Partial extinction did not diminish spontaneous recovery after 24 h retention interval

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1. Summary

Fear extinction is not permanent but it may suffer from different forms of relapse. One strategy potentially useful to diminish relapse is the partial extinction treatment, according to which, extinction may be potentiated if a gradual and sparse number of CS-US pairings are introduced within the extinction treatment. The present study, using a differential fear conditioning paradigm, tries to evaluate the efficacy of partial extinction to reduce a specific form of relapse, spontaneous recovery, after a 24 h. retention interval. The results showed that partial extinction did not diminish spontaneous recovery when compared with standard extinction. From a theoretical point of view, the pattern of results found was more consistent with the idea that extinction entails the acquisition of new knowledge than with the idea that there are conditions in which extinction entails the erasure of the original acquisition.

2. What did we do?

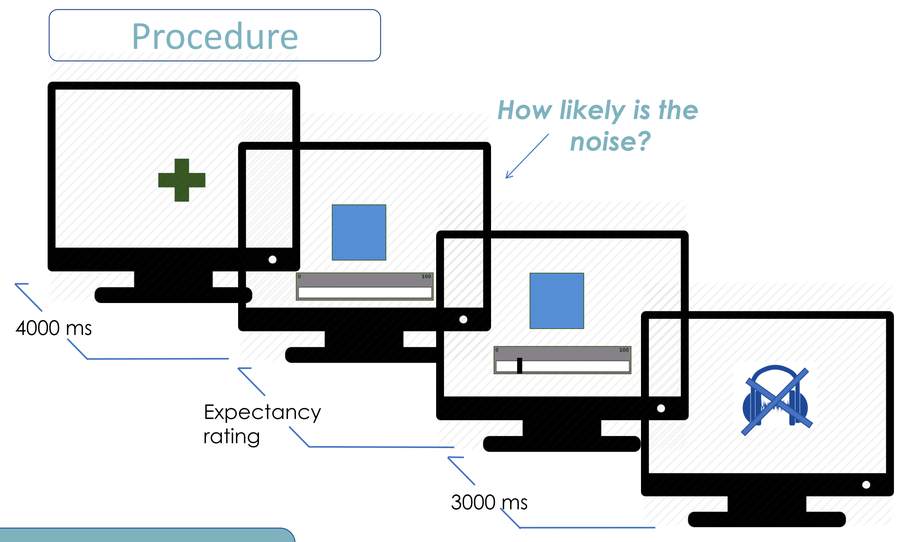
Gershman, Jones, Norman, Monfils & Niv (2013) have recently found in a series of animal fear conditioning experiments that partial extinction (i.e., gradually reducing the frequency of reinforced CS-US trials, rather than eliminating them abruptly) prevents different forms of fear relapse such as spontaneous recovery and reinstatement (see **Box 1**).
The objective of the present experiment was to generalize their results concerning spontaneous recovery to a differential fear conditioning preparation in humans.
We evaluated spontaneous recovery in two different groups of participants, a standard extinction group (i.e., in which there was an abrupt change in the CS-US contingency from the initial acquisition phase) and a partial extinction group (i.e., in which the number of CS-US pairings was gradually reduced across the extinction phase as in Gershman et al. (2013). For this, we registered participants' expectancy ratings about how likely the aversive stimulus was across trials.

3. How did we do it?

Design

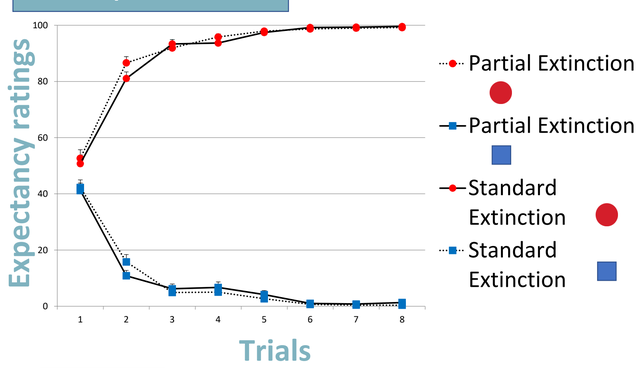
Group	Acquisition	Extinction	Retention interval	Test
Partial Extinction (**Box 2**)	8x	47x, 9x, 56x	24h	10x
Standard Extinction	8x	56x, 56x	24h	10x

Procedure

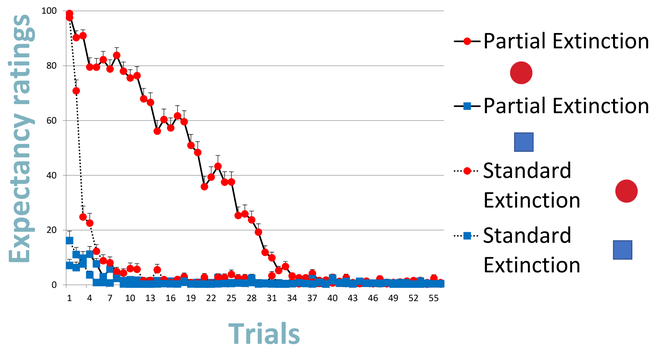


4. What did we obtain?

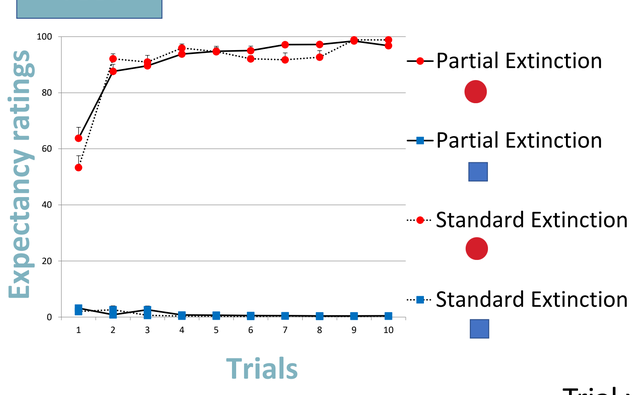
Acquisition



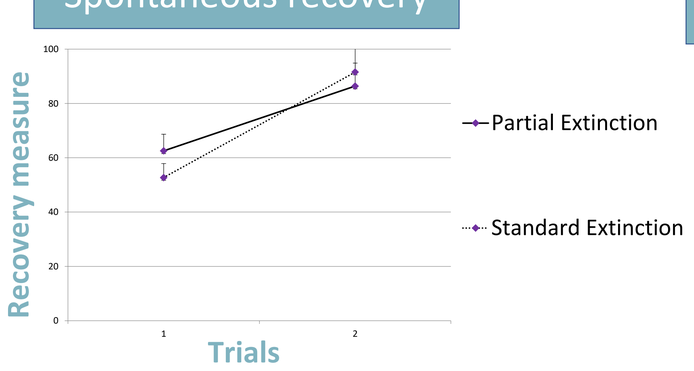
Extinction



Test



Spontaneous recovery



Trial x Group:
$F(1, 102) = 3.77$, $p = .055$

5. Conclusion

Expectancies of the aversive noise spontaneously recovered during the first trial of test phase (after a 24 h retention interval) in both groups. Gershman et al. (2013)'s results did not generalize to this differential conditioning preparation in humans.
At variance with the standard extinction training, in partial extinction, after the initial CS-US presentation in the final phase, our results are somewhat compatible with a slower reacquisition (see **Box 3**). However, this effect was short-lived due to a very rapid reacquisition. For the future, it would be interesting to know whether partial extinction allows a more efficient retrieval of the safety learning memory in a situation in which no reacquisition takes place.

Boxes for further reading

1

Fear memories are notoriously difficult to erase, often recovering over time. The longstanding explanation for this finding is that, in extinction training, a new safety memory is formed that competes with the old one for expression but does not otherwise modify it.
Gershman and colleagues suggest that there may be conditions under which extinction training can modify in a relatively stable manner the old fear memory rather than forming a new safety memory. According to their hypothesis, a new safety memory is formed when the onset of extinction training produces large "prediction errors"—discrepancies between predicted outcomes (e.g., shocks) and experienced outcomes (no shock). However, if prediction errors were small or infrequent enough to not induce formation of a new memory, but still large enough to drive learning, the old fear memory would gradually be weakened.
This suggestive hypothesis has relevant implications for our understanding of the mechanisms underlying safety learning and practical clinical implications

2

Unreinforced and reinforced trials during the Extinction phase of the Partial extinction Group

Trial Blocks:	1	2	3	4	5	6	7
	3	5	7	8	8	8	8
	5	3	1	0	0	0	0

3

Our results are compatible with the idea that a gradual reinforcement schedule during extinction may be insufficient to avoid the formation of a new safety memory. Nevertheless, the partial extinction treatment can still facilitate the retrieval of the safety memory, enhancing the effectiveness of extinction training. Including reinforced trials during extinction makes that such trials may not univocally signal the acquisition context but also the extinction context, what in turn, would finally lead to a more durable effect of extinction (see e.g., Bouton, Woods, & Pineño, 2004 in the animal conditioning literature or Morís, Barberia, Vadillo, Andrades, & López, 2017 in human contingency learning).

References

• Bouton, M. E., Woods, A. M., & Pineño, O. (2004). Occasional reinforced trials during extinction can slow the rate of rapid reacquisition. *Learning and Motivation*, *35*, 371-390.
• Gershman, S. J., Jones, C. E., Norman, K. A., Monfils, M. H., & Niv, Y. (2013). Gradual extinction prevents the return of fear: implications for the discovery of state. *Frontiers in Behavioral Neuroscience*, *7(164)*.
• Morís, J., Barberia, I., Vadillo, M. A., Andrades, A., & López, F. J. (2017). Slower reacquisition after partial extinction in human contingency learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *43*, 81-93.