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Research report

Conditioned place preferences in humans using secondary reinforcers

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HIGHLIGHTS

- We examined conditioning to a virtual room paired with arbitrary point rewards.
- Participants rated the points-paired room as significantly more enjoyable.
- Participants explicitly prefer the room previously paired with the points.
- This model can elucidate mechanisms underlying internet and gaming addictions.

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ABSTRACT

The goal of this experiment was to examine whether a conditioned place preference could be established in humans using a secondary reinforcer that provided little obvious reward to the participants. Two experiments were conducted to answer this question. In Experiment 1, 244 undergraduates were placed into a VR environment consisting of two visually distinct rooms connected by a door. Throughout the experiment, one room was randomly paired with occasional point rewards while the other unique room was never paired with rewards. Participants received thee pairings in each room. After a short break, a test session was administered, and participants were given free access to the entire VR environment and no point rewards were administered. On the test day, we observe that participants displayed a significant CPP for the room paired with points, as evidenced by significant differences in rating each of the rooms in terms of enjoyment. In Experiment 2, 77 undergraduates were tested using a biased conditioning approach in which an initial test session was conducted to obtain the participant's preferred room bias, and then the least-preferred room was designated as the points reward room for each participant. Using this biased conditioning approach, participants spent a significantly greater amount of time in the points-paired room. In this case, participants showed preferences based on explicit and implicit measures. These results suggest new approaches to examine the role of secondary reinforcers in nontraditional addictions such as internet, gaming, and gambling dependencies.

1. Introduction

Tasks designed to assess reward and reinforcement often use primary reinforcers, such as food, water, sex, social stimulation, or drugs [21]. One such task is a conditioned place preference task (CPP) in which an animal is given a reward while confined to one of two unique compartments for a fixed amount of time. Later, the animal is given a placebo substance and is confined in the other distinct compartment. These pairings are often repeated multiple times to strengthen the relationship between the context and the presence or absence of reward. Following these pairings is a test session in which the animal is given free access to both chambers on a reward-free day, and it is observed that the animal typically shows a strong preference to dwell in the chamber where the reward was paired, even though that reward is no longer present [16].

The CPP paradigm allows for testing of behavior when there are no rewards present, and it has been shown that the resulting behavior within the CPP is not identical to what would be predicted from self-administration studies [18], suggesting that different mechanisms are involved in these types of paradigms. Recently, the CPP has been extended to humans, and a number of studies have shown

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that humans can be conditioned to prefer a room that was paired with primary reinforcers such as D-amphetamine [6], music [15], or food [1].

Behavior also can be motivated by a number of secondary reinforcers, such as money, praise, or approval [10]. Unlike primary reinforcers which tend to be biological and thus reinforce behavior innately, secondary reinforcers obtain their strength by being associated, either directly or indirectly, with primary reinforcers. Money is a common example of a secondary reinforcer since it can be used to acquire primary reinforcers, like food. However, if money no longer had worth, it would lose its strength as a secondary reinforce. Interestingly, however, humans engage in a number of behaviors that seem to be motivated almost entirely by secondary reinforcers that are never actually paired with a primary reinforcer. One classic example of this is video games, in which people engage in repetitive operant responses for reinforcers which are concepts such as advancement to the next level, more points on the scoreboard, additional lives, or collecting various objects within the virtual world. Offhand, it is difficult to track the reinforcement history between these concepts within a gaming environment and any primary reinforcer. Certainly, even if the reinforcement is something as abstract as achievement, challenge, or competition, it is not clear whether these types of reinforcers elicit behavior similar to primary reinforcers in CPP or other paradigms.

Self-administration and CPP paradigms are routinely used to provide insight into drug addictions [3–5,12,14]. However, with an increased awareness of nontraditional addictions such as gambling, video game, and internet addictions, it is important to ascertain which learning phenomena are shared between primary reinforcers and these nontraditional reinforcers. To the extent that we understand the factors and phenomena involved in learning about secondary reinforcers, we are better able to design treatment plans aimed at minimizing or extinguishing undesirable behaviors, such as gaming or internet addictions. Additionally, it is our goal that exploring and understanding the conditions in which a CPP is evident in humans will help guide and inform future research devised at directly the neural mechanisms underlying such behaviors.

Accordingly, we used our VR CPP task which is logically and procedurally identical to that used with rodents [1]. Throughout the experiment, in one of the rooms, a variable number of arbitrary points were occasionally rewarded, independent of participants' actions. These points had no explicit association with any obvious primary reinforcer, and the points did not provide the participant with anything once the experiment was completed. We hypothesized that on the test day, participants would spend more time in the room previously paired with the point rewards, that they would rate this room as more enjoyable, and they would choose this room as more preferable in a forced-choice test.

2. Method

2.1. Experiment 1

2.1.1. Participants

244 University of Connecticut undergraduates (avg. age = 19.2 years; SD = 2.6; 156 females) were recruited from Introductory Psychology classes for this experiment. Participants received class credit for their participation. Approval for this study was obtained from the University of Connecticut Institutional Review Board.

2.1.2. Apparatus

An IBM-compatible computer with a SVGA color monitor was used for testing. Participants seated at the computer navigated through the virtual environments by manipulating a joystick. A speaker connected to the computer was used to provide auditory feedback.

2.1.3. Procedure

Upon arrival, participants were asked to complete a brief demographics questionnaire consisting of questions regarding age, sex, and items assessing their degree of video game experience. After being guided through a brief tutorial on how to interact with the virtual environment using a joystick, participants received a 90 s practice session in which they were placed in an empty VR room. To encourage exploration in both the practice and experimental sessions, a coin appeared periodically in pseudo-random locations and participants were required to locate and collide with the coin. Participants were allowed to ask questions at any time.

Each participant completed six, five-minute experimental pairing sessions in a virtual environment following the practice session. A short, 1-min break followed each session. Throughout the pairing sessions, there was a counter/scoreboard at the top of the VR world. The environment consisted of two visually distinct rooms connected by a neutral hallway (Fig. 1). In each of the pairing sessions, the participants were confined to one of the two rooms and were to explore the environment with the joystick. In one room, 50–100 points were pseudo-randomly added to the counter. Approximately 17 of these point increments were administered in a session. In the opposing room, the counter remained at 0 for the entire session. The orders of the pairing sessions were counterbalanced across participants. After all six pairing sessions were completed, a 10-min break was given before the test session.

For the test session, participants were placed in the same virtual environment and started in the neutral hallway. They had access to both rooms for five minutes. Points were not administered on the test session.

After the test, participants were given a survey. Questions asked which of the two rooms they preferred and how much they enjoyed each room on a scale of 1–100 (1 being "not at all"). After completing this survey, participants were debriefed, and dismissed.

3. Results

3.1. Experiment 1

There was no significant difference in time spent in the points-paired room ($t(243) = 0.41$, $p > 0.1$). However, in ratings of how enjoyable each room was after testing, the points-paired room was rated as significantly more enjoyable than the no-points room ($t(230) = 2.50$, $p < 0.01$; Fig. 2). Additionally, in a forced choice of room preference, significantly more participants chose the points-paired room as their preferred room (140 of 238 participants chose the points-paired room; $X^2 = 7.41$, $p < 0.01$; Fig. 2).

3.2. Summary

Experiment 1 results indicate a CPP for ratings of the rooms and for a forced-choice of the rooms. However, there were no differences in time spent in the rooms on the test day. In our previous work using chocolate M&Ms as a reward, we found a large CPP in time spent between the rooms on the test day. Dwell time is the standard measure used in nonhuman research and is a nonverbal measure. Using identical measures as nonhuman researchers is advantageous when designing translational research.

Our lab has used a randomized assignment of room pairings with reward to elicit a CPP [1], but other labs have used a biased-pairing approach, in which an initial test session is administered to determine room preference, and then the reward is paired with the least-preferred room [22]. To examine whether a biased-pairing