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IMPLICIT LEARNING OF BASE RATES Commentary on Koehler on Base-Rate

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Abstract

Some of the circumstances in which base rates appear to be used well (e.g., when learning is done in a trial-by-trial manner and when testing conditions mimic learning conditions) may be those in which the implicit learning system is at work. Subjects may therefore perform better on more ecologically valid tasks.

Keywords

Base rate fallacy, Bayes' theorem, decision making, ecological validity, ethics, fallacy, judgment, probability.

1. I began a recent lecture by stating: "When I first became interested in psychology, it was widely believed that rats were quite good at certain kinds of reasoning, whereas humans were quite bad at (what seemed to me to be) similar kinds of reasoning. I thought I would go into psychology and try to show that humans were at least as smart as rats." The kind of reasoning I was talking about was reasoning involving contingency or covariation and, in particular, the use of base rates in such reasoning.

2. In his target article, Koehler (1993) accurately points out that the extreme version of the base-rate fallacy is a fallacy: It is not true that people totally ignore and are never influenced by base rates. In fact, as he notes (2.2.3, 3.5; see also Holyoak & Spellman, 1993), the extent to which base rates are used appears to depend on the characteristics of the problem at hand. Base rates seem to be used more accurately when the domain or the experimental process suggests that a statistical kind of answer is warranted (e.g., Gigerenzer, Hell & Blank, 1988). Note that this resembles the kinds of situations in which subjects are more likely to invoke appropriate statistical explanations in general, such as the law of large numbers or regression to the mean (Nisbett, Krantz, Jepson & Kunda, 1983). Base rates also seem

to be used more accurately when subjects are exposed to them in a trial-by-trial manner, when they are derived from experience rather than being presented as mere summary statistics (e.g., Christensen-Szalanski & Bushyhead, 1981; Manis, Dovenalina, Avis & Cardoze, 1980), and when questions are phrased in terms of frequencies rather than probabilities (see Gigerenzer, 1991, for a review).

3. Holyoak and Spellman (1993) were struck by the fact that humans were thought to be good at frequency detection (Hasher & Zacks, 1984) but bad at using base rates. These results seemed rather paradoxical, since base rates are merely relative frequencies. The encoding of event frequencies, however, is often considered to be based on an automatic or "implicit" process that takes place largely without awareness. There is a burgeoning literature on implicit learning (e.g., see American Psychologist, 47(6); Seger, in press; Shanks & St. John 1994). Holyoak and Spellman defined implicit knowledge as follows: "It is (a) knowledge about covariations in the environment, (b) learned by exposures to stimuli exhibiting the covariations, (c) obtainable without intention or awareness (although in some cases similar knowledge might be obtained explicitly), and (d) demonstrated by improved performance on tasks that seem to require thinking (e.g., generalization and prediction); but which does not have a fully explicit representation in that (e) it is not fully verbalizable and (f) it is not manipulable in the sense that it cannot be re-represented explicitly to serve as input to other procedures (p. 278)." The experiments in which base rates are most underutilized involve nothing at all implicit: they typically involve both a stated presentation of one summary base rate and a test consisting of verbal questions about probabilities. Perhaps, however, the experiments that involved trial-by-trial learning reveal better use of base-rate information because they invoke the implicit learning system.

4. Stronger evidence for the implicit learning of base rates comes from the learning phases of categorization experiments. In typical category- learning experiments, subjects are presented with individual exemplars of the categories; they are asked to make category judgments (based on the relevant features present) and then are given corrective feedback. Gluck and Bower (1988; see also Estes, Campbell, Hatsopoulos & Hurwitz, 1989), for example, showed subjects 250 learning trials in which combinations of four "symptoms" were displayed, then subjects decided which one of two possible diseases were present and received feedback on their decision. The two diseases occurred with different relative frequencies (.75 and .25), and the symptoms were probabilistically related to the diagnosis. Subjects' performance on the last 50 learning trials correlated highly with a pattern-probability matching strategy ($r = .99$), indicating that they had learned the base-rate occurrences of the diseases. When asked verbal questions at the end of the experiment, however, subjects showed misuse of the base-rate information.

5. Holyoak and Spellman (1993) took this as evidence to suggest that there are two components to base-rate use: (1) acquisition, which, in a trial-by-trial format, can be done quite accurately by the implicit learning system; and (2) access, which, depending on the type of test, might also involve either the implicit or explicit learning system. When acquisition and the access test both tap implicit knowledge (e.g., during learning/prediction trials), subjects generally use base rates well; when the tasks are verbal and explicit, subjects are more likely to ignore base rates unless "reminded" to use them by the methods suggested above.

6. In drawing out the implicit/explicit distinction, Reber (1993) argues that the implicit learning system is evolutionarily older than the explicit system. Although the Gluck and Bower (1988) experiment involves an artificial laboratory task, it seems to be more analogous than the standard Kahneman-and-Tversky-style base-rate experiments to the kind of use of base-rate information that would have been relevant in human evolutionary history. That is, whatever was learned was learned by the observation of many stimulus events, and competence in using that acquired knowledge would not be demonstrated by reporting to an experimenter, but rather would be evinced by responding appropriately to that same stimulus when it next appeared in the environment. (Reber also suggests that implicit systems should show cross-species commonalities. When the context of learning and testing match and tap implicit knowledge, I bet humans perform as well as rats; to my knowledge, no one has ever tried the opposite and asked a rat to verbally assess the probability of a shock given a tone.)

7. All of this suggests that if Koehler's advice is heeded and the study of base-rate use turns to more ecologically valid tasks, the base-rate fallacy will be shown to be even more of a fallacy when applied to these kinds of tasks, which are likely to engage the implicit learning system.

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