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Social context-switch effects on the reacquisition of appetitive responses in rats



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ABSTRACT

It is widely accepted that the presence of one animal can influence what another learns. The present experimental series explored the role of social context in the retrieval of extinguished instrumental responses. A new experimental task with rats to study operant responses in groups was used. During acquisition, all rats were trained to approach the spout of a bottle to drink a sweet solution. Then, rats underwent extinction. Finally, a reacquisition test was conducted. A slow reacquisition was found when the social context of extinction and test were the same. However, when rats were tested in a social context different from extinction (using the same rats from acquisition or new ones) rapid reacquisition was observed. The present data suggests a parallelism between social and physical contexts.

1. Introduction

Behavior never occurs in a vacuum because a background or context is always present. For animals that live in groups, behavioral processes take place while they are surrounded by others (e.g., Heyes, 2012). Thus, the presence of conspecifics has been recognized as a social context (e.g., Dall, Giraldeu, Olsson, McNamara, & Stephens, 2005). Several findings suggest that social contexts modulate expression of some behaviors such as aggression (e.g., Ishikawa & Miura, 2012), pain (Guesgen, Beausoleil, Minot, Stewart, & Stafford, 2014), vigilance (Favreau et al., 2015) and courtship display (O'Loughlen & Rothstein, 2010). However, evidence that shows the role of social context in the recovery of memories is scarce (Nowak, Werka, & Knapska, 2013).

One question that might be very useful to investigate is whether social context can affect memory in the renewal effect. Given that renewal is the recovery of an extinguished behavior produced by changes in context, the study of renewal has been key to understanding the relation between context and memory retrieval. In a typical renewal preparation, one behavior is trained in one distinctive context A (physical features of the Skinner box) and then followed by its extinction in a different context (B); returning the subject to the original context renews the behavior (i. e., ABA renewal; Bouton & Bolles, 1979; Todd, 2013; Vila & Rosas, 2001). Moreover, renewal is often reported when acquisition, extinction and testing take place in three different contexts (i. e., ABC renewal; Bouton & Swartzentruber, 1986; Thomas, Larsen, & Ayres, 2003; Üngör & Lachnit, 2008). Thus, renewal shows that extinction does not reflect unlearning because extinguished responses can be observed simply by removing the subject from the extinction context.

Most importantly, another valuable issue that research on renewal has highlighted is the proposal that several stimuli could play the role of contexts. In addition to external contexts (such as the features of an operant chamber or a room; Bouton & Peck, 1989; Mystkowski, Craske, & Echiverri, 2002), researchers have shown renewal using internal contexts such as mood states provoked by drugs or the passage of time (Bouton & García-Gutiérrez, 2006; Lattal, 2007; Rosas & Bouton, 1998; Spear, 1978). In a similar manner, experiments that used fictional tasks presented on computer screens manipulated cognitive contexts with human participants

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(Nelson, Sanjuan, Vadillo-Ruiz, Pérez, & León, 2011; Rosas & Callejas-Aguilera, 2006).

Thus, the main goal of the present experimental series was to assess whether the renewal effect could be found by changing only the *social context* provided by conspecifics. We used a novel appetitive task involving rats in groups (social context) approaching the spout to drink a sweet solution, then extinguishing the approach performance (in groups or individually), and then testing for renewal in groups or individually. In Experiment 1, we assessed ABA renewal by conducting acquisition in groups of four rats (Context A), extinction alone (Context B), and returning the subjects to their original social context (A). In Experiment 2, we replicated the findings of Experiment 1 but used a control group (AAA) where acquisition, extinction and test were conducted in the same “social context” (groups of four rats). Finally, the third experiment explored whether renewal could be found when testing was conducted with rats that never acquired the response altogether. (i. e., ABC renewal).

2. Experiment 1

It has been accepted that the presence of others can affect the behavior of an animal. For example, learning what to eat, how to court, and what to fear are strongly modulated by social learning (Galef & Laland, 2005; Langford et al., 2006; Zajonc, 1965). Recent findings of Nowak et al. (2013) suggest that memories are modulated by the presence of others. In their Experiment 1, they trained pairs of mice to fear a tone in a particular set of external stimuli (Context A). Then, one mouse in each pair received extinction in a different context (B). After several extinction trials, mice received tone presentations in the extinction context (B). Their performance was similar to extinction when mice experienced testing alone. However, when mice were tested with the fearful cage mates, they showed a fear response to the tone again.

Nowak et al. (2013) explained that the presence of a conspecific renewed the aversive memory. However, it is important to note that assuming that the mouse could be acting as a context is difficult to claim based on their experimental design because the authors simultaneously manipulated external context and the presence of another mouse. In the present experiment we examined the renewal effect by changing only the social context of the rats.

Moreover, given that the renewal of goal-directed responses has implications for extinction-based therapies of voluntary behaviors (Bouton, Winterbauer, & Vurbic, 2012; Crombrag, Bossert, Koya, & Shaham, 2008), the present experiments presented a novel appetitive behavioral task to study the renewal effect of free operant behaviors. Two groups of rats were placed in groups of four rats (context A) within a cage. In this cage, they were allowed to perform an instrumental response (approaching the spout of a bottle) to drink a sweet solution (reinforcer). Then, extinction took place (empty bottle) in the same cage used in acquisition but in a different social context. Each rat received extinction alone (context B). Finally, both groups received a reacquisition test (bottles were filled with sweet solution). Rats in the ABA group were tested in their original social context (groups of four rats) while the ABB group was tested in the extinction social context (alone). Even though the bottles were refilled with the sweet solution, the ABA group showed higher levels of performance than ABB group.

2.1. Subjects

Twenty-four female Wistar rats (12 per group) weighing on average 356 g were used. The rats were about three months old and experimentally naïve at the beginning of the experiment. They were housed in groups of four in methacrylate cages (24 × 50 × 40 cm, H x W x D) inside a room maintained on a 12–12 h light dark cycle (onset of lights at 07:00 and offset of lights at 19:00). Each rat was marked daily on its tail with a felt pen that left a distinctive colored mark. Rats were handled for three weeks before the experiment. Temperature of the colony room was kept between 20 and 25 °C, while humidity was kept within the 45–60% range. All subjects had free access to food and water throughout the experiment.

2.2. Apparatus

A methacrylate testing cage measuring 20 × 48 × 38 cm (H x W x D) was placed on a table inside a laboratory room. The lid consisted of thirty-four 0.2-cm diameter stainless steel rods spaced 1 cm apart. The floor of the cage was covered with a white vinyl acetate sheet. The sheet was replaced daily. After each session, the cage was cleaned with a 70% alcohol solution.

A solution of 3.94-molar sucrose (150 ml kg) diluted in distilled water was used, and was administered in 100-ml bottles with a standard steel spout.

2.3. Procedure

The present experimental protocol was approved by the Ethical Committee of the Faculty of Psychology of the National University of Mexico.

Sessions were conducted on successive days at the same time each day (07:00 a.m.). The experiment was composed of three phases: Acquisition, Extinction and Testing (see the upper part of Table 1). During the first day, subjects received 10 min of acclimatation to the cage. Rats were transported to the laboratory room in their home cages. All rats received the acclimation in groups of four (rats were always cagemates). Rats were placed inside the cage one by one. After the last rat was placed inside the cage, it was closed with a wire lid. During the first 6 min, rats were merely exposed to the cage, but during the last 4 min four bottles with the sweet solution were introduced through the lid and the rats were allowed to drink. The bottles were 8 cm apart, and the spouts of the bottles were 10 cm above the floor.

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