Emotion *and* CONSCIOUSNESS

Edited by

LISA FELDMAN BARRETT
PAULA M. NIEDENTHAL
PIOTR WINKIELMAN

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CHAPTER 2

Embodiment in the Acquisition and Use of Emotion Knowledge

PAULA M. NIEDENTHAL
LAWRENCE W. BARSALOU
FRANÇOIS RIC
SILVIA KRAUTH-GRUBER

The past 50 years have seen an exponential increase in the number of journal and book pages devoted to reports and discussions of research on emotion. Despite the growth of interest in the empirical study of emotion, however, the literature remains largely unintegrated. Researchers have independently studied the processes involved in the perception, interpretation, experience, and use of knowledge about emotion, relying on very different theoretical orientations. In addressing such apparently wide-ranging problems, for example, emotion researchers have tested principles of evolutionary theory with the use of facial expression recognition data and with the use of autonomic nervous system data; they have pursued cognitive theories of emotion and measured reaction times to categorizing words or studied judgments of similarity between words denoting emotional states; and they have evaluated social constructivist theories with the use of linguistic analyses and archival data on social customs. In this chapter, we seek to understand the body of knowledge about emotion with a single mechanistic account. Following the pun present in the preceding sentence, in the present chapter, we introduce the notion of *embodiment* and argue

1. *What is the scope of your proposed model? When you use the term* emotion, *how do you use it? What do you mean by terms such as* fear, anxiety, *or* happiness?

The topic of the chapter is the processing of emotional information and emotion concepts. Our point is that processing emotional information involves a simulation of the corresponding emotional state or cue in the perceiver. Consistent with many basic emotion theorists, emotions are defined as short-term, biologically based patterns of perception, subjective experience, physiology, and action (or action tendencies) that constitute responses to specific physical and social problems posed by the environment.

2. *Define your terms:* conscious, unconscious, awareness. *Or say why you do not use these terms.*

By consciousness we mean the object of attention. Once attention has been directed at an embodied emotion, then it can become a subject of advanced representational processes. As noted at the end of the chapter, this will have many consequences for the subjective experience of emotion.

3. *Does your model deal with what is conscious, what is unconscious, or their relationship? If you do not address this area specifically, can you speculate on the relationship between what is conscious and unconscious? Or if you do not like the conscious–unconscious distinction, or if you do not think this is a good question to ask, can you say why?*

We have suggested that although emotions are embodied, this embodiment need not be conscious. It is also possible that some embodied components of emotion, such as the perceptual patterns that define them, can never be conscious. When conscious attention is directed to the cognitively penetrable

that the acquisition of knowledge about emotion—the perception, recognition, and interpretation of an emotion in the self or other—involves the embodiment of emotional states, and the use of emotion knowledge involves the reenactment of these same states. In other words, we think that (1) perceiving emotions involves embodiment, and (2) using emotion knowledge relies on the very same somatosensory and motor states. The implication of this perspective is that perceiving someone else's emotion, having an emotional response or feeling oneself, and using emotion knowledge in conceptual tasks are all fundamentally the same process.

In the sections that follow, we provide evidence for the following four claims: (1) Individuals embody other people's emotional behavior; (2) embodied emotions produce corresponding subjective emotional states in the individual; (3) imagining other people and events also produces embodied emotions and corresponding feelings; and (4) embodied emotions mediate cognitive responses. After reviewing this evidence, we discuss how theories of embodied cognition can account for these types of effects (we focus largely on Barsalou's [1999a] recent theory of embodied cognition). We end by identifying implications of this approach for understanding conscious and unconscious aspects of emotion.

WHAT IS EMBODIMENT?

By *embodiment* we mean the bodily states that arise (e.g., postures, facial expressions, and uses of the voice [i.e., prosody]) during the perception of an emotional stimulus and the later use of emotional information (in the absence of the emotional stimulus). In the area of emotion the concept of embodiment is associated with the theory of William James (1890/1981), who argued that individuals' perceptions of the bodily states that occur in the presence of emotional events constitute their emotions (really, their feelings), in the sense of "feeling" somatosensory and motor changes. In essence, James defined emotions as the conscious perception of bodily states. Although our aims are somewhat different—we are concerned with the theoretical grounding for emotion concepts—we come full circle and return to James in this chapter. We propose that the *bodily states*, or embodiments of emotion, can be, and often are, unconscious, and that the *feeling states* are conscious. If we consider that embodiments can be unconscious until consciously attended to and manifested as feelings, then the general debate about whether emotion is conscious or unconscious becomes, in our mind, more tenable, and the various disagreements on this point (e.g., see Winkielman, Berridge, & Wilbarger, Chapter 14; Clore, Storbeck, Robinson, & Centerbar, Chapter 16) can be reconciled. It is, above all, necessary to decide whether an emotion is a *bodily state*, a *feeling state*, or both.

INDIVIDUALS EMBODY OTHERS' EMOTIONAL GESTURES AND BEHAVIORS

In this first section we review empirical evidence for the claim that people embody the emotional behaviors of others. These behaviors may include, but are not limited to, facial expressions, postures, and vocal parameters that convey emotion. Here we present evidence concerning the ubiquity of imitation; in the next section we discuss the relations between imitation and subjective emotional state. There is evidence suggesting that such imitation is automatic, in that it does not have to be conscious or intentional. However, it is clear that goals, such as the goal to empathize, can enhance or suppress the tendency or the effort put into imitation.

Embodiment of Facial, Postural, and Vocal Expressions of Emotion

Probably the most extensive evidence for the embodiment of others' emotional behavior involves the facial and vocal expressions of emotion. In several frequently cited studies, Dimberg (1982, 1990) showed that 8-second presentations of slides of angry and happy faces elicited facial electromyographic (EMG) responses in perceivers that corresponded to the perceived expressions. For example, zygomatic activity (which occurs when individuals smile) was higher when participants viewed a happy, compared to an angry, face. In addition, corrugator activity (which occurs when individuals frown) was elevated when participants viewed an angry face, and it decreased when participants viewed a happy face. Furthermore, these effects were obtained when the faces were presented subliminally (Dimberg, Thunberg, & Elmehed, 2000).

Vaughan and Lanzetta (1980) used a vicarious conditioning paradigm in which participants viewed the videotaped facial expression of pain displayed by a confederate (unconditioned stimulus) while working on a paired-association learning task. The pain expression that always followed a target word of the same word category (flower or tree names) produced a similar facial response in the observer during the confederate's pain expression, as indicated by EMG activity (for related findings, see Bavelas, Black, Lemery, & Mullett, 1987).

Embodiment of positive facial expressions was demonstrated by Bush, Barr, McHugo, and Lanzetta (1989). In their study participants viewed two comedy routines. In one, smiling faces had been spliced into the film concurrent with sound-track laughter. Half of the participants were instructed to inhibit their facial expressions. The half whose expressions were spontaneous—that is, in whom mimicry was permitted—displayed greater zygomatic and oricularis activity during the spliced segments than during the segments without smiling faces. Research by Leventhal and colleagues (Leventhal & Mace, 1970; Leventhal & Cupchik, 1975; Cupchik & Leventhal, 1974) similarly showed that exposure to the expressive displays of others produces mimetic responses in observers (and see Chartrand & Bargh, 1999).

McHugo and colleagues studied the embodiment of more complex expressive behaviors (including facial expression, gaze direction, and bodily posture) of political leaders on observers' facial reactions as a function of their prior attitudes. In one study (McHugo, Lanzetta, Sullivan, Masters, & Englis, 1985), participants watched televised news conferences of then-President Ronald Reagan. Independent of their prior attitudes, participants showed increased brow activity (contraction of the corrugator supercilii muscle) in response to Reagan's negative expressions and reduced cheek activity (low zygomatic major activity) during Reagan's positive expressions.

Finally, emotional embodiment has been shown for emotional prosody. In a recent study by Neumann and Strack (2000), participants listened to recorded speeches that were read in either a sad or a happy voice. Under the pretext that the experimenters were interested in whether memory for the content of a speech is improved by the simultaneous reproduction of it by the listener, the participants had to repeat the content of the speech aloud as they listened to it. Thus the participants were focused on the content of the speech that they were instructed to repeat, not on the prosody of the speaker. Different participant-judges later rated the emotional prosody of the initial participants as they repeated the speech. Results showed that participants embodied the prosody of the speakers when shadowing their speech, even though prosody was completely irrelevant to task performance, and they were unaware of the influence on their own prosody.

In sum, a large number of studies over the last 30 years has documented the ubiquity of facial, postural, and prosodic embodiment. These studies all show that individuals partly or fully embody the emotional expressions of other people, and some of the results also show that this process is either very subtle, and likely to occur outside of consciousness, or unmoderated by contextual factors, suggesting that such embodiment is highly automatic in nature. Why would the embodiment of others' facial, bodily, and vocal expressions of emotion be so automatic and so ubiquitous? In the present view, imitation is the mechanism by which observers come to comprehend the emotions of others. But, of course, this premise would only make sense if the imitation produced a corresponding state in the observer (for a discussion, see Décety & Chaminade, 2003; Zajonc, Adlemann, Murphy, & Niedenthal, 1987). Indeed, much research has tested this notion, and it is to such work that we turn next.

EMBODIMENT OF OTHERS' EMOTIONS PRODUCES EMOTIONAL STATES

In some of the studies described in the previous sections, researchers measured not only the embodiment of others' emotional gestures, but also the occurrence of corresponding emotional states in the perceiver. For example, in the study by Vaughan and Lanzetta (1980), participants not only imitated the confederate's painful expressions, they also responded to the confederate's pain expression as if they were in pain (as indicated by an increase in autonomic arousal). Furthermore, in a follow-up study, Vaughan and Lanzetta (1981) found that the vicarious emotional responses elicited by observing the confederate's painful expression could be modified by the opportunity for embodiment, in particular, by the instruction to suppress or amplify facial expression during the confederate's shock period. Consistent with an embodiment account, participants in the amplify condition who embodied the expressions of pain showed higher autonomic arousal compared to both no-instruction participants and participants in the inhibition condition who had to suppress their facial expressions.

Feedback effects of mimicked facial expression on participants' emotional experience were also found in a study by Hsee, Hatfield, Carlson, and Chemtob (1990). Participants were secretly filmed while watching a videotaped interview of a fellow student who described either one of the happiest or one of the saddest events in his or her life, and who displayed the corresponding expressive behavior (i.e., happy or sad facial expressions, gestures, posture, tone of voice). Participants not only embodied the emotional expressions of the target person they viewed (evaluated by judges who rated the videotaped facial expressions of the participants), but also their own emotions were affected by the emotional expression they mimicked.

Finally, neuroscientific evidence that imitated emotion gestures produce emotions was found by Hutchison and colleagues, who examined the activation of pain-related neurons in patients (Hutchison, Davis, Lozano, Tasker, & Dostrovsky, 1999). Importantly, they found that not only were such neurons also activated when a painful stimulus was applied to the patient's own hand, but the same neurons were also activated when the patient watched the painful stimulus applied to the experimenter's hand. This finding was interpreted as evidence of an embodied simulation in the perceiver of what was happening to the perceived person (see Gallese, 2003, for summaries of related research).

The studies just reviewed provide correlational evidence that people's embodiments of others' emotional gestures are accompanied by congruent emotional states or responses. However, except for a few demonstrations in which mimicry was experimentally inhibited or facilitated, it cannot be concluded from the studies that embodiment *causes* emotional states. We next review research that suggests that emotion-specific embodied states, such as facial expressions, vocal expressions, and bodily postures, can produce the corresponding emotion or at least modulate the ongoing emotional experience.

Effects of Facial Embodiment: Tests of the Facial Feedback Hypothesis

Most of the research that demonstrates the influence of embodied emotions on emotional state was conducted with the aim of testing the facial feedback hypothesis, according to which feedback from facial musculature has direct or moderating effects on emotional state (for a review of findings and mechanistic accounts, see Adelmann & Zajonc, 1989; McIntosh, 1996). In canonical facial feedback studies, participants' facial expressions were manipulated by the experimenter's demand to pose (facilitate) or hide (inhibit) their spontaneous emotional expression, by using a muscle-to-muscle instruction that specified the facial muscle to contract, or by nonemotional tasks that allowed the experimenter to guide the production of facial expressions without cueing the emotional meaning of the expression. In many such studies, the opportunity to experience emotion was presented in the form of a variety of emotional stimuli, such as painful electric shocks, pleasant and unpleasant slides and films, odors, or imagery, and the moderation of the emotion by facial expression was assessed. Findings demonstrated that the intensity and quality of the participants' manipulated facial expression affected the intensity of their self-reported emotional feelings as well as their autonomic responses.

For example, in three experiments, Lanzetta, Cartwright-Smith, and Kleck (1976) demonstrated that manipulated facial expression affected the intensity of emotional reactions during the anticipation and reception of electric shocks. In Study 1 participants received an initial set of shocks (baseline sequence) that varied in intensity, and rated the aversiveness of each received shock. Shock intensity was announced by a shock signal slide. For the second set of shocks, participants were instructed to hide their facial display in response to anticipating the shocks announced by the slide. The inhibition instruction caused low- and medium-intensity shocks to be experienced as less painful, but did not decrease the painfulness of high-intensity shocks. In a follow-up study the same basic procedure was used, but this time expression-inhibition as well as expression-exaggeration instructions were given in the manipulation sequence. Participants who were asked to simulate anticipating and receiving no shocks (inhibition instruction) reported experiencing the shocks as less aversive and painful compared to participants who simulated intense shocks (exaggeration instruction). Similar results were found in a study by Kopel and Arkowitz (1974).

Kleck, Vaughan, Cartwright-Smith, Vaughan, Colby, and Lanzetta (1976) manipulated participants' facial expressions by social means. The presence of an observer during the receipt of either no-, low-, or medium-intensity shocks attenuated participants' facial expressivity (natural inhibition) and produced lower self-rated painfulness of shocks compared to the alone condition. Using pleasant and unpleasant slides as emotion-eliciting stimuli, Lanzetta, Biernat, and Kleck (1982) induced contextual inhibition of facial expression by the means of a mirror installed in front of the participants. The mirror had attenuating effects on both participants' expressivity and the self-reported intensity of felt pleasantness–unpleasantness. Similar attenuating as well as facilitating effects of facial expression, manipulated by suppression–exaggeration instructions, were also found with pleasant and unpleasant films (Zuckerman, Klorman, Larrance, & Spiegel, 1981) and odors (Kraut, 1982).

Such modulating effects of facial expressions were also found in studies that used less obvious facial manipulations. In Laird (1974), participants contracted specific facial muscles involved in smile or frown expressions while watching positive and negative slides (Study1) or humorous cartoons (Study 2). "Smiling" participants felt happier while viewing positive slides, whereas "frowning" participants felt angrier while viewing negative slides. Incongruent expressions were shown to attenuate their feelings (see also Rutledge & Hupka, 1985).

Although most of this research demonstrates that facial expressions modulate emotions induced by emotional stimuli, several studies have shown that facial expressions can also initiate corresponding emotional experience in the absence of any emotional stimulus. For instance, using a muscle-to-muscle instruction procedure similar to Laird's (1974), Duclos et al. (1989) instructed participants to adopt facial expressions of fear, anger, disgust, or sadness while listening to neutral tones. Participants then rated their feelings on several emotion scales. Self-reported fear and sadness were highest in the fear and sadness expression trials, respectively, and higher than in the other three expression trials. Equally high anger and disgust ratings were found in the anger and disgust expression trials, which were higher than in the other two expressing trials. Finally, evidence for the emotion-initiating power of facial expressions was found in other studies in which emotion-specific facial expressions, manipulated by muscle-to-muscle instructions, resulted in self-reports of the associated emotion (Duncan & Laird, 1977, 1980), especially for participants whose faces best matched the prototypical emotional expression (Ekman, Levenson, & Friesen, 1983; Levenson, Ekman, & Friesen, 1990), and for participants who were more responsive to their inner bodily cues than to external situational cues (Duclos & Laird, 2001; see also Soussignan, 2002).

Effects of Postural Embodiment

Sir Francis Galton (1884) believed that people's attitudes and feelings are reflected in their bodily postures. In an anecdotal way, he suggested that observing the bodily orientation of people during a party could reveal their attraction or "inclination" to one another. Bull (1951) was one of the first to examine the relation between bodily posture and emotional experience. In one study she induced the emotions of disgust, fear, anger, depression, and joy through hypnosis and found that participants automatically adopted the corresponding bodily postures. Furthermore, when asked to adopt emotion-specific postures, participants reported experiencing the associated emotions.

Since the work of Bull, several experimental studies have directly explored the impact of bodily posture on emotional experience. For example, Duclos et al. (1989) studied the impact of emotion-specific bodily postures on participants' feelings. All participants had to listen to the same series of neutral tones, which were not intended to induce specific emotions but were presented as part of a multiple-tasks procedure. In an unobtrusive way, they were also asked to adopt bodily postures associated with anger, fear, or sadness. As expected, posture facilitated the emotional experience of the corresponding emotion. Participants reported feeling sadder in the sad posture, more fearful in the fear posture, and angrier in the angry posture.

In Stepper and Strack (1993) participants' bodily posture was manipulated in an unobtrusive way by either having them adopt a conventional working position or one of two ergonomic positions (upright or slumped posture) when receiving success feedback concerning their performance on an achievement task. Participants who received success feedback in the slumped posture felt less proud and reported being in a worse mood than participants in the upright position and participants in a nonmanipulated control group, who did not differ from one another (see also Riskind & Gotay, 1982).

Flack, Laird, and Cavallaro (1999) examined both separate and combined effects of facial expression and bodily posture related to anger, sadness, fear, and happiness on corresponding emotional experience. Replicating the results of Duclos et al. (1989), they found specific effects of expressive behavior on participants' self-reported emotional feelings. Participants always felt the specific emotion they were enacting either with their face or with their body posture. Furthermore, they found that combined effects of matching facial and bodily expressions produced stronger corresponding feelings.

Effects of Vocal Embodiment

In a series of experiments Hatfield, Hsee, Costello, Weisman, and Denney (1995) instructed participants to listen to tapes with sound patterns that they then had to reproduce into a telephone. The sounds were designed to convey the characteristics associated with specific emotions (joy, love, fear, sadness, anger, neutral). Participants' self-reported emotions were affected by the specific sounds they produced. This result demonstrated that emotion-specific tone of voice amplifies the corresponding emotional feeling. Siegman, Anderson, and Berger (1990), in turn, showed that vocal expression can be used, like facial or postural expression, to regulate or control one's emotion. Participants who were instructed to discuss an anger-provoking topic in a slow and soft voice felt less angry and their heart rate slowed. Those who had to speak loudly and rapidly felt angrier and became more physiologically aroused.

Summary

Taken together, the studies reviewed in this section demonstrate that people's expressive behavior not only facilitates but can also produce the corresponding emotional experience. Facial expressions, bodily posture, and vocal expressions have emotion-specific, facilitative effects on self-reported emotional feelings, as well as effects on other measures of emotional experience. Facial, postural, and vocal embodiments not only modulate ongoing emotional experience but also facilitate the generation of the corresponding emotions. These findings strongly suggest that the embodiment or simulation of others' emotions provides the meaning of the perceived event. Perhaps, then, this is a general rule. Perhaps emotional meaning is the partial or full embodied simulation of an emotion. If this were the case, then simulation in the absence of a triggering affective perception or stimulus would involve embodied responses. Furthermore, simulating a particular emotion would affect the ease of processing the symbols associated with affective meanings. It is to the evidence for these two proposals that we turn next.

AFFECTIVE IMAGERY IS ACCOMPANIED BY EMOTION PROCESSES

Numerous studies have used imagery related to simulations of past experiences to manipulate emotional states in the laboratory (e.g., Bodenhausen, Kramer, & Süsser, 1994; Schwarz & Clore, 1983; Strack, Schwarz, & Gschneidinger, 1985; Wegener, Petty, & Smith, 1995). However, in these studies, it is not clear whether the required imagery activated emotion processes or only primed information merely associated with specific emotion words, which then guided subsequent judgments that constituted a dependent variable of interest (Innes-Ker & Niedenthal, 2002; Niedenthal, Rohmann, & Dalle, 2003).

Research designed to test just this question has indeed found that physiological changes resulting from imagery parallel those obtained in the presence of the stimuli eliciting the same emotion. For instance, Grossberg and Wilson (1968) asked participants to imagine themselves in various situations. One half of the situations had been evaluated by each participant as fearful, and the other half were rated as neutral. Results indicated that significant changes in heart rate and skin conductance between baseline (as measured for each individual at the beginning of the experimental session) and presentation of the situation (read by an experimenter) were similar for neutral and fearful situations. However, the increase in physiological responses between presentation and simulation were more marked for fearful situations than for neutral (see also Lang, Kozak, Miller, Levin, & McLean, 1980; Vrana, Cuthbert, & Lang, 1989).

In a related experiment, Gollnisch and Averill (1993) extended these results to other emotions. They asked participants to imagine situations that involve fear, sadness, anger, or joy. Measures included heart rate, electrodermal activity, and respiration. Mean levels of heart rate were significantly higher during imagery than baseline but did not differ as a function of emotion. Mean respiratory rates increased significantly during imagery in comparison with baseline (as measured in 2-minute pretrial rest period), but only for fear, anger, and joy; sadness produced a decrease in respiratory rates. Skin conductance was unresponsive to the manipulation (Gehricke & Fridlund, 2002; Gehricke & Shapiro, 2000).

Vrana and Rollock (2002; see also Vrana, 1993, 1995) presented participants with emotional imagery scenarios related to joy, anger, fear, or neutral. Participants were asked to imagine they were actually in the scene, participating actively in it. As expected, facial expression (as measured by EMG activity at zygomatic and corrugator facial muscles) differed as a function of emotional tonality of the scenario (see also Dimberg, 1990). Corrugator activity was greater during fear and anger simulation than during neutral and joy scenarios. In contrast, zygomatic activity was greater during joy than during any other scenario.

Differences between imagery of sadness versus joy situations were also found. For instance, Gehricke and Fridlund (2002) found that the simulation of joy situations led to greater EMG activity in the cheek region than simulations of sad situations, whereas the reverse was true for EMG activity in the brow region.

Finally, similar results were found when participants were asked to imagine fictitious persons (Vanman, Paul, Ito, & Miller, 1997) or to think about persons whose descriptions were designed to covertly resemble those of significant others participants liked or disliked (Andersen, Reznik, & Manzella, 1996).

In sum, a sizable literature now demonstrates that when emotional events are simulated using imagery, and in the absence of the initial stimulus, individuals reenact or relive the emotions, or partial feelings of emotion, as indicated by a number of different measures of emotion. If it is the case that the mental processing of past experience can produce embodied emotion, then we can ask whether the process of embodying emotions interacts with the processing of emotional meaning per se. In the next section we show that this is indeed the case.

EMBODIED EMOTIONS MEDIATE COGNITIVE RESPONSES

A growing body of research has demonstrated that embodied emotions influence cognitive responses to emotional information. In the following section, we present evidence of such an impact on stimulus identification, stimulus evaluation, and recall.

Stimulus identification

Neumann and Strack (2000, Experiment 1) instructed participants to indicate as quickly as possible whether adjectives presented on a computer screen were positive or negative. While performing the task, participants either pressed the palm of their nondominant hand on the top of the table (extension condition) or used their palm to pull up on the underside of the table (flexion condition). These motor movements were manipulated because they are associated with positive affect and approach (arm flexion) and with negative affect and avoidance (arm extension; e.g., Cacioppo, Priester, & Berntson, 1993). Arm flexion facilitated the identification of positive information, whereas arm extension facilitated the identification of negative information. These results suggest that affective movement facilitates the encoding of affective information of the same valence.

This kind of effect could be the basis of facial expression recognition (Zajonc & Markus, 1984; Zajonc, Pietromonaco, & Bargh, 1982). Indeed, Wallbott (1991) proposed that imitation of facial expression facilitates its recognition. He instructed participants to identify the emotion expressed in a series of face pictures. While performing the task, participants' faces were covertly videotaped. Two weeks later, each participant was asked to watch the videotape of him- or herself while he or she performed the identification task, and to guess the identification of the facial expression being judged (which was, of course, not visible). The participants identified the emotion expressed in the pictures above chance level by seeing only their own facial expression while performing the task. These results are compatible with the idea that participants had partially simulated others' facial expression while performing the identification task and that this simulation provided emotional cues for identifying the emotion presented in the picture (see also Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001; Adolphs, Damasio, & Tranel, 2002; Atkinson & Adophs, Chapter 7, for convergent neuropsychological evidence).

Evaluation

Evaluation responses also seem to be mediated by embodied emotions (but for an alternative view, see Clore et al., Chapter 16). Cacioppo and colleagues (1993), for example, exposed participants to neutral Chinese ideographs, and participants rated each one on a liking scale. Participants performed the task while pressing their palm on the top (arm extension) or pulling it up from the underside (arm flexion) of the table. The ideographs were judged as more pleasant during arm flexion than during arm extension. Subsequent studies demonstrated that participants associated arm flexion with an approach motivational orientation, but only when they performed the musculature contraction, not when they merely watched someone else performing it.

Using a different type of embodiment manipulation, Strack, Martin, and Stepper (1988) found that participants instructed to hold a pencil between their front teeth, thus unobtrusively expressing a smile, evaluated cartoons as funnier, compared with participants asked to hold a pencil between their lips, without touching the pencil with their teeth (which produced a frown expression), or participants instructed to hold the pencil in their nondominant hand (a control condition).

Ohira and Kurono (1993) asked participants to exaggerate their (negative) facial expressions while reading a text presenting a target person as somewhat hostile, under the cover story of transmitting nonverbal information to a person who was supposedly on the other side of a one-way mirror. These participants later judged the target more negatively than participants who had been asked to conceal their facial expressions or who were not given instructions concerning their facial expressions.

Memory

Laird, Wagener, Halal, and Szegda (1982) asked participants to read passages related either to anger or happiness. After an interpolated task, participants were instructed to recall as much information as possible about the presented stories while contracting specific facial muscles so that they expressed either a happy or an angry face (importantly, the instructions did not refer to happiness or anger). Participants expressing an angry face recalled more of the angry passages than participants expressing a happy face, whereas the reverse was true for happy passages. A second experiment generalized these findings to fear, anger. and sadness, thus ruling out the possibility that frowning leads to better recall of any negative information.

Moreover, by controlling facial expressions at encoding, Laird et al. were able to rule out another interpretation in terms of state-dependent retrieval. That is, a possible account of the Experiment 1 findings is that participants reading, for instance, angry passages had felt anger, and that the manipulation of a facial expression of anger produced the same state, which then served as a retrieval cue (i.e., an example of state-dependent retrieval). In Experiment 2, they found that the facial expression at recall still affected memory performance in an emotion-congruent manner when controlling for the facial expression at encoding; that is, participants maintained the same emotion expression throughout the experiment.

Schnall and Laird (2003) also demonstrated that such effects could be obtained even when (1) the facial expression is not maintained at time of recall, and (2) when recall implied an autobiographical event that required long-term memory. Consistent with these findings, Riskind (1983) found that participants who expressed smiles were faster at recalling pleasant autobiographical memories and took longer to recall unpleasant memories than participants who expressed a sad face.

Similar results were found when emotional gestures other than facial expressions were manipulated. Förster and Strack (1996) instructed participants to listen to positive and negative adjectives while performing either horizontal head movements (shaking, associated with negative attitude), vertical movements (nodding, associated with agreement), or circular movements (control condition), following a procedure designed by Wells and Petty (1980). They found that recognition of positive words was better when the presentation of these words was associated with vertical movements (nodding), whereas recognition of negative words was better when presentation of these words was associated with horizontal movements (head shaking; see Förster & Strack, 1997, 1998, for replications).

We have reviewed existing findings that suggest that individuals embody others' emotions, that such embodiment causes corresponding emotions in the perceiver, and that embodiment seems to be involved in facilitating and inhibiting the cognitive processing of emotional information more generally. In the next section we describe a recent theory of conceptual processing that can, we think, account for the ensemble of findings and the way we have linked and interpreted them to this point.

THEORETICAL ACCOUNTS OF EMBODIED EMOTION EFFECTS

How do we explain the roles of embodiment in emotional phenomena? What implications do these phenomena have for the emotion concepts that people use to interpret emotional experience? The standard answer to such questions is that amodal knowledge structures represent emotion concepts, and embodied states are peripheral appendages that either trigger or indicate the activation of the amodal structures. An alternative account is that embodiments constitute the core conceptual content of emotion concepts. That is, rather than serving as peripheral appendages to emotion concepts, embodiments constitute their core meanings. We address each of these two approaches in turn.

Amodal Accounts of Embodied Emotion Effects

The Transduction Principle

The amodal view of emotion concepts dominates the cognitive sciences and reflects a much wider view of knowledge. The key assumption underlying this view is the transduction principle, namely, the idea that knowledge results from transducing modality-specific states in perception, action, and introspection into amodal data structures that represent knowledge (Barsalou, 1999). To understand how the transduction principle works, first consider the modality-specific states that initiate the transduction process. Such states arise in sensory systems (e.g., vision, audition, taste, smell, touch), the motor system (e.g., action, proprioception), and introspection (i.e., mental states such as emotions, affects, evaluations, motivations, cognitive operations, memories).

The representation of these states can be thought of in two ways. First, these states can be viewed as patterns of neural activation in the respective brain systems. Consider the perception of a rose, which might produce patterns of neural activation in the visual, olfactory, and somatosensory systems. Reaching to touch the rose might produce neural activation in motor and spatial systems. Introspectively, the rose might produce neural activation in the amygdala. Together, these neural states constitute the brain's immediate response to the rose. At a second level of representation, some of this neural activation may produce conscious states. Certainly, though, much of the underlying neural processing remains unconscious. For example, people may be unaware of the low-level processing in vision that extracts shape information, or the low-level processing in action that generates an arm movement. Nevertheless, some aspects of these neural states become realized as conscious images in experience. Two points to be noted, then, are (1) that the modality-specific states activated during a specific experience occur at both neural and experiential levels, and (2) the mapping between them is not one to one.

According to the transduction principle, knowledge about the world, the body, and the mind result from redescribing the types of modality-specific states, illustrated by the example of the rose, with amodal knowledge structures. Thus, in such accounts, modality-specific states themselves do not represent knowledge, but the amodal data structures transduced from them do. Knowledge about roses does not consist of the modality-specific states that they produce in perception, action, and introspection. Instead, knowledge about roses resides in amodal knowledge structures that describe these states.

Examples of Amodal Representations

Most of the dominant theories in cognitive science represent knowledge in this manner. For example, a list representing features of a rose might look like:

<u>Rose</u>
petals
pollen
thorns
fragrance

Although words represent features in the theoretical notation, a key assumption is that amodal symbols actually represent each word in human memory, where there is a close correspondence between words and their amodal counterparts. For lack of a better notation, theorists generally use words to represent the content of amodal representations. Importantly, however, amodal symbols are assumed to constitute the underlying conceptual content in memory. During the processing of category members, these symbols are transduced from modality-specific states to represent their features. Later, when people need to communicate something about the category, they access the words associated with the symbols to do so.

A second important class of amodal theories integrates various types of conceptual relations with features to produce more complex representations (Barsalou & Hale, 1993). Theories in this category include semantic memory models, predicate-calculus representations of knowledge, frames, and production systems. Not only do such theories represent elemental features of categories, they also represent a variety of important relations between them. Rather than representing *pollen* and *fragrance* as independent features of roses, these theories might add the following relation between them:

Cause (pollen, fragrance)

Analogous to features, the relations between features are represented amodally. Specifically, as the relations arise in modality-specific states, amodal symbols for them are transduced, which then become bound to amodal symbols for the features that they integrate.

Finally, some (but certainly not all) connectionist theories implement the transduction principle. Feed-forward network theories offer one example. In feed-forward networks, a first layer of input units performs perceptual processing, extracting and representing features on a modality. The feature representations are then transduced into a second representation in the network's hidden units, which is typically interpreted as a conceptual representation. Conceptual representations are amodal for two reasons. First, random weights are set initially on the connections linking the input and hidden units; this step is necessary for implementing learning. The consequence, though, is a significant degree of arbitrariness between input- and hidden-level representations. Second, the activation patterns on the hidden units redescribe the input patterns, such that the hidden unit patterns have a linear relationship to the output units (in contrast, the input patterns have a nonlinear relationship). For these reasons, the hidden units that represent conceptual knowledge are transductions of perceptual states, much like the transductions that underlie more traditional knowledge structures. However, connectionist architectures that use a common set of units to represent perceptual and conceptual states do not exhibit transduction.

Representing Emotion Concepts Amodally

The dominant approach to representing emotion knowledge similarly rests on the transduction principle (Bower, 1981; Johnson-Laird & Oatley, 1989; Ortony, Clore, & Foss, 1987). According to these theories, various types of amodal knowledge structures are transduced from emotional experience to represent emotion concepts. Furthermore, representing knowledge of an emotion in the absence of experiencing it involves activating the appropriate amodal representation. Once this representation is active, it describes various domains of information relevant to the emotion, thereby producing inferences about it.

In general, knowledge about emotion falls into three general domains. First, people have knowledge about the situations that elicit emotions. Thus, seeing a smiling baby produces positive affect, whereas seeing a vomiting baby produces negative affect. Second, people have knowledge about the actions that are relevant when particular emotions are experienced. Thus, a smiling baby elicits approach responses, whereas a vomiting baby produces avoidance, at least initially. Third, people have knowledge about the introspective states associated with the "hot" component of emotions, including both valence and arousal information (e.g., Barrett, Chapter 11; Feldman, 1995). Thus, smiling babies produce warm, mildly aroused feelings, whereas vomiting babies produce negative, highly aroused feelings. Most importantly, amodal theories of emotion assume that amodal knowledge structures represent all three aspects of emotional experience. When people need to consult their knowledge of emotion, they activate and process such structures.

Embodiment in Amodal Theories

According to amodal theories, embodied states are peripheral appendages linked to amodal knowledge structures. Thus a positive emotion, such as happiness, might be linked with embodied states for producing the relevant facial expressions, postures, arm movements, vocal expressions, and so forth. Importantly, however, these embodied states do not constitute core emotion knowledge. Instead, each embodied state is linked to an amodal symbol that represents it. The embodied state of smiling, for example, is linked to an amodal symbol for smiling in the concept of happiness. When knowledge about happiness is processed, the amodal symbol for smiling becomes active, thereby carrying the inference that happiness includes smiling. Notably, however, embodied smiling is not necessary to represent the conceptual relation between smiling and happiness. Instead, actual smiling is only a peripheral state that can either trigger the concept for happiness or can result from its activation, mediated by the amodal symbol for smiling.

Amodal theories similarly peripheralize all other content in emotion concepts. The perception of another person smiling is represented by the same amodal symbol that represents the action of smiling, not by neural states in the visual system as it perceives smiling—which differ from neural states in the motor system that execute smiling. Similarly, the value and arousal of introspective emotional states are represented by amodal symbols, not by the neural states that underlie the modality-specific states. Thus, the modality-specific states that occur in emotion during action, perception, and introspection are peripheral appendages linked to core amodal symbols that stand for them. When these appendages are experienced, they can ultimately trigger an emotion concept via the intervening amodal symbols. When emotion concepts become active, they can ultimately trigger these appendages, again via the amodal symbols that intervene.

Modal Accounts of Embodied Emotion Effects

The Reenactment Principle

Whereas the transduction principle underlies amodal theories of knowledge, the reenactment principle underlies modal theories. According to the reenactment principle, the modality-specific states that arise during perception, action, and introspection are partially captured by the brain's association areas (Damasio, 1989). Again consider the neural activation that arises in the brain's visual, motor, olfactory, and affective systems when interacting with a rose. While these states are active, association areas partially capture them, storing them away for future use. Conjunctive neurons in association areas intercorrelate the active neurons both within and between modalities, such that a partial record of the brain's processing state becomes established as a memory. Later, when information about the rose is needed, these conjunctive neurons attempt to reactivate the pattern of neural states across the relevant modalities. As a result, the neural state of processing is reenacted to represent the modality-specific states that the brain was in while processing the rose. By no means is the reenactment complete or fully accurate. Indeed, partial reenactment is almost certainly the norm, along with various types of distortion that could reflect base rates, background theories, etc. In this view, no amodal symbols are transduced to represent experiences of the world, body, and mind. Instead, reenactments of original processing states perform this representational work. For more detailed accounts of this theory, see Barsalou (1999, 2003a, 2003b, in press), and Simmons and Barsalou (2003).

Representing Emotion Concepts Modally

According to this view, modality-specific states represent the content of concepts, including those for emotion. Consider the three domains of emotion knowledge mentioned earlier: triggering situations, resultant actions, and introspective states. Reenactments of modality-specific states represent the conceptual content in these domains, not amodal symbols. Thus reenactments of perceiving smiles visually on other people's faces belong to the situational knowledge that triggers *happiness*, as do the motor and somatosensory experiences of smiling oneself. Similarly, reenactments of valence and arousal states represent these introspective aspects of emotion concepts, not amodal symbols representing them (for a similar view, see Barrett, Chapter 11).

In this view, knowledge of the emotion is delivered via actual emotional states, some being conscious and some unconscious; knowledge of an emotion concept is not seen as a detached description of the respective emotion. Although these states may not constitute full-blown emotions, they may typically contain enough information about the original states to function as representations of them conceptually. Moreover, these partial reenactments constitute the core knowledge of emotional concepts. Embodied states are not merely peripheral events that trigger emotion concepts or that result from the activation of emotion concepts. Instead, embodied states represent the core conceptual content of an emotion.

Explaining Embodiment Effects in Emotion Research

As we saw earlier, embodiment enters ubiquitously into the processing of emotion. Viewing embodied states as the core elements of emotion concepts provides a natural account of these findings. When an embodied emotional response results from perceiving a social stimulus, this embodiment plays a central role in representing the emotional concept that becomes active to interpret the stimulus. For example, when the perception of a smiling baby activates embodied responses for smiling, approach, and positive valence in the self, these embodied states represent the emotional and affective concepts that become active, such as happiness and liking. Embodied states represent these concepts directly, rather than triggering amodal symbols that stand in for them. A similar account explains the embodiment effects reviewed earlier for visual imagery. As a person is imagining a social stimulus, the emotional categories used to interpret it are represented by the embodied states that become active.

A similar account explains the roles of embodiment in triggering emotion concepts and in their subsequent effects on cognitive processing. When a person's body enters into a particular state, this constitutes a retrieval cue of conceptual knowledge. Because modality-specific states represent knowledge, an active modality-specific state in the body or mind triggers concepts that contain the state as elements of their representation, via the encoding specificity principle (e.g., Tulving & Thomson, 1973). As matches occur, the emotion concept that best fits all current retrieval and contextual cues becomes active and dominates the retrieval competition. Furthermore, once an emotion concept dominates, it reenacts other modality-specific aspects of its content on other relevant modalities, thereby producing at least a partial semblance of the emotion. In turn, other cognitive processes, such as categorization, evaluation, and memory, are affected. As an embodied state triggers an emotion concept, and as the emotion becomes active, it biases other cognitive operations toward states consistent with the emotion.

As this brief description illustrates, the embodied approach to emotion offers a plausible and intuitive account of embodiment effects. It is also a productive approach that makes specific predictions, several of which we outline here.

Deep versus Shallow Tasks

The modal account described here predicts that bodily aspects of emotion concepts are simulated only when necessary; that is, in deep, but not in shallow, conceptual tasks. A deep task requires recourse to meaning, whereas a shallow task can be accomplished by simple associative means. According to a strict reading of the amodal models (e.g., Bower, 1981), there should be no simulation—that is, physiological manifestation of the emotion—in shallow or deep conceptual tasks because individuals can simply "read off" amodal feature lists for both tasks. A generous interpretation of an amodal model might yield the prediction that physiological manifestations will occur in both deep- and shallow-feature generation tasks because thinking about the emotion concept automatically activates the highly associated nodes that represent the physiological aspects of the emotion. However, a selective prediction that physiological manifestations of emotion are evoked *only* in deep, but not in shallow, tasks cannot easily be derived from an amodal model. This is because, if anything, physiological nodes are most directly and closely associated with emotion and should be the first to be activated during the use of the emotion concept in a deep or shallow way.

Partial Embodiment

The simulation account predicts that only the needed parts of the bodily representation are simulated (i.e., simulations occur only in the modality required to perform the task). The notion of partial simulation is illustrated by results of recent functional magnetic resonance imaging (fMRI) studies that found a selective activation of relevant parts of the sensory cortex when property verification tasks were performed in different modalities (Kan, Barsalou, Solomon, Minor, & Thompson-Schill, 2003; Kellenbach, Brett, & Patterson, 2001). Again, a strict reading of amodal models does not generate any embodiment predictions, because individuals can simply read off abstract features of emotion concepts. A more generous reading of amodal models would yield the prediction that the processing of emotion concepts should nonspecifically activate the associated sensory basis via top-down links.

Impairment/Facilitation of Sensory–Motor Processing

Finally, the simulation account predicts that manipulations of sensory–motor processing have conceptual consequences. This prediction is supported by studies showing that categorization impairments can result from damage to neural systems representing sensory characteristics of the category (Farah, 1994; Simmons & Barsalou, 2003). Further, several studies show that recognition and categorization of emotion can be impaired by damage to, or blocking of the mechanisms of, somatosensory feedback. Associative models predict no effects (or, at most, nonspecific effects) of such bottom-up manipulations. In short, amodal accounts see embodiment as irrelevant for conceptual processing. At best, they see it as a by-product of associations, not as a *constitutive element of conceptual processing.*

In sum, if these predictions were tested and evidence found in favor of modal models, this evidence would tell us much about the experience and reexperience of emotional states: how individuals ground emotion concepts, how emotion processes can be manipulated in the laboratory (or not), and how emotions and feelings can and cannot be regulated by the individual.

CONSCIOUS AND UNCONSCIOUS STATES OF EMOTION

The perspective presented here has a number of implications for conceptualizing emotion in general and defining its conscious and unconscious processes. First, consistent with William James, we have proposed that embodied states constitute the fundamental way of representing emotional information. For example, when we see a smiling face, we smile, and this response allows us to know the stimulus (see also Atkinson & Adolphs, Chapter 7; de Gelder, Chapter 6). Although James was criticized for not being able to specify why or when the perception of a given event or object would instigate the bodily state of an emotion in the first place, this is a less worrisome criticism now because good support for the notion of inherent affective "programs" (Tomkins, 1962), or bodily responding to signal stimuli, has been reported (e.g., Dimberg, 1986, 1990; Dimberg, Hansson, & Thunberg, 1989); although for a critical view, see Barrett, Chapter 11). Thus, as we have shown in our present review of the relevant research, the perception of certain stimuli, including—and perhaps especially—emotional expressions of other people, automatically produces specific bodily states in the perceiver. It is not necessary for such embodied states of emotion to be conscious, as in imitation for example, or even be available to consciousness. The states may be too subtle to gain consciousness, even if attention is directed to them. And potentially conscious embodiments may not become conscious because competing attentional demands simply win out (e.g., Neumann & Strack, 2000). One interesting implication of the notion of unconscious embodiment as stimulus encoding is that individual variability should be relatively low, within obvious morphological constraints.

When conscious attention is directed to the bodily state, and the bodily state is intense enough be consciously detected, we would suggest, consistent with James, that the individual experiences a *feeling state*. In the attention to, and interpretation of, a feeling state (e.g., in the service of self-

report), variability and individual differences, including cultural rules of interpretation, can intervene. In an example of such variability, Laird and his colleagues (e.g., Laird & Crosby, 1974) documented stable individual differences in the extent to which expressive behavior influences feeling states per se (e.g., Laird & Bresler, 1992). Laird notes:

> The differences in impact of behavior seem to reflect the type of cues on which individuals base their emotional experience. People who attend to their own bodily cues, their appearance, and their instrumental actions are more responsive to so-called "personal" or "self-produced" cues. In contrast, individuals who primarily focus on interpretations of the situation and infer responses from what is appropriate in their situation, are responsive to "situational" cues. (Schnall & Laird, 2003, p. 789; see also Feldman, 1995; Barrett, Chapter 11, for further examples and discussion)

Thus, although unconscious embodiments of incoming stimuli may be quite stable and even universal, as noted, subsequent conscious simulations should be quite variable in content because they rely on the represented feeling states; that is, conscious simulations reenact the biases introduced by directing attention to the bodily state and representing it in consciousness as a feeling state. The content of concepts of anger, joy, fear, and so forth, will vary across individuals and situations to the extent that the situation determines selective attention to parts of a represented feeling state or experience and thus helps choose the simulation to be performed.

Distinguishing the bodily state of emotion and the feeling state of emotion is useful in the interpretation of a number of findings that would appear to be inconsistent with the embodiment approach. For example, if biases and individual differences intervene in defining the conscious feeling state, and if the bodily states can occur outside of consciousness, then there is no reason why self-report of feeling states should be highly correlated with bodily states; and, indeed, they are often not correlated (see Barrett, Chapter 11).

Relatedly, in a series of studies, Rimé, Phillipot, and their colleagues examined people's knowledge about the bodily states associated with different emotions, which they call schemata of peripheral changes in emotion (e.g., Rimé, Philippot, & Cisamolo, 1990). Results showed that such schemata, or sets of beliefs, were highly consensual and highly accessible. That is, individuals were in high agreement about the peripheral changes that occur during different emotions. Several studies were then conducted to evaluate the relation between these schemata and actual peripheral changes during an emotional state produced by watching emotionally evocative films. Some experimental participants reported their feelings and peripheral changes during the emotional films, and another set of participants described the contents of their schemata of peripheral changes for the emotions that were said to be evoked by the film (Phillipot, 1997). These two sets of reports were highly correlated, such that reported peripheral changes by one set of individuals were the same as those believed to be produced in the emotional states of interest by another set of individuals. However, further work showed that the reports of peripheral changes by participants who watched the films were less highly correlated with actual peripheral changes. Thus the authors concluded that people tend to report their beliefs about embodied states of emotion rather than an accurate readout of those states. If we separate the notion of bodily states of emotions (as sometimes unconscious) and feeling states (as always the result of conscious attention to the bodily states), we can see that such biases are the norm. The fact that embodied states constitute emotional information processing does not mean that simulations are invariant reproductions of those states.

CONCLUSION

We have reviewed a number of studies that suggest that emotion knowledge is grounded in the somatosensory and motor states to which emotions give rise. We have suggested that the implication of this work is that perceiving someone else's emotion, having an emotional response or feeling a state oneself, and using emotion knowledge in conceptual tasks all rely on the same fundamental processes. As we then demonstrated, recent theories of embodied cognition, which rely on the notions of modal representation of knowledge and the principle of reenactment, account for this accumulated knowledge quite well. Further, such models suggest much about what happens when people process emotional information, and can help generate testable hypotheses about conscious and unconscious states of emotion.

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