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On the time course of rapid and repeatable response induction

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ABSTRACT

As reinforcers are delivered for a particular response, that response increases. Other similar responses also increase, with the extent to which this increase is seen being positively related to the similarity between the responses. This process, called induction, is pronounced during initial response acquisition, and dissipates as the target response is established. The present experiment examined this process in a paradigm wherein responses to one of five nose poke receptacles results in reinforcement for six sessions in each condition and the target location changes between conditions. Consistent patterns of induction were seen across conditions, with patterns of induction dissipating within each condition.

1. Introduction

In operant conditioning, as reinforcers are delivered for a target response, responses that are similar along various topographical characteristics also increase (Catania, 2013; Skinner, 1953). This spread of reinforcement effects to unreinforced response topographies, often called *induction*, is typically greatest for responses topographically similar to the reinforced response, with a systematic decrease in induction observed as the untargeted response becomes increasingly topographically distinct. Thus, induction occurs along predictable gradients of response similarity (sometimes called response generalization (Catania, 2013). This process has been demonstrated across a range of response dimensions, including force (Notterman and Mintz, 1965) duration (Margulies, 1961; Millenson et al. 1961), lever displacement (Herrick, 1963, 1964) and —importantly—response location (Antonitis, 1951; Boren et al. 1978; Eckerman and Lanson, 1969; Escobar and Bruner 2007). This increase, however, is often temporary, giving way to differentiation as individuals continue to respond on static schedules [see Antonitis (1951) for a review].

Although generally unrecorded, response induction is central to many accounts of operant conditioning. For example, induction is central to many functional approaches to operant responding (e.g., Catania, 1973; Skinner, 1953; Staddon, 1967). Additionally, induction is central to both shaping-based molecular (Shimp, 2013) and response-allocation based (Baum, 2012) paradigmatic approaches. Given the theoretical weight induction bares, additional research is necessary.

In a recent study, Escobar and Bruner (2007) examined patterns of induction as rats acquired responding on one of seven horizontally arranged response levers. Groups of rats earned reinforcers on the center lever according to tandem random interval (RI; 0–32 s) fixed time (FT; 0–32) schedules (the total of the RI and FT value always equaled 32 s). Response rate was generally highest for the center lever with systematic decreases in response rate on the outer levers. Moreover, greater induction was generally seen with longer delays and, as has been seen in other delay of reinforcement studies, the overall response rates decreased with increasing delays (Jarmolowicz and Lattal, 2013; Lattal, 2010).

The Escobar and Bruner (2007) study provided a nice parametric analysis of effects of delay/schedule combinations on induction, yet additional questions about response induction along spatial dimensions remain. First, to control for differences in rate of reinforcement, Escobar and Bruner used a RI 32 s schedule rather than continuous reinforcement. Prior studies, however, have found greater response variability with intermittent relative to continuous reinforcement schedules (Eckerman and Lanson, 1969). As a result of this differential variability, findings from the Escobar and Bruner study may not accurately describe patterns of induction

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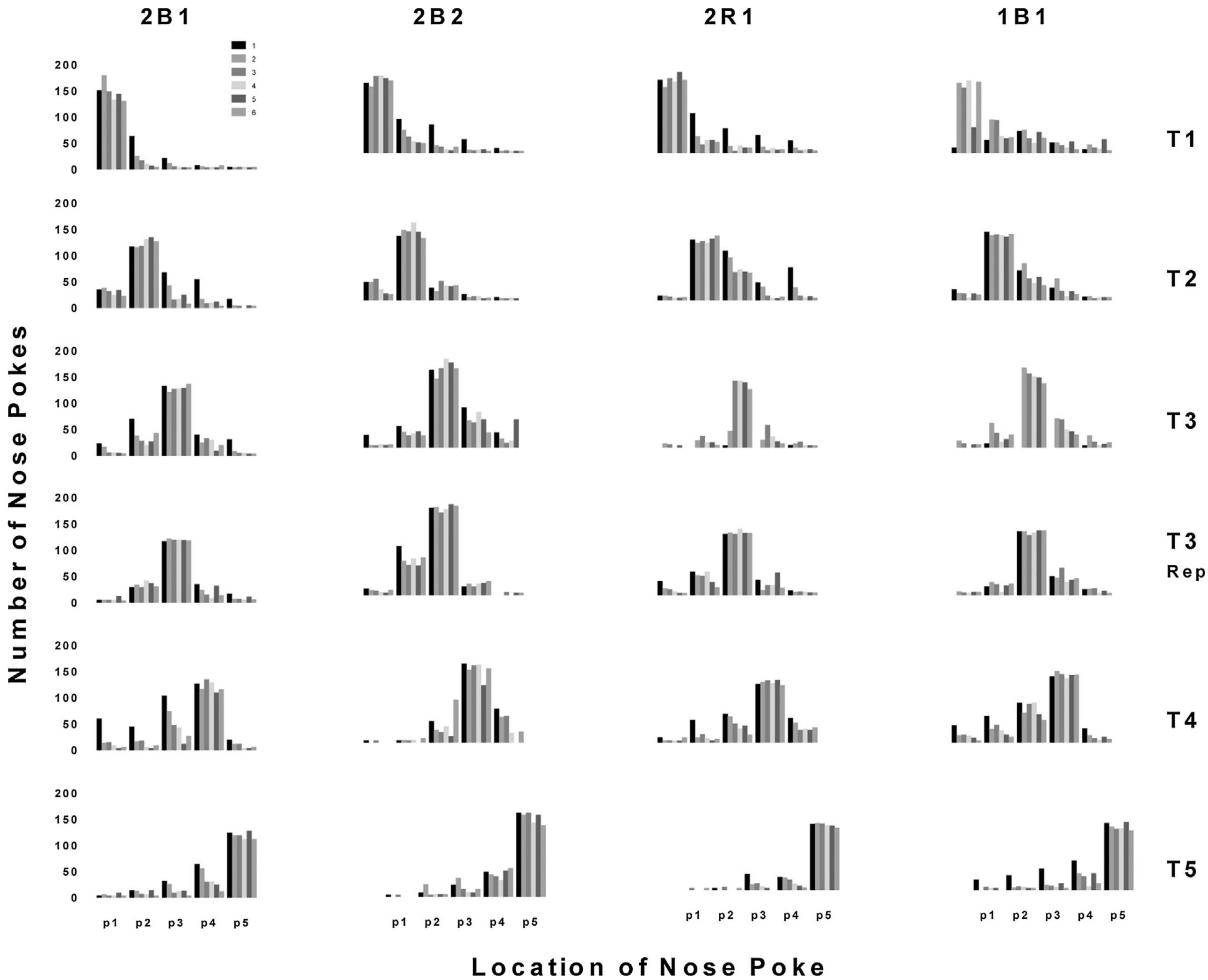

Fig. 1. Frequency of nose poke responses (y-axis) at each receptacle (x-axis) during each of the six sessions (color coded bars) in each condition (rows) for each rat (columns). Conditions are labeled by the receptacle active during that condition (e.g., T1, T2), with the replication of the T3 condition shown as T3 (Rep).

observed with continuous reinforcement. Hence, the precise patterns of induction expected with immediate reinforcement remain unknown. Second, Escobar and Bruner provided extensive analysis of patterns of induction from responding on a single target, leaving much unknown about patterns of induction expected on other targets (e.g., levers 1 or 2) or during the transition to other targets. Third, Escobar and Bruner focused on delay—of—reinforcement effects on response induction during initial response acquisition. As a result, their study used between-subject comparisons of response patterns. Acquisition, however, can be repeated (Boren and Devine, 1968), with data from these repeated acquisitions providing rich information about the effect of additional independent variables such as drugs (Moerschbaecher and Thompson, 1980) and toxin exposure (Schrot et al. 1986; Newland et al. 1996) on learning. Although response induction has not been the primary interest in these repeated-acquisition paradigms, this general approach may provide rich data on the topic.

The current study builds from the Escobar and Bruner (2007) study to provide more information about spatial induction during continuous reinforcement. Specifically, the present study will examine patterns of induction across all five targets in a five nose poke array. In doing so, a procedure that may be rapid (i.e., demonstrating induction within a single session) and repeatable will be evaluated. As in previous studies (Herrick, 1963, 1964) the progressive differentiation of responding will be examined across a series of sessions. In doing so, the time course of this rapid induction will be examined.

2. Method

2.1. Subjects

Four male Sprague-Dawley rats obtained from Charles River (Raleigh, NC) maintained on a 22-h deprivation schedule were used in the present experiments. The rats were housed in pairs, were 393–397 days old at the beginning of the experiment, and had previous experience on schedules of reinforcement. Water was freely available in the home cages, located in a colony room where a 12 h:12 h light-dark cycle was maintained. All sessions were conducted during the light phase on the light-dark cycle. All of the current procedures were in accordance with the guidelines established by the University of Kansas Institutional Animal Care and Use Committee.

2.2. Apparatus

Sessions occurred in operant conditioning chambers (33.02 cm long, 24.1 cm wide, 29.2 cm high; Med Associates, Inc., St. Albans,