

Kendler H H & Kendler T S. Vertical and horizontal processes in problem solving.
Psychol. Rev. 69:1-16, 1962.

The authors proposed a model that postulated two modes of behavior, associative and mediational, to explain the behavior of rats and college students in a discrimination-shift task involving either a reversal or extradimensional shift. The model also made assumptions about the operation of symbolic, perceptual, and motivational processes in specific problem solving tasks. A variety of data, including human developmental changes, were presented in support of the model. [The *Science Citation Index*® (SCI®) and the *Social Sciences Citation Index*TM (SSCITM) indicate that this paper was cited a total of 337 times in the period 1962-1976.]

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"This paper proposed a pretheoretical model to guide a research program, which began in 1954 and which was primarily concerned with understanding developmental changes in human problem-solving. The program was initiated by my inability to resist an offer of governmental support for research in human problem-solving at a time when I was deeply immersed in theoretical problems of animal learning. My initial attempts to investigate human problem-solving failed to yield any exciting leads until some data suggested that Kenneth W. Spence's famous discrimination-learning theory of animal organisms could serve as a good jumping-off place for excursions into human problem-solving. According to this theory, in a discrimination-shift problem an extradimensional shift should be easier to execute than a reversal shift; a prediction that was later confirmed with rats by one of my Ph.D. students. Before that, I and another investigator independently discovered that college students found a reversal shift easier. 'So what!' was a typical reaction to the discrepancy between the behavior of rats and humans. Is it surprising that rats and hu-

mans behave differently or that Spence's formulation is irrelevant to human behavior?

"At this point my wife became my research collaborator and it might be mentioned that there is no greater testimony to the sturdiness of our marriage than that it was able to withstand the stress and strain of our theoretical and methodological disputes. We perceived the discrepancy between the behavior of rats and humans more as a challenge to be explained than merely as evidence to be accepted. The findings posed two significant questions: (1) How can the difference between the behavior of rats and college students be conceptualized? (2) How would organisms 'in between' rats and college students behave?

"In answer to the first question it was postulated that rats behaved in a discrimination-shift study in a manner similar to the conditioning (associative) model suggested by Spence's theory; stimuli, defined in terms of their physical attributes, became directly linked, in a figurative sense, to the choice responses. College students, in contrast, behaved according to a mediational model; incoming stimulation was transformed (processed) into some symbolic representation that guided subsequent behavior. The second question was answered by an ontogenetic analysis of discrimination-shift behavior. The results supported the notion that in discrimination-shift studies the probability that a child's behavior will fit the conditioning or mediational model will depend on his age; the younger he is the more likely it is that he will behave according to the associative model, whereas the older he is the more likely it is that his performance will be consistent with the mediational model.

"This paper has been frequently cited because it (1) helped expand the empirical realm of theories of learning, particularly in the direction of developmental changes in problem solving, (2) offered a simple and effective experimental methodology to investigate such problems, (3) posed a variety of interesting theoretical questions about the associative and mediational modes of behavior as well as the manner in which the transition is made between them, and (4) justified a theoretical perspective that encompasses both human and infrahuman organisms.