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Short report

Proximal, but not distal, pre-exposure reduces serial overshadowing in one-trial taste aversion learning

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ABSTRACT

This experiment tested whether pre-exposing a taste would reduce its ability to overshadow conditioning to a target taste and whether this effect would depend on the delay between pre-exposure and conditioning. Two groups of rats were pre-exposed to an interfering taste (HCl) either a week before conditioning (Group Distal) or the day preceding conditioning (Group Proximal). In the single conditioning trial, rats were given the target taste (sucrose) and 65 min later were injected with lithium. The groups differed as to what they were given to drink 50 min after sucrose: The Distal, Proximal and Novel groups were given HCl, while the Control group was given water. Pre-exposure to HCl reduced overshadowing of the sucrose aversion by HCl in Group Proximal but not in Group Distal. Possible explanations for the latter result include extinction of the context-HCl association and loss of context control over an HCl-no outcome association.

1. Introduction

Latent inhibition (LI) occurs when a conditioned stimulus (CS) is presented initially without consequence and when later paired with an unconditioned stimulus (US), its subsequent ability to evoke a conditioned response (CR) is impaired compared to that of a novel CS (Lubow & Moore, 1959). This effect has been demonstrated in many kinds of conditioning paradigms (Lubow, 2009).

A related consequence of pre-exposing a stimulus is to reduce its effectiveness in overshadowing conditioning of a target stimulus. While almost all experiments examining this type of pre-exposure effect have employed a simultaneous compound (Holmes & Harris, 2010), the experiment reported here used a serial overshadowing procedure. Thus, using a conditioned taste aversion procedure, the potentially overshadowing taste was introduced during the delay between presentation of the target taste and lithium chloride (LiCl) injection. Such a procedure was first employed by Revusky (1971) using saccharin as the target taste followed by a vinegar solution as the overshadowing stimulus. The presence of vinegar was found to reduce conditioning of an aversion to saccharin, an example of serial overshadowing that has been replicated in several subsequent studies (Bond, 1983; Cannon et al., 1985; Kaye et al., 1988; Kwok et al., 2012).

Revusky (1971) also included a brief report of an experiment in which he pre-exposed his rats to vinegar prior to using this solution as the potentially overshadowing stimulus. Pre-exposed vinegar was less effective in overshadowing the saccharin aversion than when the vinegar solution was novel. To our knowledge, the present experiment is the first since then to examine the effect of pre-exposing a potentially overshadowing stimulus in long delay taste aversion or, for that matter, in any other form of serial overshadowing.

A theoretically important property of LI is its sensitivity to the length of the interval between pre-exposure of a stimulus and its use as a CS in Pavlovian conditioning. Thus, standard LI is typically reduced as the interval between pre-exposure and conditioning is increased (e.g. Aguado et al., 2001, 1994). Delay-induced attenuation of LI has not, however, always been reported (e.g. Alvarez & Lopez, 1995; De la Casa & Lubow, 2002). The more usual finding that a long delay between pre-exposure and conditioning attenuates the effects of pre-exposure has been important for accounts of LI proposing that stimulus pre-exposure causes failure in a post-conditioning test to fully retrieve CS-US associations (e.g. Aguado et al., 1994; Bouton, 1991, 1993; Kraemer & Spear, 1992; Westbrook et al., 2000).

The above accounts were developed to explain temporal effects in standard LI. Whether the same effect of passage of time is found with an overshadowing test does not appear to have been tested.

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As noted above, not all studies have reported loss of LI over a delay interval and so it was considered important to test whether the effect can be found with a serial overshadowing procedure. Consequently, the aim of the present experiment was to examine how a delay between pre-exposure and conditioning would affect the extent to which the pre-exposed stimulus (a hydrochloric acid solution; HCl) overshadowed the novel target stimulus (sucrose). Three interference groups received HCl in the interval between sucrose and a lithium injection, where the crucial manipulation was the nature of the pre-exposure to HCl: either nine days before conditioning (Distal), immediately before conditioning (Proximal), or no pre-exposure at all (Novel). A fourth group (Control) was presented with water instead of the interfering taste. The control rats were split into two subgroups that received proximal or distal HCl pre-exposure to ensure that HCl pre-exposure itself was not a factor for differences in consumption at test. It was predicted that greater overshadowing would be obtained when there was a short gap (Proximal condition) between pre-exposure and conditioning than with a long gap (Distal condition).

1. Method

1.1. Subjects

Thirty-two male naive Albino Wistar rats, aged 70 days with a mean weight of 342 g (range 298–374 g) were purchased from ARC Perth. They were group-housed, 4 per cage, and had unrestricted access to chow throughout. In an initial 4-day period access to water was progressively restricted from 4 h to 30 min. From then on rats were given 30-min water in their home cages following each daily session.

1.2. Apparatus

A separate laboratory contained sixteen transparent acrylic cages, 33 × 21 × 19 cm high, serving as drinking chambers. Flooring was commercial cat litter. Plastic drinking bottles of 100-ml capacity with a stainless steel ball-bearing spout could be attached though the roof. Fluid intakes were measured by weighing bottles to the nearest 0.1 g before and after each session. The target taste was an 8% sucrose solution and the interfering taste was a .005 M HCl, both mixed with tap water.

1.3. Procedure

Experimental sessions were conducted daily and always took place in the drinking chambers. During pre-training on Days 1–3 water access was progressively reduced from 20 to 10 min. From then on all sessions lasted 10 min, unless otherwise specified below. Groups ($n = 8$) were matched for water intake on Day 3.

In the eleven pre-exposure sessions unlimited access to a solution was given. On Days 4 and 5 rats in Group Distal and half the Control rats were given HCl, while all other rats were given water. This was followed by 7 days of water consumption (Days 6–12) for all rats. On Days 13 and 14 rats in Group Proximal and the remaining Control rats were given HCl, while all other rats were given water. Two days of such pre-exposure were given in case HCl consumption in the first session was particularly low due to neophobia. No pre-exposure was given to Group Novel. These rats received daily water sessions for the entire pre-exposure phase.

In the single conditioning session (Day 15) all rats were given 5-min access to 8 ml of sucrose followed 65 min later by an intraperitoneal injection of 0.15 M LiCl at 10 ml/kg body weight. The groups differed as to the 7 ml of fluid for 5 min they were given 50 min after sucrose: Groups Distal, Proximal and Novel were given HCl, while Group Control was given water. On Days 16–17 all rats received water. On Days 18–19 rats were given effectively unlimited access to sucrose and on Days 20–21 were given unlimited access to HCl.

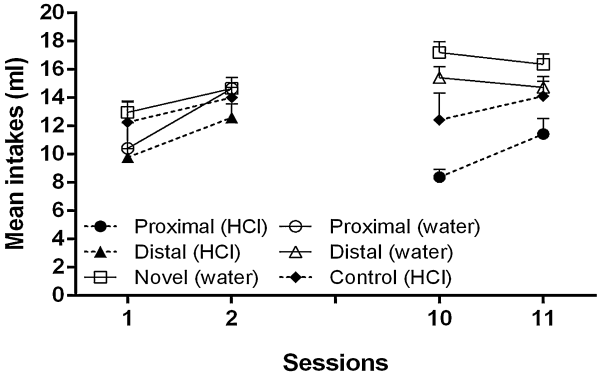

Fig. 1. Mean intakes (plus SEMs) during the first and second, and tenth and eleventh sessions during pre-exposure. HCl intakes of both the Proximal and Distal groups can be compared with their corresponding water intakes. Group Novel received only water throughout pre-exposure while HCl intakes are shown for the Control Group.

2. Results

The four groups did not differ in water intake on the final pre-training session (Day 3), $F < 1$, when the mean (and SEM) intakes were: Distal, 14.5 (0.4) ml; Proximal, 13.0 (1.0) ml; Novel, 13.8 (0.5) ml; and Control, 14.4 (1.4) ml. These intakes were compared with water intakes on Day 17 (immediately prior to the first sucrose test) as a check on whether there might be differences in context conditioning across the groups. Mean (and SEM) intakes on Day 17 were: Distal, 16.2 (0.7) ml; Proximal, 15.3 (0.7) ml; Novel, 16.5 (1.0) ml; and Control, 15.7 (1.1) ml. A mixed 4 × 2 ANOVA, with Group and Session as factors, detected a main effect of Session, such that rats increased their drinking from Day 3 to Day 17, $F(1,28) = 13.19$, $p = .001$, but no main effect of Group or their interaction was found, Fs < 1.

Intakes on Days 4, 5, 13 and 14 are shown in Fig. 1. Proximal and Distal rats that received HCl pre-exposure on Days 4–5 and Days 13–14 respectively, drank similar amounts of HCl, $t(14) = 1.55$, $p > .05$.

Sucrose intakes in the single conditioning session and two test sessions are shown in the left panel of Fig. 2. Intakes of sucrose in the conditioning session were similar across the four groups; a one-way ANOVA of sucrose consumption failed to reveal any group differences, $F(3,28) = 2.33$, $p > 0.05$. Test intakes of sucrose were examined in a repeated-measures ANOVA with Group and Session as variables. This revealed both a main effect of Session, $F(1,28) = 154.99$, $p < .001$, a main effect of Group, $F(3,28) = 14.18$, $p < .001$, but no significant interaction between Group and Session, $F(3,28) = 3.25$, $p > .05$. Planned orthogonal contrasts on mean intakes over the two tests sessions were undertaken. These revealed, first, that the pooled results of the three interference groups (Proximal, Distal and Novel) given HCl drank more sucrose than the Control group, $F(1,28) = 32.29$, $p < .001$, demonstrating serial overshadowing; second, that the HCl-preexposed groups (Distal and Proximal) drank more than Group Novel, $F(1,28) = 4.59$, $p = .041$; and, finally, that Distal rats consumed more sucrose than Proximal rats, $F(1,28) = 5.64$, $p = .025$.

Test intakes of HCl are shown in the right-hand panel of Fig. 2. A repeated measures ANOVA with Group and Session as variables revealed both a main effect of Session, $F(1,28) = 16.61$, $p < .001$, a main effect of Group, $F(3,28) = 11.63$, $p < .001$, but no significant interaction between Group and Session, $F(3,28) = 2.25$, $p > .05$. Again, mean intakes over the two HCl sessions were examined.