Behavioural Processes 124 (2016) 80–92

Contents lists available at ScienceDirect

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc

Resurgence of target responding does not exceed increases in inactive responding in a forced-choice alternative reinforcement procedure in humans

Mary M. Sweeney*, Timothy A. Shahan

Department of Psychology, Utah State University, 2810 Old Main Hill, Logan, UT 84322, United States

ARTICLE INFO

Article history:
Received 19 August 2015
Received in revised form
15 December 2015
Accepted 15 December 2015
Available online 24 December 2015

Keywords:
Operant conditioning
Forced-choice
Human
Resurgence
Relapse
Mouse click

ABSTRACT

Resurgence following removal of alternative reinforcement has been studied in non-human animals, children with developmental disabilities, and typically functioning adults. Adult human laboratory studies have included responses without a controlled history of reinforcement, included only two response options, or involved extensive training. Arbitrary responses allow for control over history of reinforcement. Including an inactive response never associated with reinforcement allows the conclusion that resurgence exceeds extinction-induced variability. Although procedures with extensive training produce reliable resurgence, a brief procedure with the same experimental control would allow more efficient examination of resurgence in adult humans. We tested the acceptability of a brief, single-session, three-alternative forced-choice procedure as a model of resurgence in undergraduates. Selecting a shape was the target response (reinforced in Phase I), selecting another shape was the alternative response (reinforced in Phase II), and selecting a third shape was never reinforced. Despite manipulating number of trials and probability of reinforcement, resurgence of the target response did not consistently exceed increases in the inactive response. Our findings reiterate the importance of an inactive control response and call for reexamination of resurgence studies using only two response options. We discuss potential approaches to generate an acceptable, brief human laboratory resurgence procedure.

1. Introduction

Although behavioral treatments using alternative reinforcement can be effective when the interventions are in place, problem behavior can relapse when alternative reinforcement is removed or reduced post-treatment (e.g., Dobson et al., 2008; Higgins et al., 2007; Volkert et al., 2009). In operant conditioning, relapse following the removal of alternative reinforcement is called resurgence (Epstein and Skinner, 1980). Often, the resurgence phenomenon is studied in laboratory animal models using pigeons (e.g., Leitenberg et al., 1975, Experiment 3; Lieving and Lattal, 2003; Podlesnik and Shahan, 2009; Experiment 2; Sweeney and Shahan, 2013a) or rats (e.g., Leitenberg et al., 1970; Leitenberg et al., 1975; Experiments 1, 2, & 4; Winterbauer and Bouton, 2010; Winterbauer et al., 2013; Sweeney and Shahan, 2013b, 2015). A laboratory model of resurgence generally consists of three experimental phases. Phase I involves the training of an operant target response. For example, the target response for a rat may be to press a particular lever in an operant chamber to receive a food pellet delivery. In Phase II, which simulates alternative reinforcement treatment, extinction is in place for the target response and alternative reinforcement is introduced. For a rat, presses to the target lever would not result in the delivery of a food pellet, but a new response such as pulling a chain provides an alternative source of reinforcement. Phase III of the laboratory model is a probe for the effect of alternative reinforcement removal on the target response. During Phase III, alternative reinforcement is removed and extinction of the target response remains in place such that no response will produce reinforcement. It is during Phase III that resurgence of the suppressed target response can occur.

The generality of laboratory animal research findings has been supported by research examining resurgence in children with intellectual or developmental disabilities (e.g., Volkert et al., 2009; Wacker et al., 2011, 2013), and in typically functioning adult participants (e.g., Dixon and Hayes, 1998; Doughty et al., 2010, 2011; Bruzek et al., 2009; Mechner et al., 1997; Wilson and Hayes, 1996).

* Corresponding author at: Department of Psychiatry and Behavioral Sciences, Behavioral Pharmacology Research Unit, Johns Hopkins University School of Medicine, 5510 Nathan Shock Drive, Baltimore, MD, 21224, United States.
E-mail addresses: marymsweeney@jhmi.edu (M.M. Sweeney), tim.shahan@usu.edu (T.A. Shahan).

http://dx.doi.org/10.1016/j.beproc.2015.12.007
0376-6357/

For example, research with laboratory animals has shown increased time in extinction plus alternative reinforcement may decrease subsequent resurgence (Leitenberg et al., 1975; Experiment 4; Sweeney and Shahan, 2013a; but see Winterbauer et al., 2013). Similarly, researchers examining the resurgence of problem behavior following alternative reinforcement treatment in children with intellectual disabilities found an overall decrease in resurgence as function of increased exposure to extinction plus alternative reinforcement treatment (Wacker et al., 2011). Another commonality is that increased length of baseline reinforcement is related to more robust resurgence in both animal research (Winterbauer et al., 2013) and in laboratory research with typically functioning adult humans (Bruzek et al., 2009; Doughty et al., 2011). The general agreement of animal and human resurgence findings is promising for future translational research.

On the other hand, current laboratory models of resurgence within typically functioning adult populations may limit the ability to isolate and manipulate predictors of persistence and resurgence. For example, Bruzek et al. (2009) conducted a study examining the resurgence of infant caregiving responses. Caregiving responses to a baby doll were negatively reinforced through the cessation of pre-recorded infant cry. This protocol is face valid, and resurgence in these scenarios may have important practical implications. However, the use of non-arbitrary responses makes it difficult to control the history of reinforcement for the target response. This is apparent in that one participant showed resurgence of the target caregiving response, but also showed a comparable increase in a response that was never explicitly reinforced in the study. The authors point out that this response may have had a history of reinforcement outside of the laboratory. Using such naturalistic responses may make it difficult to experimentally control history of reinforcement.

Some laboratory studies with adult humans have used arbitrary responses to control the history of reinforcement, but have had only two measurable behaviors (i.e., Dixon and Hayes, 1998; McHugh et al., 2012). The presence of only two measurable behaviors makes it difficult to establish that resurgence occurring in these preparations is a result of the history of reinforcement for the target behavior above and beyond extinction-induced variability (e.g., Antonitis, 1951; Morgan and Lee, 1996; Neuringer et al., 2001). In animal models of resurgence, resurgence is distinguished from a simple increase in response variability by the inclusion of an inactive response. For example, in order to be considered resurgence, target response rates when alternative reinforcement is removed ought to exceed rates on a lever that has never been associated with food (e.g, Podlesnik et al., 2006; Sweeney and Shahan, 2013a,b, 2015). Therefore, an ideal resurgence task must include at least one response that has no history of reinforcement to control for random increases in responding not associated with reinforcement history.

Other research examining resurgence in adult humans has controlled for history of reinforcement and controlled for extinction-induced variability, but has required lengthy or repeated sessions (e.g., Doughty et al., 2010, 2011; Mechner et al., 1997; Wilson and Hayes, 1996). This is a function of examining resurgence of conditional discriminations, derived stimulus relations, or revealed operant behavior, which require more extensive accuracy training on the prerequisite discriminations than the relatively more simple discriminations described above (Dixon and Hayes, 1998; McHugh et al., 2012). Determining subject characteristics that predict response to alternative reinforcement treatments may necessitate larger sample sizes. The time consuming nature of studies with extensive training does not necessarily preclude larger sample sizes, but a brief procedure that similarly controls for history of reinforcement and extinction-induced variability may be more time- and cost-effective.

A novel resurgence procedure should also attempt to constrain variability that has made between-subject comparisons difficult in prior human operant resurgence research. One way to do this would be to have a trial-based procedure that forces a choice between three arbitrary stimuli. Past studies examining resurgence of conditional discriminations or derived stimulus relations used discrete-trial matching to sample procedures and observed resurgence (Wilson and Hayes, 1996; Doughty et al., 2010, 2011), but the matching to sample aspect of the trials requiring lengthy training may not be necessary. Rather than free-operant response rate across session or matching to sample performance, proportion preference for a given stimulus during a particular trial block could be measured. This procedure is simple and would not require accuracy training beyond familiarization with the contingencies. This would increase the likelihood of adoption by other laboratories and clinical settings for replication and extension. Thus, we examined resurgence during a behavioral task in which each trial required the choice of one of three arbitrary stimuli in order to maximize points.

2. Method

2.1. Participants

Participants were 36 adult college students recruited through the Introduction to Psychology participant pool and announcements in psychology courses. We advertised that the volunteer who earned the most points at the end of the study would receive a $75 gift card to the Utah State University bookstore. Each participant completed all parts of the study in a single visit to the laboratory.

2.2. Procedure

2.2.1. Instructions

Following informed consent, participants sat in the chair in front of the experimental computer. General instructions (based in part on instructions found in Kangas et al., 2009; Doughty et al., 2011) were read aloud to the participant. The full instructions script is in Appendix A. After reading the task instructions and answering any questions, the researcher left the participant alone until the task was completed.

2.2.2. Demographic information

The computer program asked the participants to provide the following basic demographic information: age, gender, race/ethnicity, and years of education following high school. Gender and race/ethnicity had an option that read, “I prefer not to answer.”

2.2.3. Behavioral task

The behavioral task (programmed using E-prime software; Psychology Software Tools, Pittsburgh, PA) consisted of three phases. In Phase I, selecting the target stimulus earned the participant 10 points with a probability that varied according to which version, or condition, of the task they experienced. Choosing the alternative stimulus or the inactive stimulus never resulted in points. The stimuli serving as the target and alternative were selected in a pseudorandom order. The length of Phase I also varied according to condition. In Phase II, selection of the alternative stimulus produced points with a given probability according to condition, whereas selection of the target stimulus or control stimulus never produced points. In the third phase, no points could be produced no matter which stimulus was selected.

These phases are analogous to the typical three-phase resurgence procedures: Phase I in which the target response is trained, Phase II in which the alternative response is trained and the target response is no longer productive, and Phase III in which no response