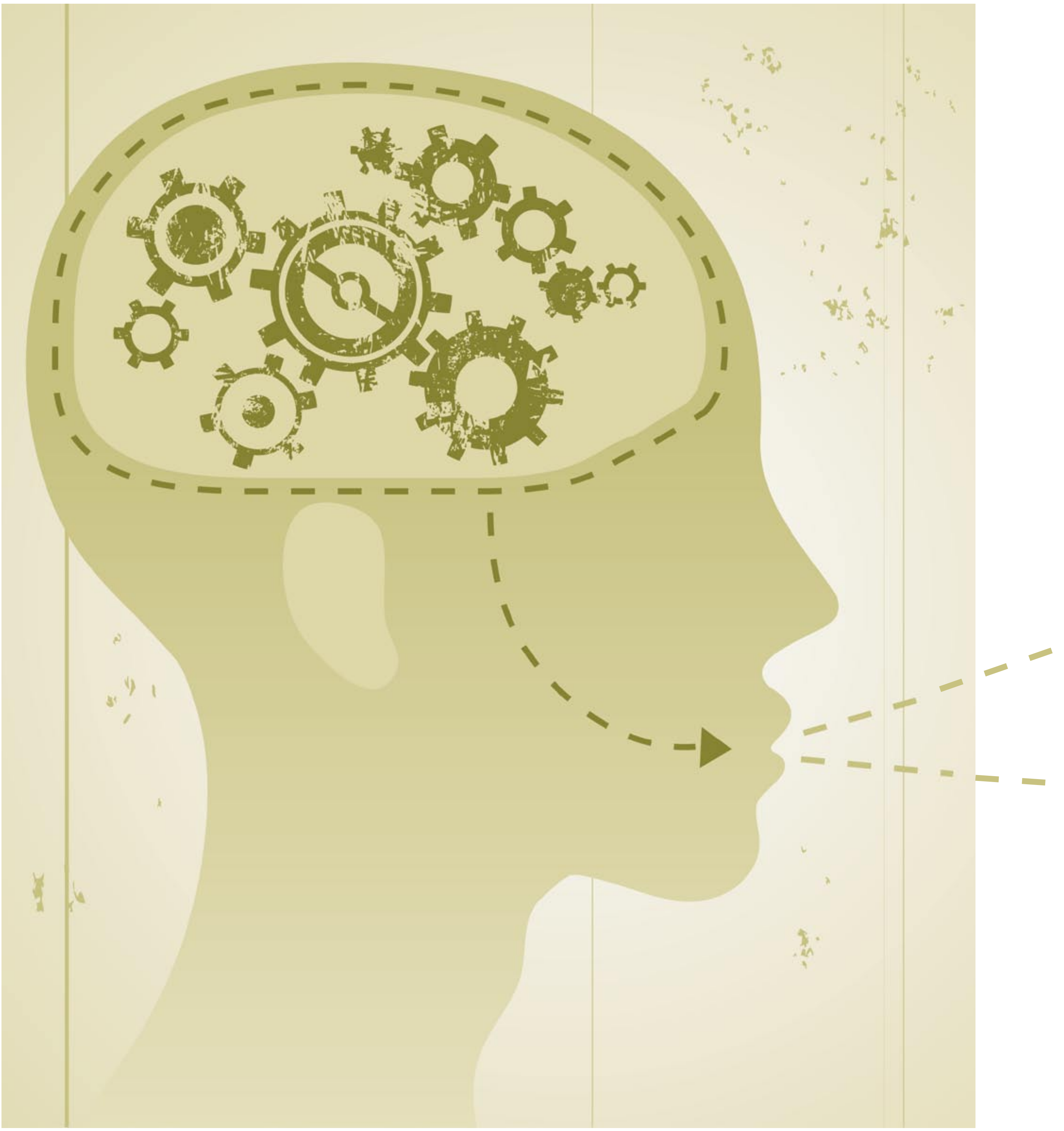
Beyond all reason

HUMAN LEARNING, BEHAVIOR MIGHT BE MORE MECHANISTIC THAN RATIONAL



People might have a lot more in common with Pavlov's dogs than any of us would care to think. Learning might be a far more mechanical, even automatic, process than most of us — most notably modern-day educators — dare to imagine. And even if a student can't recite the times tables, that doesn't mean he didn't "learn" them.

These rather startling assertions only hint at the profound implications of a growing body of work by Ralph R. Miller, distinguished professor of psychology. Miller's work, which for more than 37 years has earned continuous federal sponsorship, deals both with animal conditioning and human decision making. It is opening new windows on understanding the complex cognitive processes involved in acquiring, retrieving and using information to make decisions. And it is calling into question the common belief that human behavior is a function of rational thought.

"We don't think the view of the rational mind as the basis of behavior is illuminating," Miller explains. And even if there is such a thing as rational thought, there is certainly no good explanation for how exactly it works.

In fact, assertions about the rational mind, Miller says, often amount to variations on the Homunculus Argument, which attempts to explain thought and behavior by positing that we have in our head an agent capable of rational thought — essentially a "little person," or homunculus, who helps us make choices and reason our way through life. Most psychologists and philosophers have disavowed such accounts on the premise that to explain rational thought in such a way is circular reasoning. Rather than defer to our ability to reason, Miller studies the cognitive mechanisms and processes underlying reasoning in humans and animals.

Miller is an internationally prominent experimental psychologist whose current project, “Associative Determinants of Performance,” is funded by a five-year, $1.4 million research grant from the National Institute of Mental Health.

But he is probably best known for establishing the foundation of temporal coding theory. While the name sounds off-putting, it is essentially a theory rooted in the proposition that the human mind is mechanistic rather than rational — that what goes on in it can be explained through physical and biological causes, many of which hinge on the timing of sensory input we receive.

In essence, temporal coding theory suggests that in Pavlovian conditioning or associative learning, the timing of stimuli in connection to one another is not just important but integral to the association that results. In other words, receiving the food soon after the bell goes off doesn’t just catalyze learning. The contiguity or timing of these two events in relation to each other is actually encoded as part of the association. This theory is a radical departure from traditional views and has helped over the past two decades to change the direction of research in the field of associative learning.

Miller’s theory also takes another dramatic step away from traditional thinking concerning the role of rewards and punishments, and asserts that if the timing between the conditioned response and the unconditioned response is close enough, nothing more is needed for an association to be made. Good contiguity, it says, is sufficient for the formation of an association.

It also asserts that temporal coding is critical in determining what behavior a cue will elicit, or if and when the behavior is elicited, and perhaps more important, that temporal information from independent episodes can be integrated to effectively create an association between two disparate events, events that were never directly paired.

For example, if rats learn that pressing a lever produces a tone and, subsequently, with the lever removed, hear the tone right before they are fed, as soon as the lever is reintroduced, they press it with radically increased frequency. Presumably, they’ve associated the tone with the delivery of food and have arrived at the conclusion that the lever causes the tone and that pressing it will get them more food, even though there was no direct association between the food and the lever. This is just one of the many experiments in which Miller has explored how humans and rats attribute causality, or the relationship between cause and effect. While rats differ from humans in their approaches to complex tasks, there is little difference across the species in terms of such basic processes as influence-associative learning and causal judgments, he said.

Rats, of course, cannot tell us how they think. But by watching how they attempt to control effects by manipulating potential causes, we can draw conclusions about their perception of causality. And, as it turns out, rats, as in the situation above, behave in ways that are completely analogous to humans: both can arrive at causality without trial-and-error training. Because coming up with different explanations for such analogous behavior just doesn’t fly from a scientific perspective, Miller said he is forced to conclude either that rational thought has little to do with rat or human behavior, or that rational thought processes are also widespread among non-human species.

Seen through the lens of his theory, results such as these begin to explain how something that might appear to involve a rational thought process is actually the result of purely mechanistic processes. Miller’s opinion is that the rats aren’t “reasoning out” the connection between the lever and the food, but are instead quite mechanistically calling upon temporal information from two independent learning episodes to create a meaningful association between events that were not directly paired.

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Unlike most theories of associative learning, temporal coding theory also maintains a clear distinction between learning and the behavioral expression of that learning. Miller believes, in fact, that learning itself is ultimately an automatic process. He likens the mind to a garbage pail.

"Everything goes into it, and the real questions are about the conditions under which we are going to be able to retrieve and make use of things," he said.

"The problem is not so much about what you learn, but rather, what you can retrieve and how you use the information." Again, our mathematically challenged student might have "learned" the times tables just fine, thank you, but for a variety of reasons might not be able to access that information.

Miller's research also distinguishes between information processing that occurs during training and processing that occurs at test. His findings here contradict and reverse what he describes as the general view in academia that initial learning is a complex chore for an organism and that once something is learned, translating that information into behavior later on is relatively trivial. He thinks instead that learning is relatively simple, and that complexity arises in retrieving and using that which has been "encoded."

"The conditions of testing are absolutely crucial to what is going to be retrieved," Miller says, "with much better recall produced by matching conditions of retrieval to conditions of training.

"This is fine," he adds, "if you can control conditions of retrieval as you can in a laboratory. But in the real world, we don't control them to any great extent. Hence, we should try to match the conditions of training to the conditions of retrieval, as imposed by real-world situations."

In successful 19th-century classrooms, Miller said, the focus was on teaching students by introducing them to problems drawn from the real-world experiences they would encounter when they left school. A math test, for instance, might ask them to determine, based on the measurements of a wagon, the optimal size of hay bales to be transported in it.

Today, teaching often takes a more abstract approach, but Miller's research suggests that educators who focus on trying to teach students to "think" might be misguided. There might be a small, highly elite part of the population that can benefit from training with abstractions, he said, but the vast majority of people learn better when training is specific to a real application.

"We tend not to generalize from how to solve one task to being able to solve parallel tasks that are superficially quite different," he said.

Teaching to the test, which is another common approach these days, could, according to Miller's research, be a better strategy — but only if the tests are based on real-world problems. Medical and business schools that are increasing the use of case studies to train students by exposing them to real-life problems and conditions are, according to his research, on the right track. ■