensive studies on mimicry and contagion in adults by Dimberg and Lundqvist (e.g. Dimberg, 1990; Lundqvist, 1995; Lundqvist and Dimberg, 1995) employed stimuli selected from the 'Pictures of facial affect' (Ekman and Friesen, 1976), which are a set of highly recognizable and prototypic facial expressions. Such stimuli may in fact elicit a reflex-like response due to their extremity that is not found for less extreme expressions. This notion is supported by the observation that studies finding evidence for the situation dependence of mimicry employed somewhat weaker and more natural expressions (Lanzetta and Englis, 1989; Gump and Kulik, 1996; Hess et al., 1998). Also, McHugo et al. (1991) and Bourgeois and Hess (1999) using video exert of news programs featuring politicians found that mimicry was modulated by the political attitude of the observer. That is, observers were more likely to mimicry a politician if they shared his political beliefs than when not.

In sum, studies finding clear evidence for facial mimicry and emotional contagion tend to employ prototypical, high intensity, still photographs as stimulus material, whereas those studies that found evidence of situational influences on mimicry employed more naturalistic, less prototypical or weaker, facial stimuli. Thus, the question of whether individuals mimic the type of expressions they are likely to encounter in everyday life deserves further investigation.

As regards the lack of evidence for the facilitation of emotion recognition by mimicry, it is possible that the use of prototypical stimulus material may not suffice to uncover subtle improvements in decoding accuracy due to mimicry. Specifically, the process described by Lipps (1907) is relatively elaborate and demands both a certain empathic ability and introspection. Yet, emotion displays can be decoded by using other sources of information. The sender's emotion displays, the facial, vocal, postural, etc., expressions emitted by the sender can be used to draw inferences regarding the presumed emotional state of the sender using a pattern-matching approach (e.g. Buck, 1984). For example, the presence of upturned corners of the mouth and of wrinkles around the eyes can be interpreted as signaling happiness whereas eyebrows drawn together in a frown may signal anger. This process should be especially useful for the decoding of the prototypical, highly recognizable expressions often used in studies on mimicry and contagion. In those circumstances, the additional information provided by the process described by Lipps may not in fact add to the already high level of decoding accuracy.

Thus, facial mimicry may be expected to have a facilitative effect on emotion recognition mainly in situations where the emotion displays are relatively weak and non-prototypical and where the participants do not know the sender and have no previous attitude towards the sender. Finally, it may also be that contagion, but not mimicry facilitates emotion recognition.

The present study is aimed to address these issues. Given the preceding considerations, it was considered important to use expressions that were not preselected according to their correspondence to an emotion stereotype. Furthermore, to enhance ecological validity dynamic facial expressions were chosen.

Specifically, participants were asked to decode a series of video clips of emotional expressions of happiness, anger, sadness, and disgust. These facial expressions were recorded during an emotional imagery task and represent the spontaneous, idiosyncratic expressions of the expressor. Participants' own facial expressions were measured using facial electromyography and their emotional state was assessed using an unobtrusive self-report measure. Mediational analyses (Baron and Kenny, 1986) were used to assess the influence of mimicry on emotional contagion and on emotion recognition.

2. Method

2.1. Participants

Forty-one female volunteers with a mean age of 24.3 years (S.D. = 8.6) from the University of Quebec at Montreal participated individually. Participants were recruited on campus and via announcements in classrooms. Facial EMG data for some episodes had to be deleted for two participants due to movement artifacts.

2.2. Dependent measures

2.2.1. Facial EMG

Facial EMG was measured on the left side of the face. Electrode placements were chosen according to Fridlund and Cacioppo (1986). Activity of the *Orbicularis oculi*, and *Zygomaticus major* was employed to assess smiling, activity of the *Corrugator supercilii* (eyebrow) was employed to assess frowning, and activity of the *Levator labii alesque nasii* was employed to assess the 'sneer' found in disgust expressions. Muscle activity was measured using bipolar placements of Med. Associates Inc. Ag/AgCl miniature surface electrodes with Med Associates Inc. electrolyte gel (TD41). The skin was cleansed with PDI disposable electrode prep pads (70% alcohol and pumice). A Contact Precision Instruments system with a 60-Hz notch filter was used to amplify the raw EMG signals, which were integrated with 200-ms time constant. The smoothed EMG signal was sampled at 10 Hz and stored to disk. In addition, skin conductance level and interbeat interval were measured. The results pertaining to these measures will not be reported in the framework of this article as these measures were included to bolster the notion that we are interested in the participants physical reactions to the stimuli (see below). Furthermore, due to equipment failure, activity of the *Zygomaticus major* could not be assessed for most subjects. The implications of this will be discussed below.

2.2.2. Ratings

Following the presentation of each stimulus sequence, subjects were asked to assess the emotions portrayed as well as their intensities using an emotion profile. For this, subjects indicated the degree to which the expression reflected each of the following seven emotions: joie (happiness), tristesse (sadness), peur (fear), colère (anger), dégoût (disgust), surprise (surprise), and mépris (contempt). Participants clicked a point along each emotion scale indicating the intensity with which the face reflected that specific emotion. The scales were represented by a 200-pixel long, bounded rectangle on the screen, the pixels were graded in color from light gray to dark gray, with the darker end of the scale indicating greater intensity of the emotion. Each scale contained an emotion label and was anchored with the verbal labels 'not at all' and 'very intensely.' Furthermore, participants were asked to indicate how difficult the task was.

2.2.3. Decoding accuracy

Decoding accuracy was defined as the observers' ability to correctly infer the imagined emotion. An expression was considered as accurately identified when the emotion receiving the highest intensity rating on the emotion profile corresponded to the target emotion. An accurately identified expression received a score of 1 and a misidentified expression received a score of 0.

2.2.4. Self-reported emotional state

For each type of emotion expression participants were asked once, following the rating task, to fill out a questionnaire regarding their well-being. The questionnaire is an adaptation of a questionnaire developed by Philippot et al. (1994) describing sensations that may be experienced during such a task and contains 16 scales describing a variety of physical sensations (e.g. butterflies in the stomach, feeling cold) as well as the items relevant to the assessment of emotional contagion: énervé/agressif (irritated/aggressive), triste/déprimé (sad/depressed), gai/enthousiaste (cheerful), repulsé (repulsed). The labels were chosen to correspond to the emotion displays serving as stimulus material without using the same terms as those employed for the rating scales. The correspondence of the two sets of emotion labels was assessed in a separate study where participants were asked to indicate for each of a number of emotion terms to which 'basic' emotion they refer. The terms used for the contagion scale were recognized as referring to the target emotion by at least 90% of the respondents with the exception of 'enervé' which was confused with fear. The scales were continuous and anchored by 'not at all' at one extremity and 'strongly' at the other. Presenting these scales together with the physical sensations allowed to reduce the possibility that participants became aware that we were interested in their own emotional states. This questionnaire has been extensively used in paradigms related to the one employed in the present study. In the past, participants have not reported suspicions regarding the link between the emotion terms in the scale and the judgment task during the debriefing sessions where they are explicitly encouraged to speculate about the purpose of the 'well-being' scale. Participants typically report that the scale serves to assess stress. The notion that we are mainly concerned with the participants' physical reactions to the task is further sustained by the heart rate and skin conductance measures taken.

2.3. Stimuli

Stimuli were recorded during an emotional imagery task. The task consisted of either imagining the events described in an emotion script or thinking about an emotion-inducing event. Following each imagery period, self-reports of the participants' emotional state during the imagery period were obtained.

For the present study, we pre-selected video recordings from those imagery periods for which the participants described having felt the target emotion. From this pool of sequences we selected those that contained at least one visible expressive display (as assessed by an experienced FACS coder, see below). For each emotion (happiness, anger, disgust, and sadness) one sequence from two male and two female stimulus persons was selected from this pool of expressions. For the experiment sequences were edited to a length of 15 s. The resulting set of 16 episodes was digitized and converted to black and white. As mentioned above, we were interested in using the idiosyncratic expressive displays of the stimulus person. Thus, expressive displays for the different emotion conditions were expected to vary across stimuli. In order to be able to establish a criterion for the presence of mimicry we coded the actual expressive displays of the stimulus persons using the Facial Action Coding system (FACS, Ekman and Friesen, 1978). The expressions were coded by the first author who is an experienced FACS coder.

The FACS data revealed that AU4, describing the drawing together and lowering of the brows, a facial movement involving the activity of *Corrugator supercilii*, was present for all anger displays. Furthermore, three of the four anger displays contained AU23 describing the pressing together of the lips. Sadness displays also involved AU4. In addition, AU1 (describing the drawing together of the inner corner of the eyebrows) and AU15 (describing the pulling down of the corner of the lips) occurred once each.

All four happiness expressions contained AU12 (describing the pulling up of the corner of the lips, an activity involving *Zygomaticus major*) accompanied by AU6 (describing the movement that creates the wrinkles around the eyes and involves *Orbicularis oculi* activity). The four disgust displays showed little similarity. However, AU12 occurred as part of three of the four displays. AU10 (lifting of the upper lip as in a sneer, an activity involving *Levator labii alesque nasii activity*) occurred twice as did AU23. Furthermore, AU 17 (pushing up of the chin) and AU15 occurred once each.

The expressions were presented in one of two different random orders using an Apple Macintosh Quadra 840AV with a 14-inch color monitor at a rate of 30 frames/s.

2.4. Procedure

The experimenter explained to the participants that their task would be to judge the emotion(s) portrayed by a series of stimulus persons. They were informed that during the experiment physiological measures would be taken. To reduce the possibility that participants were aware that we were interested in their facial expressions we employed a cover story suggesting that the experiment was concerned with changes in skin temperature and that the transducers affixed to their face were intended for this purpose. Furthermore, participants were informed that they would be filmed during the experiment. To avoid that participants focus on the camera during the experiment, the video camera was hidden. Participants who signed a consent form repeating this information were seated in a comfortable armchair and the electrodes were attached. In order to familiarize the participants with the rating task they were asked to complete two practice trials during which the experimenter answered questions regarding the procedure.

For each trial, the participant first saw a video sequence showing the stimulus person's neutral facial expression and then a video sequence showing the emotional facial expression. Each sequence was approximately 15 s long. There was a 5-s interval between the neutral and the expressive sequence. Sequences were shown at a rate of 30 frames/s (standard NTSC video rate). Following this, the rating scales were presented, once the participant had finished the ratings the next set of sequences was shown. The stimuli were presented in one of two different random orders. The well-being questionnaire was presented following the rating task.

At the end of the experiment, participants were interviewed regarding their hypotheses. They were then fully debriefed and any remaining questions were answered by the experimenter.

2.5. Artifact control and data reduction

The video records for all participants were inspected for movements that could disrupt the psychophysiological measures. Using a visual editing computer program PHYSIO3 (Banse, 1995), periods corresponding to such movements were set missing and excluded from further analyses. For the purpose of the following analyses the periods during which the subjects saw the *neutral* face of the stimulus person served as baselines. This period was chosen to exclude that reactions to the stimulus persons are confounded with reactions to the emotional facial expressions. One way analyses of variance using a multivariate approach were employed to assess whether facial reactions to the neutral faces differed across emotions. The results were non-significant for all three muscle sites ($F < 1$). Difference scores were therefore calculated using the neutral face baseline. The difference scores were averaged across the four episodes for each emotion. For the ANOVAs, EMG data was transformed into within-subjects z-scores prior to averaging.

3. Results

3.1. Facial mimicry

The presence of facial mimicry implies a pattern of facial activity in response to the emotional display of others. To assess facial mimicry, we therefore verified first whether a distinct pattern of facial activity emerged in response to the stimuli. For this, the standardized difference scores were analyzed using a one-way repeated measures ANOVA across muscle sites. This analysis across muscle sites is allowable as facial EMG data were previously transformed into z-scores and the data are thus on the same scale. We then used planned contrasts to assess whether the facial activity conformed to the expected patterns specified as a function of the mimicry indices described above.

Specifically, for both anger and sadness, mimicry should be indexed by significantly higher levels of *Corrugator supercilii* than *Orbicularis oculi* and *Levator LAN* activity. However, *Levator LAN* activity should be significantly lower for sadness than for anger mimicry. Mimicry to happy displays should be indexed by significantly higher levels of *Orbicularis oculi* than *Corrugator supercilii* and *Levator LAN* activity. For disgust displays, *Corrugator supercilii* activity should be significantly lower than *Orbicularis oculi* and *Levator LAN* activity. The means for participants' facial EMG activity are shown in Fig. 1. Note that the data was transformed to z-scores and that the zero level refers thus to the mean across all data points and not to an absence of difference from baseline.

Significant main effects of muscle site, indicating a differentiated pattern of muscle activity across sites, emerged for participants' facial activity during the decoding of anger, $F_{2,37} = 7.29$, $P = 0.002$, sadness, $F_{2,37} = 11.85$, $P < 0.001$, and happy episodes, $F_{2,37} = 36.86$, $P < 0.001$, but not for disgust episodes. Furthermore, the contrasts specified for the anger, $F_{1,38} = 9.91$, $P = 0.003$, sadness, $F_{1,38} = 21.99$, $P < 0.001$, and happy episodes $F_{1,38} = 45.41$, $P < 0.001$, were also significant. The test comparing *Levator LAN* activity for anger and sadness episodes was marginally significant in the predicted direction, $t = -1.70$, $P = 0.098$. Thus, clear evidence emerged for mimicry during the decoding of anger, sadness, and happiness displays.

3.2. Emotional contagion

To assess emotional contagion, planned contrasts were conducted on the relevant scales of the well-being questionnaire. As we can not assume that the different emotion scales are scaled identically, the ratings were first z-transformed. Since use of z-scores obliterates information regarding the grand mean for the scales, a separate analysis was conducted on the grand means. Across all conditions, participants reported to be quite cheerful (mean = 24.46, S.D. = 31.55) as well as somewhat irritated (mean = 17.13, S.D. = 17.38). This emotional state is quite consistent with the experimental situation, which was calm

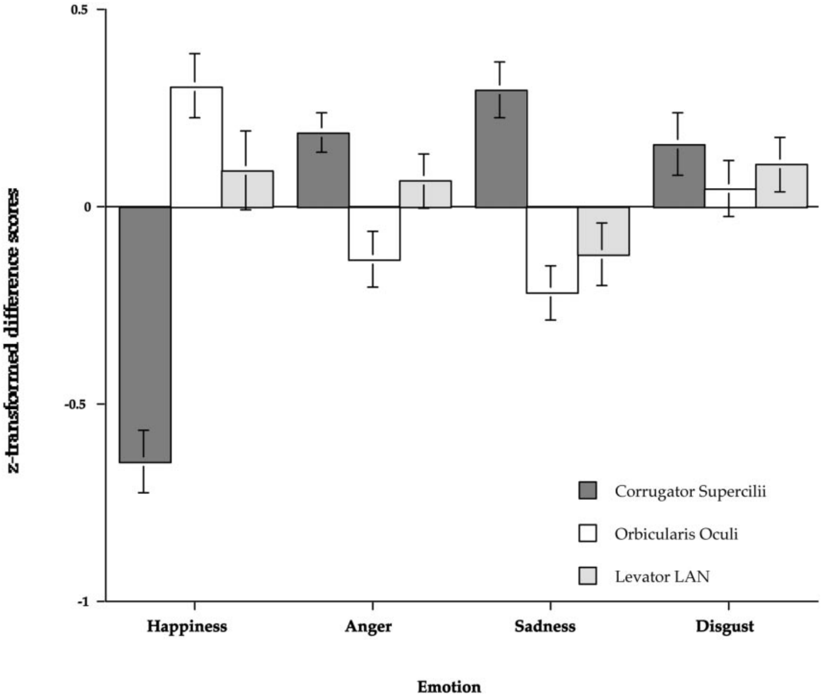


Fig. 1. Observers' facial EMG as a function of the emotional facial expression of the sender.

and relaxed but presented the participants with occasional frustrations when they had difficulty with the decoding task. Importantly, this implies that the emotional contagion effects reported below *modulated* the participants' affective state rather than changing it.

The planned contrasts assessed whether participants reported feeling more cheerful when decoding expressions of happiness, more repulsed when decoding expressions of disgust, more sad/depressed when decoding expressions of sadness, and more irritated/aggressive when decoding expressions of anger. The means are shown in Fig. 2, note that the zero level of the *z*-scored data refers to the mean across all data points and that negative scores indicate levels lower than the mean and not the use of a bimodal scale.

Significant contrasts in the expected direction emerged for self-reported affect during the decoding of happy, $F_{1,40} = 8.74$, $P = 0.005$ and sad faces, $F_{1,40} = 4.45$, $P = 0.041$, for which participants reported significantly more cheerfulness and sadness/depression, respectively. During the decoding of anger expressions the pattern of the means did not conform to the planned contrast as repulsed emerged as the highest rated emotion, and participants reported feeling significantly more repulsed than cheerful, $F_{1,40} = 7.14$, $P = 0.011$. Yet it is interesting to note, that the French word 'repulsé' connotes a desire to get away from something. Thus, reporting this feeling in response to an anger expression, while not indicative of empathy, represents an adequate emotional reaction to a threat display (see, e.g. Dimberg and Öhman, 1996). No difference emerged for the decoding of disgust expressions. In sum, the pattern of results is consistent with contagion of happiness and sadness.

3.3. Decoding accuracy

Decoding accuracy was 45% for anger expressions, 87% for happiness expressions, 43% for disgust expressions, and 75% for sadness expressions.

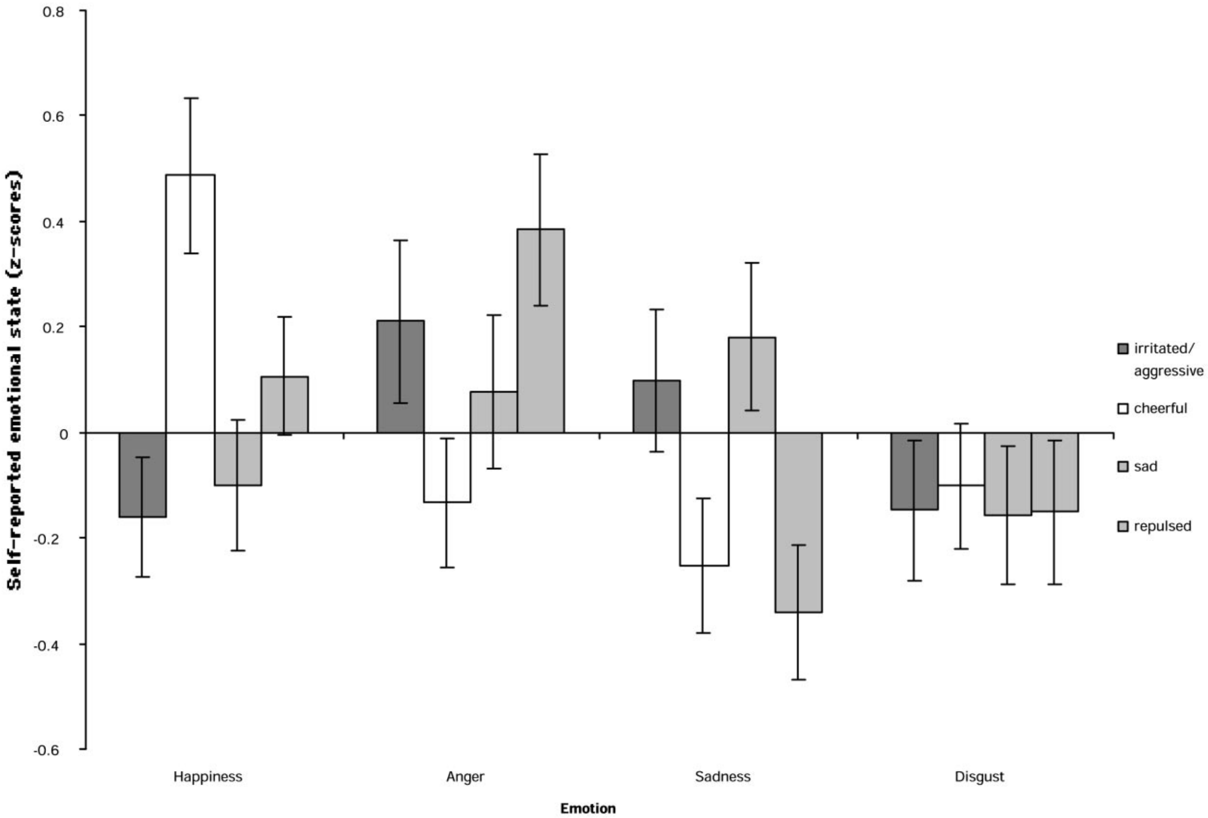


Fig. 2. Observers' self-reported emotional state as a function of the emotional facial expression of the sender.

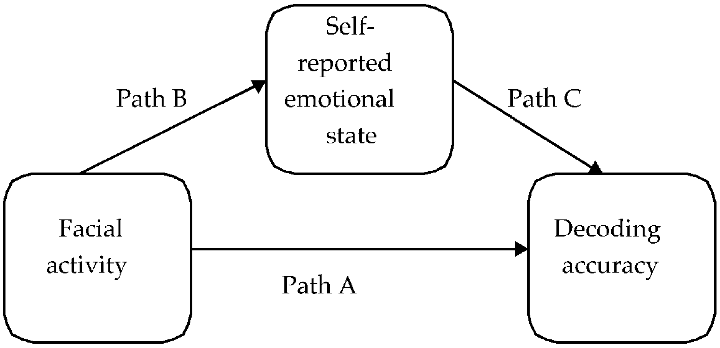
3.4. Mediational analyses

The notion that mimicry leads to emotional contagion which in turn positively influences decoding accuracy, was assessed using mediational analyses as proposed by Baron and Kenny (1986). For this, decoding accuracy was first regressed on facial activity as assessed by facial EMG (path a). Second, self-reported emotional feeling state was regressed on facial activity (path b). Finally decoding accuracy was regressed on both self-reported feeling state and facial activity (path c).[1] The mediational pathway proposed by Lipps would be confirmed if facial activity predicts self-reported emotional state and decoding accuracy, whereas self-reported emotional state predicts decoding accuracy after facial activity is controlled for. Table 1 shows the beta values for the paths. For each emotion expression the self-report on the corresponding scale was employed as well as EMG data from all muscle sites. For this analysis the untransformed difference scores were employed.

Inspection of Table 1 does not provide evidence for a mediation of decoding accuracy through contagion from mimicry. Considering first the two analyses for the expressions for which evidence for both mimicry and contagion emerged in the previous analyses, that is, expressions of happiness and sadness. For the decoding of happiness expressions, we note no evidence that either higher levels of activity of *Orbicularis oculi*

[1]As self-reported emotional feeling state was assessed only once for each emotion, the corresponding data for decoding accuracy (0 or 1) and facial EMG for the specific expressions for which the participant's emotional state had been assessed were entered in the equation.

Table 1
Beta values for the mediational analyses as a function of the emotional facial expression of the sender and the muscle site for the participants' facial activity



	Path A	Path B	Path C
Happy expressions			
Corrugator Supercilii	−0.173	−0.120	0.183
Orbicularis Oculi	−0.094	−0.106	0.193
Levator L.A.N.	0.207	0.307[t]	0.151
Anger expressions			
Corrugator Supercilii	−0.253	−0.036	0.144
Orbicularis Oculi	−0.102	0.331*	0.196
Levator L.A.N.	−0.159	0.308[t]	0.210
Sad expressions			
Corrugator Supercilii	−0.057	0.209	0.238
Orbicularis Oculi	−0.515**	−0.417**	0.002
Levator L.A.N.	−0.553***	−0.145	0.139
Disgust expressions			
Corrugator Supercilii	−0.315*	0.028	−0.136
Orbicularis Oculi	−0.281[t]	0.233	−0.083
Levator L.A.N.	−0.048	0.341	−0.144

N.B.: [t]$P < 0.09$, *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

or lower levels of activity of *Corrugator supercilii* are associated with either self-reports of cheerfulness or decoding accuracy. Furthermore, no evidence for a link between cheerfulness and accuracy in decoding happy expressions emerges. Regarding the decoding of sad expressions, we note that lower levels of *Orbicularis oculi* (which is congruent with, but certainly not indicative of a sad expression) are related to self-reported sadness and to decoding accuracy; however, no direct link between emotional state and decoding accuracy emerged once facial activity was controlled for. Similarly, lower levels of *Levator LAN* are associated with an increase in decoding accuracy. At best, this pattern suggests that lower levels of facial movements incongruent with mimicry are related to an increase in decoding accuracy but no mediation through emotional contagion seems to be involved.

The pattern for the decoding of anger is even less supportive of Lipps' model. Here, the presence of movements that are incongruent with mimicry, specifically, *Orbicularis oculi* and *Levator LAN* activity is positively related to self-reports of irritation/aggressiveness. It is possible to speculate, based on the lower decoding accuracy for this expressions (43%), that anger expressions were particularly difficult to decode and that participants therefore showed both some grimacing and reported more irritation/aggressiveness. Yet, this finding is clearly not in support of Lipps' model. For the decoding of disgust expressions no evidence for either mimicry or contagion emerged. We thus can not expect mediation through these processes. Low levels of both *Currugator supercilii* and *Orbicularis oculi* activity were found to be related to higher decoding accuracy, suggesting that lower levels of facial movements that are incongruent with mimicry are related to an increase in decoding accuracy, but again no evidence for mediation via contagion emerges. Furthermore, *Levator LAN* activity is positively related to self-reported feelings of repulsedness.

4. Discussion

The present study presents evidence that participants mimicked dynamic facial expressions of happiness, anger, and sadness. Furthermore, evidence for emotional contagion was found for happiness, sadness, and, tentatively, for anger. It is important to note that the emotional contagion effects modulate the affective experience rather than shape it. Specifically, participants reported generally moderate levels of both cheerfulness and irritation/aggression — a self-report that is congruent with the participants general positive attitude towards the task, which was reflected in debriefing interviews, and the fact that the task was at times somewhat difficult. However, participants also reported higher levels of cheerfulness when decoding expressions of happiness, higher levels of sadness when decoding expressions of sadness, and higher levels of anger when decoding expressions of anger.

Thus, the present study presents evidence for mimicry and contagion in situations where relatively realistic, low intensity, idiosyncratic emotional facial expressions served as stimulus material. This finding corroborates the contention by Hess et al. (1998) that people mimic facial displays in situations where they are interested in the emotional state of the expressor (as was the case for the participants of this study, who were explicitly asked to rate this state based on the emotional expressions).

4.1. Lipps' model

No evidence for a link between mimicry and contagion was found. Furthermore, mimicry was not systematically related, neither directly, nor indirectly via contagion, to decoding accuracy. Some evidence emerged that lower levels of facial movements that are incongruent with mimicry can be related to an increase in decoding accuracy, but no evidence for mediation via contagion emerged in these cases. Evidence for a positive link between facial activity congruent with mimicry and self-reported emotional contagion emerged only for the decoding of disgust expressions, for which, however, no evidence for either mimicry or contagion on a group level was found. A number of positive relationships between facial movements not congruent with mimicry and self-reported contagion emerged for the decoding of happiness, anger, and disgust expressions, suggesting an unspecific link between facial activity per se and emotional contagion per se.

Thus, no evidence for the process proposed by Lipps was found. This finding confirms previous negative findings regarding the relationship between mimicry and emotion recognition accuracy (e.g. Blairy et al., 1999). It can be argued that the failure to find a relationship between mimicry and decoding accuracy in studies using highly prototypical stimulus material was due to the fact that participants based their judgments on pattern matching (Buck, 1984) rather than on the more elaborate empathic process suggested by Lipps. However, this argument is less valid in the present case, where the expressions employed were much closer to real life expressions than those typically employed in research on mimicry in so far as they were relatively weak and non-prototypical. The use of video stimuli as opposed to stills further enhanced ecological validity.

4.2. Limitations of the study

One concern regarding the present study is the relatively low level of decoding accuracy for anger and disgust displays. It may be argued that the decoding task was too difficult to allow the detection of facilitative effects of mimicry and contagion. However, mimicry, and tentatively, contagion was observed for anger expressions. Furthermore, for happy expressions, which were very well recognized, no evidence for a facilitation of decoding accuracy due to mimicry and contagion was found. Thus, decoding difficulty alone should not have been an issue.

Furthermore, the value of the stimulus material lies in its relative ecological validity. The stimulus material was chosen from a set of expressions obtained during a study involving emotional imagery and the selection criterion was that the expressor reported feeling the target emotion during imagery and not the prototypicality of the expression. Thus, these expressions are closer to those that participants may encounter in real life. However, the use such idiosyncratic expressions implies a relatively lower decoding accuracy when compared to highly prototypical material or posed expressions in general (see also Motley and Camden, 1988). Finally, and most importantly, the mode of emotion recognition described by Lipps should be most useful in situations where the decoding task is not trivially simple.

A second possible problem is posed by the technical difficulties that rendered the *Zygomaticus major* data unusable. *Zygomaticus major* is the muscle that pulls the corners of the mouth up and the predictions for mimicry of happy expressions are partially based on activity of this muscle. Yet, even though the measurement of the activity muscle was deemed important, we feel that its absence does not present a serious impediment to the interpretation of the results as it has been shown that crow's feet wrinkles around the eye reliably accompany genuine happiness (e.g. Duchenne, 1862/1990) and can thus be employed as a marker for a happy expression and AU6 (the movement due to *Orbicularis oculi* activity that causes crow's feet wrinkles around the eyes) was present in the stimulus expressions. Thus, mimicry of happy expressions should be indexed by *Orbicularis oculi* activity as well as by *Zygomaticus major* activity.

4.3. Summary

The present study demonstrates mimicry and emotional contagion effects to dynamic, idiosyncratic, relatively weak emotional expressions. However, these two processes were not found to be related to each other. Nor was either mimicry or contagion related to decoding accuracy. Thus, mimicry does not seem to serve to facilitate emotion communication nor does it seem to be a symptom or 'side-effect' of emotional contagion. This raises the question of why people mimic?

It has been suggested (Bavelas et al., 1986, 1988) that mimicry serves to communicate empathy and Hess et al. (1999) conclude in their review that evidence for this effect is among the clearest in the literature on mimicry. That is, observers' facial mimicry informs the expressor of their 'understanding' of the expressor's emotional state. However, the present data does not support the notion that this communication could be accurate since mimicry was not systematically related to either recognition accuracy nor emotional contagion.

Furthermore, it has been suggested that emotional contagion may be mediated by a social comparison process. Specifically, Gump and Kulik (1997) suggest, based on the extension of social comparison theory of Schachter (1959), that emotional contagion may be one of the processes by which emotional states of individuals in similar situations may converge. In support of this notion, they point to studies showing stronger contagion effects when participants were in similar rather than dissimilar situations compared to the model (Kulik and Mahler, 1987; Sullins, 1991).[2]

Both notions described above imply that the individual first attributes a specific internal state to the interaction partner and that these attributions then influence the internal state of the individual (indirect contagion). That is, observers 'mimic' the emotions they decode and do not reflexively adopt the emotion displays they see. However, the present stimulus set can not be employed to address the question whether people mimic what they see, that is, show reflex-like mimicry of the facial expressions they are presented with, or what they know, that is, show the expression corresponding to the decoded affect. To adequately address this question, stimuli need to be constructed for which the decoded affect and the displayed stimulus are incongruent such that different expressions would be shown when 'mirroring' than when displaying the decoded affect.

In sum, the present study could show clear evidence for mimicry and contagion to non-prototypical dynamic emotion displays. No evidence was found that either process serves to facilitate decoding. This finding adds to and extends previous negative findings in this regard. The nature of the stimulus material and the relatively lower decoding accuracy undermine the argument that the observed lack of the mediational relationship proposed by Lipps (1907) is due to the ease of the task. These findings raise the question of why people mimic?

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[2] Interestingly, the evidence for counter mimicry reported by Lanzetta and colleagues (Lanzetta and Englis, 1989; McHugo et al., 1991) was also found in studies in which participants were either in competition with the model or held strong opinions contrary to those of the model.

References

Banse, R., 1995. Physio3 (PC software). Humboldt University, Berlin.

Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J. Pers. Soc. Psychol. 51, 1173–1182.

Bavelas, J.B., Black, A., Lemery, C.R., Mullett, J., 1986. 'I show how you feel': motor mimicry as a communicative act. J. Pers. Soc. Psychol. 50, 322–329.

Bavelas, J.B., Black, A., Chovil, N., Lemery, C.R., 1988. Form and function in motor mimicry: topographic evidence that the primary function is communicative. Hum. Commun. Res. 14, 275–299.

Blairy, S., Herrera, P., Hess, U., 1999. Mimicry and the judgment of emotional facial expressions. J. Nonverbal Behav. 23, 5–41.

Bourgeois, P., Hess, U., 1999. Emotional reactions to political leaders facial displays: a replication. Psychophysiology 36, S36.

Buck, R., 1984. Nonverbal receiving ability. In: Buck, R. (Ed.), The Communication of Emotion. Guilford Press, New York, pp. 209–242.

Cappella, J.N., 1993. The facial feedback hypothesis in human interaction: review and speculation. Special issue: emotional communication, culture, and power. J. Lang. Soc. Psychol. 12, 13–29.

Dimberg, U., 1990. Facial electromyography and emotional reactions. Psychophysiology 27, 481–494.

Dimberg, U., Öhman, A., 1996. Behold the wrath: psychophysiological responses to facial stimuli. Motiv. Emotion 20, 149–182.

Duchenne, G.B., 1862/1990. The mechanism of human facial expression. In: Cuthbertson, R.A. (Ed. and Trans.), Cambridge University Press, Cambridge.

Ekman, P., Friesen, W.V., 1976. Pictures of Facial Affect. Consulting Psychologists Press, Palo Alto, CA.

Ekman, P., &. Friesen, W.V., 1978. The Facial Action Coding System: A Technique for the Measurement of Facial Movement. Consulting Psychologists Press, Palo Alto, CA.

Freud, S., 1921. Group psychology and the analysis of the ego. In: Strachey, J. (Ed. and Trans.), The Standard Edition of the Complete Psychological Works of Sigmund Freud, vol. 18. Hograth Press, London (Original work published 1921).

Fridlund, A.J., Cacioppo, J.T., 1986. Guidelines for human electromyographic research. Psychophysiology 23, 567–589.

Gump, B.B., Kulik, J.A., 1997. Stress, affiliation, and emotional contagion. J. Pers. Soc. Psychol. 72, 305–319.

Hatfield, E., Cacioppo, J.T., Rapson, R.L., 1993. Emotional Contagion. Cambridge University Press.

Hess, U., 1998. Mimicry: fact and fiction. Proceedings of the Xth Conference of the International Society for Research on Emotion, Würzburg, Germany, 4–8 August.

Hess, U., Blairy, S., Philippot, P., 1998. Facial reactions to emotional facial expressions: affect or cognition? Cognit. Emotion 12, 509–532.

Hess, U., Blairy, S., Philippot, P., 1999. Facial mimicry. In: Philippot, P., Feldman, R., Coats, E. (Eds.), The Social Context of Nonverbal Behavior. Cambridge University Press, New York, NY, pp. 213–241.
Hoffmann, M.L., 1984. Interaction of affect and cognition on empathy. In: Izard, C.E., Kagan, J., Zajonc, R.B. (Eds.), Emotion, Cognition, and Behavior. Cambridge University Press, Cambridge, pp. 103–131.
Kulik, J.A., Mahler, H.I.M., 1987. Effects of preoperative room-mate assignment on preoperative anxiety and recovery from coronary-bypass surgery. Health Psychol. 6, 525–543.
Laird, J.D., Alibozak, T., Davainis, D. et al., 1994. Individual differences in the effects of spontaneous mimicry on emotional contagion. Motiv. Emotion 18, 231–247.
Lanzetta, J.T., Englis, B.G., 1989. Expectations of cooperation and competition and their effects on observers' vicarious emotional responses. J. Pers. Soc. Psychol. 33, 354–370.
Lipps, T., 1907. Das Wissen von fremden Ichen. In: Lipps, T. (Ed.), Psychologische Untersuchungen (Band 1). Engelmann, Leipzig, pp. 694–722.
Lundqvist, L.O., 1995. Facial EMG reactions to facial expressions: the case of facial emotional contagion? Skand. J. Psychol. 36, 130–141.
Lundqvist, L.O., Dimberg, U., 1995. Facial expressions are contagious. Int. J. Psychophysiol. 9, 203–211.
McHugo, G.J., Lanzetta, J.T., Bush, L.K., 1991. The effect of attitudes on emotional reactions to expressive displays of political leaders. Nonverbal Behav. 15, 19–41.
Motley, M.T., Camden, C.T., 1988. Facial expression of emotion: a comparison of posed expressions versus spontaneous expressions in an interpersonal communications setting. West. J. Speech Commun. 52, 1–22.
Philippot, P., Chapelle, G., Blairy, S., 1994. Respiratory feedback in the generation of emotion. In: Frijda, N. (Ed.), Proceedings of the VIIIth conference of the International Society for Research on Emotion, Cambridge, England.
Rogers, C.R., 1957. The necessary and sufficient conditions of therapeutic personality change. J. Consult. Psychol. 21, 95–103.
Schachter, S., 1959. The Psychology of Affiliation. Stanford University Press, Stanford, CA.
Schneider, F., Gur, R.C., Gur, R.E., Muenz, L., 1994. Standardized mood induction with happy and sad facial expressions. Psychiatry Res. 51, 19–31.
Siegel, E.V., 1995. Psychoanalytic dance therapy: the bridge between psyche and soma. Am. J. Dance Therapy 17, 115–128.
Strayer, J., 1993. Children's concordant emotions and cognitions in response to observed emotions. Child Dev. 64, 188–201.
Sullins, E.S., 1991. Emotional contagion revisited: effects of social comparison and expressive style on mood congruence. Pers. Soc. Psychol. Bull. 17, 166–174.