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The dimensionality of individual differences in perceptual decision making

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Abstract

Perceptual decision-making is the process of integrating perceptual evidence and prior experience to a decision. Yet even simple tasks show systematic deviations from optimality. To explore the suboptimalities and their latent structure, we analyzed behavioral data from 155 participants performing a Bernoulli clicks task, each completing 500 trials identifying the side with more clicks. The data were fit with a customized neural-network incorporating temporal kernel weighting individual clicks, side bias, and win–stay/lose–shift effect. Weights on these suboptimalities exhibited substantial variabilities across participants but were captured by a concise structure: two dimensions represented temporal integration kernel, two dimensions reflected win–stay/lose–shift kernel, and one dimension corresponded to side bias. This compact five-dimensional structure and random noise explained the observed suboptimalities. Our results indicate seemingly complex individual differences can be decomposed into a small set of dissociable cognitive processes, providing insight into the structure underlying decision-making variability.

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