COGNITION AND EMOTION, 2001, *15* (6), 853–864

# BRIEF REPORT

## When did her smile drop? Facial mimicry and the influences of emotional state on the detection of change in emotional expression

Paula M. Niedenthal and Markus Brauer

*CNRS and the University of Clermont-Ferrand, France*

Jamin B. Halberstadt

*University of Otago, Dunedin, New Zealand*

Åse H. Innes-Ker

*Indiana University, Bloomington, IN, USA*

Participants in manipulated emotional states played computerised movies in which facial expressions of emotion changed into categorically different expressions. The participants' task was to detect the offset of the initial expression. An effect of emotional state was observed such that individuals in happy states saw the offset of happiness (changing into sadness) at an earlier point in the movies than did those in sad states. Similarly, sad condition participants detected the offset of a sad expression changing into a happy expression earlier than did happy condition participants. This result is consistent with a proposed role of facial mimicry in the perception of change in emotional expression. The results of a second experiment provide additional evidence for the mimicry account. The Discussion focuses on the relationship between motor behaviour and perception.

The problem of the perception and interpretation of facial expression of emotion commands an impressive position in the psychological literature (e.g., Buck, 1988; Darwin, 1872/1965; Ekman, 1982; Ekman & Friesen, 1975; Ellison & Massaro, 1997; Fridlund, 1990; Frijda, 1969; Izard, 1980; Russell & Bullock, 1987; Wallbott & Ricci-Bitti, 1993;

Correspondence should be addressed to Paula M. Niedenthal, LAPSCO/UFR Psychologie, Université Blaise Pascal, 34, avenue Carnot, 63037 Clermont-Ferrand Cedex, France; e-mail: niedenthal@srvpsy.univ-bpclermont.fr

This research was supported by National Science Foundation grant SRB-9514449 and a Programme Cognitique-2000 grant from the Minister of Research and Technology, France. We thank Jim Sherman for his helpful comments on an earlier draft of this article.



http://www.tandf.co.uk/journals/pp/02699931.html DOI:10.1080/02699930143000194

Young et al., 1997). However, extant research has largely modelled the perception of single, usually static, facial expressions. Static facial expressions of emotion are seen, for example, in photographs and advertising, but often individuals are confronted with facial expressions that change over time. As with other affective changes (Aronson & Linder, 1965; Hsee & Abelson, 1991; Hsee, Salovey, & Abelson, 1994), changes in emotional expression are informative. Individuals use this information to judge others' attitudes, to regulate others' emotions, and to guide social interaction (Salovey & Mayer, 1990).

Once a dynamic stimulus is considered, the number and complexity of mechanisms implicated in its processing increases. In this research we took as a starting point recent work by Niedenthal and colleagues (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000) which examined the influences of emotional state on the perception of the disappearance of a distinct emotional expression from the face. Although their findings were interpreted in terms of a standard perceptual mechanism, the present experiments examined the role of mimicry in the perception of change in emotional expression from one expression to another.

## Detecting expression offset

Niedenthal and colleagues (2000) induced happiness, sadness, or neutral emotion in their experimental participants. Using a computer mouse, participants then played 100-frame computerised movies in which faces displaying happiness or sadness gradually became neutral (see Fig. 1, top panel), and stopped each movie when they first perceived that the initial expression had disappeared from the face. An emotion-congruence effect was observed such that participants in happy states saw the offset of happy expressions later in the movies than did the sad participants. Participants in a sad state saw the offset of sad expressions at a later frame in the movie than did the happy state participants.

This findings was interpreted as consistent with a perceptual account in which emotions prime related perceptual codes in memory and thereby facilitate the encoding of emotion-congruent information (e.g., Bower, 1981; Niedenthal, Halberstadt, & Setterlund, 1997). Thus, participants in the happy condition perceived evidence of happiness in an expression that was becoming neutral more efficiently than did participants in the sad condition, and consequently saw the offset of happiness at a later point in the dissolution of the expression. And the same was true of participants in the sad condition with regard to sad expressions.

## The role of facial mimicry in perceiving expressions

There is another mechanism that could influence the perception of facial expression. This is mimicry on the part of the perceiver. Evidence exists that mimicry accompanies the perception of a facial expression (Bush, Barr, McHugo, & Lanzetta, 1989; Dimberg, 1982). The mere observation of a facial expression can also evoke the corresponding emotion in the perceiver (Bandura & Rosenthal, 1966; Berger, 1962; Hygge, 1976). Taken together, such findings suggest that mimicry could also be involved in the detection of change in facial expression of emotion. Specifically, individuals might detect changes in the facial expression of another person through the feedback, and perhaps change in subjective state, caused by facial mimicry (Niedenthal, 1992; Wallbott, 1991; Zajonc, Adelmann, Murphy, & Niedenthal, 1987; see also Niedenthal & Showers, 1991).

Furthermore, mimicry itself may be influenced by a number of factors, including the emotional state of the perceiver. Individuals probably mimic emotion congruent facial

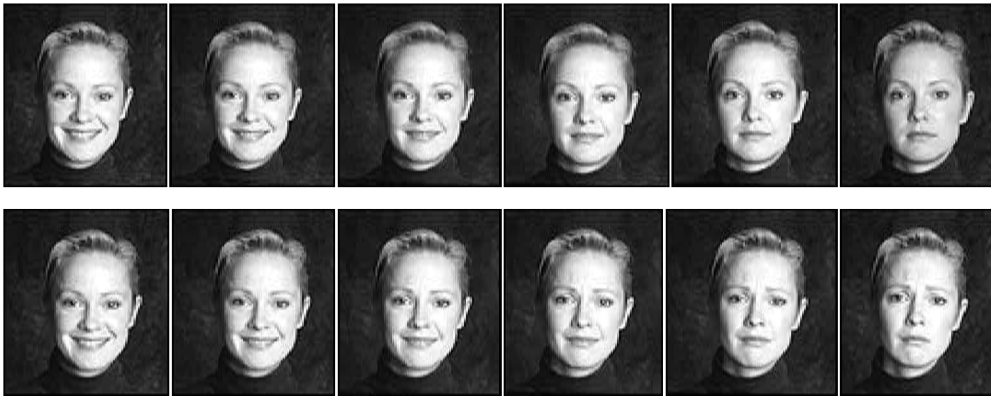

**Figure 1.** Six frames of a happy-to-neutral morph movie (top panel; adapted from Niedenthal et al., 2000) and six frames of a happy-to-sad morph movie used in the present experiments.

expressions more easily than incongruent ones. The effort required to mimic an emotion-inconsistent expression is apparent when we smile at a sad individual and tell them to smile too. Typically they fail. Individuals who feel mirth in a context in which sadness is appropriate also have trouble mimicking the expressions of others who are present. Thus, happy individuals probably mimic happy faces more readily than sad individuals do, and sad individuals probably mimic sad faces more readily than happy individuals do. Differences in facial feedback from mimicry may therefore account for the Niedenthal et al. (2000) emotion-congruence finding as follows: Happy condition participants mimicked the happy expressions more efficiently and for a longer time than sad condition participants. They thus received facial feedback of the offset of the perceived (happy) expression later than the sad condition participants. And the same was true of sad condition participants looking at sad faces. Furthermore, because the expressions became neutral over time, no new facial information appeared to compete with a congruence effect.

To test this account of the Niedenthal et al. (2000) result one could replicate their experiment and prevent half of the participants from mimicking the face stimuli. However, such a solution does risk interfering with the induced emotional state of the participant, thus changing entirely the nature of the experiment. Instead, here we propose a new hypothesis derived from the mimicry account. According to the hypothesis, the effect of emotion on the perception of a facial expression that changes from an emotion *congruent* expression to an emotion-*incongruent* one should be opposite that of emotional state on the perception of a *congruent* expression that becomes *neutral*. When individuals readily mimic the initial expression (i.e., it is emotion congruent), which then becomes an emotion-incongruent expression, they can detect this change quickly because it produces a noticeable shift in their own facial behaviour. When individuals do not readily mimic the initial expression (i.e., it is emotion incongruent), which then changes to an emotion-congruent expression, far less shift in facial responding due to concurrent mimicry is experienced. They thus perceive change later. The first experiment tested this hypothesis.

## EXPERIMENT 1

Participants in happy, sad, and neutral emotion conditions, saw computer-driven movies in which they first saw a face expressing happiness or sadness. During the movie, the expression became sad or happy, respectively (see Fig. 1, bottom panel). Participants stopped the movie at the frame at which they no longer perceived the initial facial expression. The above logic suggests that happy condition perceivers will see the offset of happiness earlier in the movies than sad participants, whereas sad condition perceivers will see the offset of a sad expression earlier than the happy participants.

### Participants

A total of 160 undergraduates at Indiana University took part in the experiment in exchange for partial credit toward a research requirement. The data from 15 participants were discarded because some of their data were not recorded or because they failed to follow instructions.

### Materials

*Emotion movies.* Slides of happy and sad faces of 14 actors/models (8 female, 6 male) were used to create the emotion movies. Pre-testing revealed that the expressions conveyed the intended emotions. Mean ratings (on 1–7 scales) of the extent to which different emotions were expressed on the happy faces were: happiness, 6.59; sadness, 1.15; disgust, 1.03; and anger, 1.03 (in paired *t*-tests, all means differed from the happiness rating at $p < .01$). Mean ratings of sad faces were: 1.28, 4.80, 2.46, and 2.23 (all means differed from the sadness rating at $p < .01$).

Happy and sad faces of the same individuals were digitally blended using the *Morph* software package (Maxwell, 1994), which produced 100-frame movies. For each of the 14 actors/models, one movie was created in which the expression changed from happiness to sadness, and a second was created in which the expression changed from sadness to happiness. The movies were presented, and the data collected, with a customised program created in MacroMedia Director software.

*Manipulation of emotional state.* For two-thirds of the participants, emotional state was induced using a combination of films and music (Halberstadt & Niedenthal, 1997). Films were presented on individual VCR/monitor units. Classical music appropriate to the emotion condition was presented during the experimental task over high quality stereo headphones.

The combined films-music technique has proven to be effective in previous experiments (e.g., Niedenthal, Halberstadt, & Innes-Ker, 1999). However, for the present experiment there was a risk that expressions displayed by characters in the films would influence performance on the morph task by directly priming the relevant perceptual face codes. Therefore, the remaining third of the participants received the music induction alone (Eich & Metcalfe, 1989).

## PROCEDURE

One to four participants were tested at a time in individual experimental cubicles equipped with Dell 450DE personal computers, and a VCR/monitor unit attached to stereo headphones. After learning that the experiment concerned the categorisation of emotional expressions and gender, participants performed four practice trials. On two emotional expression trials, the first frame of the morph movie contained a face expressing a clear emotional expression. A sliding bar appeared at the bottom of the screen. Participants played the movies by dragging the bar from left to right using the mouse. They were instructed to stop the movie at the frame in which they perceived that, for the first time, the face no longer expressed its initial emotion (for details, see Niedenthal et al., 2000).

On two gender practice trials, participants played each movie until the gender of the face had changed from male to female or the reverse. These trials were included to distract from our interest in emotion; the main experiment did not contain any gender morph movies.

Following the practice trials, participants moved to a comfortable chair in the same cubicle where they watched emotion-inducing or neutral films or listened to 8 minutes of happy or sad music through stereo headphones (or no music in the control condition). Participants then returned to the computer, and completed the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988). They then performed the morph task. Each morph movie appeared twice, presented in one of four random orders, for a total of 56 trials. In the happy and sad music/film and music-only conditions, the appropriate emotional music played throughout the task. Control participants wore their headphones, although they heard no music.

The experiment conformed to a 3 (emotional state: happy, sad, control) $\times$ 2 (morph movie: happy-to-sad, sad-to-happy) mixed design in which the first factor varied between participants and the second varied within participants.

## Results

*Manipulation check.* Happiness and sadness scores were computed by summing participants' ratings of *happy*, *content*, *active*, *lively*, and *peppy*, and of *sad*, *gloomy*, *tired*, and *drowsy* on the BMIS, respectively (for details see Niedenthal & Setterlund, 1994). A single score was then derived by subtracting the sadness score from the happiness score. The means were $M = 2.93$ for the happy condition, $M = 1.58$, for the control condition, and $M = -0.46$ for the sad condition. A polynomial contrasts analysis revealed a significant linear trend, $F(1, 142) = 13.81$, $p < .001$, and a nonsignificant quadratic trend ($F < 1$), indicating that the manipulation of emotional state was effective.

Preliminary analyses revealed that emotion induction procedures were independently effective and significant, and there were no interactions between induction procedure and any variable in the analyses of the perception of facial expression offset. Therefore, induction method is not considered further.

*Expression offset.* A 3 (emotion condition: happy, sad, control) $\times$ 2 (morph movie: happy-to-sad, sad-to-happy) mixed-model analysis of variance, with the second factor treated as a repeated measure, was performed to examine perceived expression offset. Mean offset frames (which could vary from 0 to 99) are illustrated in Figure 2. A main effect of movie was observed, $F(1, 142) = 97.24$, $p < .001$, indicating that sad expressions was seen to offset earlier than happy expressions. The interaction was also significant, $F(2, 142) = 4.30$, $p < .02$. *Post-hoc* comparisons showed that this latter effect was due to

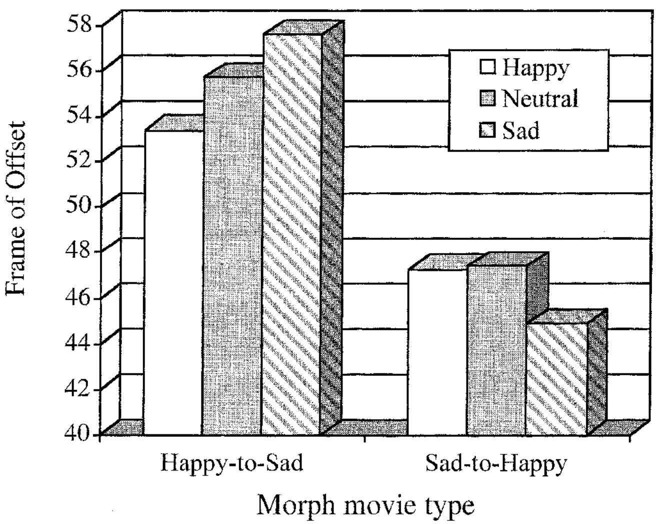


**Figure 2.** Mean frame of offset of expressions in happy-to-sad and sad-to-happy morph movies by individuals in happy, sad, and control emotion conditions.

an interaction between morph movie and the linear trend of emotion condition, $F(1, 142) = 8.29$, $p < .005$, whereas the interaction between morph movie and the quadratic trend of emotion condition was negligible, $F(1, 142) = 0.29$, ns. This means that—as expected—happy condition participants saw the offset of happiness earlier in the movie than did the sad condition participants and the sad condition participants saw the offset of sadness earlier than the happy condition participants.

## EXPERIMENT 2

The first experiment demonstrated that the offset of an emotion congruent expression changing into a categorically different expression is perceived earlier than the offset of an emotion-incongruent expression changing into a congruent one. But we provided no evidence for the role of facial mimicry. This was the goal of the second experiment. Participants whose emotional states had *not* been experimentally manipulated performed the morph task. However, half of the participants held a pen between their lips and teeth. This intervention does not itself induce an emotional state (cf. Strack, Martin, & Stepper, 1988), but it does disrupt mimicry. The control participants were free to mimic the emotional expressions. The reasoning here was that individuals who can mimic the faces freely are similar to individuals trying to detect the offset of an emotion-congruent expression (i.e., they can both mimic the initial expression effectively). Individuals who cannot mimic are conceptually similar to individuals trying to detect the offset of an emotion-incongruent expression (i.e., in neither case is the initial expression mimicked effectively). If our interpretation of the first experiment is correct, then individuals prevented from mimicking should see facial expressions offsetting later than individuals who can mimic the expressions.

Furthermore, if the offset of an initial expression is indicated in part by feedback from the progressive mimicry of a new emerging expression, then it is the contrast to the new expression that provides evidence of the offset of the initial one. Thus, if participants are told to detect the ‘‘onset’’ of a new expression, they should perform the morph task identically to those participants who perform the task looking for the ‘‘offset’’ of the initial expression. To examine this issue, we asked half of the participants to detect the onset of a new facial expression. As before, the remaining participants were instructed to detect the offset of the initial emotion.

### Participants

A total of 97 undergraduates at Indiana University took part in the experiment in return for partial credit for a course requirement. Between one and three participants arrived at the laboratory at a time. Sessions were randomly assigned to mimicry (mimicry, mimicry prevented) and task instruction (perceive offset, onset) conditions. The data from two participants were eliminated because they failed to follow instructions.

### Procedure

The stimuli were the same morph movies used in Experiment 1. The same procedure was also followed, with two exceptions. First, emotional states were not manipulated. Rather, prior to the morph task, half of the participants were invited to choose a new pen from a box of red ballpoint pens. (At the end of the experiment, they were told that they could keep the pen.) These participants were instructed to hold the pen sideways in their mouth, lightly using both their teeth and their lips, throughout the morph task. They were informed that this was done to prevent movements of the face. The remaining participants learned nothing about holding a pen in the mouth.

The second difference concerned the experimental instructions. Half of the participants were instructed to stop the morph movies at the point at which they first detected the offset of the initial emotional expression. The remaining participants were told to stop the morph movies at the point at which they first detected the onset of a new emotional expression.

The experiment conformed to a 2 (mimicry: possible, prevented) $\times$ 2 (instruction: offset, onset) $\times$ 2 (movie: happy-to-sad, sad-to-happy) design. The first two factors varied between participants, the last one within participants.

## Results

When overall happiness scores, computed as in the previous experiment, were submitted to a 2 (mimicry) $\times$ 2 (instruction) ANOVA, a marginal effect emerged such that those in the mimicry prevented condition were slightly happier than those in the mimicry possible condition, $F(1, 91) = 3.78$, $p < .06$. Examination of the happiness and sadness scores separately revealed that this was due to elevated happiness among those in the mimicry prevented condition, $F(1, 91) = 9.21$, $p < .01$. Levels of sadness were identical in the two conditions. This difference might be due to the fact that the participants in the mimicry prevented condition believed that they had received a free gift, which has been shown to induce mild states of happiness (e.g., Isen, Niedenthal, & Cantor, 1992). We therefore used the self-reported happiness score as a covariate in the primary analysis.

*Facial expression offset and onset.* Frames of perceived offset and onset were submitted to a 2 (mimicry: possible, prevented) $\times$ 2 (instructions: offset, onset) $\times$ 2 (movie: happy-to-sad, sad-to-happy) mixed-model ANCOVA, with repeated measures on the last factor, and self-reported happiness as a covariate. There was only one significant effect: the possibility to mimic the faces, $F(1, 91) = 5.97$, $p < .02$.

Unadjusted means are reported in Table 1. As can be seen, regardless of instruction (e.g., onset, offset), participants who could mimic the faces detected expression change earlier in the movies than did participants who could not mimic the faces. And the effect of the manipulation was significant both for the happy-to-sad movies, $F(1, 92) = 3.71$, $p =$ .05, and for the sad-to-happy movies, $F(1, 92) = 5.71$, $p < .02$.

# DISCUSSION

The present research examined influences of emotional state in the detection of change in emotional expression. Niedenthal and colleagues (2000) demonstrated that emotions affected the detection of offset of an expression such that individuals reported seeing emotion-congruent expressions last longer on the face than emotion-incongruent expressions, when the expressions became neutral over time. Although such an effect might be accounted for by a perceptual mechanism, influences of facial mimicry and the facial feedback provided by such mimicry could also in part explain the result.

The present Experiment 1 demonstrated that emotional state affects the detection of the offset of a facial expression—when it changes from congruent to incongruent with the

TABLE 1
Experiment 2: Mean frame of perceived change in expressions in happy-to-sad and sad-to-happy morph movies by individuals able to mimic (no pen) and unable to mimic (pen) with instructions to find the offset or onset of the initial expression

| | *Movie* | |
|---|---|---|
| *Instruction* | *Happy-to-sad* | *Sad-to-happy* |
| Offset | | |
| Pen | 57.9 | 51.9 |
| No pen | 56.6 | 46.2 |
| Onset | | |
| Pen | 57.0 | 48.3 |
| No pen | 51.9 | 44.5 |

perceivers' own emotional state—such that emotion congruent expressions are seen as offsetting *earlier* than are emotion incongruent expressions. We suggest that this finding is predicted by a mimicry account. Specifically, individuals probably more easily (and even willingly) mimic emotion-congruent facial expressions. Given also that they mimic changes in expressions as they occur, individuals should detect changes in the expression caused by the intrusion of an emotion-incongruent expression with great precision. Individuals should not detect the offset of emotion-incongruent expressions efficiently because they are not mimicking the faces readily in the first place and because the changes increasingly correspond to their own facial expression tendencies.

In order to provide some direct support for the mimicry account, a second experiment was conducted. In Experiment 2, half of the participants were allowed to mimic the faces, which in the present account is similar to individuals confronted with emotion-congruent expressions, and the remaining participants were prevented from mimicking the faces effectively, which is similar to individuals confronted with emotion-incongruent expressions. Findings indicated that individuals who could mimic the faces tended to see the offset of the initial expression earlier than did those participants who were not able to mimic the expressions. Thus, the results of the two experiments are conceptually consistent.

The present account also implies that the early detection of offset of emotion-congruent expressions is due to information provided by the emergence of a new, incongruent expression. If the information from the emerging expression is important in determining the point of perceived offset of the initial expression, then instructions to detect the offset of the initial expression and the instructions to detect the onset of a new expression should yield the same pattern of results. This is indeed what we observed.

Of course, the results of the second experiment are open to other interpretations. For example, it may be that individuals who held a pen in their mouths were in some way distracted from their task and therefore noticed expression offset later. Given that the manipulation was, according to the participants themselves, not difficult, this interpretation seems unlikely. Furthermore, the participants in the pen condition were found to be happier than were the participants in the no-pen condition. According to some approaches to affect-cognition interaction, happiness should if anything have led individuals to indicate earlier rather than later offset. This is because each trial in part involves asking whether the stopping point has been reached, and happier participants should have felt that they could say ''yes'' to this question earlier than sad participants (e.g. Martin, Ward, Achee, & Wyer, 1993). Clearly, this was not the case, and statistical analyses controlled for happiness in any event.

One might also object to the use of the pen manipulation as an inhibitor of mimicry. The instruction to hold a pen between both the teeth and lips (as opposed to one or the other as in Strack et al., 1988) effectively prevents mimicry with the mouth, but use of the upper face can still occur. Rather than being problematic, this may be quite similar to the situation of being confronted with an emotion-incongruent facial expression. Under that condition it is also possible that some aspects of the face are at least temporarily mimicked. The point is that the pen manipulation does not allow the same level of mimicry as that of an emotion-congruent facial expression to which small changes can contrast more clearly. Indeed, the goal of the second study was not to provide a test of mimicry in the perceived offset of facial expression, but to provide a conceptually similar situation to that in which expressions are easily or readily mimicked versus not.

Of course, although the presented results are provocative, arguing that mimicry influences the perception of change in facial expression still begs the question of mechanism. How is mimicry, and the facial feedback it provides, used in perceiving expression change? Two explanations seem possible. First, perceptual input and feedback from facial mimicry may be two sources of independent evidence, that perceivers combine at the level of judgement to decide that an expression has changed. Another possibility is that feedback from mimicry and perception interact earlier in the process. Specifically, feedback from facial mimicry may itself activate perceptual representations that support encoding and processing of facial expression. Mimicry of a smile, for example, may operate directly on perceptual codes. Such an interpretation is consistent with previous considerations of the interaction between emotional processing and perception (Niedenthal, 1992), as well as recent views of concepts as simulators that preserve perceptual and motoric information relevant to the concept (e.g., Barsalou, 1999a, b).

The importance of mimicry in perceiving and recognising emotional expressions is compelling. This is most clearly demonstrated in research, like the present research, that employs dynamically changing stimuli. Future work will have to establish why and how mimicry is related to perception.

Manuscript received 21 February 2001
Revised manuscript received 26 February 2001

## REFERENCES

Adelmann, P.K., & Zajonc, R.B. (1987). Facial efference and the experience of emotion. *Annual Review of Psychology*, *40*, 249–280.

Aronson, E., & Linder, D. (1965). Gain and loss of esteem as determinant of interpersonal attraction. *Journal of Experimental Social Psychology*, *1*, 156–171.

Bandura, A., & Rosenthal, T.L. (1966). Vicarious classical conditioning as a function of arousal level. *Journal of Personality and Social Psychology*, *3*, 54–62.

Barsalou, L.W. (1999a). Perceptual symbol systems. *Behavioral and Brain Sciences*, *22*, 577–609.

Barsalou, L.W. (1999b). Language comprehension: Archival memory or preparation for situated action? *Discourse Processes*, *28*, 61–80.

Berger, S.M. (1962). Conditioning through vicarious instigation. *Psychological Review*, *69*, 450–466.

Bower, G.H. (1981). Mood and memory. *American Psychologist*, *36*, 129–148.

Buck, R. (1988). The perception of facial expression: Individual regulation and social coordination. In T.R. Alley (Ed.), *Social and applied aspects of perceiving faces*. Hillsdale, NJ: Erlbaum.

Bush, L.K., Barr, C.L., McHugo, G.J., & Lanzetta, J.T. (1989). The effects of facial control and facial mimicry on subjective reactions to comedy routines. *Motivation and Emotion*, *13*, 31–52.

Darwin, C. (1872/1965). *The expression of the emotions in man and animals*. Chicago, IL: University of Chicago Press. (Original work published in 1872)

Dimberg, U. (1982). Facial reactions to facial expressions. *Psychophysiology*, *19*, 643–647.

Eich, E., & Metcalfe, J. (1989). Mood-dependent memory for internal versus external events. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 443–455.

Ekman, P. (1982). *Emotion in the human face* (2nd ed.). Cambridge, UK: Cambridge University Press.

Ekman, P., & Friesen, W.V. (1975). *Unmasking the face*. Englewood Cliffs, NJ: Prentice-Hall.

Ellison, J.W., & Massaro, D.W. (1997). Featural evaluation, integration, and judgment of facial affect. *Journal of Experimental Psychology, Human Perception and Performance*, *23*, 213–226.

Fridlund, A.J. (1990). The behavioral ecology and sociality of human face. *Personality and Social Psychology Review*, 2, 90–122.

Frijda, N.H. (1969). Recognition of emotion. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 4, pp. 167–224). New York: Academic Press.

Halberstadt, J.B., & Niedenthal, P.M. (1997). Emotional state and the use of stimulus dimensions in judgment. *Journal of Personality and Social Psychology*, *72*, 1017–1033.

Hsee, C.K., & Abelson, R.P. (1991). The velocity relation: Satisfaction as a function of the first derivative of outcome over time. *Journal of Personality and Social Psychology*, *60*, 341–347.

Hsee, C.K., Salovey, P., & Abelson, R.P. (1994). The quasi-acceleration relation: Satisfaction as a function of the change of velocity of outcome over time. *Journal of Experimental Social Psychology*, *30*, 96–111.

Hygge, S. (1976). *Emotional and electrodermal reactions to the suffering of another: Vicarious instigation and vicarious classical conditioning*. Stockholm: Almqvist & Wiksell.

Isen, A.M., Niedenthal, P.M., & Cantor, N. (1992). An influence of positive affect on social categorization. *Motivation and Emotion*, *16,* 66–78.

Izard, C.E. (1980). Cross-cultural perspectives on emotion and emotion communication. In H. Triandis (Ed.), *Handbook of cross-cultural psychology* (pp. 95–126). Boston, MA: Allyn & Bacon.

Martin, L.L., Ward, D.W., Achee, J.W., & Wyer, R.S. (1993). Mood as input: People have to interpret the motivational implications of their moods. *Journal of Personality and Social Psychology*, *64*, 317–326.

Mayer, J.D., & Gaschke, Y.N. (1988). The experience and meta-experience of mood. *Journal of Personality and Social Psychology*, *55*, 102–111.

Maxwell, D. (1994). *Morph* (*Version 2.5*) [Computer Software]. San Diego, CA: Gryphon Software Corporation.

Niedenthal, P.M. (1992). Affect and social perception: On the psychological validity of rose-colored glasses. In R.F. Bornstein & T.S. Pittman (Eds.), *Perception without awareness*. New York: Guilford Press.

Niedenthal, P.M., Halberstadt, J.B., & Innes-Ker, A.K. (1999). Emotional response categorization. *Psychological Review*, *106*, 337–361.

Niedenthal P.M., Halberstadt, J.B., Margolin, J., & Innes-Ker, A.H. (2000). Emotional state and the detection of change in facial expression of emotion. *European Journal of Social Psychology*, *30*, 211–222.

Niedenthal, P.M., Halberstadt, J.B., & Setterlund, M.B. (1997). Being happy and seeing ‘‘happy’’: Emotional state mediates visual word recognition. *Cognition and Emotion*, *11*, 403–432.

Niedenthal, P.M., & Setterlund, M.B. (1994). Emotion congruence in perception. *Personality and Social Psychology Bulletin*, *20*, 401–410.

Niedenthal, P.M., & Showers, C. (1991). The perception and processing of affective information and its influences on social judgment. In J.P. Fogas (Ed.), *Emotion and social judgment*. Oxford, UK: Pergamon.

Russell, J.A., & Bullock, M. (1987). Fuzzy concepts and the perception of emotion in facial expression. *Social Cognition*, *4*, 309–341.

Salovey, P., & Mayer, J.D. (1990). Emotional intelligence. *Imagination, Cognition and Personality*, *9*, 185–211.

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

Wallbott, H.G. (1991). Recognition of emotion from facial expression via imitation? Evidence for an old theory. *British Journal of Social Psychology*, *30*, 207–219.

Wallbott, H.G., & Ricci-Bitti, P. (1993). Decoders’ processing of emotional facial expression—a top-down or bottom-up mechanism? *European Journal of Social Psychology*, *23*, 427–443.

Young, A.W., Rowland, D., Calder, A.J., Etcoff, N., Seth, A., & Perrett, D.I. (1997). Facial expression megamix: Tests of dimensional and category accounts of emotion recognition. *Cognition*, *63*, 271–313.

Zajonc, R.B., Adelmann, P.K., Murphy, S.T., & Niedenthal, P.M. (1987). Convergence in the physical appearance of spouses. *Motivation and Emotion*, *11*, 335–346.