Imagination and the Meaningful Brain

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A Bradford Book
The MIT Press
Cambridge, Massachusetts
London, England

10 Mirror Neurons, Gestures, and the Origins of Metaphor

Mimetic skill rests on the ability to produce conscious self-initiated representational acts that are intentional but not linguistic.

Merlin Donald

In a series of remarkable papers Vittorio Gallese and Giacomo Rizzolatti, Italian investigators from the University of Parma, report their discovery of "mirror" neurons in the premotor cortex of monkeys (Gallese, Fadiga, et al. 1996; Rizzolatti and Arbib 1998; Gallese 2000). Using microelectrodes that recorded from individual neurons, they observed that the same neuron fired both when the monkey grasped an object, such as a raisin, and when a human or another monkey performed the same specific action. Mirror neurons respond only to intentional motor actions. This is the first evidence that there is an area in the motor cortex that can respond specifically and only to goal-directed, relational actions.

"Relational" Mirror Neurons and the Concept of Representation

When mirror neurons are activated, there is a very tight, precise correspondence between a specific motor action and neuron firing. For example, if a neuron responded to an object held between the fingers, it would not respond to the same object held by tweezers. Self-initiated actions and the individual's perception of the identical action performed by another evoke the same neural response. So it can be said that the *monkey's brain (and ours as well) is intrinsically relational.* Noninvasive techniques such as fMRI and PET scans have confirmed the existence of mirror neurons in humans as well (Gallese, Fadiga, et al. 1996; Rizzolatti and Arbib 1998). It is a reasonable supposition that mirror neurons are found in all primates.

It is important to emphasize that what is activated in mirror neurons is not simply a response to the visual perception of the object, for these neurons fire only when a specific *action* is observed. Seeing the object itself will not cause the neurons to fire. Of particular interest is that the specific area of the monkey's prefrontal cortex area that contains mirror neurons (F5) is thought to be homologous with Broca's area in the human brain, so the relational specificity of motor actions may constitute an analog for what in the human brain evolved into a capacity to imitate the precise sounds of speech. As Rizzolatti and Arbib state, "This observer/execution matching system provides a bridge from doing to communicating" (1998).

Mirror neurons may help to explain the "representation" of motor actions. Throughout this book, I have criticized the idea that representation is logically coded information. The mirroring of self-initiated actions with those identical ac-

tions performed by the other provides an alternative explanation that may help to explain and redefine the concept of representation. You will recall that Descartes invoked the idea of representation to explicate the correspondence between the mind and the world, a correspondence that assures a precise fit between the external object and its representation in the mind. Descartes believed that this correspondence was due to God's benevolence—that he would not play tricks on his subjects. The concept of representation was thought by some philosophers and cognitive scientists to explain the enigma of meaning, that the object "represented" in the mind corresponded to object in the world, as the one was translated into the other by means of a code or some form of "mental language" (see chapter 1). That a representation is some form of symbolic or logical code remains a central concept for many in the cognitive-science community. The discovery of mirror neurons suggests that certain actions may be represented in the mind because they trigger a neural link between self and other. This representation of the other's action by means of mirror neurons is direct and immediate and does not require any intervening symbolic code or a mental language, as there is an instantaneous mapping from self to other and from other to self. Mirror neurons support ecological theories of perception in that there is an innate coupling between the self and the other: we respond to directly perceived qualities of the other's intentionality; we do not require coded information. Gallese (2001) suggests that mirror neurons may be only one among other matching mechanisms in the brain that provide a neural explanation for intersubjectivity. Yet, as mirror neurons fire only in response to the performance of specific intentional acts, mirror neurons cannot explain the mind's

perceptual representation of nonrelational events, such as inanimate objects.

We know that shortly after birth the newborn human infant shows an innate capacity to imitate motor actions. Meltzoff and Moore (1977) have observed that infants between 12 and 21 days of age and even one hour after birth imitate tongue protrusion and other facial and manual gestures. In the case of the one-hour-old infant, who has not yet acquired any visual memory, it is possible that the infant did have a kinesthetic memory as a consequence of having practiced this gesture of tongue protrusion in utero. Mirror neurons may explain this behavior as a result of the visual experience after birth having matched the memory of the earlier intrauterine kinesthetic experience. This explanation may account for apparent innateness of the infant's imitation. Such behavior can be described as an innate form of kinesthetic empathy. Kinesthesia provides a medium for relatedness. We may, therefore, have underestimated the significance of the infant's imitative gestures. Mirror neurons may also explain the observation that rhythmic kinesthetic sensations promote bonding. We know that rhythmic motion such as dancing fosters a sense of relatedness and union. You recall that the historian William McNeill, in his book *Keeping Together in Time* (1995), observes that all human societies, both ancient and modern, bond together by means of dance. Kinesthesia too should be recognized as a medium of communication. We innately reverberate to the movement of the other.

The Origin of Empathic Feelings

In chapter 6, I described projective identification, a phenomenon that is occasionally encountered in psychoanalysis.

When this occurs, specific feelings associated with traumatic past relationships are somehow "placed" in the analyst. This mysterious unconscious communication of feeling is not in any sense mystical or telepathic, as it now might be explained by mirror neurons. Vittorio Gallese, who with Giacomo Rizzolatti was a codiscoverer of mirror neurons, recently reports that the experience of witnessing pinpricks that the experimenter applies to his own finger will stimulate the same neurons as when the subject receives a pinprick (Gallese 2001). The implication is that our brains resonate to the other's feelings in manner similar to how we resonate with the other's intentional actions. Gallese concludes that mirror neurons are not restricted to motor acts, that our brains may contain a range of different mirror-matching neurons. This research suggests that we use our bodies as a template that enables us to feel our way into the other's experience. This supports the contention that the roots of empathy are in the body, and as with projective identification, this process occurs unconsciously.

Metaphoric Gesture and the Coevolution of Language

The discovery of mirror neurons provides a neural explanation for the fact that the other person's bodily movements are mirrored within the self. One "feels" oneself into another person's gestures: gestures are innately communicative. Inasmuch as mirror neurons are found in Broca's area, this provides some support for the speculation that in the evolution of language, gesture was the ancestor of language, that imitative gesture evolved before the appearance of the high-speed, precisely articulate language that is characteristic of our species. Philip Lieberman, an authority on the evolution of language, claimed that rapid, precise vocal communica-

tion was the engine that produced the modern human brain (1991). He suggested that ancient hominids, who showed left-brain asymmetry, lacked the vocal apparatus for modern speech. They presumably had the capacity for a more complex method of communication than nonhuman primates, but a capacity that fell far short of modern speech. If ancient humans did not have the apparatus for modern speech, how did they communicate? The use of gesture would be one obvious explanation.

This speculation that gesture is the precursor of language is by no means a new idea. You may recall that Vico thought that initially humans were without language and communicated by means of signs and gestures, and that then metaphor was the primary mode of knowing and understanding the world. The French philosopher Condillac, who was born nearly 50 years after Vico, also believed that gesture preceded spoken language (cited by Corballis 1991). So by the eighteenth century this idea had a certain currency.

The psychologist Merlin Donald, in *Origins of the Modern Mind* (1991), emphasized the significance of imitative gesture in the evolution of language. He proposed a theory of the evolution of language in which a "mimetic culture" was interposed between the culture of nonhuman primates and homo sapiens. Donald suggested that early hominids, such as *Homo erectus,* possessed a complex prelinguistic system of gestural communication that was superior to that of contemporary nonhuman primates. He hypothesized that such a system was based on communication by means of imitation. Donald further believed, as did Darwin, that such gestural communication utilized a new cognitive ability. Darwin wrote, "The mental powers of some early progenitor of man must have been more highly developed than in

any existing ape before even the most imperfect form of speech could come into use" (1872, p. 463). It seems likely to me that this new mental power that Darwin inferred is the capacity for metaphoric thought. A species that had the capacity for forming conceptual and perceptual metaphors would have expanded its ability for thought exponentially, even though its aptitude for spoken language may have been rudimentary. This would be consistent with the idea, central to this book, that thought can exist apart from language. This would also suggest that the origin of metaphor and the origin of language are not a coincidence, but represent a coevolution. Donald's theory of *mimetic culture,* an argument for gradualist theories of the evolution of language, represents an alternative to a Chomskian conception of the sudden appearance of an "innate language-acquisition device." Donald proposes that a mimetic culture may have existed for over a million years and is possibly associated with *Homo erectus,* who appeared about 1.5 million years ago and survived until several hundred thousand years ago. If *Homo erectus* did possess language, Donald hypothesizes, it was not a very efficient language and needed to be supplemented by imitative gestures.

The psychologist David McNeill (1992), who has analyzed the gestures that accompany modern speech, makes an important distinction between *iconic* and *metaphoric* gesture. Iconic gestures are based on similarity, whereas metaphoric gestures can represent abstracts thoughts and the unseen. Iconic gestures, but not metaphoric gestures, can be observed in chimpanzees and other nonhuman primates. An iconic gesture may simply imitate or abbreviate a motor action, such as holding out a hand to beg for food. Such ges-

tures are commonly used as a form of communication in immature chimpanzees (Wrangham, McGrew, et al. 1994). You may recall the iconic gesture of the female howler monkey in estrus, who will form an oval opening with her lips and will rapidly oscillate her tongue in and out and up and down. It is clear to the observer that the function of this gesture is to invite copulation (Sheets-Johnstone 1984).

In Donald's theory of mimetic culture, metaphoric gestures are complex and generative, in that they can be broken down into partial elements and recombined into novel forms. Metaphoric gestures could be used to communicate complex emotional intentional states. If spoken language is absent or inefficient, metaphoric gesture could fill in the gap. I am reminded of the use of gestures on the old silent screen, where the actors conveyed emotions by means of exaggerated facial expressions and bodily movements. Donald suggests that the expression of intentionality through gesture may have enabled our ancestors to *voluntarily* communicate emotional intentions. This ability to voluntarily communicate a complex intentionality distinguishes a mimetic culture from that of nonhuman primates. If voluntary control of the expression of emotion characterizes mimetic culture, this capacity would promote the cohesion of the social group. We know that our voluntary control of emotional expression coexists with an older involuntary limbic system that we share with other primates. This combination of involuntary and voluntary communication may be similar to what Darwin (1965) observed with regard to the smiling response in humans. He contrasted the true or involuntary smile, in which the orbicular muscles of the eyes are contracted, with the voluntary smile. We share with other species the homologue of the involuntary smile, while the intentional smile is uniquely human.[1]

Terrence Deacon, in *The Symbolic Species* (1997), proposed that language did not evolve as a separate modular faculty but that it co-opted preexisting cognitive structures. Language and the brain evolved together. It would be equally true to claim that metaphor and language represent a co-evolution, that language co-opted the preexisting cognitive faculty for metaphor. The evolution of a vocal apparatus that can imitate the precise sounds of others would have utilized the prior existence in the brain of mirror neurons that support precise gestural imitation. This enhanced motor capacity to communicate precisely would then be exponentially enhanced by the acquisition of metaphor.

Metaphoric Gesture in a Ritual Dance

We will never know the form that mimed gestures assumed in Donald's hypothesized mimetic culture of *Homo erectus.* However, we do know something of mimed gesture in contemporary aboriginal cultures, such as the rain dance of Native American Indians. A remarkable account of such a dance was provided by the art critic Aby Warburg (1995), who described the rain dances of Pueblo Indians as they were performed at the end of the nineteenth century. In one such rain dance the dancers held live rattle snakes. The snake is treated as a symbol of lightning because rattle snakes move in zigzag patterns that correspond metaphorically to the zigzag appearance of lightning. In Warburg's description, the dancer hurls the snake with great force onto a sand painting that depicts lightning streaks in the form of serpents. The magic of the dance is thus based on a visual metaphor created by the dancers. Metaphor is mimed. Warburg describes this as "danced causality." Of course, in contrast to Donald's hypothesized "mimetic culture," the

context of mimesis in aboriginal culture is that of a highly evolved and sophisticated religious system of thought. While we may no longer believe in "danced causality," we remain open and reactive, as were our ancestors, to the evocative power of the mimetic gestures of the dance. Our response to mimesis is phylogenetically ancient and developmentally innate.