

## COGNITION AND BEHAVIOR ANALYSIS

Cognition and behavior analysis have a continuing, close, and perhaps difficult, relationship. Both share functional origins in Darwin's promise of mental continuity. For instance, Ebbinghaus' (1885/1913) seminal study of remembering and Thorndike's (1898) exploration of the determinants of acquired behavior share an inherently functional strategy, as do Tulving's (1983) treatment of contextual specificity of retrieval and Staddon's (1983) analysis of adaptive behavior. In understanding what an individual knows, cognitive approaches nonetheless have tended to emphasize structural support for information processing. In understanding what an individual does, behavior analysis emphasizes the environmental conditions favoring the occurrence of behavior.

The kinds of behavior of interest when we speak of acquisition of knowledge define the domain of cognition: recognizing patterns, attending, remembering, imaging, problem solving, categorization, abstracting, decision making, and so on. The experimental study of cognition examines stimulus conditions determining performance. Yet the study of human cognition has paid little attention to the consequences of accurate or inaccurate performance. Behavior analysis, on the other hand, has an impressive history of success in quantifying the influence of behavioral consequences in maintaining performance. Nevertheless, behavior analysis still has considerable ground to cover in advancing an analysis of the complex stimulus control involved in cognition. The present special issue witnesses the rapid gains made in the study of complex stimulus control and the wide scope of problems associated with an empirical analysis of cognition.

The lead article in this issue, by Blough, shows how the susceptibility of visual search to reinforcement effects can be understood in terms of a memory model for discrimination processes. Following Blough's lead, future analyses of cognition will benefit from exploration of the interaction between the stimulus context for behavior and its consequences.

The fundamental problem of cognition, stimulus equivalence, is addressed by four articles that examine categorization and con-

trol by stimulus relations (Bhatt & Wasserman; D'Amato & Colombo; Wright, Cook, & Kendrick; Thomas & Schmidt). These papers explore different methodologies to ask about the conditions favoring categorization or relational learning in nonhumans. Three papers advance behavioral analysis of stimulus equivalence and relational learning in humans (Sidman, Wynne, Maguire, & Barnes; Hayes, Thompson, & Hayes; Lowenkron).

The study of memory has occupied a central position in the analysis of human cognition. Contributions from both cognitive and behavioral approaches to nonhuman remembering are evident in two papers on the analysis of bias and directed forgetting (Fetterman & MacEwen; Grant). In a theoretical article, Wixted contributes a functional analysis of remembering based on delay reduction. Wixted also reviews Kendrick, Rilling, and Denny's *Theories of Animal Memory* and raises the issue of whether theories of remembering benefit from the use of cognitive terminology.

The study of cognition is extended in papers that include a novel analysis of intention and temporal discrimination (Allen & Lattal; Shimp, Sabulsky, & Childers; Myerson, Hale, Hirschman, Hansen, & Christiansen; Cheng & Roberts). In some cases, papers in the special issue incorporate elements of theorizing from traditional views of cognition in humans and nonhumans, whereas in others, a distinctly behavioral analysis of cognition is advanced.

Theoretical developments in the area of direct perception or ecological psychology (J. J. Gibson, 1979) share much in common with the behavioral analysis of stimulus control. Ecological analyses have inspired new empirical directions such as the study of reaching, wielding, throwing, tracking, and catching. An instance is the paper by Rilling and LaClaire, which explores the pigeon's performance of tracking moving targets. The ecological approach advocated by J. J. Gibson (1979) and E. J. Gibson (1987) elaborates the analysis of stimulus control by quantifying the nature of information, specifying the mutuality between individual and environment, and tracing the development of perception through attunement to information. This approach is illustrated by Turvey, Solomon, and

Burton's theoretical article on the haptic perceptual system. Their research program identifies the invariants that support knowledge of the properties of hand-held objects. Such analyses provide new insights for the behavioral study of complex stimulus control.

Another major direction for future research is signaled by Kehoe's theoretical article on connectionist modeling, a topic that is preeminent in cognitive science and one discussed recently in this journal (Donahoe & Palmer, 1989). Kehoe's article demonstrates the important role of behavioral principles in artificial intelligence and the utility of connectionist approaches in modeling adaptive behavior.

In sum, the Special Issue on the Experimental Analysis of Cognition points to several new directions for research on the complex stimulus control of behavior, the interaction between stimulus conditions and behavioral consequences, the analysis of conditional discriminations and stimulus equivalence, the ecological analysis of invariant information, and connectionist modeling. Together with the fine empirical research on a wide range of aspects of cognition reported here, these new directions promise an active future for the experimental analysis of cognition.

K. Geoffrey White  
Dianne McCarthy  
Edmund Fantino

Editors for Special Issue

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