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Fuzzy-trace theory and lifespan cognitive development

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A R T I C L E   I N F O

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A B S T R A C T

Fuzzy-trace theory (FTT) emphasizes the use of core theoretical principles, such as the verbatim-gist distinction, to predict new findings about cognitive development that are counterintuitive from the perspective of other theories or of common-sense. To the extent that such predictions are confirmed, the range of phenomena that are explained expands without increasing the complexity of the theory's assumptions. We examine research on recent examples of such predictions during four epochs of cognitive development: childhood, adolescence, young adulthood, and late adulthood. During the first two, the featured predictions are surprising developmental reversals in false memory (childhood) and in risky decision making (adolescence). During young adulthood, FTT predicts that a retrieval operation that figures centrally in dual-process theories of memory, recollection, is bivariate rather than univariate. During the late adulthood, FTT identifies a retrieval operation, reconstruction, that has been omitted from current theories of normal memory declines in aging and pathological declines in dementia. The theory predicts that reconstruction is a major factor in such declines and that it is able to forecast future dementia.

Theories perform two principal functions in science. They explain and predict, and their accomplishments in both arenas serve as criteria for evaluating how successful they are. In psychology, the explanation function is well understood: Explanations are collections of principles or assumptions that tell us why our data are as they are. How the explanation function is implemented as an evaluative criterion is also well understood. It involves a trade-off between adequacy and parsimony; that is, theories are judged to be more successful as they explain larger numbers of findings with the same

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assumptions, as they explain the same findings with smaller numbers of assumptions, or both. This trade-off can be shown visually, in a vector space that is generated by an adequacy dimension and a parsimony dimension, with the explanatory success of individual theories being vectors in that space. An example is shown in Fig. 1, where adequacy (number of findings explained) is the ordinate, parsimony (number of assumptions made) is the abscissa, and two theories appear as vectors (Theory A and Theory B). To find a theory's adequacy score, its vector is projected over to the ordinate (horizontal dotted lines), and to find its parsimony score, its vector is projected down to the abscissa (vertical dotted lines). In the example in Fig. 1, Theory A is superior to Theory B because A's adequacy score (number of findings explained) is higher, and its parsimony score (number of assumptions made) is lower. It is easy to see that any theory above the diagonal is superior to any theory below it because their adequacy and parsimony scores will differ in just this way.

The prediction function is less well understood, and it is not widely grasped that prediction is more crucial than explanation. Prediction itself is merely a theory's ability to forecast new effects on the basis of its assumptions. The reason that predictive power is the more critical of the two yardsticks is that it is always possible to formulate competing explanations of the same existing phenomena that are not readily distinguishable on the basis of adequacy/parsimony trade-offs. Readers who remember their first psychology course will recall that most of the prominent phenomena that they studied (e.g., heritability of IQ, implicit racism, suggestibility of eyewitness memory, heuristics and biases in decision making) seemed to be accompanied by multiple theories that did comparable jobs of explaining them. That is the standard situation in any science, even the most advanced ones, because an explanation is just a *model* of reality, not reality itself. Of course, a model's mechanisms are motivated by evidence, but it is always possible to model reality with different assumptions. Prediction is how science escapes this *cul de sac*.

When two or more theories explain the same facts and do not differ markedly in the complexity of their assumptions, their relative predictive power refers to their respective abilities to forecast new and interesting findings. A predicted finding must, by definition, be new, but it should be interesting in the following specific sense. It ought to be unexpected on the basis on other considerations, such as other theories or common-sense. A theory's most interesting predictions, then, violate expectations because they seem like improbable outcomes on any basis other than that theory's assumptions; the more improbable, the better. Experimental confirmation of such predictions therefore counts heavily in favor of the theories that make them.

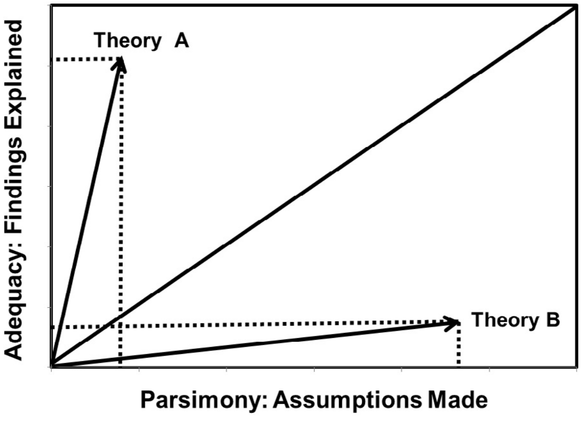

Fig. 1. Vector space representing the trade-off between explanatory adequacy and explanatory parsimony. Theories are vectors in this space, with those that fall above the diagonal being more successful than those that fall below because they explain more findings with fewer assumptions.