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LETTER TO THE EDITOR

Paradoxes of optimal decision making: a response to Moran (2014)

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The optimality of human decision making is a topic of enduring fascination and intense scrutiny. The article by Moran adds fuel to the fire by proving several paradoxical phenomena. First, models that have long been upheld as prototypes of optimality (e.g., the Sequential Probability Ratio Test and the diffusion model) appear to lose this desirable characteristic in environments with heterogeneous difficulty. In such environments, optimal responding requires response criteria that change during stimulus processing. The extent to which people are actually able or willing to execute such optimal adjustments of response criteria is not yet fully clear and requires a systematic set of experiments and model comparisons.

Second, Moran revisits our work (van Ravenzwaaij et al. 2012) in which we challenged the conjecture by Hanks et al. (2011). The conjecture holds that in biased environments with heterogeneous difficulty, decision makers should incorporate prior information by adjusting both the starting point of processing and the evidence evaluation process itself (i.e., by adding a bias to drift rate). As Moran demonstrates, Hanks' conjecture is correct as long as the decision maker is allowed to optimize not only starting point and drift rate bias, but also boundary separation. The fact that the correctness of Hanks' conjecture hinges on boundary separation was never apparent to us. Hence, one of the conclusions in van Ravenzwaaij et al. (2012) was premature, and Hanks' conjecture can now be considered proven instead of refuted.

Moran also shows that for certain fixed values of boundary separation, optimal start point bias and optimal drift rate bias can exert opposing effects. For instance, the optimal start point bias causes the decision maker to require less evidence for the selection of a biased response alternative A. However, as time unfolds and more information becomes available, the optimal drift rate bias progressively drives the accumulation process in the other direction, favoring response alternative B. This is a surprising result that suggests new possibilities for experiments aimed at verifying such a counterintuitive pattern of response biases.

The empirical results from van Ravenzwaaij et al. (2012) are consistent with Hanks' conjecture in the sense that for heterogeneous environments, decision makers showed both a starting point bias and a drift rate bias. However, a similar pattern was evident in homogeneous environments. On an empirical level, these findings are inconsistent with Hank's conjecture, because they suggest that when a decision maker takes prior information into account, this is accomplished in a manner that does not depend on whether the environment is homogeneous or heterogeneous.

What does all this mean for psychology? Should we abandon the diffusion model with fixed bounds because it

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is not optimal in heterogeneous environments? Not necessarily. Sometimes, it is in fact rational to prefer the simpler model (see e.g., Griffiths et al. 2012). One key issue is whether decision makers actually use the optimal "changing response bound" model or whether they stick to the simpler model with (approximately) constant bounds. The preference for a simple model may be motivated by a consideration of energy costs; perhaps the neural implementation of a changing bounds model requires too much effort in terms of return on investment.

References

Griffiths, T.L., Vul, E., Sanborn, A.N. (2012). Bridging levels of analysis for probabilistic models of cognition. *Current Directions in Psychological Science*, *21*, 263–268.

Hanks, T.D., Mazurek, M.E., Kiani, R., Hopp, E., Shadlen, M.N. (2011). Elapsed decision time affects the weighting of prior probability in a perceptual decision task. *The Journal of Neuroscience*, *31*, 6339–6352.

van Ravenzwaaij, D., Mulder, M.J., Tuerlinckx, F., Wagenmakers, E.J. (2012). Do the dynamics of prior information depend on task context? An analysis of optimal performance and an empirical test. *Frontiers in Cognitive Science*, *3*, 1–15.