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Learned, instructed and observed pathways to fear and avoidance

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ABSTRACT

Background and objectives: Conditioned fear may emerge in the absence of directly experienced conditioned stimulus (CS) – unconditioned stimulus (US) pairings. Here, we compared three pathways by which avoidance of the US may be acquired both directly (i.e., through trial-and-error instrumental learning) and indirectly (i.e., via verbal instructions and social observation).
Methods: Following fear conditioning in which CS+ was paired with shock and CS− was unpaired, three separate groups of participants learned by direct experience (Instrumental-learning), were instructed about (Instructed-learning), or observed (Observational-learning) a demonstrator performing an avoidance response that canceled upcoming US (shock) presentations. Groups were then tested in extinction with presentations of the directly experienced CS+ and CS−, and either a novel CS (Instrumental and observational groups) or an instructed CS (instructed-group).
Results: Similar to instrumental learning, results demonstrate that avoidance may be acquired via instructions and social observation in the absence of directly learning that an avoidance response prevents the US. Retrospective US expectancy ratings were modulated by the assumed presence or absence of avoidance. Overall, these findings suggest that instrumental-, instructed-, and observational-learning pathways to avoidance in humans are similar.
Limitations: Alternative experimental designs would permit direct comparison between the pathways for stimuli with no prior experience of fear conditioning, and trial-by-trial US expectancy ratings would help track the modulation of fear by avoidance pathway.
Conclusions: Instrumental-, instructed-, and observational-learning pathways of avoidance are similar. Findings may have implications for understanding the etiology of clinical avoidance in anxiety.

1. Introduction

The fear-conditioning paradigm is widely used to investigate the behavioral processes underpinning anxiety (Beckers, Krypotos, Boddez, Effting, & Kindt, 2013; Boddez, Baeyens, Hermans, & Beckers, 2014). In this paradigm, a neutral stimulus (the conditioned stimulus; CS+), is repeatedly paired with an aversive, unconditioned stimulus (US), such as a brief electric shock, and comes to elicit a conditioned fear response (CR), in the absence of the US. Another cue (CS−) is never paired with shock and as a result takes on the functions of safety relative to the threat properties of the CS+. An instrumental avoidance response made in the presence of the CS+, which cancels upcoming US presentations, may then be added to this procedure to study acquisition and maintenance of avoidance. The behavioral dynamics of fear-conditioning paradigms such as this are generally considered to be important translational models of the acquisition of debilitating fear and avoidance behavior in anxiety disorders (Dymond & Roche, 2009; Vervliet & Raes, 2013).

It is notable that individuals with anxiety do not always report prior direct conditioning episodes like those described in fear-conditioning studies (Beckers et al. 2013; Coelho & Purkis, 2009; Muris, Merckelbach, de Jong, & Ollendick, 2002; Ost & Hugdahl, 1983). To account for these cases, Rachman (1977) first postulated alternative pathways to fear. That is, Rachman argued the environment provides other, indirect means of learning fear-relevant information, which can then be used to avoid potential harm, without the need to directly experience either the aversive event or the

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behavior that prevents it (here, defined as differential Pavlovian fear-conditioning and instrumental learning of avoidance). These indirect pathways include *verbal instruction* and *social observation.* The verbal instruction (or information) pathway relies on knowledge provided by another individual about CS–US pairings or the role of instrumental avoidance in canceling US delivery. The social observation pathway relies on the transmission of information obtained by viewing another individual experience the relevant CS–US pairings and performing the instrumental avoidance response. To date, limited research has been conducted on Rachman's pathways to fear account and those studies that have been conducted have focused near-exclusively on fear (Askew & Field, 2007; Field, Argyris, & Knowles, 2001; Kelly, Barker, Field, Wilson, & Reynolds, 2010; Muris & Field, 2010; Olsson & Phelps, 2004, 2007). For example, Olsson and Phelps (2004) compared fear learning acquired through direct (CS–US pairings) and indirect experience (instructions and observation) and found similar levels of fear learning across all three groups, as measured by skin conductance response (SCR). These findings have been supported by studies using functional magnetic resonance imaging (fMRI) identifying activation in the amygdala for both direct and observed pathways (Olsson, Nearing, & Phelps, 2007) and correlations between SCR and amygdala activation during instructed pathways (Phelps, Connor, Gatenby, Gore, & Davis, 2001), suggesting a common neural circuitry underlying direct and indirect pathways to fear.

Avoidance is a basic coping strategy driven by the anticipation of threat and/or further fear (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Surprisingly little is known about the potentially different pathways by which avoidance may be acquired and whether they result in equivalent levels of maintained avoidance under extinction. There is, however, a growing body of evidence to suggest that avoidance can be acquired vicariously, in the absence of either direct CS–US pairings or experience of the avoidance response canceling the US, through one such pathway: verbal information (Dymond, Schlund, Roche, De Houwer, & Freegard, 2012; see also, Olsson & Phelps, 2004; Phelps et al., 2001). Dymond et al. (2012) not only demonstrated the acquisition of avoidance responding via learned and instructed pathways, but also that the proportion of avoidance was equivalent between these routes. In their study, a fear-conditioning procedure was employed in which one CS was paired with shock (CS+) and another was not (CS−). Using a between-subjects design, one group then directly learned that avoidance canceled an impending US and another group were *instructed* that avoidance canceled the US. The latter group were also presented with a second instructed CS, which participants were verbally instructed would be followed by a US. The two groups reported greater shock expectancy ratings for the CS+ relative to the CS− and made a greater proportion of avoidance responses to the CS+ than the CS−. Furthermore, the instructed group did not differ in avoidance or ratings towards the instructed CS compared to the directly learned CS+. These results show that despite the different pathways by which avoidance was acquired, avoidance levels did not differ.

The present study sought to extend the findings of Dymond et al. (2012) by including an observed avoidance pathway. This would allow for a well-controlled simultaneous comparison of the three major pathways of avoidance acquisition with a single paradigm. The inclusion of an observed pathway is important because the behavior of others provides a rich source of information that individuals use to model their own behavior in order to avoid potential harm. Social fear learning affords the transmission of biologically relevant information between individuals and is a likely driving force in human evolution, which has allowed humans to readily understand and imitate the actions of others (Boyd & Richerson, 1985; Boyd, Richerson, & Henrich, 2011). This idea is supported by evidence from the fear conditioning literature which shows that observing the arm movement of another person in response to a shock, can generate fear. Interestingly, this was only the case when the observer believed that it was caused by a shock and not when the model's arm moves without a shock or when a shock is delivered without arm movements (Berger, 1962; see also, Helsen, Goubert, & Vlaeyen, 2013). This suggests that observing an actor avoid an aversive outcome by making an avoidance response in the presence of threat-related cues would result in an understanding of those cues as being potentially threatening leading to the same level of avoidance behavior to that observed (Olsson et al., 2007).

We predicted that groups would not differ following fear conditioning; retrospective US expectancy ratings for CS+ were expected to be greater relative to CS−. Furthermore, after avoidance learning, we expected all groups to make a greater proportion of avoidance responses to CS+ relative to CS−, give lower retrospective US expectancy ratings in the assumed presence of avoidance and higher ratings in the assumed absence of avoidance to CS+ relative to CS−. We also predicted that this trend would be maintained during extinction testing and that levels of avoidance and US expectancy ratings occasioned by either a novel CS or an instructed CS would not differ.

2. Method

2.1. Participants

Eighty-three participants, 22 men and 61 women (*M* age = 21.16, *SD* = 4.64) were randomly assigned to one of three groups: Instrumental-learning, Instructed-learning, and Observational-learning. Due to a programing error, one participant's behavioral and ratings data from the Instructed-learning group was removed from analysis of the avoidance learning and test phases. One participant's behavioral data from the Instrumental-learning group was also removed from analysis of the avoidance learning and test phases due to a programing error. Two participants were removed from the Instrumental-learning group for failing to meet criterion during avoidance learning. The final sample sizes included participants who contributed to the analysis of one or more dependent measures: Instrumental-learning ($n = 26$; 9 men), Instructed-learning ($n = 28$; 5 men), and Observational-learning ($n = 26$; 8 men). All participants provided written informed consent and were compensated with either course credit or £5. The Department of Psychology Ethics Committee approved the study.

2.2. Apparatus and material

Stimuli consisted of three colored circles (red, blue and yellow) presented on a white background, which served as the CSs for all groups. Stimuli were presented on a 17″ computer screen with a 60 Hz refresh rate through a program written in Visual Basic.NET. Electric shocks (250 ms duration), delivered via a bar electrode fitted to each participant's non-dominant forearm, served as the US and were controlled by an isolated stimulator (STM200-1, BIOPAC Systems, Santa Barbara, CA). At the outset, all groups underwent a shock calibration procedure in which they selected a shock level that was “uncomfortable, but not painful”.

2.3. Procedure

The procedure consisted of four phases: pre-conditioning, fear conditioning, avoidance learning and extinction. All groups