

## *Introduction: Identifying and Defining Imitation*

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Imitation has long been regarded as a special kind of social learning, unique in both its psychological complexity and potential to support cultural transmission (e.g., Thorndike, 1898; Washburn, 1908; Piaget, 1962; Boyd & Richerson, 1985; Galef, 1988). Consequently, although imitation may appear to be just one of many types of social learning, it is the principal focus of psychological research on social learning in animals, and, correspondingly, the concern of nearly half of the chapters in this collection.

The dual significance of imitation, its perceived importance not only as a sign of complex psychological processing but also as a means of effecting the nongenetic transmission of information, may have contributed to the problems that have been encountered both in defining imitation conceptually and in identifying it empirically. For at least a century, researchers have been preoccupied with the questions of how the term "imitation" should be applied, which hypothetical class of phenomena it should be understood to name, and how instances of this class can be identified in practice, distinguished empirically from other forms of social learning. These issues may have proved especially intractable in the case of imitation because its dual significance entails that they are addressed by people with a variety of disciplinary backgrounds and theoretical purposes, including ethologists, experimental

psychologists, primatologists, and behavioral biologists. The potential for cross-talk and confusion has been immense.

The chapters that follow show that, in recent years, genuine progress has been made in defining and identifying instances of imitation, so that we can proceed with greater confidence to examine the phylogenetic distribution of imitation, its evolutionary history, adaptive function, ontogeny, and mechanisms of operation. A subtle but important sign of this progress is that the contributors to this volume exchange views. They acknowledge the positions, and address the arguments, of other authors in this collection and elsewhere. This exchange contrasts with the tradition in research on imitation in which each contributor has, typically, reported his or her own demonstration of imitation, or preferred taxonomy of imitative learning, either in splendid isolation or with reference only to like-minded colleagues.

### DEFINING IMITATION BY EXCLUSION

Thomas Zentall begins the first substantive chapter on imitation by highlighting intradisciplinary diversity in the way in which imitation has been defined. Some psychologists (including, in this volume, Whiten and Tomasello) define imitation as learning that is mediated by a particular cognitive process, for example, an intentional process like "perspective taking" or "mind reading," while others eschew reference to unobservable psychological processes, and view imitation as a variety of instrumental conditioning. Zentall argues that the latter approach is preferable because it may not be possible to measure intentionality directly, and he pursues a more behavioral analysis through a survey of varieties of nonimitative social learning.

The purpose of Zentall's broad and incisive review of types of nonimitative social learning (which includes contagion, social facilitation, socially mediated aversive conditioning, local enhancement, stimulus enhancement, observational conditioning, matched dependent behavior, copying, and goal emulation) is to show that "true imitation" can be defined by exclusion; using identified control procedures, one can demonstrate that a social learning phenomenon is *not* nonimitative, and therefore, by default, *is* imitation. The control procedure that Zentall favors in this context is the "two-action" method, in which observer animals witness demonstrators performing one of two different actions on the same object or manipulandum. He argues that if, in a two-action test, observers tend to execute the same action as their demonstrators, it is most unlikely that this behavioral matching is due to

nonimitative social learning, and suggests that the two-action method has provided evidence of true imitation in budgerigars (Dawson & Foss, 1965; Galef, Manzig, & Field, 1986), pigeons (Zentall, Sutton, & Sherburne, 1995), and rats (Will, Pallaud, Soczka, & Manikowski, 1974; Heyes & Dawson, 1990).

### THE EVOLUTION OF IMITATION

The two-action method is one powerful means of distinguishing imitative learning from cases in which observers and demonstrators perform similar actions either independently (without the demonstrator's behavior having any influence on the observer) or as a result of the demonstrator attracting the observer's attention to a particular place or object, i.e., through stimulus enhancement. Bruce Moore, whose approach to the study of imitation is influenced both by the behavioral or associative tradition and by ethology, begins his chapter on the evolution of imitation by summarizing the results of an ingenious alternative method of achieving the same end. In his studies of a Grey parrot, Okichoro, Moore eliminated the possibility of stimulus enhancement by looking for imitative learning of gestures, rather than actions on objects, and "labeled" each nonvocal gesture in order to distinguish imitation from independent or chance production by the parrot of behavior resembling that of the human experimenter. Thus, the experimenter would, for example, wave his hand while saying "ciao," and subsequently the bird would be scored as having imitated the gesture only if it waved a wing while, or soon after, vocal imitation of this word.

Moore believes that there is satisfactory evidence of movement imitation in only two groups of animals: parrots and great apes. He is sceptical about the two-action method studies of budgerigars, rats, and pigeons because each examines imitation on only one behavioral dimension, and it is not clear, in each case, that the imitated behavior was not already in the observers' repertoires. Thus, Moore takes generality and novelty to be definitive of imitative learning, and argues that it is only parrots and great apes that have been shown to meet these criteria.

Using comparative data and deduction, Moore weaves the parrot and great ape data into a rich set of hypotheses about the evolution of imitative learning. He suggests that the capacity for movement imitation evolved independently in the psittaciformes and hominids, deriving in the former case from song learning via vocal and percussive mimicry, and in the latter from conditioning via skill learning and putting through. Thus, Moore's conception of the hominid sequence is consistent with the behavioral or associative analysis adopted by Zentall and, to some

extent, Heyes, while his account of the psittaciform line, and his focus on phylogeny more generally, reflects a more ethological orientation.

### CULTURAL BEHAVIOR IN JAPANESE MACAQUES

Michael Huffman's chapter on stone-handling behavior in Japanese macaques is the first of four chapters concerning primates, and it is appropriate that Huffman's contribution should occupy this leading position. As Huffman emphasizes, we cannot be certain that stone handling has been transmitted through imitation. It could be that, while observing seasoned stone handlers, juvenile macaques learn about the properties of stones, but not how to handle them, via stimulus enhancement or emulation (Tomasello, this volume). However, Huffman's meticulous observational studies are very much a part of the Japanese primatological tradition, originating in the work of Imanishi, Itani, and Kawai on Koshima Island, which has had a long standing and profound influence on theorizing about the relationship between imitation and culture.

Huffman's studies focus on careful description of stone-handling behavior and its practitioners, identification of the conditions in which stone handling occurs, and documentation of the route of its spread through populations of individually identified monkeys whose matrilineal relationships are known to investigators. The resulting data reveal that stone handling is unique among the socially transmitted, traditional behaviors described in Japanese macaques because it occurs in the absence of any tangible direct benefits to practitioners. Thus, it would appear that, over a period of less than 20 years, stone handling has become a tradition within certain populations of macaques without contributing to their reproductive fitness.

### DO APES APE?

With the introduction of the two-action method, new standards of evidence have been established, and the once easy assumption that apes "ape," that chimpanzees and other nonhuman apes are capable of imitative learning, is being reexamined. The chapters by Andrew Whiten and Deborah Custance, and by Michael Tomasello, which reach contrasting conclusions, are the most recent and most rigorous contributions to this process of reexamination.

Whiten and Custance summarize the results of their recent experiments with chimpanzees and human children using a refinement of Hayes and Hayes (1952)

"do-as-I-do" procedure and a two-action method involving "artificial-fruit" apparatus. The within-subjects, seriate design of the do-as-I-do experiment resembles that of the procedure used by Moore with the parrot Okichoro; each subject is presented with a series of distinct gestures, A, B, C, etc., and evidence is sought of imitation by the observer of each of these actions. However, unlike Moore's procedure, the do-as-I-do test is preceded by a training phase in which animals are encouraged, through body molding and reward, to imitate modeled gestures on the command "Do this." Furthermore, the do-as-I-do test relies, not on the subjects' vocalizations, but on the timing of behavior relative to the demonstration of each action to distinguish imitation from independent production of behavior resembling that of the experimenter/demonstrator. Two-action tests, including Custance and Whiten's artificial-fruit procedure, differ from both of these within-subject, seriate procedures, not only in their focus on object-directed actions, but also in controlling for independent production, or chance resemblance, by making an explicit comparison of the frequency with which observers execute action A after observing A and after observing B.

Whiten and Custance conclude from their studies that both chimpanzees and 2- to 4-year-old children are capable of imitation, but that chimpanzees imitate with less fidelity. In the process, they raise the question of what it means for a behavior to be "novel," and, complementing Zentall's survey of varieties of non-imitative social learning, discuss putative types of imitative learning, including emulation (Tomasello, this volume) and "program-level imitation" (Byrne, 1994). It is argued that neither of these should be understood to be discrete categories of phenomena distinct from "true" imitation, because, *inter alia*, the three cannot be distinguished empirically from one another.

Tomasello's chapter is a substantial review and critique of research on tool use and gestural imitation in wild, captive and home raised or "enculturated" nonhuman apes, and includes comprehensive coverage of experiments on imitation in this group.

The review is prefaced with a lucid statement of how Tomasello's "cognitive" approach to the study of imitation, influenced by Kohler, Piaget, and Vygotsky, contrasts with the behavioral or associative tradition. This cognitivism allows Tomasello to accept that imitation can be distinguished from other forms of social learning as that which involves learning through observation about behavior, rather than learning through observation about the environment (Heyes, 1993). However, Tomasello's cognitive approach also leads him to stress that not all observational learning about behavior is imitation, and not all observational learning about the environment is stimulus or local enhancement. Rather, imitative learning should be

distinguished from mere "mimicry," with only the former involving some understanding of the demonstrator's goals or purposes, and stimulus enhancement should be distinguished from "emulation," in which the observer learns about the affordances, or dynamic properties, of environmental objects, not merely to attend to their static features.

With these distinctions, between imitation, mimicry, emulation, and stimulus enhancement, in hand, Tomasello makes the case through his empirical review that imitation occurs only in home-raised apes, and that it is a product of the influence of human culture on these animals. Thus, his conclusion is that nonhuman apes do not, spontaneously, ape.

Whiten and Custance's data are apparently at odds with Tomasello's conclusion because the chimpanzees they tested were captive but not home raised. Their exchange on this issue, in which Tomasello suggests that the artificial-fruit experiment provides evidence of emulation rather than imitation, and Whiten and Custance resist the distinction between emulation and imitation, provides an excellent demonstration of recent progress in research on imitation. That progress has facilitated direct, detailed confrontation between theory and data.

### IMITATION IN HUMAN INFANTS

In the fourth and final chapter devoted to primates, Andrew Meltzoff reviews the rapid progress that has been made in the last 20 years of research on imitation in human infants. The majority of this research has been informed and inspired by Meltzoff and Moore's (1977) demonstration, using a "cross-target" procedure, that prelinguistic infants can imitate a variety of actions, including facial gestures, that cannot be perceived in the same sensory modality when executed by the self (observer), and another (a demonstrator).

The logic of Meltzoff's cross-target procedure is identical to that of the two-action method first used by Dawson and Foss (1965) to test for imitation in nonhuman animals. In experiments with human infants, this logic is typically applied in a within subjects or repeated measures design, rather than an independent groups design. However, the terms "cross target" and "two-action" apparently represent independent invention, or convergent cultural evolution, of the same, powerful method of testing for imitation in subjects without language.

While the two-action or crosstarget method is just beginning to be used consistently to find out whether various nonhuman animals can imitate, use of this method in developmental research over two decades has revealed much about the conditions in which infants imitate and the psychological processes involved. Melt-

zoff reviews studies showing that infants imitate vocalizations and object-related acts as well as facial gestures, that they can imitate after a delay of as long as several weeks, even when they did not have the opportunity to imitate during observation, and that infants will imitate peers as well as adults. Furthermore, in recent, elegantly controlled experiments, Meltzoff and his colleagues have shown that in the process of imitation infants "perfect" actions that were unsuccessfully executed by adult models, and that infants know when they are themselves being imitated by adults.

These findings lead Meltzoff to suggest that, at least in humans, imitation plays a major role in both the acquisition of theory of mind and enculturation. In contrast with Tomasello (e.g., this volume), who takes enculturation and the capacity to attribute intention as prerequisites for imitation, Meltzoff argues that imitation provides the foundation of inferences from first person to third person experience, and contributes to enculturation directly by effecting social transmission of a range of behaviors, and indirectly via its role in the acquisition of phonetic and prosodic features of language.

By surveying what has been achieved using a crosstarget or two-action procedure with infants, Meltzoff's discussion both encourages use of the same procedure to investigate imitation in nonhuman animals, and acts as a reminder that comparative research has not yet identified a nonhuman animal that is, like an infant, an "imitative generalist," capable of imitating a broad range of actions without extrinsic motivation. In emphasizing generality and intrinsic motivation, Meltzoff's characterization of imitation is like that of Moore (this volume). However, unlike Moore and Zentall (this volume), and in common with Heyes, Whiten and Cusance (this volume), Meltzoff does not regard the reproduction of *novel* behavior as, in any straightforward way, a defining property of imitation.

## RATS AND REALISM

In the final chapter, I summarize the results of bidirectional control experiments on imitation in rats, and use them to make some general points about the way in which imitation has been defined in this book and elsewhere.

The bidirectional control procedure is like other two-action tests in that it allows subjects to observe one of two actions, A and B, on a single object, and then compares the proportions of A and B responses made by observers of A and B, respectively. However, the bidirectional control procedure has a distinctive history [it was derived from Grindley's (1932) method of demonstrating instrumental learning], and, unlike other two-action methods, it uses a perspective manipulation to test for imitation. Subjects witness lateral displacement of a joystick from one

position relative to the manipulandum and surrounding chamber, and they are tested, allowed to displace the joystick themselves, in another position. Consequently, although a simple dimension of behavior, direction, is recorded in the bidirectional control procedure, like other two-action tests, it apparently allows imitation to be distinguished from independent production of similar behavior, stimulus enhancement, observational conditioning, and a range of other types of nonimitative social learning.

In Chapter 17, I measure the putative, bidirectional-control evidence of imitation in rats against the standards set by various definitions of imitation, including the definition by exclusion discussed by Zentall (this volume), Thorndike's characterization of imitation as learning to do an act from seeing it done, Thorpe's novelty and "no instinctive tendency" criteria of imitation, and definitions that link imitation with ideation, self-consciousness, intentionality, and cultural transmission. The behavior of observer rats in bidirectional control experiments seems to constitute imitation when the latter is defined by exclusion, to involve ideation, and to meet Thorndike's definition of imitation. However, it is not clear whether the rats' behavior meets Thorpe's criteria for imitation, and it does not imply self-consciousness, intentionality, or cultural transmission. More important, I argue that the bidirectional control example illustrates some more general problems: 1. The various definitions of imitation circumscribe different sets of phenomena, and 2. both Thorpe's criteria and definitions that link imitation with self-consciousness and/or intentionality make it impossible to identify examples of imitation with any confidence.

In contrast with Tomasello (this volume), who upholds that intentionality is characteristic of imitation, and with Zentall and Moore (this volume), who seek to overcome problems of definition by interpreting Thorpe's criteria and avoiding reference to psychological processes, I favor a "realist" approach which adheres to Thorndike's operational definition of imitation while acknowledging that the phenomena it circumscribes are of interest precisely because they are likely to be mediated by some complex, as-yet-underspecified psychological processes. This realist approach is consistent with that of Meltzoff (this volume).

### IS IMITATION RARE OR ELUSIVE?

"Can animals learn by imitation?" is a deceptively simple question. It has proved remarkably difficult for researchers to agree on a definition of imitation and to decide which nonhuman animals, if any, can imitate motor, or nonvocal, behavior.



The fact that nearly 100 years of research on imitation in animals has produced only a few convincing examples, could indicate that imitation is rare among nonhuman animals (Galef, 1988; Chapter 1, this volume). However, it is at least equally likely that imitation in animals is elusive, rather than rare. A broad range of species may be capable of imitation, and these animals may even imitate frequently under free-living conditions, while we have been prevented from identifying imitation with confidence by conceptual confusion and a lack of effective experimental methods.

If imitation is elusive rather than rare, then the contributions to this book encourage the expectation that many, reliable examples of imitation in animals will become known in the next few years. Conceptual issues are now being recognized and discussed, rather than written off as merely terminological problems, and it is now broadly agreed that two-action/crosstarget/bidirectional control procedures provide effective methods of distinguishing imitation from its many pretenders.

## REFERENCES

- Body, R., & Richerson, P. (1985). *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.
- Byrne, R. W. (1994). The evolution of intelligence. In P. J. B. Slater & T. R. Halliday (Eds.), *Behaviour and Evolution* Cambridge: Cambridge University Press.
- Dawson, B. V., & Foss, B. M. (1965). Observational learning in budgerigars. *Animal Behaviour*, *13*, 470-474.
- Galef, B. G. (1988). Imitation in animals: History, definition and interpretation of data from the psychological laboratory. In T. R. Zentall & B. G. Galef (Eds.), *Social Learning: Psychological and Biological perspectives*. (pp. 3-28). Hillsdale, NJ: Erlbaum.
- Galef, B. G., Manzig, L. A., & Field, R. M. (1986). Imitation learning in budgerigars: Dawson and Foss (1965) revisited. *Behavioral Processes*, *13*, 191-202.
- Grindley, G. C. (1932). The formation of a simple habit in guinea pigs. *British Journal of Psychology*, *23*, 127-147.
- Hayes, K. J., & Hayes, C. (1952). Imitation in the home-raised chimpanzee. *Journal of Comparative and Physiological Psychology*, *45*, 450-459.
- Heyes, C. M. (1993). Imitation, culture and cognition. *Animal Behavior*, *46*, 999-1010.
- Heyes, C. M., & Dawson, G. R. (1990). A demonstration of observational learning using a bidirectional control. *Quarterly Journal of Experimental Psychology*, *42B*, 59-71.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, *198*, 75-78.
- Piaget, J. (1962). *Play, dreams and imitation in childhood*. New York: Horton.
- Thorndike, E. L. (1898). Animal intelligence. *Psychological Review Monographs* (Vol. 8) 2.
- Washburn, M. F. (1908). *The Animal Mind*. New York: Macmillan.

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- Will, B., Pallaud, B., Soczka, M., & Manikowski, S. (1974). Imitation of lever pressing "strategies" during the operant conditioning of albino rats. *Animal Behaviour*, 22, 664-671.
- Zentall, T. R., Sutton, J., & Sherburne, L. M. (1995). Imitation of treadle stepping and pecking by pigeons using the two-action method. Paper presented at the conference on Comparative Cognition, Melbourne, FL.