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COGNITION AND BEHAVIOR ANALYSIS: A REVIEW OF RACHLIN'S JUDGMENT, DECISION, AND CHOICE[1]

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As Rachlin notes in his preface, efforts to reconcile behavioral and cognitive research are not new. Previous attempts at reconciliation, such as those of Tolman and Brunzwik, started from a single set of facts from which all others could be derived. Instead, Rachlin's approach takes "an historical, contextual view of method and theory in two apparently opposed areas, juxtaposes them and tries to construct a coherent framework for them in which each research program can be seen as background to the other" (p. x). This is a lofty and important aim: Interdisciplinary approaches can help foster a rich contextual perspective from which all of the disciplines may profit.

Behavior analysts have become aware of the importance of interdisciplinary work. The 1980s saw increasing attention directed to the relation between behavior analysis and biological factors (e.g., Fantino & Logan, 1979; Skinner, 1984; Staddon, 1983). *JEAB* recently devoted an entire issue to this relation (November 1988; see Hursh, Lea, & Fantino, 1988). The 1990s may well witness a comparable burgeoning of interest in the relation between cognition and behavior analysis. Because both share functional origins in Darwinian conceptions of mental continuity, an integration of the two approaches is apt historically (see Catania, 1973, for a discussion). But in their preface to this journal's special issue on cognition and behavior analysis, White, McCarthy, and Fantino (1989) note that in attempting to understand an individual's knowledge, cognitive approaches have emphasized structural, and not functional, support for information processing, whereas in appreciating an individual's behavior, behavior analysis focuses on the environmental conditions fostering behavior. As White et al. note:

> 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. (White et al., 1989, p. 197)

A book that presents the cognitive and behavioral viewpoints succinctly would be extremely useful to researchers from either persuasion in becoming conversant with the theory, methodology, and findings of the other. A book that succeeds in framing an effective synthesis of the two areas would constitute a major and potentially far-reaching contribution. As difficult to accomplish as the first goal is (for a given author), accomplishing the second is considerably more challenging. In our opinion Rachlin succeeds admirably

[1] Rachlin, H. (1989). *Judgement, decision, and choice: A cognitive/behavioral synthesis.* New York: W. H. Freeman.

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in the first objective and makes progress in achieving an integration of the behavioral and cognitive viewpoints.

Rachlin begins with a chapter on historical background, an area in which he has long been a consummate and engaging scholar (e.g., Rachlin, 1970). Following this introduction he reviews the areas of probability, judgment, and decision, largely from a cognitive perspective. These three chapters constitute an interesting and thoughtful overview of cognitive decision making. The next four chapters review reinforcement and punishment, choice, self-control, and economics and choice. Because these are Rachlin's primary areas of expertise, the fact that they are excellent treatments is unsurprising. It is not until the final chapter, "Decision and Choice Reconsidered," that he moves systematically to integrate the cognitive and behavioral viewpoints "into a single, more global (and, we hope, more powerful) viewpoint" (p. 247). His stated aim is to "convince readers that cognitivism and behaviorism are entirely compatible ways to view the human mind" (p. xii). As an example he imagines going to the movies to see the late Laurence Olivier in *Richard III*. He assumes we would all agree that "there must be some difference between the thoughts and emotions of a real person (Richard III) living through a series of events and an actor (Olivier) behaving as though he were living through those events. What is the nature of that difference?" (pp. xii–xiii). Rachlin answers that, for the cognitivist the difference is one between their internal states, whereas for the behaviorist the "emotions felt by the two men differ . . . by virtue of their differing behavior at other times and places" (p. xiii). Rachlin concludes that the two approaches are complementary (as each is incomplete). Later he notes:

> Thus, while the behavioral theorist considers the choice process by looking at its operation as a whole (as a driver might view a car), the cognitive theorist considers the decision process by looking at its parts and their interactions (as a mechanic might view a car). Just as the driver's and the mechanic's views of a single car must be compatible with each other, so too must be the behaviorist's and cognitivist's views of a person's choices. In other words, cognitive decision theories and behavioral choice theories are complementary (or at least not contradictory) explanations of the same choice behavior. (p. 239)

As befitting a constructive attempt at a harmonious synthesis, Rachlin does not pass judgment on the relative usefulness of the behavioral and cognitive perspectives. He does, however, make comparisons between them. For example, in Chapter 2, the discussion of the relationship of probability to choice juxtaposes the cognitive view—that behavior is guided by internal representations of objective probabilities—with the behavioral—that the probabilities themselves, in the form of rates of occurrence of particular events, guide behavior. Similar comparisons are made for explanations of base-rate errors (Chapter 3) and the effects of contingencies on choice (Chapter 10). To the behaviorist the implications are clear. Complicated theorizing about internal states can be avoided most often without significantly affecting the ability to predict future behavior.

Given that cognitive phenomena may be translated fairly readily into more parsimonious behavioral equivalents, one might conclude that the behavior analyst need not be cognizant of the cognitive. This is not Rachlin's conclusion, however, nor is it ours. On the contrary, Rachlin's book brings to our attention some important phenomena that behavior analysts have largely ignored. These phenomena deserve a behavioral analysis, both theoretical and empirical. But the phenomena would not have been uncovered without the research of cognitive psychologists. As one of us has noted previously, ". . . basic research in behavior analysis has much to gain by contemplating our research issues in the context of related perspectives such as the biological and the cognitive. Phenomena addressed in these areas have relevance for our own work, and we are often in an optimal position to make important contributions to the analysis of these phenomena" (Fantino 1988, p. 1).

Rachlin's book serves as a lucid introduction to several of the important phenomena reported by Kahneman and Tversky (e.g., Kahneman, Slovic, & Tversky, 1982; Kahneman & Tversky, 1979; Tversky & Kahneman, 1981; Tversky, Sattath, & Slovic, 1988) and their colleagues, including useful discussions

of base-rate errors, framing, and prospect theory. For example, Rachlin presents some of Tversky and Kahneman's (1982) examples involving base-rate errors. In one problem, subjects are told that a cab was involved in a hit-and-run accident one night and that a witness identified the cab as blue. Given that 85% of the cabs in the city are green and only 15% are blue (the "base rate") and also given that the witness, when tested for reliability, identified each one of the two colors correctly 80% of the time and incorrectly 20% of the time, what is the probability that the hit-and-run cab was blue? Although it can be shown (Rachlin, p. 55) that the probability is less than .5, subjects typically equate the probability with the reliability of the witness, that is, at .8, a value apparently unaffected by the base rates of the two cars (i.e., their relative frequency in the city). Such effects could be assessed in the behavior analyst's laboratory. For example, a pigeon could be presented with two sources of information in a delayed-matching-to-sample task. On 90% of the trials the sample would be a 1-s presentation of a green light on the center key of a three-key display; on the other 10% the sample would be a 1-s presentation of a blue light. Twelve seconds later the comparison stimuli would appear. These would be the same blue and green lights but on the side keys. Correct pecks (i.e., pecks to the comparison that matched the previous sample) would be reinforced with grain. On occasional trials a cross would appear on one of the side keys near the end of the delay interval. On 80% of the trials this cross would appear on the key on which the correct comparison stimulus would appear at the end of the delay interval. On the other 20% of the trials, however, the cross would appear on the key on which the incorrect comparison was arranged. Thus, the cross cue would be 80% reliable, corresponding to the witness in the cab example. After extensive training, unreinforced probe trials would occur, on which the sample would not appear. On half of the these probe trials the comparison stimuli would appear following the delay interval. These trials permit the assessment of base rates alone (90% vs. 10% on training trials, favoring green). On the other half of the probe trials a cross would appear on one key just before the onset of the comparison stimuli. On trials in which the cross preceded blue would the pigeon peck blue (following the cross cue) or green (following base rates)? However the results from this experiment turn out, there is evidence from the search-image formation literature suggesting that base rates can be important. Repeated encounters with rare prey types increase their detectability (e.g., Pietrewicz & Kamil, 1981); however, the implications of this evidence are controversial (see Fantino, in press, for a review).

Another type of base-rate error, also reported by Tversky and Kahneman (1982), is the "conjunction effect." This effect first came to our attention in an article on sports statistics in the *New York Review of Books* (Gould, 1988), an indication of how successful these cognitive researchers have been at disseminating their message. Subjects demonstrating the conjunction effect report that the conjunction of two events is more rather than less likely to occur than one of the events alone. This example of illogical reasoning best can be illustrated by examples, two of which are presented below (adapted from Tversky & Kahneman, 1982, p. 92):

> Bill is 34 years old. He is intelligent, but unimaginative, compulsive, and generally lifeless. In school, he was strong in mathematics but weak in social studies and humanities.
>
> Please rank order the following statements by their probability, using 1 for the *most* probable and 8 for the *least* probable.
>
> Bill is a physician who plays poker for a hobby.
> Bill is an architect.
> Bill is an accountant.
> Bill plays jazz for a hobby.
> Bill surfs for a hobby.
> Bill is a reporter.
> Bill is an accountant who plays jazz for a hobby.
> Bill climbs mountains for a hobby.

> Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.
>
> Please rank the following statements by their probability, using 1 for the *most* probable and 8 for the *least* probable.
>
> Linda is a teacher in elementary school.
> Linda works in a bookstore and takes Yoga classes.

Linda is active in the feminist movement.
Linda is a psychiatric social worker.
Linda is a member of the League of Women Voters.
Linda is a bank teller.
Linda is an insurance salesperson.
Linda is a bank teller and is active in the feminist movement.

The only statements that matter are the third, fourth and seventh for Bill and the third, sixth, and eighth for Linda. Logically, Bill is at least as likely to play jazz for a hobby (fourth item) as he is to play jazz for a hobby *and* happen to be an accountant as well (eighth item). Yet Tversky and Kahneman's subjects ranked "Bill plays jazz for a hobby" as much less likely (mean rank of 6.2 among the eight items) than "Bill is an accountant who plays jazz for a hobby" (mean rank of 3.6; "Bill is an accountant" is, unsurprisingly, the highest ranked with a mean of 1.1). Similar results were obtained for Linda, who was seen as more likely to be a bank teller active in the feminist movement (mean rank: 4.1) than simply a bank teller (mean rank: 6.2). The robustness of this effect was demonstrated in subsequent manipulations with both within-subjects and between-subjects designs, with statistically naive and sophisticated subjects and even when the logical relation between the critical items was made transparent by not embedding them in a set of eight items. Could the illogical behavior of most (over 80% even among the statistically sophisticated) of Tversky and Kahneman's subjects be attributed to the "demand characteristic" of the instructions? As Rachlin notes ". . . language is a discriminative stimulus that signals the presence of a contingency. If an experimenter is telling a subject to do something, the experimenter's language determines the contingency that forms the context for the subject's act" (p. 181). Perhaps, we reasoned, if the instructions provided discriminative stimuli favoring logical responses the conjunction effect would be eliminated. To assess this we asked a group of University of California–San Diego students the same questions as above (replication group) and three other comparable groups the same or altered questions with the following sentence added before each set of eight items: "Your judgments should be made in terms of their probability and not simply in terms of whatever intuitive appeal is generated by the description above." For Group 2 this sentence was the only difference from the replication group. In addition, for Group 3 the logical relations were spelled out even more clearly by changing the key item "Bill plays jazz for a hobby" to "Bill plays jazz for a hobby and may or may not be an accountant" and the key item "Linda is a bank teller" to "Linda is a bank teller and may or may not be active in the feminist movement." Perhaps subjects in the basic group were assuming that the statement "Bill plays jazz for a hobby" implied that he was not also an accountant (and that "Linda is a bank teller" implied she was not also in the feminist movement). If so, our changes should countermand this assumption and facilitate logical responding. Finally, for subjects in Group 4, we changed the same key items in a different way, but this time to make it more likely that subjects' responses would favor the conjunctive item. "Bill plays jazz for a hobby" now became "Bill plays jazz for a hobby and is not an accountant" and "Linda is a bank teller" became "Linda is a bank teller and is not active in the feminist movement." Subjects in this group can respond in keeping with the character descriptions without violating the conjunction rule. Were these changes sufficient to alter the prevalence of Tversky and Kahneman's conjunction effect in the direction of more logical responding? Results from our UCSD students (with n of 8 to 14 subjects in each of the four groups) are clearly negative. In fact the conjunction effect was *least* prevalent in the direct replication of their study (mean percentage of subjects in each of the four groups showing the conjunction effect: 64%, 86%, 94%, and 84%). Surely college undergraduates are capable of logical thinking. Whether they demonstrate it, then, must depend upon aspects of stimulus control or rule-governed behavior that are not clear at present. The consequences of subjects' responses may also prove to be a fruitful area for analysis.

In the chapter titled "Decision and Choice Reconciled," Rachlin reminds us that, because behaviorists view all learning as functional, it is "logical" only when logic subsumes function. And, as Skinner (1966) first pointed out, subjects do not necessarily react to de-

scriptions of contingencies in the same way as they would react to actual contingencies. Giving more detailed instructions is not always the answer. In our case it actually worsened subjects' performance. Perhaps subjects performing "paper and pencil" tasks like those given them by Tversky and Kahneman (1982)—and ourselves—fail to respond logically partly because their responses have no real consequences.

Some support for this view comes from an examination of the work of other investigators. For example, Mazur and Logue (1978) were able, using a fading procedure, to train pigeons to wait for a larger reward (a more "logical," or at least optimal, response). Nor have cognitive psychologists failed to notice this. Hammond, Stewart, Brehmer, and Steinman (1975) demonstrated that the sensitivity of human subjects to base-rate information could be increased with appropriate feedback and conditions of presentation.

As Nisbett and Ross (1980) point out, in daily life most of people's inferential errors have no serious behavioral consequences. In fact, using erroneous inferential rules may even be reinforced inadvertently when two errors cancel each other out and lead to a rewarding outcome. Furthermore, they state, the low-cost effort of using intuitive, as opposed to logical, strategies offsets some of their disadvantages. Rachlin also makes this point frequently and gives examples of situations in which a less logical approach suffices for people under some circumstances ("satisficing").

How can the study of human subjects' decisions be made more amenable to behavioral analysis? The use of computers could provide an alternative to unrealistic paper-and-pencil tasks. For example, Case, Ploog, and Fantino (1990) have used a modified version of the computer game "Star Trek" to assess college students' preferences for different types of information. In future work, subjects could experience the usefulness of different types of information and of different logical strategies over a number of sessions. In such a dynamic, interactional setting the effects of using "satisficing" and more strictly "optimal" strategies on their future use may be assessed. For example, does a history of reinforcement for the use of intuitively appealing (but illogical) strategies diminish the likelihood of logically consistent behavior in situations in which such behavior is required for reinforcement?

Rachlin's discussion of economic theory should be of interest to both cognitively and behaviorally oriented students of choice. For example, he devotes considerable attention to the issue of the substitutability and complementarity of goals. This is a topic that has already inspired some elegant behavioral research that Rachlin does not take the time to describe (although he is a major contributor in this area). A basic approach is to restrict one activity (or access to one commodity) and observe the change in alternative activities (or commodities). For example, Bernstein (e.g., Bernstein & Ebbesen, 1978) has restricted the activity of human subjects and assessed the rate of occurrence of alternative activities. Those that increase may be said to be substitutable for the restricted activity; those that decrease may be said to be complementary. Hursh (1978, 1984; personal communication) has restricted activities indirectly by raising the cost (or "price") of an activity (i.e., responding maintained by one commodity) and observed any change in responding maintained by other commodities. In his most recent (and unpublished) work he has raised the price of food and looked at responding maintained by alternative water sources. If the alternative source is simple water, increasing the price of food decreases responding maintained by water, showing complementarity. However, if the alternative source is water flavored with saccharin then there is no evidence of complementarity. Instead, as the price of food increases responding maintained by water remains constant to a point but then actually increases, showing substitutability. Moreover if *both* water sources are available as the price of food increases, responding maintained by water decreases (complementarity) while responding maintained by the sweetened water increases even with small increases in the price of food; that is, the substitutability is amplified.

The main strength of Rachlin's book is the opportunity it affords researchers of either a behavioral or cognitive persuasion to become familiar with the application of both perspectives to problems of mutual interest. This

opportunity, if seized, should lead to an enriched appreciation of human behavior.

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