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## Review of *Evolution and Cognition*, edited by Cecilia Heyes and Ludwig Huber.

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BOOK REVIEW

*Evolution and Cognition*

Edited by Cecilia Heyes and Ludwig Huber.

Cambridge, MA: The MIT Press, 2000, 386 pages, ISBN 0-262-08286-1, US\$47.95

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Heyes and Huber have edited a volume that surveys much of the current research into cognition in animals, reflecting the strengths and weaknesses of this field. The book is divided into five sections. In the first part, titled “Orientations,” four authors lay out their basic general views of the field. The first two chapters in this section are by the editors. First, Heyes makes the case for an approach to evolutionary psychology that she labels “in the round,” an approach that would encompass studies of human and nonhuman animals alike and include a broad range of contemporary evolutionary approaches. This is a broad, well-visioned charge. Sadly, neither the book nor the field itself lives up to this promise as yet. I will return to this theme in the concluding section of this review. Then, in a chapter titled “Psychophylogenesis,” Huber relates many of the ideas of Konrad Lorenz to the study of the evolution of cognition. He explicitly recognizes that a full answer to the question of how cognition evolved is not currently available and that developing a full answer will require multiple approaches.

The next two chapters lay out rather different views. Shettleworth takes up the issue of modularity in the evolution of cognition. She reviews evidence for modularity in nonhumans and possible routes for the evolution of cognition and encourages research at the interface of biology and psychology. In contrast, in the next chapter Bitterman presents the psychological tradition originating with Pavlov and Thorndike. This is a resolutely non-modular, general process view and, in my view, also resolutely nonbiological and therefore nonevolutionary. Although the power of the associative approach is real, and the similarities among very diverse species equally real, the challenge of integrating these realities with biological approaches is not advanced by Bitterman’s approach.

The second section of the book is focused on categorization, defined as how animals categorize and represent objects and events. Bateson discusses imprinting, an excellent example of highly constrained learning. Imprinting can be viewed as a process that results in the categorization of social stimuli. Bateson argues that imprinting differs from classical or instrumental conditioning in some important ways. Bateson also offers a good discussion of the several possible meanings of the word “module” or “modular.” In the next chapter, Delius and his colleagues discuss learned stimulus equivalencies, particularly those learned through repeated reversals of value. In this procedure, a large set of

stimuli is arbitrarily divided into two sets. At the beginning of the experiment, one set is designated as rewarded and the other not, and then these designations are repeatedly reversed. This often leads to the animals learning the equivalence of stimuli within each set.

The next chapter, by Mackintosh, takes a much different tack. He first critically reviews the question of whether pigeons can learn to respond to the relationship between stimuli and concludes that there is no convincing positive evidence. He argues that there are three ways that animals can represent sets of stimuli: in terms of their absolute values, in terms of relationships between arrays (e.g., larger) and in terms of comparing relationships among one set of arrays with those among another set. He then argues that all three of these are also shown by humans. Mackintosh's chapter demonstrates how powerful the general processes approach can be, and pushes the argument for mental continuity further than most. In the final chapter in this section, Sterelny focuses on the representational abilities of primates and the idea of a theory of mind. Although this subject matter is related to Mackintosh's in that both chapters focus on the issue of how relationships among stimuli are represented, the approach is completely different, assuming the existence of mental states. A key issue for Sterelny is the distinction between detecting and tracking mental states.

The next section focuses on the issue of animals' understanding of causality. A variety of viewpoints are represented. Tomasello proposes two hypotheses about primate cognition. The first is that primates differ from all other organisms, mammalian and nonmammalian, in their ability to understand third-party social relationships, the relationships between other conspecifics. The second is that humans differ from all other organisms in their ability to understand causal and intentional relationships among others. In stark contrast, in the next chapter Dickinson and Balleine argue that goal-directed actions of rats are based on representations of action–outcome relationships.

In the third chapter in this section, Dunbar reviews the correlation between group size and neocortical size across primate species. He argues that large brain size is a consequence of the computing power required to maintain group coherence and that scaling effects of large brain size may allow apes to devote more of their cortical capacity to non-visual information processing, and reports data from behavioral experiments suggesting that apes, but not monkeys have a theory of mind. Dunbar concludes that "... apes but not monkeys, are able to understand causality" (p. 218). In the next chapter, Rumbaugh, Beran, and Hillix take a much broader definition of causality and argue that differences among species in the understanding of causal relationships, including differences between humans and other animals, are the result of quantitative changes that can, in some cases, lead to the appearance of qualitatively new cognitive abilities.

The fourth section of the book focuses on consciousness. Humphrey presents an intriguing idea that over evolutionary time, overt reactions to different stimuli have become internalized in the form of sensory 'qualia' (e.g., redness or brightness), which are the subjective qualities of sensory experience. Macphail takes a very different approach, one based on his "... inability to conceive a function for feelings ...," which seems a bit lame. He argues that the experience of feelings requires language and therefore only humans with language are capable of such experience.

Clayton, Griffiths, and Dickinson take a much more specific, empirical approach. Episodic memory includes information about what happened, where it happened, and when

it happened. The authors review a series of very clever experiments with seed-caching scrub jays that demonstrate that these birds do possess such information about their food caches, remembering not only the location of a cache but what it contains and when it was made. But does this demonstrate episodic memory? It all depends on the definition one uses. If episodic memory is defined so as to require consciousness, as some define it, then it can probably never be conclusively demonstrated in a nonhuman. In contrast, Heinrich, in his work with ravens, sees no such difficulty. He reports the results of a series of studies, which were nonexperimental in the sense that they generally lacked adequate controls. Despite this lack of control conditions, Heinrich interprets his results as demonstrating insight in these remarkable birds. Unfortunately, the evidence is far from convincing, at least to this reader.

In the final section of the book, three chapters address the particularly interesting but difficult issue of the evolution of culture. I must admit to a bias here: in the past, I have often found papers on this issue to be fuzzy-minded and uninteresting. But I found the first two chapters among the most interesting sections of the entire book. This is in part because evolutionary ideas are more integrated into these two chapters than most others.

In the first chapter of the section, Lefebvre presents an intriguing review of the cultural transmission of feeding innovations of birds. He suggests that there are three components of the nongenetic transmission of information, innovation, social learning, and cultural transmission, and that these need not covary. Richerson and Boyd present a very interesting view of the evolution of cognition. They emphasize the importance of environmental variability to the evolutionary economics of cognition, and suggest that climatological variability may be important. They also offer an approach that could successfully integrate the study of nonhuman and human cognition. They argue that the advanced cognition shown in many lineages may have been a preadaptation to the evolution of human cognitive abilities, but that human abilities probably required an additional adaptive breakthrough that may be unique to our own lineage. In the final chapter of the book, Wilson et al. argue that gossip may be an adaptation at the level of the group. The idea is interesting, but seems very opaque to direct, convincing test.

As the contents of this book make clear, a great strength of the contemporary study of animal cognition is the diversity of phenomena that have been uncovered. From associative learning to learned stimulus equivalence, from episodic memory to evidence suggesting the theory of mind, from cultural transmission to categorization, we now know that animals are capable of an array of cognitive abilities that were unimaginable in the era of Skinner-inspired behaviorism. The book also reveals the great diversity of conceptual approaches to animal cognition. Some regard the question of mental continuity between nonhuman and human animals as central, often appearing to be attempting to use the mechanisms of associative learning as proof of few (or even no) important differences. Others appear to be attempting to define the features of cognition that are unique to humans or some primates. Some take a modular approach, others emphasize general processes.

Having diverse approaches can be a source of strength for a field. Different approaches lead to different hypotheses, which can then be treated as alternatives. But in the case of animal cognition, each approach seems to exist in a vacuum, generally failing to do much more than barely acknowledge the existence of other approaches. Thus, Mackintosh can

argue that there is no good evidence that animals respond to the relationships among stimuli while Sterelny seems to assume they do; Tomasello can argue for the uniqueness of the cognitive abilities of some primates while others argue the general process view; Bitterman can dismiss Shettleworth's arguments for modularity as "airy sermon," and so forth. There is no common framework uniting the approaches, or even giving the field some organization or cohesion. It seems that part of the problem is that different approaches give rise to different questions. Little thought has been given to how to relate these questions, although Heyes tries hard to deal with this in her introductory chapter.

Another problem is revealed by this book. Given the title, one reasonably expects to find both evolution and cognition as central themes of the book. But I was struck by how little evolution there is in *Cognition and Evolution*. Only a few of the authors (most notably Dunbar, Lefebvre, Richerson, & Boyd, and Wilson et al.) seem concerned with the issues that are central to contemporary evolutionary biology. And very little use seems to be made of the methods of evolutionary biology. For example, there is no talk of mapping cognitive traits onto cladograms and very little discussion of functional analysis. There is only very limited use of comparative method based on the study of convergence and divergence. However, these omissions are characteristics of the field, not the book. The book does do a good job of giving an overview of much of what is going on in the study of animal cognition today. The challenges of more adequately integrating evolutionary and cognitive approaches is one that we all need to confront. Indeed, the major issue confronting evolutionary psychology today is probably the challenge of adapting the methods of evolutionary biology to the study of human behavior in an evolutionary context and developing new methods. Only when this is successfully accomplished will we be able to rigorously test the hypotheses that spring from the Darwinian approach.