Form and Function in Motor Mimicry

Topographic Evidence that the Primary Function Is Communicative

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Motor mimicry is behavior by an observer that is appropriate to the situation of the other person, for example, wincing at the other's injury or ducking when the other does. Traditional theories of motor mimicry view this behavior as an indicator of a vicarious cognitive or empathic experience, that is, of taking the role of the other or of "feeling oneself into" the other person. However, Bavelas, Black, Lemery, and Mullett (1986) have shown that motor mimicry of pain is affected by communicative variables and acts as a nonverbal message indicating that the observer is aware of and concerned about the other's situation. This raises a more general question: Is communication its primary or secondary function? We propose (i) that motor mimicry functions as a nonverbal, analogic, relationship message about similarity between observer and other and (ii) that this message is encoded according to Gestalt principles of form, in that the observer physically mirrors the other. In other words, the observer maintains a relationship with the other. The special case of left/right leaning when observer and other are facing each other permits a test of our theory against two theories that treat motor mimicry as an indicator of vicarious experience. The results of three experiments showed that when motor mimicry by an observer facing someone who is leaning left or right occurs, it is both displayed and decoded in the form consistent with a communication theory; this form is called reflection symmetry. We conclude that, because of the topography of the response, the primary function of motor mimicry must be communicative and that any relationship to vicarious processes is secondary. A similar analysis of other nonverbal behaviors may well reveal that they are also expressions to another person rather than expressions of intrapsychic states.

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Human Communication Research, Vol. 14 No. 3, Spring 1988 275-299

ELEMENTARY motor mimicry is a ubiquitous phenomenon with a long history in social psychology (see Allport, 1968; Bavelas, Black, Lemery, & Mullett, 1987). It is overt and precise mimesis in which an observer's nonverbal behavior is appropriate to the situation of the person being observed, rather than to the observer's own situation. For example, an observer may lean with the athlete's effort, wince at someone else's injury, or smile at another's joy. Instances of this rapid, almost reflexive phenomenon have been noted for at least two centuries, beginning with Adam Smith (1759/1966) and including Spencer (1870), Darwin (1872/1965), Baldwin (1895, 1897), Ribot (1897), Lipps (1907), McDougall (1908), Scheler (1912/1970), Blanton and Blanton (1927), Köhler (1927), Hull (1933), Gordon Allport (1937, 1961), Margaret Mead (1968), and O'Toole and Dubin (1968).

Previous reviews (Allport, 1968; Bavelas, Black, Lemery, MacInnis, & Mullett, 1986; Strunk, 1957) have revealed a considerable variety of proposed explanations for this simple phenomenon. Most of these are not true theories but descriptions, using terms current at the time: Smith (1759/1966), Spencer (1870), Ribot (1897), and Scheler (1912/1970) saw motor mimicry as an instance of "sympathy," although only the most primitive kind, because it was essentially a "reflex." Darwin (1872/1965) gave many examples, which he described variously as "sympathy" and "imitation" based either on "reflex" or "habit." Baldwin (1895, 1897) gave this "nondeliberate imitation" an important role in early development. For McDougall (1908), motor mimicry was not a true instinct but a "nonspecific innate tendency," and Allport (1968, p. 30) describes him as "much troubled" by its precision. Hull (1933) chose the term "unconscious mimicry," noting that the phenomenon had also been called "unconscious imitation, ideomotor action, and empathy"; he added without further elaboration that "the process is definitely not voluntary and the imitation not conscious" (pp. 40-41). Allport (1968,)

classified motor mimicry as the simplest form of imitation, "basically a perceptual motor reaction at present not fully understood." (p. 32) He separated this kind of imitation from those based on either classical or instrumental conditioning and puzzled over whether conditioning was the cause or the effect:

> Some motor mimicry . . . seems reducible to previous conditioning, but in other cases it appears to precede and to be a precondition of learning. The nature of the mechanism is not yet understood. (p. 30)

There are two theoretical traditions that go beyond renaming the phenomenon: empathic experiencing and role-taking. Motor mimicry was the overt behavior that Lipps (1907) wanted to explain with his term *Einfühlung* (feeling oneself into); in 1912, Titchener coined the term *empathy* as the English translation (Allport, 1961, p. 533; *Shorter Oxford English Dictionary*). According to Lipps, we display the other's nonverbal behavior in motor mimicry because we have "felt ourselves into" the other person. Thus he proposed a process of projective understanding in which

> we do not perceive our own body in action but the body of the other. . . . There is no break between the strain, pride, sorrow, or playfulness which I feel empathically and the personality of the one I am seeking to understand. (Allport, 1961, p. 536)

Note that when Lipps called motor mimicry "empathy," he had made the subtle but critical shift from the behavior to an inferred process underlying and causing the behavior. Virtually all subsequent uses of the term *empathy* also refer to (nonbehavioral) psychological processes, although these are often quite different from Lipps's usage—for example, individual differences in understanding others (starting with Dymond, 1949), vicarious classical conditioning (e.g., Stotland, 1969), and so forth. To avoid confusion with these many other, often more global, uses of the term *empathy*, we will use *empathic experiencing* for Lipps's *Einfühlung*, that is, for the particular empathic process he called "feeling oneself into," by which the observer seems to become the other, psychologically, for that moment.

The other substantial theoretical tradition is from the social psychology of George Herbert Mead (1934), whose concept of "taking the role of the other from the standpoint of the other" (TRO) was explicitly applied to motor mimicry by O'Toole and Dubin (1968). Indeed, the latter authors felt that motor mimicry presented the first possibility of

an "empirical indicator of TRO" (p. 60). They distinguished Mead's construct from imitation or mere copying by the crucial variable of *standpoint*. If the process were one of simple imitation, the observer would copy the other's behavior as seen from the observer's actual standpoint. If it were TRO, the observer would replicate the behavior from the other's standpoint, having taken the other's place psychologically. O'Toole and Dubin devised two ingenious tests of this distinction and concluded that the behaviors they observed were consistent with the TRO interpretation.

Note that both the empathic experiencing and TRO explanations emphasize vicarious experience, although in one case this experience is more cognitive (TRO) and in the other more affective (feeling oneself into). Also, both theories treat the overt mimicry as an indicator or by-product of the observer's inner state. From this traditional perspective, the behavior is a conveniently observable, but secondary, aspect of a primarily intrapsychic event.

A COMMUNICATION THEORY

By its very nature, motor mimicry requires two people, observer and other. Our theory (Bavelas, Black, Lemery, & Mullett, 1986; Bavelas et al., 1987) differs from traditional psychological and sociological approaches in viewing this behavior as an interpersonal event, as nonverbal communication by observer to other. Specifically, motor mimicry encodes the message, "I am with you" or "I am like you," by displaying a literal mimesis of the other's behavior. By immediately displaying a reaction appropriate to the other's situation (e.g., a wince for the other's pain), the observer conveys, precisely and eloquently, both awareness of and involvement with the other's situation.

We propose, in other words, that motor mimicry is not the manifestation of a vicarious internal state but a *representation* of that state to another person. This distinction is an especially subtle one when the message is encoded analogically or iconically, as is the case with motor mimicry. Nonverbal behaviors often serve the same representational or descriptive function as do words; such acts have been called illustrators or emblems (Ekman & Friesen, 1969) and referential or discourse-oriented gestures (McNeill, 1985). For example, when describing a disliked food, the narrator may make a "disgust" face; he or she is not presently disgusted but rather is representing the state of being disgusted. We propose that, just as a word is not the

object or state it represents, motor mimicry should not be equated with the state it represents.

It is important to add that we are not denying that a vicarious experience may occur, only that it causes motor mimicry. We do not agree with theories that, in effect, assume that the overt behavior is a "spill-over" from an inner vicarious experience. We propose that it has a function of its own, a communicative one. Our parallel process model (Bavelas, Black, Lemery, & Mullett, 1986) proposes that the stimulus may elicit both inner and communicative processes but that these are independent of each other, and it is the communicative process that causes the overt, nonverbal behavior. This is in marked contrast to the widely accepted view that the major determinants of overt behavior are to be found within individuals (e.g., in their cognitions, emotions, and motivations) and that social and communicative factors have a secondary or even superficial influence. What we are questioning here is the view that individual processes are always "primary" and social processes "secondary."

What is the nature and purpose of motor mimicry as a nonverbal message? Watzlawick, Beavin, and Jackson (1967) proposed that nonverbal behaviors often serve to convey, analogically, the nature of the relationship between communicants. In the case of motor mimicry, we propose that the relationship message is one of similarity or "togetherness." Further, we propose that the code being used is a familiar and natural one, namely, the Gestalt principles of similarity and common fate. Koffka (1935, pp. 654 ff.) and later Heider (1958, pp. 177-180) proposed that the factors that make us see simple figures as part of a unit will also lead us to see two people as forming a unit. LaFrance (1982) suggested that postural mirroring follows the perceptual principle of similarity. Thus we propose that when an observer sees an injury to another person, the observer will often wince, thereby conveying a "unit relation" (Heider, 1958) with the other by displaying similar behavior, behavior that in this case means "It is as if I am you and can share your feeling."

To support our first and most basic tenet, that motor mimicry is sent and received as nonverbal communication, we (Bavelas, Black, Lemery, & Mullett, 1986) showed that wincing at another's injury was affected by the visual availability of the other. The pattern and timing of the observer's reaction were determined by eye contact with the victim. Moreover, such mimetic wincing was interpreted by naive decoders as indicating "caring" and "awareness." Thus motor mimicry was sent and

interpreted in a manner consistent with its use as a nonverbal communication.

However, it could still be argued that, although it can be transformed into a communicative act, motor mimicry is primarily the manifestation of an inner state. So it might be argued equally plausibly that motor mimicry is primarily a communicative behavior *or* that it is primarily the result of an intrapsychic process, with a secondary communicative aspect.

RATIONALE FOR THE EXPERIMENTS

The purpose of the present experiments is to move past plausible arguments to empirical evidence that might resolve the issue. The guiding premise of these experiments is the classic maxim that "form follows function." The form of a behavior should reveal it primary function. In the vast majority of instances, communicative and intrapsychic causes of motor mimicry would produce topographically similar behaviors. This is because, except perhaps for some stylization, an analogic encoding of an internal state would look much like the actual reaction caused by that state: A mimetic wince could be either the result of vicarious pain or a representation of the other's pain. If, as we propose, motor mimicry is an illustrator rather than an expression of emotion, there may be some differences in form, analogous to those found for spontaneous versus posed facial expressions (e.g., Ekman, Hager, & Friesen, 1981). For example, analysis of expressions to one's own versus another's pain might reveal differences in distinctness and length of expression, with mimetic expressions being clearer and longer, that is, more stylized. However, besides the difficulty of this kind of microanalysis, there would also be the problem of obtaining comparable expressions, that is, of assuring that the amount of pain expressed was the same for other as for self.

Fortunately, there is a more straightforward instance in which these different processes would lead to different behavioral manifestations: left/right leaning when observer and other are facing each other. If the other person leans to reach or to avoid something, the observer may also lean; indeed, this is one of the classic examples of motor mimicry. Unlike other instances, though, this particular mimicry has two different possible forms; a lean in either direction would still be a lean and therefore motor mimicry. As will be seen, the direction of that lean, given the direction of the other's movement, would be different

depending upon its function, so the form that this particular instance of motor mimicry takes can reveal the underlying process. The competing theories, and their predictions, will be outlined below.

It will be useful in deriving these predictions to have a clear terminology for left/right relationships in this situation. We will use the geometric terms, *reflection symmetry* (in which the observer's motion mirrors that of the other) and *rotation symmetry* (in which the observer's motion is the same as the other's if the observer is rotated into the other's position). To avoid confusion, we will also use "she" for the other and "he" for the observer in the upcoming examples. Thus when she leans to her right and he (facing her) leans to his left, they are moving the same direction with respect to each other and "reflect" each other. When she leans to her right and he leans to his right, they are moving in opposite directions with respect to each other, but his movement can be seen to be symmetrical if he is "rotated" 180 degrees into her position. Similarly, if she leans left, the observer's lean to his right produces reflection symmetry and to his left produces rotation symmetry.[1]

TRO Prediction

Mead's (1934) theory, as adapted by O'Toole and Dubin (1968) to motor mimicry, can be applied to this instance (left/right leaning when the observer is facing the other) by a direct extension of O'Toole and Dubin's logic. Their subjects stood in one spot and observed another person reaching far forward across a large table, toward its center, from four different positions in relation to the observer (facing the observer, back to the observer, and perpendicular to the observer at either side). They proposed that these observers would "take the role of the other from the standpoint of the other" and would therefore tend always to lean forward, as the other had, regardless of the physical position of the other relative to them.

If the same reasoning is applied to the case in which the other leans to either side while facing the observer, a clear prediction can be derived: The observer would again "take the role of the other *from the standpoint of other*." When the other leans to her right, the observer would also lean to his right. In other words, the observer would (psychologically) take the other's place and do as she did; the observer becomes the other, reacting from her point of view instead of from his own. According to this theory, when motor mimicry occurs, it should be in the form of *rotation symmetry*.

Prediction from "Empathic Experiencing"

Note that Mead's theory requires that a fairly complex spatial relationship be acted upon quite precisely, within the very short reaction time characteristic of motor mimicry (as little as 1 second; see Bavelas, Black, Lemery, & Mullett, 1986). The theory of empathic experiencing is less cognitive and would be unlikely to make this prediction. It assumes only that the observer has "felt himself into" the other's situation; there is no restriction as to the standpoint from which this is done. Thus, when the other moves, the observer would move too, although without regard to direction. So if the other ducks to her right to avoid danger, the observer will experience the danger vicariously and duck as well, but he will not necessarily take her standpoint and move toward the same hand. This theory would therefore predict either (i) no systematic direction or (ii) perhaps a tendency to duck in the direction of the dominant side, which would be to the right for most people. In the first case, reflection and rotation symmetry would be equally probable. In the second case, most observers would lean right.

Both of the above theories are monadic in the sense that they ignore the other person; the other is not there because the observer has momentarily become the other. In the metaphor of these theories, the observer supplants the other and has the other's experience and reaction. Therefore, the observer cannot at the same time have any relationship with the other; for that moment, only one of them exists psychologically.

Communication Prediction

In contrast, a communication theory must keep the other in the situation; both people are essential to an interaction. Rather than taking the role of the other, the observer takes a role *in relation to* the other, and he displays that he feels *with* (not "into") the other.

Moreover, if the encoding follows the principles of naive perception, then the observer must assume a precise relationship to the other, conveying their "unit relation" by displaying similarity between the two. Just as two lines going in the same direction will be seen as together (e.g., //\\), so when the other moves to her right, the best way for the observer to encode that he is "with" her would be to move with her. Reflection symmetry creates an immediate image of moving together by mirroring her movement: If she leans to her right, he would lean in the

same direction *from his point of view*, that is, to his left. Rotation symmetry does not accomplish this very well, because it does not maintain the appropriate relationship to the other. The observer appears to move away from the other, in the opposite direction; only after rotation can it be seen to be similar. Reflection symmetry of movement, on the other hand, follows the Gestalt principles of similarity and common fate. Because this is the clearest encoding of the message that we propose is being sent, we must predict that any motor mimicry of left/right leaning will follow reflection symmetry.

The only data we could find on this issue supports our prediction. In LaFrance and Broadbent's (1976) field study of rapport and posture sharing in college classrooms, they recorded separately instances of reflection symmetry (which, following Scheflen, 1964, they called mirroring) and of rotation symmetry (which they called congruent postures). There was a significant correlation between student ratings of rapport (involved versus disinterested, together versus apart, high versus low rapport) and reflection symmetry but not between rapport and rotation symmetry.

In summary, if motor mimicry in this instance functions as an expression of vicarious experience, then it should either take the form of rotation symmetry (if the observer is taking the role of the other) or show no systematic direction except perhaps as affected by handedness. If, on the other hand, its function is to communicate a unit relation with the other, then when it occurs it should always take the form of reflection symmetry. It may occur to the reader that, in considerably less formal terms, the mirrored movement simply feels more natural, while the opposite direction looks odd in relation to the other. Note, however, that theories of vicarious experience cannot explain why we should have this intuition, whereas a communication theory can.

It appears, then, that very simple experiments may provide clear information regarding these rival hypotheses. We conducted three experiments aimed at providing convergent evidence for a communication theory. The first was an encoding study, to find out how people would lean; the other two were decoding studies, which asked how such leaning would be interpreted.

EXPERIMENT 1

To distinguish among the predictions described above, it was necessary to have observers facing an experimenter who would lean to her right, eliciting some mimetic leaning. In this case, both TRO and handedness would predict that observers would lean to their right. Empathic experiencing would predict no systematic tendency. Only a communication theory would predict that observers would lean left, in reflection symmetry.

Leaning is less easy than other instances of motor mimicry to evoke experimentally; in our experience, it can be elicited between one-quarter and one-half of the time. Because we have found that stimuli involving pain or danger are the most likely to produce motor mimicry, ducking to avoid danger to the head was used rather than reaching for or toward something. However, if the danger were at all serious (e.g., an object thrown at the face), the motor mimicry would probably take the form of wincing rather than moving. (For example, when we shot a "nerf ball" at an experimenter's face, most observers winced, but only about one-quarter of them ducked.) Moreover, while the apparent danger must occur to one side of the experimenter—so that she could duck aside rather than back—it could not go past the observer's head, as it would if an object were thrown from behind either of them, because the observer's leaning might then be his own avoidance rather than mimesis. Another important consideration was to eliminate the possibility that the leaning was done in order to get a better view of what was happening at the time. For all of these reasons, a story was used rather than a live incident.

Method

Participants. In total, 24 volunteers from the Department of Psychology's "subject pool" participated individually. Data from 1 participant were not used because of video problems. Of the remaining 23 participants, 13 were female and 10 were male.

Procedure. One of the authors, who is a good anecdotist, conducted all experimental sessions. She and the participant took chairs opposite each other in our Human Interaction Lab. The experimenter explained that they were being videotaped and that she was going to tell two stories about "close calls"; the participant's role was simply to listen. Both stories were light and humorous, and both were well practiced, so that the same words and movements were used each time. The purpose of the first story (about the irony of nearly drowning in a life-saving class) was to relax the listener. This story included illustrators of up and down movements but no left/right leaning.

The second story was the experimental stimulus and included a quick lean to the right at two points. Two leans were enacted in order to increase the probability of leaning by the observer, both by doubling the instances and by using the first lean to "set up" the second. That is, because of the story line and having seen the first lean, the observer should anticipate the second lean, even though it also happened quickly. The ducks were quick and only to a slight angle so that there would be no need for the observer to lean in order to see better. Indeed, the best view of the narrator would be from a constant upright position.

The story was about the dangers of being a short person at a crowded Christmas party, where she was nearly hit in the head by the elbow of a much taller person. At two points, the storyteller enacted a duck to her right to "avoid" being hit by the elbow of the tall person. After this story, the experiment was explained to the participant, who saw the videotape and consented to its use.

Scoring. The experiment was videotaped in split-screen, with each person (filmed full-face) on half of the screen. A time signal accurate to .01 second appeared on the bottom of the screen. The videotape of the second story was scored for movements to the left or right within 2 seconds of both times the narrator ducked. Only the initial movement and not the recoil from that movement was counted. One judge scored all of the participants' tapes, and a second judge independently scored 13 of them; they agreed on whether or not a lean occurred for all of the 26 occasions (two occasions for each of 13 participants).

Results and Conclusions

All but one of the leans elicited were to the listener's left (reflection symmetry): 4 of the participants leaned in response to the experimenter's first lean; all of these were to the left. Then, 10 leaned in response to the second lean; 9 of these were to the left. Because 1 person leaned left both times, the binomial test was done on 12 (instead of 13) leans to the left versus 1 to the right; $p = .002$.

Thus the listeners who leaned almost always mirrored the storyteller's movement in reflection symmetry. These results are not consistent with the TRO prediction of predominant rotation symmetry or with predictions of equiprobable directions or a bias to the right. It appears that, when motor mimicry occurs in this situation, it is in the form that can be predicted only by a communication theory. These results can be added to LaFrance and Broadbent's (1976) finding, cited earlier, that

only reflection symmetry is correlated with rapport. We conclude that such motor mimicry occurs in order to communicate to the other and not as a result of any vicarious inner process such as feeling oneself into or taking the role of the other. The behavior is aimed outward and is interpersonal in function rather than being an indicator of an intrapsychic process.

EXPERIMENT 2

If we grant that motor mimicry occurs in a form consistent only with a communication theory, we still have not shown that such behavior in fact communicates a unit relation with the other person by means of Gestalt laws of form. It could be that this reflection symmetry means nothing at all to the other person and that motor mimicry occurs in reflected form for some other reason. For example, it could be that people always duck (in reflection symmetry) to match a movement, whether by a person or an object. If this were the case, such movement would not be communicative and would have no meaning to decoders. We propose, on the other hand, that reflection symmetry predominates because it is the form that is best decoded as meaning the observer is "with" the other.

Because the results of the first experiment were so strong, there were not enough cases of leans in both directions to show these tapes to decoders as we had done in a previous study (Bavelas, Black, Lemery, & Mullett, 1986). We also rejected the possibility of reversing the roles of Experiment 1 by having the experimenter be a listener who might lean in either direction to a story told by the participant. Besides the obvious difficult of ensuring that these unpracticed storytellers would lean appropriately during a prescribed narrative, it would be very difficult to ensure that the experimenter-listener could maintain identical behavior in all other aspects throughout a story that might vary unpredictably. (In pilot work, two experienced theater students were unable to do so.)

To avoid these problems, we chose to use a variety of convergent methods to test our prediction. The first was simply to ask the participant to imagine telling a story and to choose between two possible mimetic reactions (reflection and rotation symmetry). Pilot work indicated that the phrases "together with" and "involved with" best conveyed the idea of a unit relation. These were also among the

terms LaFrance and Broadbent (1976) and LaFrance (1979) used to measure rapport.

Method

Participants. Initially, 25 volunteers were recruited from the Psychology Department's "subject pool." Data for 1 person were not used because of an error in the instructions; the final *N* was 12 men and 12 women.

Procedure

All sessions were conducted by a female experimenter who was unaware of our hypothesis; this was done to avoid any inadvertent nonverbal cues (e.g., by different facial expressions as she demonstrated the two possible leans).

The participant came to the Human Interaction Lab, where he or she was given a general overview, asked to stand facing the experimenter, told about the videotaping, and then instructed as follows:

> I'd like you to imagine that you are telling me a story and that you've moved your head to one side to demonstrate how you ducked out of the way of something. Could you lean over this way? [At this point, the experimenter guides the participant's head into a leaning position to the left or right.]
>
> Now, as the listener, I could either lean over this way (Number One) or over this way (Number Two). [The experimenter moves her head each way while saying the number of that position; the participant's head is still learning as originally directed.]
>
> So here are the questions: Which of the two movements demonstrates that the listener is more *involved* in the story? [Waits for reply.] The second question is, Which of these two reactions shows that the listener is more *"together"* with you?

Note that the experimenter and participant actually held each of the two configurations for a moment. After each answer, the experimenter verified the participant's answer by repeating the number chosen and enacting its direction. She also asked for any comments the participant might have about his or her choices and then showed the participant to the control room, where another experimenter explained the purpose of the study, showed the videotape, and asked for permission to keep it.

The direction of the participants' guided lean (left or right) and the order of the two choices (rotation or reflection) were permuted in all four possible combinations and randomly assigned to participants. Thus a given participant might be leaned to the left and see first rotation symmetry and then reflection symmetry.

Results and Conclusions

The videotapes were reviewed for adherence to the procedure and to record the participants' choices. Of the 24 participants, 22 chose reflection symmetry for the first question (binomial test, $p < .001$), and 20 chose reflection symmetry for the second question (binomial test, $p = .003$).

As predicted, reflection symmetry was chosen overwhelmingly by participants as the better indicator of involvement and being "together." Typical reasons included "If you are involved with somebody, you move with them" and "If they went the opposite way [rotation symmetry] I'd get the impression they were puzzled or thinking about something else." Recall that rotation symmetry can, by an additional step, be seen as similar, so it may be a suitable choice compared to no mimicry at all. To most of our participants, however, it did not convey a unit relation as well as reflection symmetry did.

EXPERIMENT 3A

A second decoding experiment was conducted in order to add convergent evidence that was as different as possible in method from Experiment 2. Pairs of photographs of mimetic situations were produced[2]; each set showed the back of an observer who was leaning left in one photograph and right in the other, watching an otherwise identical situation. Two of the sets portrayed avoidance situations (such as those used in the first two experiments). The two other pairs portrayed situations in which the actor was leaning toward (rather than avoiding) something; these would show whether our hypothesis held for both approach and avoidance leaning.

Method

Stimuli. Four sets of 5" by 7" 35 mm color photographs taken with a Pentax single-lens reflex camera were selected from a larger number of

pilot sets taken for this purpose. Their selection was based on maximum similarity between both pictures in the pair and the credibility of the situation to pilot subjects.

(1) Snow photos: In an outdoor winter scene, a male observer is watching one man playfully pushing a handful of snow toward the face of another man, who is leaning away to his right. (See Figure 1.)
(2) Squash photos: A male observer is watching (through a glass back-wall) two women playing squash; one woman is swinging widely at the end of her backhand stroke so that her racquet is approaching the face of the woman on her right, who is ducking away.
(3) Office photos: A female observer is seated across from another woman in an office; the other woman is holding a phone to her right ear while stretching out to her left to reach a coffee mug on a side table.
(4) Juggler photos: A man and a boy are watching a man juggle three balls. One of the balls in the air is going off far to the right of the juggler, who is leaning over onto his right leg and reaching out with his right arm to catch it. The observing man and boy both lean in the same direction (to their left in one picture and to their right in the other).

Each pair of photographs was matted and mounted on a single photo album page, under a plastic sheet, and placed in its own folder. In order to control for position of photo (top or bottom), there were two sets of each pair. Each of the resulting eight folders had a pocket containing "ballots" in a color that matched its folder.

Participants. In order to obtain a broad cross-section of decoders, we went to a municipal recreation center and asked adults using the facility to volunteer; 104 of them agreed.

Procedure. The order of the eight folders was randomly permuted 13 times, so that participants saw a randomly assigned pair of photos. When a volunteer approached the experimenter's table, she chose the folder indicated by the permutation sheet, opened it, and held it up to the participant. The general instructions were as follows:

> We're interested in your opinion of a couple of pictures. So that your opinion will be anonymous, after we've asked the question, we'll give you a ballot to mark.

The instructions for a particular photo went on to say, for example,

> Notice that both of these photos show two spectators watching a juggler. What we'd like to know is: Which photograph conveys better that the two observers are *involved* or *"together"* with the juggler?

Figure 1 Snow Photo Set from Experiment 3A, Portraying Reflection and Rotation Symmetry

NOTE: Subjects saw 5" x 7" color photos.

This latter part of the instruction was also printed on the ballot, along with the choice of "top picture" or "bottom picture." The volunteer marked the ballot and deposited it through a slot into a large box. He or she was then directed to the other end of a long table, where other experimenters were waiting to explain the purpose of the study and to answer questions. Care was taken that those who had not yet participated did not overhear this explanation. The experimenter was the same as in Experiment 2, and she remained blind to the hypothesis, although the procedures probably made this unnecessary.

Results and Conclusions

The results are shown in Table 1. There was a marginal effect of the position of the photo, with the top one being chosen somewhat more frequently than the bottom one over all four sets; this was not significant for any single set of photos. There was the predicted strong preference for the photo portraying reflection symmetry in three of the four pairs. Participants who afterwards volunteered their choice and the reason for it usually said they chose reflection symmetry because the observer was leaning or moving "with" the other person. It is also interesting that those who chose the rotated version of the Snow, Juggler, or Office photos described a process that was, in fact, essentially rotation. Contrary to our prediction, however, rotation symmetry was chosen as often as reflection symmetry for the pair of Squash photos. Participants who afterwards offered their reasons for choosing the rotated version of the Squash photo did not describe rotation; they usually said that the observer appeared to be trying to see the victim's face.

Although the results for all four sets of photos eliminated a TRO theory and three of them strongly supported our communication theory, there were still several possible explanations for the results with the Squash pair: (1) Few participants were squash players, so many may not have understood exactly what was going on in these photos. Also, this pair was relatively darker than the other three sets, and the people were closer together, so the action may have been less clear. All of these factors may have resulted in essentially random choices. (2) However, the result obtained for this pair is exactly what we would predict if the process were empathic experiencing. It could be argued that the other three pairs were too mild to elicit a viewer's empathic involvement (two portrayed approach rather than avoidance, and the Snow photo was obviously playful). Only the Squash pair portrayed the

TABLE 1

Experiment 3A: Frequency of Choice of Photograph Portraying Reflection Symmetry as Showing Observer is "Involved" and "Together" with Other

		Subject's Choice of Photograph	
Snow Photograph			
Position of photograph		Top	Bottom
portraying reflection	Top	13	0
symmetry:	Bottom	2	11
Overall chi-square ($1, N = 26$) = 19.06, $p < .001$.			
Binominal tests:			
Reflection vs. rotation (24 vs. 2), $z = 4.31$, $p < .00003$.			
Top vs. bottom photograph (15 vs. 11), $z = .78$, $p > .10$.			
Juggler Photograph			
Position of photograph		Top	Bottom
portraying reflection	Top	11	2
symmetry:	Bottom	4	9
Overall chi-square ($1, N = 26$) = 7.72, $p < .01$.			
Binomial tests:			
Reflection vs. rotation (20 vs. 6), $z = 2.74$, $p = .003$.			
Top vs. bottom photograph (15 vs. 11), $z = .78$, $p > .10$.			
Office Photograph			
Position of photograph		Top	Bottom
portraying reflection	Top	13	0
symmetry:	Bottom	3	10
Overall chi-square ($1, N = 26$) = 16.24, $p < .001$.			
Binomial tests:			
Reflection vs. rotation (23 vs. 3), $z = 3.92$, $p < .00005$.			
Top vs. bottom photograph (16 vs. 10), $z = 1.18$, $p > .10$.			
Squash Photograph			
Position of photograph		Top	Bottom
portraying reflection	Top	7	6
symmetry:	Bottom	7	6
Overall chi-square ($1, N = 26$) = 0, $p > .10$.			
Binomial tests:			
Reflection vs. rotation (13 vs. 13), $z = 0$, $p > .10$.			
Top vs. bottom photograph (14 vs. 12), $z = .39$, $p > .10$.			
All Photographs			
Position of photograph		Top	Bottom
portraying reflection	Top	44	8
symmetry:	Bottom	16	36
Overall chi-square ($1, N = 104$) = 30.88, $p < .001$.			
Binomial tests:			
Reflection vs. rotation (80 vs. 24), $z = 5.49$, $p < .00003$.			
Top vs. bottom photograph (60 vs. 44), $z = 1.57$, $p = .06$.			

possibility of a real injury; therefore, it could be that only this pair was intense enough to bring people to feel themselves into the situation. (3) Finally, this was the only pair in which the other person (the victim) was not facing the observer. In the game of squash (like handball and racquetball), the players are most often facing the front wall of the court, while observers watch from behind, outside the court. In pursuit of accuracy, we had inadvertently made the victim visually unavailable to the observer—yet the availability of a receiver had been the crucial variable in our previous experiment (Bavelas, Black, Lemery, & Mullett, 1986). These three possible alternative explanations could only be resolved by another experiment.

EXPERIMENT 3B

The most appealing (and surprising) explanation for the anomalous result in one of the four sets of photos in Experiment 3A was that there was no one who would see the observer's reaction—and that this factor affected even decoders who were not part of the action. It may be that when there is no possibility of the observer's motor mimicry being seen, it is not treated as communication and is therefore not decoded. In order to test this possibility against the other two outlined above (clarity of photo or the intensity of feeling elicited), we created two new pairs of photos with characteristics that would distinguish among the three explanations.

The problem of clarity or quality of photo was eliminated by a clearer enactment on a brightly lit court. Emotional intensity was increased by increasing the apparent severity of injury; the racquet was actually touching the victim's face, across the nose and eyes. The communication interpretation was tested by producing a matching pair of photos in which the victim did or did not face the observer. According to our hypothesis, decoders would choose predominantly the reflected version when the victim is facing the observer. When the victim is not facing the observer, the choices should replicate the previous results. If, instead, the process were empathic experiencing, decoders should be equally likely to choose rotation symmetry or reflection symmetry (just as they had chosen for the Squash photos in Experiment 3A). Whether or not the victim is facing the observer should not affect the decoder's choice.

Method

Stimuli. Two new pairs of photos were made. All portrayed a male player swinging so widely after his backhand stroke that his racquet is

hitting the face of the female player on his right. Although she is leaning away to her right at a 45-degree angle, the racquet is in contact with the upper half of the right side of her face. An observer is standing in the foreground of the photo, with her back to the camera. The two players are facing the observer in one pair and not in the other; see Figure 2. In both cases, the victim's head is slightly tilted, so that even when the players' backs are to the observer, it is clear that the racquet is in contact with the upper half of the victim's face. As before, the players held the same stance while the observer leaned left and right for the two photos of a pair.

Participants. Because the community sample in Experiment 3A made choices identical to those of pilot decoders from the university population, this study was conducted on campus. A total of 40 individuals were asked and agreed to volunteer as they walked through the lobby of the University Centre building, near the entrance to the cafeteria.

Procedure. The procedures were identical to those of Experiment 3A, except that position was not a factor. Because there had been a slight bias toward choosing the top photo in that experiment, the photo showing reflection symmetry was always on the bottom. The Facing and Not-Facing versions were randomly assigned to participants by the permutation procedure used in Experiment 3A. The experimenters and debriefers were four of the present authors.

Results and Conclusions

The decoders' choices were as predicted: Reflection symmetry was chosen by 16 out of 20 people in the Facing condition ($z = 2.69$, $p < .004$). Reflection and rotation symmetry were chosen equally in the Not-Facing condition (11 versus 9; $z = .44$, $p > .10$). Two pilot studies leading to this experiment had also supported our hypothesis: Using only Facing versions, 12 out of 14 people chose reflection symmetry in a pair of photos of a pillow fight (binomial test, $p = .006$). Out of 9 people, 4 chose reflection symmetry for the Squash photos from Experiment 3A (binomial test, $p > .10$), as compared to 7 out of 8 for the Facing version of the new 3B photos (binomial test, $p = .035$).

Because visual availability affected the choices, whereas increased severity of injury did not, only our communication theory remains viable. The reasons, when volunteered, were similar to those in Experiment 3A. In the Facing version, reflection symmetry was chosen

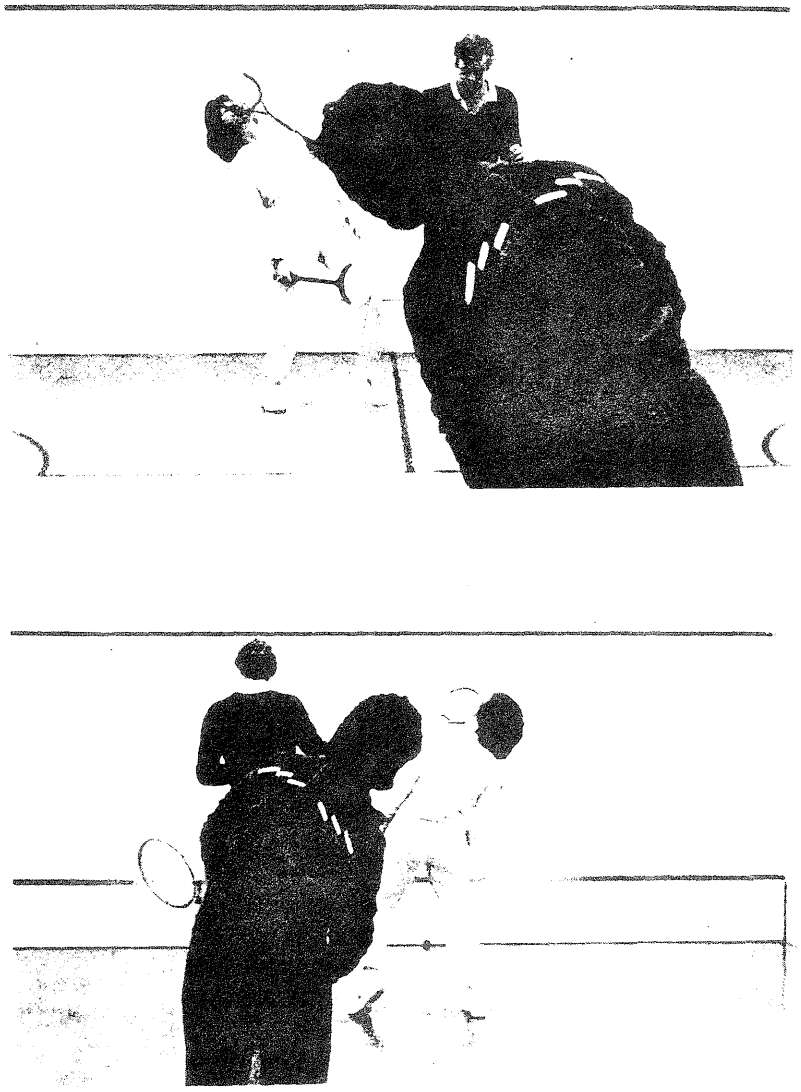

Figure 2 Squash Photos from Experiment 3B, One from the Facing Set and One from the Not-Facing Set

NOTE: The photo set subjects saw portrayed reflection versus rotation symmetry; both were either Facing or Not-Facing. All were 5" x 7" color photos.

because the observer was moving "with" the victim. In the Not-Facing version, when reflection symmetry was chosen, the same reason was given; when rotation symmetry was chosen, the reason was often that the observer was trying to see better (even though her head was actually slightly farther from the victim's face). Note that this reason does not fit any of the three theories that have been considered here. We conclude that when the photos portray no possibility of communication, decoders may not even see the observer's behavior as motor mimicry and may instead judge the behavior on other, nonsocial criteria.

GENERAL DISCUSSION

We set out to establish whether the form motor mimicry takes is more consistent with a vicarious process or with a communicative function. If motor mimicry were primarily or originally an expression of vicarious experience, then it should retain the form suited to that expression. If, on the other hand, motor mimicry is primarily or originally a communicative behavior, then it should retain the form best suited to that function.

These different theories predict different behaviors in the case of left/right leaning when observer and other are facing each other, so this special instance was studied to establish which function shapes the form that motor mimicry takes. O'Toole and Dubin (1968) had proposed that motor mimicry is behavioral evidence of George Herbert Mead's theory that observers take the role of the other from the standpoint of the other, but the data of Experiment 1 are not consistent with their hypothesis. Similarly, these data are not consistent with the theory, originally proposed by Lipps, of motor mimicry as evidence of empathic experiencing.

The results of all of the experiments, over a variety of situations, are consistent with motor mimicry as a communicative behavior that is analogically encoded by Gestalt principles of form. Reflection symmetry best represents the observer's similarity to the other, and there is a strong bias toward reflection symmetry on the part of both the observers who engage in motor mimicry and the decoders who interpret it. The two theories of vicarious experience must make the predictions derived from them here and cannot, within their own terms, predict reflection symmetry.

The results of previous studies (Bavelas, Black, Lemery, & Mullett, 1986) showed that (i) motor mimicry is differentially affected by the visual availability of a receiver, (ii) its display is synchronized to this visual availability, (iii) it occurs too rapidly to have required prior inner processing, and (iv) it is consistently decoded by receivers. The present studies add further evidence that (v) the form that motor mimicry takes—reflection symmetry—cannot be accounted for by any alternative theory such as role-taking or empathic experiencing; (vi) this form is consistent with analogic encoding of a unit relation between observer and other; (vii) decoders interpret reflection (and not rotation) symmetry as indicating a unit relation; and (viii) even decoders who are third parties to the interaction are sensitive to the visual availability of a receiver. Because the above findings included at least two different instances of motor mimicry (leaning and facial expressions of pain), we believe that they would probably hold for the broader class of motor mimicries identified in Bavelas, Black, Lemery, MacInnes, and Mullett (1986).

The data strongly support our parallel process model. The stimuli that elicit motor mimicry do so directly. These same stimuli may also elicit intrapsychic processes, but such processes do not cause motor mimicry; they are instead parallel to and independent of the overt behavior. We believe that the reason for this independence is the high priority on a communicative *display* of similarity to the other in such instances. As Watzlawick et al. (1967) and Kraut and Johnson (1979) have proposed, overt acts in the presence of another are likely to be communications to the other rather than private expressions of an inner state. In other words, they are subtle and precise expressions *to* the other interactant rather than global and diffuse expressions *of* one person's intrapsychic state.

These findings also have methodological implications for communication researchers (see Bavelas et al., 1987). First, we cannot know about the communicative function of a nonverbal behavior unless we study it in a communicative setting rather than in experimentally isolated individuals. Second, we may need to recast the common view of nonverbal behavior as more global and "leaky" than verbal acts. Here and in our other studies, we have found motor mimicry to be so subtle and precise that very tight reasoning, experimentation, and analysis were required. Upon careful examination, many nonverbal acts may be found to be equally demanding.

NOTES

1. To be precise, it produces one kind of rotation symmetry, as this class comprises any rotation, including the 180-degree rotation we are concerned with here.

2. Historically, photographs have had an important role in portraying motor mimicry. Except for Hull's pilot study in 1933, the three photos by Köhler (1927) and Allport (1937, 1961) were the entire empirical evidence for the phenomenon until O'Toole and Dubin's experiments in 1968. See Bavelas et al. (1987) for details and reproductions of those photos.

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