

# Avoided by Association: Acquisition, Extinction, and Renewal of Avoidance Tendencies Toward Conditioned Fear Stimuli

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## Abstract

Traditional theoretical models hold that avoidance reflects the interplay of Pavlovian and instrumental learning. Here we suggest that avoidance tendencies to intrinsically neutral cues may be established by mere Pavlovian association. Following fear conditioning, in which pictures of one object were paired with shock (CS<sup>+</sup>) whereas pictures of another object were not (CS<sup>-</sup>), CS<sup>+</sup> pictures facilitated avoidance reactions and interfered with approach responses, relative to CS<sup>-</sup> pictures, in a symbolic approach/avoidance reaction time task. This was achieved without any instrumental relation between responses and CS continuation or unconditioned stimulus presentation. Moreover, those avoidance tendencies were sensitive to Pavlovian extinction (they were reduced after repeated presentations of the CS<sup>+</sup> without shock) and renewal (recovery of conditioned responding upon returning to the initial conditioning context after extinction in a different context). The present results may help us understand the self-perpetuating nature of pathological fear and anxiety.

## Keywords

avoidance, fear, learning, anxiety disorders

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Avoidance behavior is a core concomitant of normal anxiety. Nonetheless, excessive avoidance of essentially neutral situations and nondangerous entities can impair individuals' functioning and prevent confrontation with anxiety-correcting information (Barlow, 2002). Accordingly, avoidance is a key feature of several anxiety disorders (American Psychiatric Association, 2000), making it critical to understand the factors that control such behavior.

Historically, avoidance behavior has been assumed to reflect the interplay of Pavlovian and instrumental learning. According to two-factor theory (Mowrer, 1960), an initially neutral cue (conditioned stimulus; CS) that reliably precedes an aversive outcome (unconditioned stimulus; US) will come to elicit (conditioned) fear (Pavlovian component). Avoidance responses that lead to CS termination or omission will be positively reinforced by reduction of CS-elicited fear (instrumental component).

Subsequent animal research suggested that rather than CS termination, it is omission of the anticipated US that

instrumentally reinforces avoidance (Bolles, Stokes, & Younger, 1966; Seligman & Johnston, 1973). Alternative cognitive theories of avoidance learning have since been postulated, stressing the role of explicit knowledge about the CS-US association on the one hand and between the avoidance response and US-omission on the other (Declercq, De Houwer, & Baeyens, 2008; Lovibond, Saunders, Weidemann, & Mitchell, 2008). Although, unlike two-factor theory, those newer accounts are mainly concerned with primary avoidance (responses aimed at avoiding the aversive US) rather than secondary avoidance (responses aimed at escaping the fearsome CS), a common characteristic of the aforementioned avoidance theories is their reliance on a combination of Pavlovian and instrumental processes.

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Still, some findings suggest that explicit omission of an aversive outcome is not always involved in establishing avoidance behavior. Miller (1944) reported that rats, after being shocked in a maze, avoid that part of the maze in following trials, although avoidance is never explicitly paired with shock omission or termination. Such findings of CS-oriented or secondary avoidance have been invoked as an argument to retain two-factor theory's reinforcement-through-fear-reduction account of avoidance (e.g., Walker, 1987).

Here, we aim to test the possibility that, instead of relying on instrumental reinforcement through fear reduction, a CS-elicited avoidance tendency can be a direct consequence of *mere* Pavlovian learning. That is, we propose that once a CS has been established as a predictor of an aversive event and induces fear, it will automatically elicit avoidance *without* the involvement of an instrumental component (be it fear reduction or outcome omission).

This hypothesis fits with contemporary emotion theories, which propose that fear, like any emotion, is a composite of subjective experience, physiological activity, and action disposition (Mauss & Robinson, 2009). For many theorists, emotions are even primarily action tendencies (Frijda, 2010; Lang, 1985). In such a framework, the fact that a CS elicits fear after pairing with a threatening US implies that the CS also elicits an avoidance tendency—to fear *equals* to have the urge to avoid. CS-presentation prompting avoidance *behavior* then merely means that the avoidance *tendency* installed through Pavlovian fear learning is translated into overt action.

In Experiment 1, we tested whether following Pavlovian differential fear learning in which a neutral picture (CS<sup>+</sup>) was paired with an electric stimulus (shock US), the CS<sup>+</sup> would elicit an automatic avoidance tendency (relative to a stimulus never paired with shock; CS<sup>-</sup>) in a speeded approach/avoid reaction time task (AAT). Of importance, the AAT precluded all possibility for differential reinforcement of approach or avoidance: Responses had no influence on CS presentation or US occurrence. Moreover, shock electrodes were removed before the AAT, excluding any US-centered basis for CS-elicited avoidance. Also, participants equally often approached and avoided CSs in the AAT, preventing the experience of differential approach/avoidance and US-omission associations. To evaluate the automaticity of CS-elicited avoidance, we manipulated whether the stimulus dimension relevant for responding in the AAT was the same as or different from the dimension distinguishing the CS<sup>+</sup> from the CS<sup>-</sup> (see the next section).

## Experiment 1

Inherently aversive stimuli yield an avoidance tendency, revealed through symbolic approach/avoidance reaction

time tasks (Krieglmeyer & Deutsch, 2010). In such tasks, reaction times (RTs) are influenced by the congruency between the hedonic nature of the stimulus (appetitive vs. aversive) and the to-be-emitted response (approach vs. avoidance). Specifically, participants react faster on congruent trials (approaching appetitive stimuli, avoiding aversive stimuli) than incongruent trials (avoiding appetitive stimuli, approaching aversive stimuli). The difference in RTs is considered a measure of automatic action tendencies.

Here we test the idea that neutral stimuli previously paired with an aversive US will elicit, by association, a similar avoidance tendency. First, participants underwent differential conditioning with pictures of one neutral object (CS<sup>+</sup>) consistently paired with shock, whereas pictures of another object were never paired with shock (CS<sup>-</sup>). In the subsequent AAT, the same pictures were presented one by one accompanied by a manikin. Participants had to move the manikin toward or away from the pictures as quickly as possible. We hypothesized that participants would move the manikin faster away from CS<sup>+</sup> pictures than toward them, relative to CS<sup>-</sup> pictures.

To evaluate the automaticity of CS-elicited avoidance tendencies, we manipulated the stimulus dimension to which participants had to respond in the AAT. One group of participants had to make the manikin approach and avoid pictures on the basis of the same stimulus feature that discriminated the CSs (i.e., stimulus shape; relevant feature group). The other group had to respond on the basis of a feature that was irrelevant for CS<sup>+</sup>/CS<sup>-</sup> discrimination (i.e., orientation of the surrounding frame; irrelevant feature group). If avoidance is under voluntary control, it should be expressed more readily when task demands require processing of stimulus features that supposedly elicit avoidance. However, if avoidance tendencies are triggered automatically, they might be also observed when people do not explicitly have to process features that discriminate CS<sup>+</sup> and CS<sup>-</sup> to execute the AAT (Moors & De Houwer, 2006).

## Method

**Participants.** A total of 35 adults participated for course credits or monetary reward (€7). In all, 3 participants were excluded for lack of contingency awareness (see the Exit Interview section; Cornwell, Echiverri, & Grillon, 2007). (For full sample results, see the Supplemental Material available online.) The remaining 32 (23 females; mean age = 22.09 years; range = 18–31) were randomly assigned to the experimental groups.

**Stimuli and apparatus.** Pictures (50 mm × 50 mm) of a cube and a cylinder, depicted from four viewpoints against a white frame (100 mm × 100 mm), served as CS<sup>+</sup> or CS<sup>-</sup> (counterbalanced across participants).

The US was a 2-ms electric stimulation delivered through two Ag electrodes to the wrist of the nonpreferred hand (Effting & Kindt, 2007).

For the AAT, the same objects as for conditioning were used. However, the surrounding frame differed between groups. For the relevant feature group, each object was surrounded by the same frame as during conditioning. For the irrelevant feature group, objects were depicted against a landscape (100 mm × 55 mm) or portrait (55 mm × 100 mm) frame.

**CS and US measurements.** During fear conditioning, US-expectancy ratings were recorded trial by trial, within 7 s after CS onset, on a scale from  $-5$  (*certainly no electric stimulus*) to  $+5$  (*certainly an electric stimulus*).

After the AAT, participants rated the valence of the CSs (from  $-5$ , *negative*, to  $+5$ , *positive*), US pleasantness (from  $-5$ , *unpleasant*, to  $+5$ , *pleasant*), US intensity (*weak, moderate, intense, enormous, unbearable*), and US startlingness (*not, light, moderate, strong, too strong*).

**Procedure.** For a schematic overview of the procedure, see Table S2 in the Supplemental Material.

**Preparation.** After informed consent, shock electrodes were attached and US intensity was individually set at a level deemed “uncomfortable, but not painful.”

**Fear conditioning.** On-screen and oral instructions indicated that pictures of two objects would be presented; one object always followed by an electric stimulus, the other never followed by an electric stimulus. Participants were asked to learn to predict after which object an electric stimulus would occur. They indicated their expectancy on a rating scale presented at the bottom of the screen.

Each CS was presented eight times (two repetitions per viewpoint, 16 trials in total) for 8 s. On CS<sup>+</sup> trials, the US appeared 7.5 s after CS onset. Intertrial intervals (ITIs) were 15, 20, or 25 s, with a 20-s mean. CS order was semirandom (no more than two consecutive CS<sup>+</sup> or CS<sup>-</sup> trials).

Next, after a 3-min waiting period, shock electrodes were removed and the AAT started.

**AAT.** The AAT consisted of two blocks of 20 trials each (4 practice trials followed by 16 test trials). For practice trials, 2 CS<sup>+</sup> and 2 CS<sup>-</sup> pictures were randomly selected for each participant and presented once. For test trials, each CS viewpoint (4 CS<sup>+</sup>, 4 CS<sup>-</sup>) was presented twice, in semirandom order (no more than two consecutive CS<sup>+</sup> or CS<sup>-</sup> trials).

On each trial, a white manikin figure (71 mm × 95 mm) appeared centered on the bottom or top half of a

black computer screen. After 1,500 ms, a CS picture was presented, centered on the opposite half of the screen.

On-screen and oral instructions emphasized speed and accuracy. Instructions, counterbalanced across participants, differed according to group allocation and block number. Participants in the *relevant feature group* were instructed to move the manikin toward or away from each object according to its identity (i.e., cube or cylinder), with reversed instructions between blocks. Participants in the *irrelevant feature group* were asked to move the manikin according to the orientation of the white frame (i.e., toward landscape and away from portrait or vice versa), with instructions switched between blocks.

Participants moved the manikin upward or downward by pressing the “Y” (labeled “↑”) or “B” (labeled “↓”) key, respectively, on a standard computer keyboard. Upon a response, the manikin started moving, to disappear after 500 ms. In case of an incorrect response, a red cross followed at the manikin’s starting position for 500 ms; no feedback followed after a correct response. The ITI was 2,000 ms. Time between CS picture onset and response was measured as a dependent variable.

**Exit interview.** Upon completion of both tasks, evaluative ratings of CSs and US were obtained and contingency awareness was assessed.

**Statistical analyses.** Ratings for US and CS characteristics were analyzed using one-way analyses of variance (ANOVAs). US-expectancy ratings were analyzed with a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 8 (trial: 1–8) × 2 (group: relevant feature, irrelevant feature) ANOVA, using Greenhouse-Geisser correction as necessary, with stimulus and trial as within-subject factors and group as the between-subject factor. For the AAT, practice trials, test trials with incorrect responses (5.37%), and test trials longer than 3,000 ms (0.10%) were omitted from the analyses. For each participant, median RTs were calculated for each stimulus (CS<sup>+</sup>, CS<sup>-</sup>) by response type (approach, avoid) combination. RTs were analyzed with a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 2 (response: approach, avoid) × 2 (group: relevant feature, irrelevant feature) ANOVA with stimulus and response as within-subject factors and group as the between-subject factor.

## Results and discussion

No group differences were observed in US or CS evaluation or selected US intensity ( $F$ s < 1.03; see Table S1 in the Supplemental Material). Figure S1 (in the Supplemental Material) suggests the development of differential US-expectancy (CS<sup>+</sup> versus CS<sup>-</sup>) during conditioning in both groups. This was confirmed by a significant Stimulus × Trial interaction,  $F(3.84, 115.08) = 61.48$ ,

$p < .001$ ,  $\eta_p^2 = .67$ , and a nonsignificant Stimulus  $\times$  Trial  $\times$  Group interaction,  $F(3.84, 115.08) = 1.47$ ,  $p = .34$ ,  $\eta_p^2 = .04$ .

Figure 1 shows that, in line with our predictions, participants were faster to approach the CS<sup>-</sup> and avoid the CS<sup>+</sup> than vice versa, Stimulus  $\times$  Response interaction,  $F(1, 30) = 7.41$ ,  $p = .01$ ,  $\eta_p^2 = .20$ , indicating that Pavlovian conditioning successfully induced avoidance tendencies. Paired  $t$  tests indicated that participants were faster to avoid the CS<sup>+</sup> than the CS<sup>-</sup>,  $t(31) = 2.71$ ,  $p = .01$ ; no differences were found for approaching both CSs,  $t(31) = -1.51$ ,  $p = .14$ . Furthermore, participants were faster to approach the CS<sup>-</sup> than avoid it,  $t(31) = -3.78$ ,  $p = .001$ , whereas no differences were found for approaching versus avoiding the CS<sup>+</sup>,  $t < 1$ . However, unlike the interaction effect, those simple effects do not lend themselves to unambiguous interpretation (see Supplemental Material).

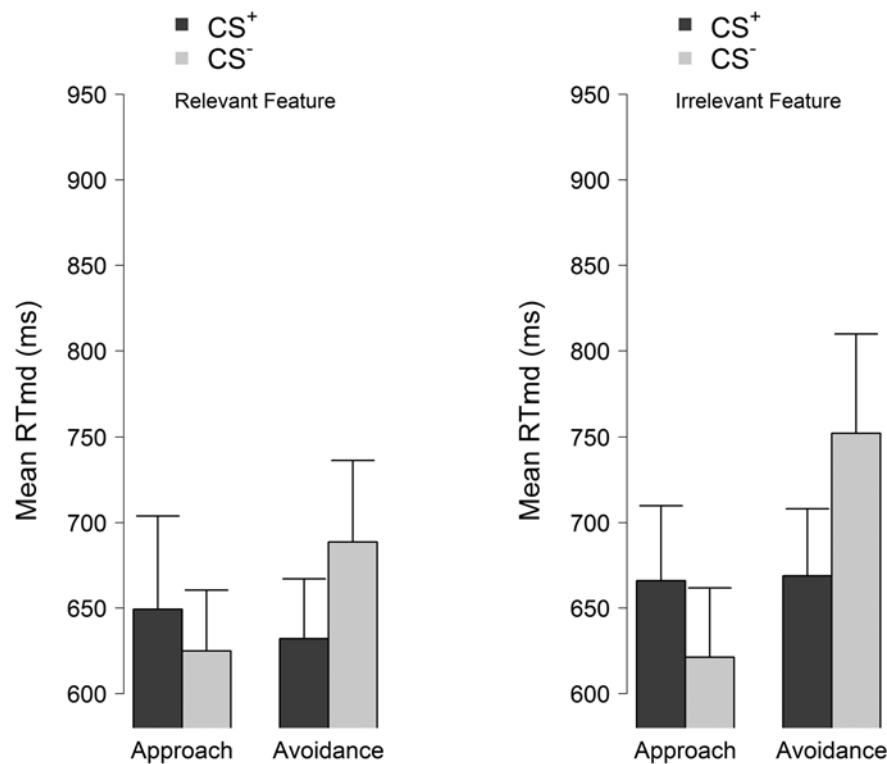
Of importance, the RT pattern did not differ between groups, Stimulus  $\times$  Response  $\times$  Group interaction,  $F < 1$ . Apparently, the tendency to avoid a fear-conditioned CS is elicited also when task demands do not require processing of stimulus dimensions relevant for predicting threat, which attests to the automatic nature of such avoidance tendency.

The present results might bear on the origins of excessive avoidance in anxiety disorders. Our findings suggest

that people may develop avoidance tendencies toward essentially innocuous cues by mere association of those cues with intrinsically unpleasant or dangerous events even if avoiding those cues does not serve a direct purpose in terms of dealing with the unpleasant event that they are associated with. This provides a mechanism through which an ever-increasing set of intrinsically harmless stimuli might become objects of avoidance. The automatic nature of such avoidance tendencies moreover implies that they might occur most readily in situations that allow little opportunity for conscious thought or in individuals with limited cognitive control, creating room for situational variability and individual differences in the degree of excessive avoidance.

### Experiment 2

Avoidance *behavior* is notoriously persistent, because of its self-perpetuating nature: CS avoidance prevents people from experiencing that the CS will not be followed by the US, thereby withholding individuals from anxiety-correcting information and maintaining CS-elicited fear (protection from extinction; Lovibond, Mitchell, Minard, Brady, & Menzies, 2009). One way to break this self-perpetuating cycle is by repeatedly presenting the CS in the absence of the opportunity for



**Fig. 1.** Experiment 1: Mean median RT in ms for the Relevant Feature (left panel) and Irrelevant Feature (right panel) groups (error bars represent standard errors of the means).

avoidance behavior, a technique known as *exposure treatment with response prevention*.

Secondary avoidance *tendencies* are arguably less self-perpetuating, given that they do not hinge on an actual contingency with CS removal or US omission (see Experiment 1). In Experiment 2, we evaluated the persistence of conditioned CS-elicited avoidance tendencies by testing whether they are sensitive to Pavlovian extinction and renewal.

Fear extinction involves repeated presentation of a CS<sup>+</sup> without US. Such a procedure typically leads to attenuation of the conditioned fear response, providing ground for therapeutic interventions such as exposure (Hermans, Craske, Mineka, & Lovibond, 2006). However, conditioned fear may be renewed when after extinction the CS<sup>+</sup> is tested in a context different than extinction (e.g., Eftting & Kindt, 2007). Such renewal suggests retention of the original CS<sup>+</sup>-US memory throughout extinction and has been used as a theoretical model for explaining relapse of anxiety symptoms after successful exposure treatment (Bouton, 2000).

To test for extinction and renewal, we extended the conditioning procedure of Experiment 1 with an extinction phase that was performed in a different context (Context B) than fear acquisition (Context A; see Eftting & Kindt, 2007). We assessed renewal by having one group (ABA) perform the AAT in the acquisition context (A), while the other group (ABB) performed the AAT in the extinction context (B). Similar to Experiment 1, shock electrodes were detached for the AAT. We expected avoidance tendencies to be weaker in the ABB group than the ABA group. As Experiment 1 revealed no between-group differences, we used the irrelevant-feature version of the AAT in Experiment 2, as it provides the more automatic assessment of avoidance tendencies and is least likely to be influenced by response strategies.

## Method

**Participants.** A total of 33 adults took part. Just 1 participant was excluded for lack of contingency awareness, leaving a sample of 32 (22 females; mean age = 21.94 years; range = 18–31). Participants were randomly assigned to the ABA or ABB group.

**Stimuli and context manipulation.** We used the same stimuli as in Experiment 1 (irrelevant feature group). Contexts were manipulated by switching the room lighting on or off.

**Procedure.** The procedure was similar to that of Experiment 1, with a few modifications (see Table S3 in the Supplemental Material). Fear acquisition was followed by an extinction phase, during which the different

projections of the CSs were presented five times each (40 trials total), without US. Instructions mentioned that one object would sometimes be followed by an electric stimulus whereas another object would never be. Extinction was performed in a different context (B) than acquisition (A). Group ABA then conducted the AAT in Context A, group ABB in Context B (contexts were counterbalanced across participants), both with shock electrodes detached.

**Statistical analyses.** Ratings for US and CS characteristics were analyzed as before. US-expectancy ratings for acquisition were analyzed with a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 8 (trial: a1–a8) × 2 (group: ABA, ABB) ANOVA with stimulus and trial as within-subject factors and group as the between-subject factor. We tested for generalization of acquisition to the extinction context with a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 2 (trial: e1, e2) × 2 (group: ABA, ABB) ANOVA. Fear extinction was evaluated using a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 2 (trial: e1–e20) × 2 (group: ABA, ABB) ANOVA. Greenhouse-Geisser corrections were applied when necessary.

For the AAT, test trials with incorrect (6.25%) and late (0.97%) responses were excluded. Median RTs were subjected to a 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 2 (response: approach, avoid) × 2 (group: ABA, ABB) ANOVA.

## Results and discussion

No significant group differences emerged for US and CS characteristics,  $F_s < 1.12$  (Table S1 in the Supplemental Material).

During acquisition, differential US expectancies were established, Stimulus × Trial interaction,  $F(3.42, 102.63) = 75.49$ ,  $p < .001$ ,  $\eta_p^2 = .72$ , similarly in both groups, Stimulus × Trial × Group interaction,  $F(3.42, 102.63) = 1.38$ ,  $p = .25$ ,  $\eta_p^2 = .04$  (see Figure S2 in the Supplemental Material).

Switching context produced a decrease in differential ratings from the last acquisition trial to the first extinction trial, CS × Trial interaction,  $F(1, 30) = 515.80$ ,  $p < .001$ ,  $\eta_p^2 = .89$ . Paired samples  $t$  tests revealed that this was due to an increase in CS<sup>-</sup> ratings,  $t(31) = -38.42$ ,  $p < .001$ ,  $d = -13.8$ ; the change for CS<sup>+</sup> was not significant,  $t < 1$ . Differentiation was still highly reliable on the first extinction trial,  $t(31) = -19.95$ ,  $p < .001$ ,  $d = -7.16$ .

Differential expectancy ratings were successfully extinguished, Stimulus × Trial interaction,  $F(3.30, 98.98) = 34.55$ ,  $p < .001$ ,  $\eta_p^2 = .54$ . Extinction differed between groups, Stimulus × Trial × Group interaction,  $F(3.30, 98.98) = 3.14$ ,  $p = .03$ ,  $\eta_p^2 = .10$ . Although significant for both groups, extinction was somewhat stronger in the ABB than the ABA group (which, if anything, should work against our hypothesis for the AAT). Nevertheless, an additional 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>) × 2 (group: ABA, ABB) ANOVA on ratings for the last extinction trial

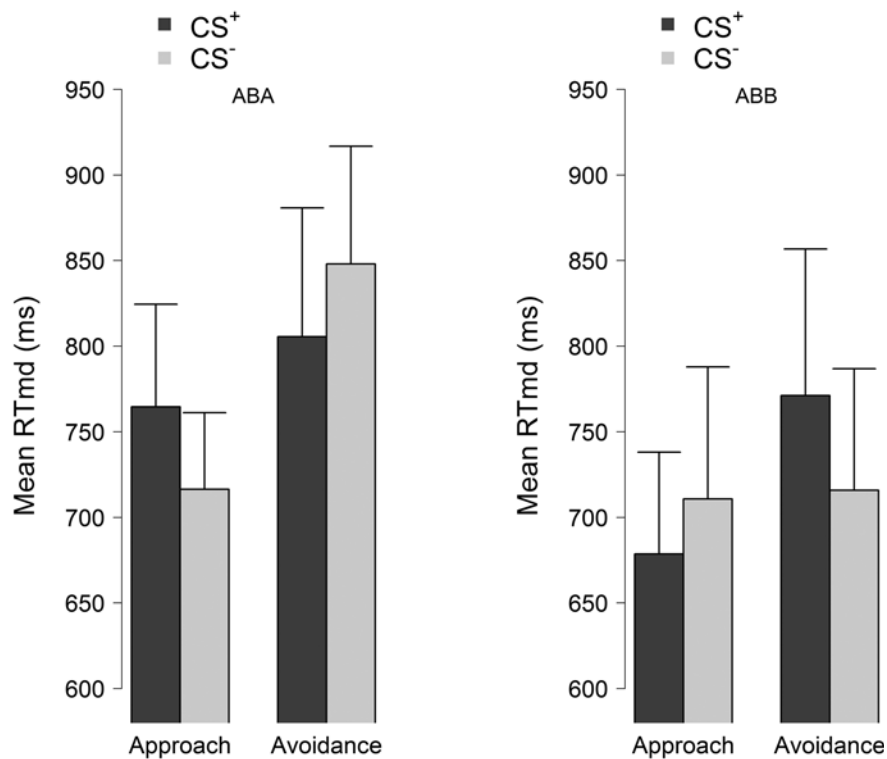
revealed a main effect of stimulus,  $F(1, 30) = 8.68, p = .006, \eta_p^2 = .22$ , indicating higher CS<sup>+</sup> than CS<sup>-</sup> ratings at the end of extinction, but no group effects,  $F_s < 1$ .

For the AAT (Figure 2), a significant Stimulus  $\times$  Response  $\times$  Group interaction was obtained,  $F(1, 30) = 5.57, p = .03, \eta_p^2 = .16$ . To decompose this interaction, we conducted separate 2 (stimulus: CS<sup>+</sup>, CS<sup>-</sup>)  $\times$  2 (response: approach, avoid) ANOVAs for each group. For the ABA group, the main effect of response was significant,  $F(1, 15) = 4.95, p = .04, \eta_p^2 = .25$ , as was the crucial Stimulus  $\times$  Response interaction,  $F(1, 15) = 4.92, p = .04, \eta_p^2 = .25$ , indicating faster responses for approaching the CS<sup>-</sup> and avoiding the CS<sup>+</sup> than vice versa (main effect of stimulus  $F < 1$ ). Paired  $t$  tests showed that participants were faster to approach than avoid the CS<sup>-</sup>,  $t(15) = -3.15, p = .007$ ; all other simple effects were nonsignificant,  $t_s < 1.20$  (but see the Supplemental Materials, which may be found at <http://cpx.sagepub.com/content/by/supplemental-data>). For the ABB group, no significant effects were obtained,  $F_s < 1.76$ . In combination, these results suggest that secondary avoidance tendencies established through Pavlovian learning can be extinguished, but will renew when conditioned fear cues are presented outside the extinction context.

Actual avoidance behavior can serve to maintain CS fear through protection from extinction (Lovibond et al., 2009), lending it a self-perpetuating nature. In clinical practice, the persistence of avoidance behavior can be disrupted through exposure treatment with response prevention, which allows for corrective experiences. The present results suggest, however, that even when persistent avoidance triggered by a cue or situation is disrupted and corrective information about that cue or situation is acquired (extinction learning), cue-elicited avoidance tendencies can readily recover upon a context switch. This may in turn lead to a recovery of overt CS-elicited avoidance behavior, which might provide an additional mechanism to account for maintenance of cue-elicited avoidance, in addition to the self-perpetuating mechanism based on preservation of CS fear through protection from extinction. Together, both mechanisms provide a particularly strong drive toward persistence of conditioned fear and avoidance.

### General Discussion

We tested whether initially neutral cues will elicit avoidance tendencies through their mere pairing with an



**Fig. 2.** Experiment 2: Mean median RT in ms for the ABA (left panel) and ABB (right panel) groups (error bars represent standard errors of the means).

aversive outcome, in the absence of instrumental reinforcement or an instrumental basis for avoidance. Experiment 1 showed that, following Pavlovian fear learning, participants responded slower when they symbolically approached a conditioned fear stimulus or avoided a conditioned safety stimulus than vice versa. Experiment 2 showed that although fear extinction resulted in the attenuation of avoidance tendencies in the extinction context, a switch to the acquisition context lead to their reappearance. Of importance, avoidance tendencies did not reduce contact with the CS<sup>+</sup> or affect US occurrence, something that past theories would posit as necessary for observing avoidance. In fact, in both experiments shock electrodes were detached during the AAT, removing any instrumental basis for avoidance behavior in terms of US anticipation.

We assessed avoidance tendencies in an RT task rather than overt avoidance behavior. Even though emotion theories regard action dispositions as central to emotions (Frijda, 2010; Lang, 1985), such tendencies need not translate into overt behavior. Dual process models, for instance, advocate that although emotions involve an automatic tendency to act (impulsive system), emotional impulses can be regulated by cognitive evaluation processes operating under cognitive control (reflective system; Frijda, 2010; Strack & Deutsch, 2004). Therefore, assessment of overt avoidance behavior might fail to find strong links between fear and avoidance (e.g., Mineka, 1979).

The observation that conditioned fear is accompanied by an automatic secondary avoidance tendency does not imply that avoidance behavior occurs only in the presence of fear. Evidence suggests that with prolonged instrumental reinforcement of avoidance responding, stable avoidance behavior can be maintained even when the fear for the CS has waned (Herrnstein, 1969; Rachman, 1977). Neither do our data suggest that *primary* avoidance ever occurs for other reasons than instrumental learning. As such, our findings neither contradict an expectancy-based account of primary avoidance nor rule out expectancies as a possible source for secondary avoidance. They merely suggest that CS avoidance *can* be established through mere Pavlovian association and expressed in the complete absence of either fear reduction or the expectation of a negative outcome.

We may not be able to completely rule out all instrumental basis for the observed avoidance tendencies. Shock electrodes were detached during the AAT and approach and avoidance responses had to be made equally often, so that participants got to experience that symbolic approach and avoidance responses had no differential contingencies with outcome omission. Also, moving the manikin toward or away from the pictures did not affect their presentation duration or size. This all notwithstanding, it is probably impossible to definitively

rule out an instrumental basis for the observed effects; research has yielded remarkable examples of how behavior that was seemingly under Pavlovian control turned out to be instrumental in nature and vice versa (Hearst & Jenkins, 1974). Future studies could try to further disentangle the Pavlovian versus instrumental basis of the effects reported here, for instance by assessing the effect of instrumental punishment on automatic conditioned avoidance tendencies (see Coleman & Gormezano, 1971). Specifically, following Pavlovian conditioning, an aversive US could be presented upon avoidance of the CS<sup>+</sup> or approach of the CS<sup>-</sup> in the AAT. If the avoidance tendency reported here is not instrumental, results should be similar to an unpunished version of the AAT. If it is instrumental, RTs should reveal a main effect of approach versus avoidance rather than a CS by response interaction as observed here.

A potential limitation of Experiment 2 concerns the lack of control for context familiarity that is often included in animal renewal studies. Such control is particularly important for establishing the cognitive mechanisms underlying renewal; it is perhaps less important for the present purpose of using renewal as a laboratory model for return of fear after exposure treatment.

On a methodological level, when aiming for a comprehensive assessment of fear in laboratory research, the inclusion of avoidance tendencies should perhaps be considered.

Finally, in terms of intervention, targeting conditioned avoidance tendencies, through retraining, could augment the therapeutic efficacy of exposure treatment for anxiety disorders. Therapeutic application of such intervention seems feasible, given that action tendency modification has recently been demonstrated to improve social behavior in individuals with elevated social anxiety symptoms (Taylor & Amir, 2012) and has therapeutic effects in other types of dysfunctional behaviors (e.g., heavy alcohol use; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011).

### Author Contributions

A.-M. Krypotos, M. Effting, M. Kindt, and T. Beckers contributed to the concept of the study and the design of the experiments. A.-M. Krypotos collected the data. A.-M. Krypotos, I. Arnaudova, and T. Beckers contributed to data processing and statistical analysis. A.-M. Krypotos, M. Effting, and T. Beckers interpreted the results. A.-M. Krypotos and T. Beckers drafted the manuscript. All authors contributed to manuscript revisions and approved the final version of the manuscript for submission.

### Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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## Supplemental Material

Additional supporting information may be found at <http://cpx.sagepub.com/content/by/supplemental-data>

## References

- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.
- Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic* (2nd ed.). New York, NY: Guilford.
- Bolles, R. C., Stokes, L. W., & Younger, M. S. (1966). Does CS termination reinforce avoidance behavior? *Journal of Comparative and Physiological Psychology*, *62*, 201–207.
- Bouton, M. E. (2000). A learning theory perspective on lapse, relapse, and the maintenance of behavior change. *Health Psychology*, *19*, 57–63. doi:10.1037/0278-6133.19.Suppl1.57
- Coleman, S. R., & Gormezano, I. (1971). Classical conditioning of the rabbit's (*Oryctolagus cuniculus*) nictitating membrane response under symmetrical CS-US interval shifts. *Journal of Comparative and Physiological Psychology*, *77*, 447–455.
- Cornwell, B. R., Echeverri, A. M., & Grillon, C. (2007). Sensitivity to masked conditioned stimuli predicts conditioned response magnitude under masked conditions. *Psychophysiology*, *44*, 403–406. doi:10.1111/j.1469-8986.2007.00519.x
- Declercq, M., De Houwer, J., & Baeyens, F. (2008). Evidence for an expectancy-based theory of avoidance behavior. *Quarterly Journal of Experimental Psychology*, *61*, 1803–1812. doi:10.1080/17470210701851214
- Effting, M., & Kindt, M. (2007). Contextual control of human fear associations in a renewal paradigm. *Behaviour Research and Therapy*, *45*, 2002–2018. doi:10.1016/j.brat.2007.02.011
- Frijda, N. H. (2010). Impulsive action and motivation. *Biological Psychology*, *84*, 570–579. doi:10.1016/j.biopsycho.2010.01.005
- Hearst, E., & Jenkins, H. M. (1974). *Sign tracking: The stimulus-reinforcer relation and directed action*. Austin, TX: Psychonomic Society.
- Hermans, D., Craske, M. G., Mineka, S., & Lovibond, P. F. (2006). Extinction in human fear conditioning. *Biological Psychiatry*, *60*, 361–368. doi:10.1016/j.biopsycho.2005.10.006
- Herrnstein, R. J. (1969). Method and theory in the study of avoidance. *Psychological Review*, *76*, 49–69. doi:10.1037/h0026786
- Krieglmeyer, R., & Deutsch, R. (2010). Comparing measures of approach avoidance behaviour: The manikin task vs. two versions of the joystick task. *Cognition and Emotion*, *24*, 810–828. doi:10.1080/02699930903047298
- Lang, P. J. (1985). The cognitive psychophysiology of emotion: Fear and anxiety. In A. H. Tuma & J. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 131–170). Hillsdale, NJ: Erlbaum.
- Lovibond, P. F., Mitchell, C. J., Minard, E., Brady, A., & Menzies, R. G. (2009). Safety behaviours preserve threat beliefs: Protection from extinction of human fear conditioning by an avoidance response. *Behaviour Research and Therapy*, *47*, 716–720.
- Lovibond, P. F., Saunders, C., Weidemann, G., & Mitchell, C. J. (2008). Evidence for expectancy as a mediator of avoidance and anxiety in a laboratory model of human avoidance learning. *Quarterly Journal of Experimental Psychology*, *61*, 1199–1216. doi:10.1080/17470210701503229
- Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion: A review. *Cognition and Emotion*, *23*, 209–237. doi:10.1080/02699930802204677
- Miller, N. E. (1944). Experimental studies of conflict behavior. In J. M. V. Hunt (Ed.), *Personality and the behaviour disorders* (pp. 431–465). New York, NY: Ronald Press.
- Mineka, S. (1979). The role of fear in theories of avoidance learning, flooding, and extinction. *Psychological Bulletin*, *86*, 985–1010. doi:10.1037/0033-295X.108.3.483
- Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin*, *132*, 297–326. doi:10.1037/0033-2909.132.2.297
- Mowrer, O. H. (1960). *Learning theories and behavior*. New York, NY: John Wiley.
- Rachman, S. (1977). The conditioning theory of fear-acquisition: A critical examination. *Behaviour Research and Therapy*, *15*, 375–387. doi:10.1016/0005-7967(77)90041-9
- Seligman, M. E., & Johnston, J. C. (1973). A cognitive theory of avoidance learning. In F. J. McGuigan & D. B. Lumsden (Eds.), *Contemporary approaches to conditioning and avoidance learning* (pp. 69–110). Washington, DC: Winston.
- Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220–247. doi:10.1207/s15327957pspr0803\_1
- Taylor, C. T., & Amir, N. (2012). Modifying automatic approach action tendencies in individuals with elevated social anxiety symptoms. *Behaviour Research and Therapy*, *50*, 529–536. doi:10.1016/j.brat.2012.05.004
- Walker, S. F. (1987). *Animal learning: An introduction*. London, England: Routledge.
- Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2011). Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. *Psychological Science*, *22*, 490–497. doi:10.1177/0956797611400615