Heterogeneous Suppression of Sequential Effects in Random Sequence Generation, but Not in Operant Learning

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Abstract:

There is a long history of experiments in which participants are instructed to generate a long sequence of binary random numbers. The scope of this line of research has shifted over the years from identifying the basic psychological principles and/or the heuristics that lead to deviations from randomness, to one of predicting future choices. In this paper, we used generalized linear regression and the framework of Reinforcement Learning in order to address both points. In particular, we used logistic regression analysis in order to characterize the temporal sequence of participants’ choices. Surprisingly, a population analysis indicated that the contribution of the most recent trial has only a weak effect on behavior, compared to more preceding trials, a result that seems irreconcilable with standard sequential effects that decay monotonously with the delay. However, when considering each participant separately, we found that the magnitudes of the sequential effect are a monotonous decreasing function of the delay, yet these individual sequential effects are largely averaged out in a population analysis because of heterogeneity. The substantial behavioral heterogeneity in this task is further demonstrated quantitatively by considering the predictive power of the model. We show that a heterogeneous model of sequential dependencies captures the structure available in random sequence generation. Finally, we show that the results of the logistic regression analysis can be interpreted in the framework of reinforcement learning, allowing us to compare the sequential effects in the random sequence generation task to those in an operant learning task. We show that in contrast to the random sequence generation task, sequential effects in operant learning are far more homogenous across the population. These results suggest that in the random sequence generation task, different participants adopt different cognitive strategies to suppress sequential dependencies when generating the “random” sequences.

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