

**Perspectives on Imitation: From Neuroscience to Social
Science**

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edited by Susan Hurley and Nick Chater

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8.7 The Application of Ideomotor Theory to Imitation

Merlin Donald on W. Prinz

Wolfgang Prinz has presented several elegant demonstrations of strong coupling between percepts and actions that support an ideomotor approach to imitation. Although I have no problem with his experiments, I am not completely convinced of the applicability of his theoretical model to imitation. Or perhaps it would be more accurate to say that the model cannot be as simple, or as universal as he proposes, for several reasons.

First, it is worth reminding readers that the building blocks of the vertebrate motor system do not follow an ideomotor principle. Simple segmental reflexes, and even some of the more complex suprasegmental reflexes, are sensorimotor in nature, and ubiquitous, even in humans. They are present in the nervous systems of all vertebrates and form the evolutionary foundation for all voluntary action. For very good adaptive reasons, they are generally quite resistant to the kinds of perceptual influences Prinz describes. An example is the so-called "H-reflex," which balances movement patterns that engage antagonistic muscle groups. It adheres to what Prinz calls a sensorimotor principle, in that it is the output of a highly quantifiable, reliable, and linear set of responses to a specific stimulus. The same is true of most basic protective reflexes, such as sneezing and vomiting; even when they involve significant suprasegmental coordination. For many species, this is the only type of action available. Of course, higher vertebrates and human beings have additional kinds of movement control, but reflexes are nevertheless built into their motor systems. In some instances, these reflexes can be overcome by corticospinal influences, but in most cases they cannot. In every case, voluntary action systems evolved on the backbone of reflexes, adding certain modifications but not replacing them. While some classes of action are undoubtedly ideomotor in their governance, many are not, and thus the ideomotor principle is far from universal.

Second, the ideomotor principle does not apply to all classes of voluntary movement. Prinz seems to be claiming that ideomotor theory provides a universal principle that governs voluntary action, including imitation. In humans, it appears that way. But humans are special, and demonstrations in human subjects are not necessarily representative of a universal principle. An ideomotor theory of imitation will have serious difficulty explaining why imitation is so difficult for many species when they obviously have very good control of voluntary movement in some domains. Many

primates have very precise control of voluntary movement in specific areas, such as visual-manual coordination, and yet lack precise imitative skills in those same areas. If their movements were governed entirely by ideomotor principles, then their imitative skills should reflect the precision of their actions and perceptions in various domains, but they do not. For example, apes can visually parse many subtle human gestures and respond to them appropriately, but they cannot reproduce those gestures, despite having sufficient motor control to do so.

The same criticism applies to the theory of "mirror" neurons. To a degree, mirror neurons behave as if they were components of ideomotor maps, and their existence seems to bolster the likelihood that ideomotor theory will prove useful in explaining some aspects of voluntary movement. However, the presence of mirror neurons does not guarantee the existence of imitative skills in a species. Monkeys have mirror neuron systems and learn to make excellent predictions about the consequences of their actions, but are nevertheless very poor at imitation. Imitation is different. Its explanation will not entail a simple extrapolation of a universal principle of movement control. In human evolution, the refinement of imitative skill has been linked to the emergence of mimetic gesture, role-playing, social transmission, and skilled rehearsal; in a word, to the intensification of social life, nonverbal communication, and group coordination.

8.8 How to Analyze Learning by Imitation

Bennett Galef on Heyes

For me, the most interesting feature of Heyes's associative-sequence learning model of imitation is not that it predicts that the ability to imitate will be experience dependent or that imitative learning is simply the production of novel sequences of familiar acts, controversial though those notions may be. Rather, my attention is captured by the assertion that the ability to imitate rests entirely on processes that are not unique to imitation itself. It is here that the contrast with theories, such as Meltzoff's active intermodal matching model (Meltzoff & Moore, 1999a), that postulate a dedicated, innate mechanism for imitation that transforms visual input into representations encoding modeled movements, is most pronounced.

The implications of Heyes's approach are quite profound. If, as Heyes proposes, imitation results from the formation of horizontal links among visual representations and vertical links between sensory and motor representations, such general processes may be better studied in nonimitative