



# Evidence for recovery of fear following immediate extinction in rats and humans

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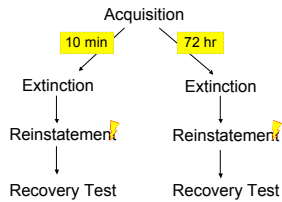


## Background

- Research has demonstrated that extinguished fear associations can be recovered with the passage of time (spontaneous recovery), a shift of context (renewal), and unsigned presentations of the fear-inducing stimulus (reinstatement).
- This suggests that fear extinction is due to the inhibition rather than the erasure of the fear association.
- However, recent rat studies have shown that when extinction is conducted *immediately* after acquisition, conditioned fear responses fail to reemerge, suggesting that the fear association is unlearned or erased (Myers et al., 2006).

### Rat Data

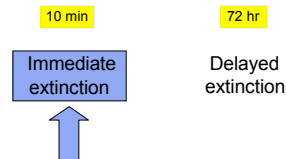
Adapted from Myers et al., 2006



### Recovery Test Results:

Post-extinction test  
Reinstatement test

Difference Scores  
375  
250  
125

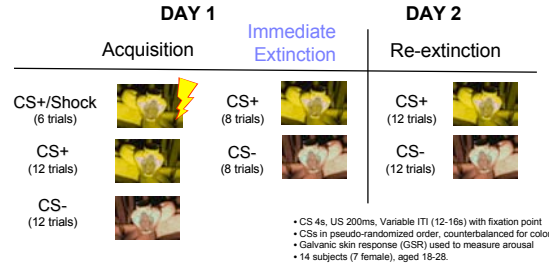


- A recent attempt to replicate this finding in humans using a renewal paradigm failed (Alvarez, et al., 2007).
- We further investigated the immediate extinction effect in spontaneous recovery and reinstatement in rats and humans.

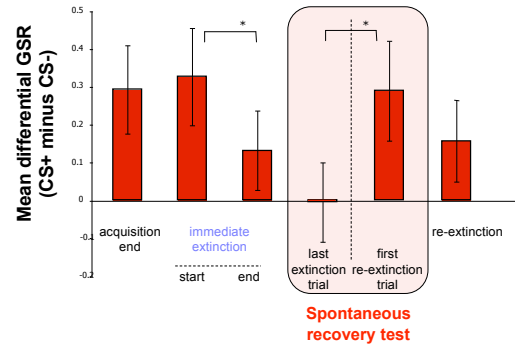
## Methods & Results

### Spontaneous Recovery

#### Humans



- CS 4s, US 200ms, Variable ITI (12-16s) with fixation point
- CSs in pseudo-randomized order, counterbalanced for color
- Galvanic skin response (GSR) used to measure arousal
- 14 subjects (7 female), aged 19-28

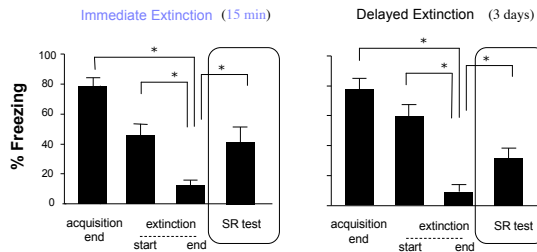


➤ Fear responses were spontaneously recovered.

#### Rats



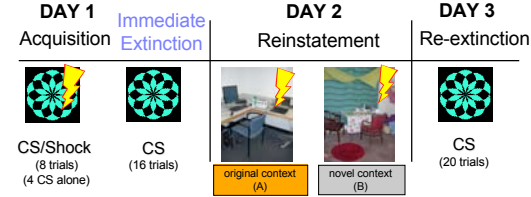
- acquisition: 3 presentations of CS paired with US
- extinction: 20 unreinforced CS
- SR test: a single presentation of the CS 21 days after extinction session in both groups.
- acquisition in context A, extinction & SR test in context B.
- 9 male, Sprague-Dawley rats per group. Weighed approx. 350g; maintained on 12:12h light:dark schedule; all testing done in light phase. Ad lib food/water throughout.



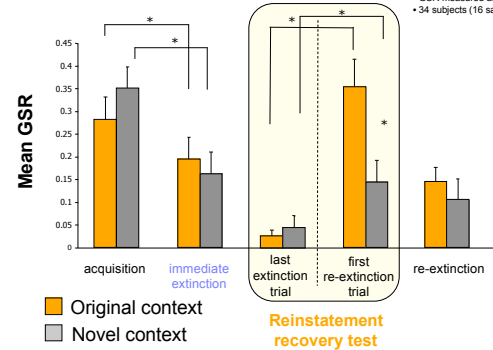
➤ Fear responses were spontaneously recovered.

### Reinstatement

#### Humans



- reinstatement: 4 x 200ms shock
- 6s CS, variable 10-12s ITI
- GSR measured arousal
- 34 subjects (16 same, 18 diff. context)

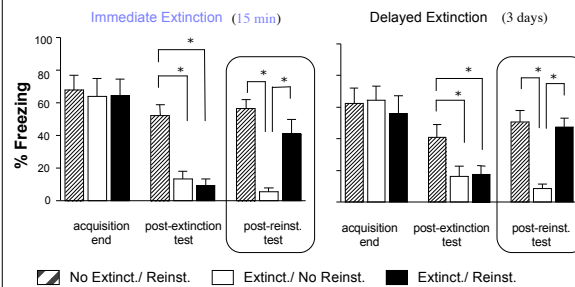


➤ Fear responses were reinstated and modulated by context.

#### Rats



- acquisition & extinction same as SR study
- extinction: 20 presentations of CS alone
- Post-ext. test 1: 5 days after extinction, 5 CS-alone
- Reinstatement: 1 day after test 1, 3 unpaired US
- Post-reinst. test: 1 day after reinstatement, same as test 1
- 8 rats/group, same type, weight and schedule as SR study.



➤ Fear responses were reinstated in both groups.

## Discussion

- We failed to replicate the results of Myers, et al (2006) using different measures of fear learning.
- We instead found spontaneous recovery of fear response in both rats and humans after immediate extinction. This effect was cue-specific and not due to general arousal effects.
- We also found successful reinstatement of fear responses in rats and humans after immediate extinction.
- The effect of immediate extinction on fear recovery in rats was not different than that of delayed extinction.

## Conclusions

- Conditioned fear that is immediately extinguished in rats and humans can spontaneously recover or can be recovered following reinstatement.
- Immediate extinction may not be a sufficient method for erasing fear, but measures for erasing fear memories need to be further explored.

## References

Alvarez, R.P., Johnson, L., Grillon, C. (2007). Contextual-specificity of short-delay extinction in humans: Renewal of fear-potentiated startle in a virtual environment. *Learning & Memory*, 14(4): 247.

Myers K.M., Ressler K.J., Davis M. (2006). Different mechanisms of fear extinction dependent on length of time since fear acquisition. *Learning & Memory*, 13(2):216-223.

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