A Bayesian Analysis of Serial Reproduction

Jing Xu (jing.xu@berkeley.edu)
Thomas L. Griffiths (tom.griffiths@berkeley.edu)
Department of Psychology, 3210 Tolman Hall, MC 1650
University of California at Berkeley, Berkeley, CA 94720 USA

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Bartlett (1932) explored the consequences of “serial reproduction” of information, in which one participant's reconstruction of a stimulus from memory becomes the stimulus seen by the next participant. These experiments were done using relatively uncontrolled stimuli such as pictures and stories, but suggested that serial reproduction could reveal the biases inherent in memory. We formally analyze the process of serial reproduction under a Bayesian account of memory, and test this approach with experiments using simple one-dimensional stimuli.

When people reconstruct a stimulus drawn from a category, they are influenced by the structure of the category. Huttenlocher, Hedges, and Vevea (2000) proposed that this effect can be modeled as a Bayesian inference, in which people combine the inexact fine-grain stimulus information with category information to achieve higher accuracy. We show that if this is the case, serial reproduction can be modeled as an autoregressive time-series, with a predictable trajectory and stationary distribution. Within the same theoretical framework, we also formally analyze how the convergence rate and stationary distribution of the serial reproduction chain by applying Equation 1 recursively to itself, and as \( n \to \infty \)

\[
x_{n+1} \mid x_0 \sim N(\mu_0, \sigma_x^2 + \sigma_0^2).
\]

The rate at which the Markov chains converge to the stationary distribution depends on the value of \( \lambda \). Since \( \lambda = 1/(1 + \sigma_x^2 / \sigma_0^2) \), the convergence rate thus depends on the ratio of the participant's perceptual noise and the variance of the prior distribution \( \sigma_x^2 / \sigma_0^2 \). We have tested these predictions through a series of experiments, implementing serial reproduction in the laboratory with a population of university undergraduates.

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References
