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The influence of contingency reversal instructions on electrodermal responding and conditional stimulus valence evaluations during differential fear conditioning

Camilla C. Luck[a,b,*], Ottmar V. Lipp[a,b]

[a] School of Psychology and Speech Pathology, Curtin University, Australia
[b] ARC-SRI: Science of Learning Research Centre, Australia

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ABSTRACT

In differential fear conditioning, the instruction that the conditional stimulus (CS) will no longer be followed by the unconditional stimulus (US; instructed extinction) reduces differential physiological responding (expectancy learning) but leaves differential CS valence evaluations (evaluative learning) intact. This dissociation suggests that expectancy, but not evaluative learning, responds to contingency instructions. Alternatively, as instructed extinction removes the threat of receiving the US, this dissociation could be caused by a drop in participants' arousal levels which could render the physiological indices of fear learning less sensitive. To test this alternative explanation, we examined the impact of an instructed reversal manipulation on electrodermal responding and CS valence evaluations. After instructed reversal, electrodermal responses to CS+ decreased and electrodermal responses to CS− increased, in the instruction, but not in the control group. In addition, there was some evidence for an instruction dependent change in CS valence, however, this finding seems limited to changes in CS+ valence and possible explanations for this finding are discussed. Overall, the study confirms that the dissociation detected in instructed extinction studies is unlikely to be caused by a drop in the participants' arousal levels.

1. Introduction

During classical fear conditioning, a neutral conditional stimulus (CS) is paired with an aversive unconditional stimulus (US). After repeated pairings, the CS generates an expectation that the US will occur (Lipp, 2006) and acquires negative valence (De Houwer, Thomas, & Baeyens, 2001). Dissociations between the predictive (expectancy) and the emotional (evaluative) components of human fear learning have been reported in response to instructed extinction (see Luck & Lipp, 2015a), generating debate about whether these components reflect different underlying mechanisms or operate under different boundary conditions.

Understanding the mechanisms underlying expectancy and evaluative learning is important from a number of viewpoints. Residual negative valence has been associated with higher relapse rates after fear extinction, and prior research suggests that CS valence may resist current fear and anxiety treatments (Hermans et al., 2005; Luck & Lipp, 2015a; Zbozinek, Hermans, Prenoveau, Liao, & Craske, 2015). From a theoretical perspective, there is some debate about whether Pavlovian conditioning

* Corresponding author at: School of Psychology and Speech Pathology, Curtin University, GPO Box U1987 Perth WA 6845, Australia.
E-mail address: c.luck@curtin.edu.au (C.C. Luck).

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can be considered the result of propositional processes alone or whether both propositional and associative processes co-occur during Pavlovian conditioning. According to single-process propositional theories, Pavlovian conditioning is the result of the formation and truth evaluation of non-automatic propositions regarding the CS-US relationship. Dual-process theories propose that automatic associations between CS and US representations also develop during CS-US pairings (see De Houwer, 2009 for a review and discussion of these theories). Some theories (see Baeyens, Eelen, Crombez, & Van den Bergh, 1992) propose that evaluative and expectancy learning are two different types of Pavlovian conditioning, both based on the formation of stimulus representations in memory. According to these theories, expectancy learning concerns the learning of predictive relationships in which the CS becomes a signal that the US will occur, whereas, evaluative learning concerns the learning of referential relationships, in which the CS becomes a stimulus which activates the mental representation of the US without generating an expectancy that the US will occur.

Dissociations between evaluative and expectancy learning in response to the same experimental manipulation could hold the key to understanding whether or not they have the same underlying mechanism. Expectancy and evaluative learning can be examined simultaneously using a differential fear conditioning paradigm. In this paradigm, one CS, the CS+, is repeatedly paired with the US, and another, the CS−, is presented alone. Electrodermal responding, a physiological index which is very sensitive to the CS-US contingency, and CS valence evaluations are frequently collected as dependent measures, and both can be measured continuously throughout conditioning. Differential electrodermal responding and differential valence evaluations develop across training trials, such that CS+ elicits larger electrodermal responding and is rated as less pleasant than CS−. During extinction, CS+ and CS− are both presented alone and eventually the differential electrodermal responding and valence evaluations reduce and return to baseline levels. Using this paradigm, Luck and Lipp (2015a; 2015b) reported that instructed extinction, a manipulation which involves informing participants prior to the extinction phase that the US will no longer occur, results in the immediate elimination of differential electrodermal responding (and fear-potentiated startle), but leaves differential valence evaluations intact. These results can be interpreted to indicate that expectancy learning responds to the instructed CS+− no US contingency immediately, but that evaluative learning continues to reflect the valence acquired during acquisition, requiring further Pavlovian training to reduce the negative CS+ valence. This interpretation is consistent with literature examining US expectancy and CS evaluation in picture–picture evaluative conditioning paradigms (Lipp, Mallan, Libera, & Tan, 2010). Alternatively, the elimination of differential physiological responding after instructed extinction could occur because participants' general arousal level is reduced after being informed that they will not receive US presentations anymore. Electrodermal responding is also sensitive to stimulus valence but only under conditions of high arousal (Bradley, Codispoti, Cuthbert, & Lang, 2001). As CS evaluations are not sensitive to the overall level of arousal, the dissociation between physiological and evaluative indices of fear learning could reflect the differential sensitivity of electrodermal responding and CS evaluations to changes in arousal.

An instructed reversal manipulation (Grings, Schell, & Carey, 1973) involves informing participants after acquisition training, that the contingencies will switch, such that CS+ will no longer be followed by the US, but that the US will now be presented after the CS−. This manipulation is unlikely to cause a drop in participants' overall arousal because of the ongoing threat of receiving the US and therefore provides a test of the arousal account described above. While instructed extinction involves examining safety instructions to the CS+, instructed reversal allows for the examination of both safety instructions to the CS+ and danger instructions to the CS−, providing a more comprehensive examination of the effects of instructions.

Effects of the instructional manipulation can be examined across the entire reversal phase or on the very first trial after the instruction was provided. Although differences between the instruction and control groups may be observed in both cases, the two assessments can indicate different processes. Instruction effects detected across the entire reversal phase could indicate that instructions facilitate learning of the new contingency (Instruction × Training interaction) and not necessarily a reversal change caused by the instructions alone. Differences on the first reversal trial, however, can be considered the effects of the instructional manipulation alone and provide for the strongest test of the instructed reversal manipulation. The nature of the first trial (CS+/CS−) presented after instruction should also be controlled because experiencing a contingency change on the first reversal trial (i.e. unreinforced CS+ or reinforced CS−) could lead participants to infer that the experimental contingencies have changed.

Using a differential fear conditioning paradigm, we examined whether electrodermal responding and trial-by-trial CS valence would respond to an instructed reversal manipulation. To be able to examine the effects of instructed reversal without any influence of additional learning (or inference), half of the participants received a CS+ as the first reversal trial and the others received a CS− as the first reversal trial. We hypothesized, based on the results of Luck and Lipp (2015a,b), that electrodermal responding to CS+ would decrease and that electrodermal responding to CS− would increase on the first reversal trial in the instruction group but not in the control group. It was further hypothesized that CS valence would not be affected in either group.

2. Method

2.1. Participants

One hundred and forty-nine undergraduate students (95 female), aged between 17 and 43 years ($M = 23.16$) provided informed consent and volunteered participation in exchange for course credit or monetary compensation of AU$15. Partici-