Book Review

A window to the structure of the mind

The Imitative Mind: Development, Evolution and Brain Bases
edited by Andrew N. Meltzoff and Wolfgang Prinz,
Cambridge University Press, 2002.
£47.50 (353 pages) ISBN 0 521 80685 2

Imitation has long intrigued students of human nature, because it is both pervasive in human life and a channel connecting the individual mind to the social and cultural context in which it lives. There is a recent resurgence of interest in imitation among investigators of cognition and perception, cognitive neuroscience, human development and comparative cognition [1]. A number of groundbreaking discoveries across these domains have led to the converging conclusion that imitation and the processes by which it occurs offer a unique window to the mind. Building on this synergy, Meltzoff and Prinz have assembled a volume that both illustrates the growing breadth of interest in imitation and distills the core questions that surface across disciplines. These questions concern the level at which action is represented and the system that relates self-produced actions to the observed actions of others.

A critical insight emerging throughout the book is that behavior can be imitated at various levels, from specific motor patterns to the more abstract goals that guide action. This insight informs debates about whether, when and why reproducing the specific motor details of an action are crucial (see Refs [2,3], as well as the chapters by Byrne, Gattis and colleagues, Meltzoff, and Whiten). This insight also shows that imitation can be used to investigate action representations. Many chapters of the book illustrate this method, converging on the conclusion that actions are represented beyond the level of motor patterns: the various authors demonstrate that adults and children (Bekkering, Gattis and colleagues, Prinz, Vogt), infants (Meltzoff), and non-human primates (Byrne, Whiten) represent action in terms of its goal structure. As Tversky and colleagues elucidate, goal-directed action is richly structured. Some aspects of this structure are represented at different points in ontogeny, in different species, or in different situations. The book provides initial insights into these more specific aspects of action representation, including the ability to interpret the same motor pattern flexibly based on an analysis of the actor's goals (Decety, Gattis and colleagues, Prinz), sensitivity to the hierarchical and sequential structure of action (Byrne, Whiten), and the ability to anticipate the outcome of an incomplete action (Jellema and colleagues, Meltzoff).

Imitation rests on the ability to relate one's own actions to the actions of others. Throughout the book there is converging evidence for an important insight into this process – that observed and self-produced behaviors are united by common neurocognitive representations. Elegant behavioral research has shown that producing a particular action and perceiving that action draw on some of the same representational resources (Bekkering, Prinz, Vogt). Moreover, recent findings have revealed neural substrates (so-called 'mirror neurons') that respond to both observed actions and self-produced actions (Decety, Rizzolatti and colleagues). These findings yield important insights into perception–action relations, the production of voluntary behavior, and neural architecture. Crucially, they also indicate that imitation can result directly from the activation of these common representations, requiring no translation to account for the match between actions perceived and actions performed. This activation would be maladaptive if it were expressed for all actions. Several authors propose mechanisms for the modulation of imitative behavior (Bekkering, Decety, Kinsbourne, Rizzolatti and colleagues), and several consider instances in which this modulation fails to occur – in infancy (Decety, Kinsbourne, Heimann), in autism (Nadel, Whiten), and in certain cases of neuropathology (Decety, Kinsbourne, Goldenberg and Hermsdörfer).

The existence of common representations for self-produced and observed actions leads to the speculation, expressed widely in the book (and elsewhere), that these representations could contribute to mind-reading. Developmentalists find this possibility particularly intriguing because it provides a wedge into a classic developmental problem – how children learn to 'read' what others are thinking. The suggestion in this book is that imitation provides a window to the mind for children as well as for cognitive scientists. A number of authors suggest that imitation itself plays a causal role in the development of mind-reading (Heimann, Meltzoff), whereas others suggest that mind-reading and imitation are separate products of the same set of representations (Bekkering, Jellema and colleagues, Prinz, Rizzolatti).

In order for a mirroring system to contribute meaningfully to action knowledge, much less to mind-reading, it must be informed by systems for analyzing behavior into meaningful units. Throughout the volume there is attention to this issue, including investigations of neural systems that respond to behavior at different levels of analysis (Decety, Jellema and colleagues, Rizzolatti and colleagues), as well as the cognitive, comparative and developmental work described above. In addition, there is broad consideration of the importance of distinguishing information about the self from information about others, and the development and function of self-awareness (Asendorpf, Goldenberg and Hermsdörfer Kinsbourne, Meltzoff, Nadel, Reed, Rochat). These converging lines of work might one day yield an account of the origins of theory of mind in human children. They might also help to explain why, despite cross-species commonalities in action representation, only humans create a theory of mind.

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Opposing associationism

The Symbolic Foundations of Conditioned Behavior

by C. Randy Gallistel and John Gibbon, Lawrence Erlbaum, 2002.
£49.95 (196 pages) ISBN 0 8058 2934 2

This is an important, provocative and polemical book. The target of the polemic is associationism, the most venerable tradition in learning stretching back to the British empiricist philosophers, Locke and Hume. Not only do Randy Gallistel and the late, and greatly missed, John Gibbon attack associationism in its citadel – namely animal conditioning – but they also seek to usurp its authority with a synthesis of two cognitive theories. The first is Scalar Expectancy Theory (SET), developed by Gibbon over many years to explain the temporal control of behaviour, and the second is Rate Estimation Theory (RET) that was elaborated by Gallistel over 10 years ago to account for the acquisition of conditioning. This synthesis was presented in a paper published in *Psychological Review* in 2000, and the present volume is an elaboration of that paper.

Gallistel and Gibbon challenge associationism on three main issues. The first concerns the representational poverty of the concept of associative strength. According to associative theory, the predictive relationship between a conditioned stimulus (CS) and reinforcer is encoded by the strength of an association, a form of encoding that conflates many different features of the relationship, most notably the amount of training with the probability and magnitude of reinforcement. The second issue is the timescale invariance of acquisition which the authors claim is both the single most important discovery about conditioning, and problematic for associative theory. This invariance refers to the fact that acquisition is determined by the ratio of the interval between reinforced CSs to the duration of the CS, whatever the absolute lengths of these intervals and the probability of reinforcement. The final issue concerns the failure of associative theory to provide an account of the subtle timing of conditioned behaviour.

In response to these challenges, Gallistel and Gibbon offer a cognitive theory in which they assume that, during training, an animal encodes and remembers both the times at which reinforcers occur in the CS (based on SET) and the rates of their occurrence (based on RET). Then, when presented with a test CS, the animal retrieves memories of these intervals and rates before choosing whether to respond and, if so, *when* to respond, on the basis of decision rules. This account is applied not only to response acquisition and timing but also to complex temporal inferences revealed in studies of secondary conditioning, and to the operant choice behaviour.

Whether or not this cognitive theory presents a serious challenge to the hegemony of associationism is far from certain. Gallistel and Gibbon clearly seek to influence the neuroscience community by persuading us of the illusory nature of what they call the 'neurobiological transparency' of associationism. But be warned – this is not an introductory book and a critical appreciation of its central theses requires a firm grounding in both conditioning and associative learning theory. Moreover, I suspect that associative theorists will be mildly irritated by the numerous, dismissive over-generalizations that ignore many of the subtleties of their theories. My own judgment is that RET is too baroque an account to have a sustained influence in the field. Even so, it must be acknowledged that this book is a unique contribution to conditioning and learning. To maintain a healthy and generative state, every theoretical programme needs an official opposition and, at long last, associationism has found a worthy one.
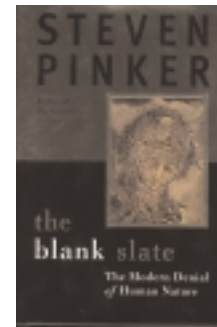
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Back to nature

The Blank Slate: The Modern Denial of Human Nature

by Steven Pinker,
Viking 2002. £25.00/$27.95 (509 pages)
ISBN 0 670 03151 8

When Steven Pinker's *Language Instinct* came out in 1994, a philosopher friend of mine described it as a wonderful book with an awful ending. Being greatly influenced by Noam Chomsky, she was sympathetic to Pinker's arguments that language is an innate module – an instinct – and persuaded as well that language has evolved through natural selection. But she was troubled by his suggestion in the final chapter that the same approach should be extended to psychology more generally. Pinker's next book, *How the Mind Works*, did just that, applying a biological perspective to everything from depth perception to maternal love to aesthetic appreciation. She *hated* this book, seeing the whole enterprise of evolutionary psychology as repugnant: morally suspect and politically reactionary.

The Blank Slate is written for her. Pinker does a lot of things in this extraordinary work, but his main goal is to show that the notion of an evolved human nature does not have the negative connotations that many people think it does. There is no conflict between a materialist and biological perspective on the mind and the religious, political and moral values that people hold most dear.

Pinker starts by identifying three doctrines: the blank slate (mental structure comes from the environment, mostly from culture), the noble savage (humans are essentially good) and the ghost in the machine (mental life is the