Instrumental Blocking and Rule Learning in Rat Serial Pattern Learning

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Introduction

Sequential learning involves learning to anticipate events occurring in a consistent temporal order. Theorists seeking to describe this learning typically seek to explain it in the simplest way. For some, this has meant relying on "simple" associative processes, usually by attempting to reduce the sequential problem to its component associative units. For others, the approach has been to rely on "complex" cognitive processes, typically by attempting to reduce the sequential problem to its component "structures" described by "rules". The present study examined the role of rule learning versus discriminative learning in rat pattern learning utilizing a classic associative phenomenon—blocking. Rats pressed levers in an 8-lever circular array according to a rule-based serial pattern. Each pattern contained a chunk with a final element violation (e.g., 454 instead of 456). Rats learned in Phase 1 that noise signaled the violation chunk. In Phase 2, a concurrent spatial cue was added. In Phase 3, we tested for instrumental blocking by presenting spatial cues alone.

Method

Subjects. 10 male hooded rats implanted with bipolar electrodes for hypothalamic brain-stimulation reward (BSR) served as subjects.

Phase 1: Initial cued violation element training.

Patterns:	Violation location varied:
123-234-345-456-567-678-781-812	787-812-123-234-345-456-567-678
456-567-678-781-812-123-234-345	781-812-123-234-345-456-565-678
781-812-123-234-345-456-567-678	781-812-123-234-343-456-567-678
678-781-812-123-234-345-456-567	
345-456-567-678-781-812-123-234	234-345-456-567-678-787-812-123
812-123-234-345-456-567-678-781	234-343-456-567-678-781-812-123
234-345-456-567-678-781-812-123	234-345-456-565-678-781-812-123
567-678-781-812-123-234-345-456	underlining = noise cue
	pink coloring = violation element

Phase 2: Added cue training.

234-345-454-567-678-781-818-123	818-123-234-345-454-567-678-781
454-567-678-781-818-123-234-345	567-678-781-818-123-234-345-454
781-818-123-234-345-454-567-678	123-234-345-454-567-678-781-818
678-781-818-123-234-345-454-567	345-454-567-678-781-818-123-234

Phase 3: Instrumental blocking test. The noise cue was removed. In Phase 3, rats were not reinforced for their violation element choices.

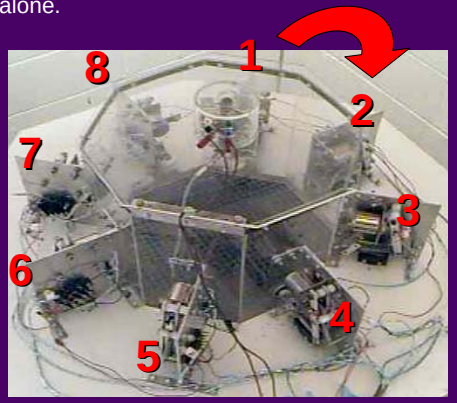
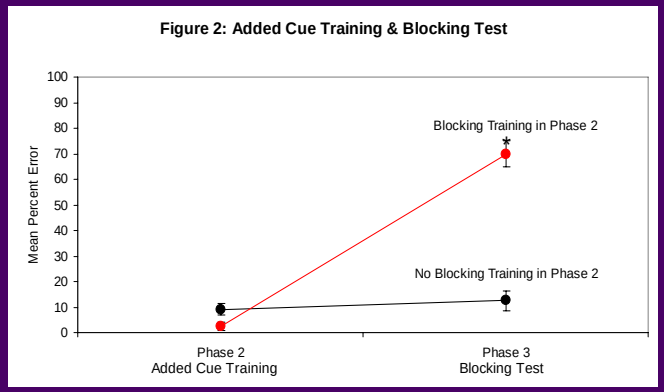


Figure 1. Octagonal Operant Chamber



Results

Phase 1: Initial cued violation element training. Rats acquired the pattern and learned noise indicated a violation. Rats quickly met criterion for within chunk and chunk boundary errors, but took longer for violations.

Phase 2: Added cue training. Rats performed well at chunk boundaries and within chunks. They performed well on the noise+spatial cues compound cued violation and quickly learned to predict the location of the spatial cues alone cued violation. As shown in Figure 2, in the last session of Phase 2, rats made few errors on either violation.

Phase 3: Instrumental blocking test. Rats made few errors for the violation element that did not receive blocking training in Phase 2, but made many errors at the violation element that received blocking training. While rats performed well on the violation element with blocking training in Phase 2, they performed poorly on the same violation element in Phase 3.

Discussion

In Phase 1, rats learned to anticipate violations cued by noise even though the randomization procedure ensured serial position was not a relevant cue. This shows rats are not constrained to using serial position or periodicity of violations to anticipate them. In Phase 2, rats quickly learned to use new spatial cues as signals for a violation despite the absence of consistent serial position cues. These results lead us to wonder if rats can use serial position cues at all to anticipate violations, especially when the violation is positioned at the end of a pattern. Another conclusion that can be drawn from Phases 2 and 3 is that although spatial location cues appear salient in this paradigm, spatial cues did not overshadow the already established association of noise as a cue for the violation. Instead, already learned noise cues blocked learning about spatial cues in Phase 2. Thus, it appears rats can use a variety of cues to control responding in our serial pattern learning paradigm. More work is needed to investigate if associative mechanisms could be demonstrated to account for learning features of patterns that previously have been attributed to non-associative processes like rule induction.