“Extreme” Sequential Learning: Rats Learn 60-Element Interleaved Serial Patterns

Amber M. Chenoweth, Steven A. Wolfe, & Stephen B. Fountain, Kent State University, Kent, OH 44242

Introduction

Humans have the ability to chunk together information from nonadjacent serial positions in sequential patterns. For example, human subjects typically learn the pattern, A-M-B-N-C-O-D-P-E-Q, by cognitively sorting pattern elements into component subpatterns: A-B-C-D-E and M-N-O-P-Q. Our earlier studies demonstrating similar capacities in rats showed that patterns composed of two interleaved subpatterns were difficult to learn, but that subpattern difficulty was nonetheless determined by subpattern structure. In the present study, we investigated rats’ ability to learn a 60-element interleaved pattern.

Method

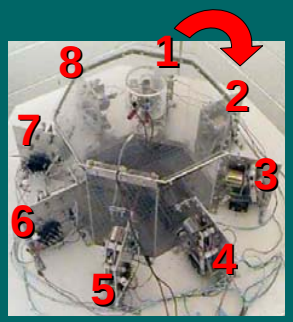
Subjects. 5 male hooded rats implanted with bipolar electrodes for hypothalamic brain-stimulation reward (BSR) served as subjects.

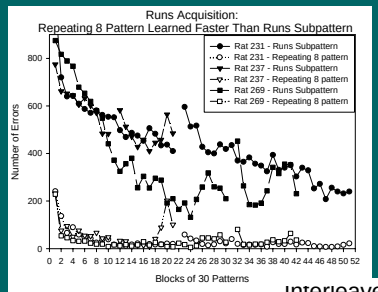
Training. Rats were trained to press levers in a particular order for BSR in a discrete-trial procedure with correction in which all levers were inserted into the chamber at the beginning of each trial. Correct responses were reinforced and all levers retracted. For incorrect responses, all levers except the correct lever retracted, and the rat was reinforced when pressing the correct lever. The rats learned a 60-element interleaved pattern where one subpattern was one of two 30-element hierarchically organized patterns composed of either “runs” or “trills” chunks, & the other subpattern was composed of a repeating element (8):

Runs: 182838-283848-384858-485868-586878-786858-685848-584838-483828-382818

Trills: 182818-283828-384838-485848-586858-786878-685868-584858-483848-382838

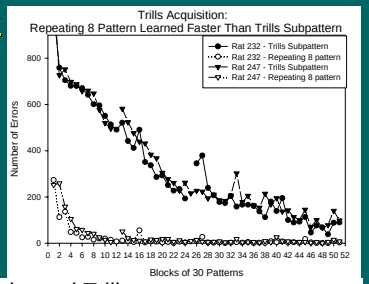
where the digits represent the clockwise positions of levers in the chamber, dashes indicate 3-s pauses, and other intertrial intervals were 1 s. Underlined digits were “free trials” in which only that lever was inserted at the beginning of that particular trial. Rats were trained in blocks of 30 patterns.

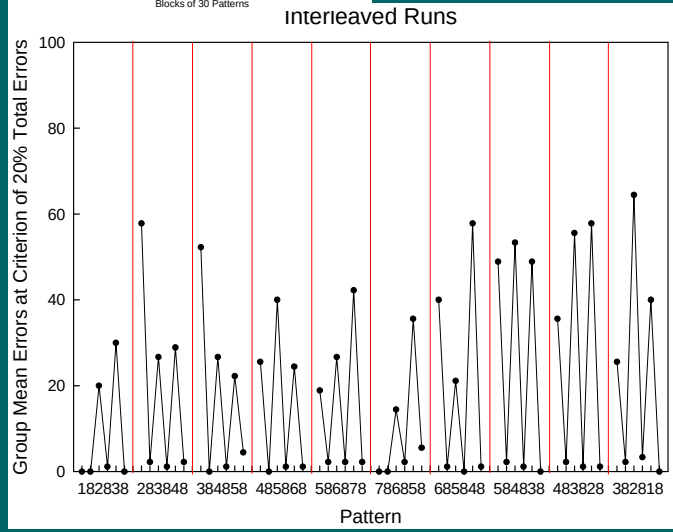


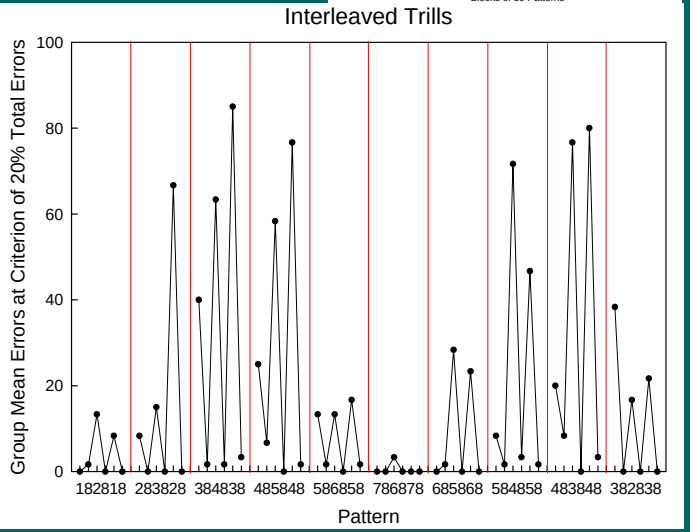


Results: Acquisition of Interleaved Patterns

- Rats learned the repeating 8 subpattern faster than the Runs and Trills subpatterns, and at approximately the same rate in both groups.
- Rats appeared to learn the Trills subpattern faster than the Runs subpattern.







Results: Interleaved Runs

- Rats trained on the Runs subpattern had difficulty learning the first elements of chunks.
- Rats learned the Runs subpattern elements uniformly across chunks.
- Errors within the Runs subpattern were primarily perseverations of the previous element of the same subpattern, not perseverations of the immediately preceding element, “8”.
- The results indicate that rats parsed the 60-element pattern into Runs vs. repeating-8 subpatterns.

Results: Interleaved Trills

- Rats trained on the Trills subpattern had less difficulty learning the first elements of chunks.
- Rats learned the first and last chunk of each half of the Trills subpattern faster than middle chunks.
- On trials in the first half of the pattern where error rates were relatively high, errors were primarily overextensions of a “run” rule (e.g., choosing 18283**8** instead of 18281**8**), showing a bias to press levers in a runs-type pattern. In the second half of the pattern, errors generally did not reflect a consistent strategy.

Discussion

The simple repeating 8 subpattern was learned faster than the formally more complex Runs and Trills subpatterns. These results are consistent with the idea that rats are sensitive to the patterning of nonadjacent elements even in extremely long serial patterns.