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Context affects resurgence of negatively reinforced human behavior

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ABSTRACT

The effects of context on the resurgence of negatively reinforced (escape) responding was studied in an experiment with undergraduate students in which resurgence and renewal procedures were combined. Across conditions, in baseline (BL), key-pressing produced 3-s timeouts from pressing a force cell on a variable-ratio schedule of reinforcement; in the Alternative-Reinforcement and Test phases, a differential-reinforcement-of-other-behavior schedule and extinction were in effect, respectively. Conditions differed according to the context (the computer-screen color) in effect in each phase: ABA vs. ABB (with each letter representing a context; order of exposure to conditions was counterbalanced across participants). For each of six participants, independent of (a) order of exposure to conditions, (b) slight differences in BL reinforcement, and (c) differences in BL key-pressing rates, resurgence of greater magnitude occurred in the ABA than in the ABB condition. These results replicate and extend to contingencies of negative reinforcement previous findings with nonhumans and humans showing that context modulates the magnitude of resurgence.

1. Introduction

Resurgence is the recurrence of previously reinforced and later extinguished responding when alternative reinforcers are reduced or withdrawn (Epstein, 1983; Lattal et al., 2017). It is usually studied by using a three-phase procedure: In baseline (BL) a target response is reinforced; in the alternative-reinforcement (AR) phase, target responding is extinguished and reinforcers are produced by alternative responses; in the Test phase, alternative reinforcers are reduced or removed and an increase in the frequency of the target response relative to the AR phase operationally defines resurgence. Typically, the procedure involves no explicitly programmed changes in the stimulus context in effect in each phase.

Recently, studies with rats, pigeons, and humans have reported that explicitly manipulating the stimulus context in effect across the three phases of a resurgence procedure can affect its magnitude (Kincaid et al., 2015; King and Hayes, 2016; Podlesnik and Kelley, 2014; Trask and Bouton, 2016; but see Sweeney and Shahan, 2015). In these studies, the procedure to study resurgence is combined with that for studying another recurrence phenomenon, renewal. Renewal is the recurrence of previously reinforced and later extinguished responding when the stimulus context changes from that in effect in extinction (e.g., Bouton et al., 2011; Podlesnik and Miranda-Dukoski, 2015). Generally, resurgence of greater magnitude has been reported when the reduction or removal of alternative reinforcers occurs in the stimulus context in effect during BL (i.e., a combination of resurgence and an ABA renewal procedure) than when there is no context change from AR to Test phases (i.e., a combination of resurgence and an ABB renewal procedure). Podlesnik et al. (2019), for example, in a series of experiments with typically-developing adult humans and children diagnosed with autism, reported that resurgence of previously positively-reinforced responding was of greater magnitude when, during the test, there was a return to the stimulus context in effect when target responding was reinforced (BL) than when there was no change from the stimulus context in which target responding was under extinction and alternative responding was being reinforced (AR) context.

Most experiments on the determinants of resurgence have been conducted with nonhumans and by using contingencies of positive reinforcement. Alessandri et al. (2015, Experiments 1 and 2; see also Bruzek et al., 2009) reported resurgence and renewal of negatively-reinforced responding of humans. In their procedure, escape from continuously pressing a force cell was used as a reinforcer for key-pressing responses. Resurgence and renewal were reliably observed under this procedure, replicating and extending previous findings obtained with humans and nonhumans to contingencies of negative reinforcement. In addition to being theoretically relevant, analyses of these phenomena under contingencies of negative reinforcement might be relevant to understanding and dealing with the recurrence of behavior in applied set-

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tings (e.g., recurrence of avoidance behavior following exposure treatment in anxiety disorders).

The effects of contextual manipulations on resurgence of negatively reinforced human behavior remain uncertain. In the present experiment, we used the procedure described by Alessandri et al. (2015) to assess if resurgence of negatively-reinforced human behavior would be affected by context as has been previously demonstrated with nonhumans (e.g., Kincaid et al., 2015; Trask and Bouton, 2016) and humans (Podlesnik et al., 2019; see especially their Experiment 1) under contingencies of positive reinforcement.

2. Materials and methods

2.1. Participants and apparatus

Six non-Psychology undergraduate students (3 males and 3 females, 20–30 years old, all right-handed) from the University of Lille participated (no extra-course credit or money were provided). Participants sat individually at a desk containing a Novatech Mini40 ATi force cell (Tatem Industrial Automation Ltd., Derby, U.K.), a computer monitor and a keyboard (see Alessandri et al., 2015, for details).

2.2. Procedure

2.2.1. Force-criterion assessment and general aspects

First, participants were required to press the force cell with their left thumbs continuously and with the maximum force possible for three, 10-s intervals (separated by 3-s timeouts from pressing the force cell). The force criterion was equal to 75 % of the maximum force each participant attained during these three 10-s intervals (see Table 1).

A vertical gauge (updated every 0.1 s) was displayed at the top center of the computer screen in subsequent phases. It indicated the proportion of the force criterion attained by the participant, who was instructed to continuously maintain the force indicator at the top of the gauge (i.e., at the force criterion).

Responses were pressing the down-arrow key of the keyboard and reinforcers were 3-s timeouts from pressing the force cell. During sessions, the word "press" was displayed continuously on the screen except when a timeout was produced, during which the word "break" was displayed for 3-s. Participants were told they could key press at any time, but not that it produced timeouts.

Sessions lasted for 5−10 min (excluding reinforcement time). Up to three sessions were conducted during each laboratory visit, which occurred twice a week across participants.

2.2.1.1. Pretraining Key pressing produced timeouts on a fixed-ratio (FR) schedule. The FR value was increased within sessions from 1 to 75, with at least two reinforcers produced under each FR value (i.e., 1, 2, 5, 10, 15, 20, 25, 30, 50 and 75). This phase lasted for 10−20 min across participants.

2.2.1.2. Three-phase procedure Each participant was exposed to two conditions. Each condition comprised three phases and differed based on the stimulus context in effect in each phase (cf. Podlesnik et al., 2019, Experiment 1).

2.2.1.2.1. Baseline (BL) Key pressing was reinforced according to a variable-ratio (VR) 23 schedule (constructed with 10 values – 1, 2, 5, 10, 15, 20, 25, 30, 50, and 75 – selected randomly without replacement during a session). The screen color was gray (Context A) during this phase, which lasted for one, 10-min session. After a 5-min break, the next phase started.

2.2.1.2.2. Alternative reinforcement (AR) The color of the screen was green (Context B) and a DRO schedule was in effect. Thus, reinforcers occurred only if key pressing did not occur during the DRO interval; key presses restarted the interval and delayed reinforcers. This phase lasted for two 5-min sessions, separated by a 5-min break. The DRO

Table 1
Force Criterion (in N), Median of the Percentage of the Force Criterion (and interquartile ranges); and total number of reinforcers in each phase and in each condition.

Condition	Participant	Force Criterion	BL	AR	Test
ABA	P1	23	67 (60–78); 14	77 (55–96); 32	74 (63–88)
	P2	34	55 (45–66); 12	57 (49–66); 32	38 (35–42)
	P3	27	98 (93–106); 8	99 (93–105); 32	94 (89–99)
	P4	22	73 (70–77); 20	89 (80–97); 32	82 (66–100)
	P5	46	74 (61–87); 27	63 (55–70); 32	75 (51–92)
	P6	39	55 (46–63); 16	58(45–67); 32	61 (53–73)
ABB	P1	23	67 (59–85); 10	85 (73–95); 32	66 (52–80)
	P2	34	58 (50–71); 9	50 (44–55); 32	47 (41–56)
	P3	27	82 (73–92); 11	83 (69–92); 32	79 (65–90)
	P4	22	88 (75–102); 15	96 (82–110); 32	97 (88–108)
	P5	46	80 (75–84); 41	76 (64–83); 32	60 (54–66)
	P6	39	51 (40–63); 23	58 (46–71); 32	44 (38–51)

Note: Medians (and interquartile ranges) and total reinforcers are for all sessions of Baseline (BL), Alternative Reinforcement (AR) and Test phases.

value initially was 2 s and was increased gradually to 20 s (i.e., 2, 4, 8, and 20 s), after two consecutive reinforcers, in the first session. In the second session, a DRO 20-s schedule was implemented. The next phase started immediately (i.e., without a break) after the end of the second session.

2.2.1.2.3. Test Reinforcement for key pressing was discontinued (i.e., extinction) for 10 min. In the ABA condition, the color of the screen was gray (i.e., Context A, in effect during BL); in the ABB condition, the color of the screen was green (i.e., Context B, in effect in the AR phase).For P1, P2, and P5, the ABA Condition was implemented first, whereas for P3, P4, and P6, the ABB Condition was implemented first.

3. Results and discussion

Table 1 shows the force criterion for each participant, and the median percentage of the force criterion in each phase, for each participant. In both conditions, participants pressed the force cell continuously, although not always maintaining the force criterion. In general, the median percentage of the force criterion was above 50 % (exceptions being P2, in the Test phases of both conditions, and P6, in the Test phase of the ABB condition). Table 1 also shows that the total number of reinforcers in BL was slightly higher in the ABA condition, for P1, P2 and P4, and in the ABB condition, for P3, P5 and P6; the number of reinforcers was equal between AR phases in both conditions, across participants.

Fig. 1 shows, for each participant, response rates in 60-s blocks during the last five minutes of BL, and during the AR and Test phases, in both conditions (left and right graphs show data for participants exposed first to the ABA and to the ABB condition, respectively). In BL, responding occurred consistently at rates that were sometimes higher in the ABA condition (P2 and P6) and in the ABB condition (P3, P4 and P5; no systematic differences occurred across conditions for P1). In the AR phase, response rates decreased to near zero during the first min of exposure and remained zero or near zero during this phase (see Alessandri et al., 2015, Fig. 1, for similar results due to the DRO schedule programming in this phase). In the Test, resurgence occurred reliably, and was of greater magnitude, in the ABA than in the ABB condition for each participant (resurgence occurred reliably in the ABB condition only for P3). This effect was independent of the order of exposure to conditions (i.e., ABA or ABB first), and of differences in response rates or total number of reinforcers between BL phases.

These results replicate previous findings with nonhumans (e.g., Kincaid et al., 2015; Trask and Bouton, 2016) and with humans (Podlesnik et al., 2019, see especially Experiment 1) showing that context affects the magnitude of resurgence. That is, the magnitude of resurgence was greater when, during the test, the context was similar to that in effect during reinforcement of a target response than when it resembled that in effect during extinction. These results extend previous findings by demonstrating the effect when human behavior is maintained under contingencies of negative reinforcement (cf. Alessandri et al., 2015; Bruzek et al., 2009).

Further extensions of this experimental work are warranted to better understand the variables controlling the recurrence of negatively reinforced human behavior, and to inform the development and implementation of behavioral interventions to modulate (i.e., to stimulate or mitigate) recurrence. For example, manipulating the context parametrically in the Test phase (cf. Podlesnik and Miranda-Dukoski, 2015) would allow the assessment of resurgence magnitude under combinations of resurgence and ABA, ABB and ABC renewal procedures. Additionally, the general procedure used in the present experiment (cf. Alessandri et al.) can be useful to assess the effects of varying parameters of negative reinforcement (e.g., rate, magnitude) on resurgence and other recurrence phenomena. One potential limitation of the present procedure was that the obtained force requirement was not directly manipulated and depended on the compliance of participants to press the force cell with the maximum force. As shown in Table 1, the obtained force sometimes varied across phases but the differences in force exerted across phases and conditions were not systematically related to the differences in the magnitude of recurrence between ABA and ABB conditions. As such, they do not limit the validity of the present findings. Future research in which this procedure is used, however, could implement contingencies to guarantee that required and obtained force levels are similar and that the force criterion is maintained throughout sessions and conditions. A possible solution could be to stop the session timer when the force is below criterion, signal this to the participant, and resume the procedure when the criterion is achieved (see Alessandri and Rivière, 2013).

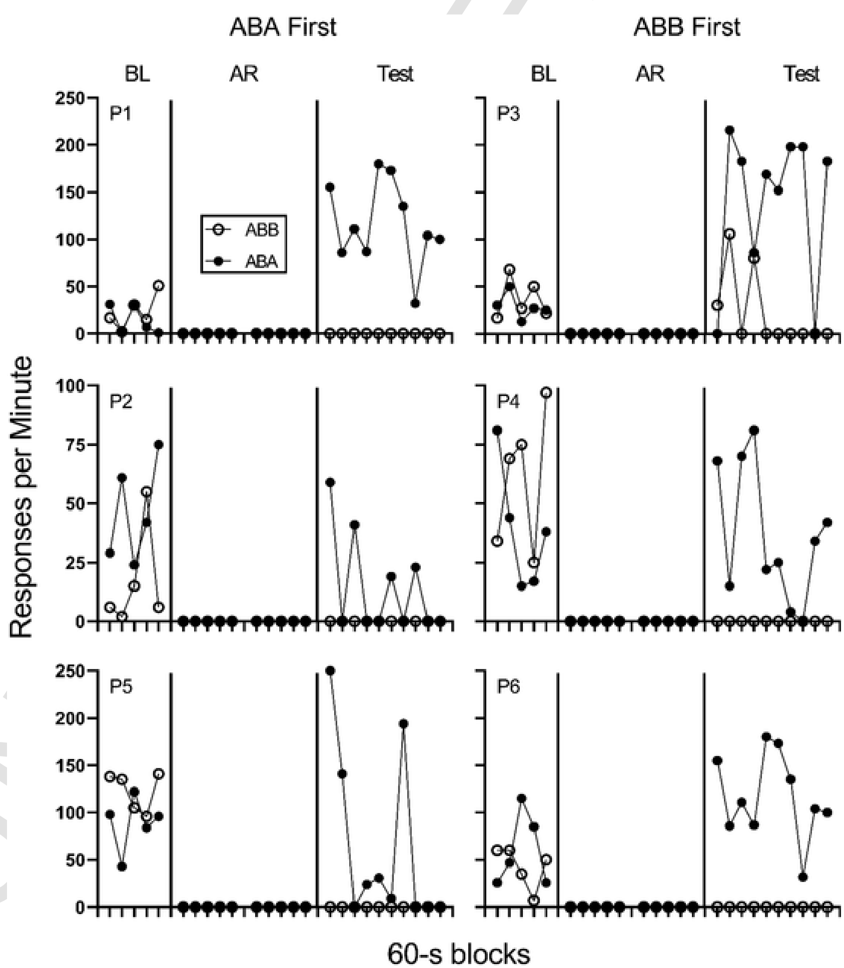

Fig. 1. Responses per min in 60-s blocks during the last five minutes of Baseline (BL), and in the Alternative-Reinforcement (AR) and Test phases. The left and right graphs show data for participants exposed first to the ABA and to the ABB condition, respectively. Closed and open symbols represent the ABA and ABB conditions, respectively. Note the different Y-axes scales between the center and the upper and lower graphs.

Authors note

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