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Speed accuracy trade-off under response deadlines

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Abstract

The majority of two-alternative forced choice (2AFC) psychophysics studies have examined speed-accuracy trade-offs either in free-response or fixed viewing time paradigms with no hard time constraints on responding. Under response deadlines, reward maximization requires participants to modulate decision thresholds over the course of a trial such that when the deadline arrives a response is ensured despite the possible reduction of accuracy to the chance level. Importantly, this normative threshold collapsing process should take account not only of the deadline time but also the participants’ level of timing uncertainty about the deadline. For instance, for a given level of timing uncertainty participants facing a more stringent deadline and for a given deadline participants with higher timing uncertainty should start collapsing thresholds earlier within a trial (Frazier, P., & Yu, A. J. (2008). Sequential hypothesis testing under stochastic deadlines. Advances In Neural Information Processing Systems, 20, 465-472). We tested human participants in random dot motion discrimination task in three different conditions: free-response paradigm and with two different response deadlines (800 and 1000 ms). We also quantified the level of timing uncertainty using two different temporal reproduction tasks. Micro speed-accuracy trade-off curves suggested that participants might have collapsed thresholds within a trial when facing a response deadline; however, observed performance diverged markedly from optimality. Participants did not take account of either response deadline times or their timing uncertainty. Our findings define a limit on the optimal temporal risk assessment performance of humans. We also consider other possible sources of observed reduction in accuracy as response times approach the deadline, through simulations of data using empirical model parameters.

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