

Multiverse Analyses of Fear Conditioning and Extinction Retention in PTSD

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Introduction

- Fear extinction retention is hypothesized to be deficient in PTSD. However, prior tests of this hypothesis have used inconsistent methods and have found inconsistent results.
- Multiverse analysis facilitates examination of results across different methodological approaches.
- We reviewed prior literature to identify methodologies and performed multiverse analysis using previously published methodologies in a new dataset.

Methods

Review: A literature search catalogued methods and results from studies examining PTSD and extinction retention using skin conductance response (SCR).

Multiverse Data: Participants were 25 PTSD patients and 36 trauma-exposed non-PTSD controls (TENC). SCR was recorded during *fear acquisition* and *extinction* (day 1), and *recall* (day 2).

Multiverse Analysis: All possible combinations of previously published methods were included in two separate multiverse analyses. First, a Conditioning Multiverse Analysis determined whether participants acquired differential fear (CS+ versus CS-) and whether the effect of conditioning was robust to methodology. Next, an Extinction Retention Multiverse Analysis determined whether findings from group comparisons of fear extinction retention (PTSD versus TENC) were robust to methodology.

Funding: NIMH R01MH096987 (IMR).

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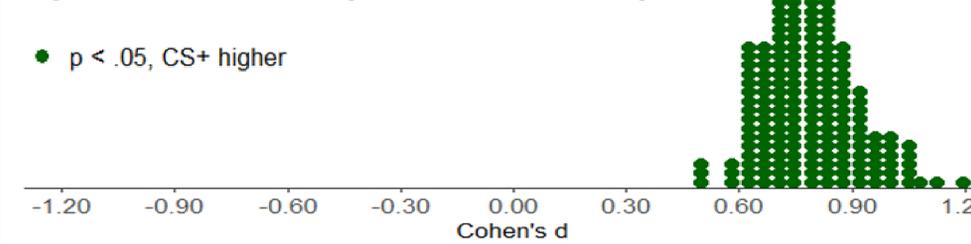
Results

(1) Conditioning

Table 1. Conditioning Literature Review Findings

Study Info		Inconsistent Methodologies					Results	
Citation	Sample Size	CQ	Sex	Non-Responder	CAPS	Outlier	Effect Size	p value
(1)	n = 31	CQ1	F+M	NR	NR	NR	F = 19.6	p < 0.001
(3)	n = 56	CQ1	F+M	NR	Yes	NR	F = 27.64	p < 0.001
(6)	n = 47	CQ2	F+M	<0.05 uS	Yes	NR	F = 57.48	p < 0.001
(7)	n = 28	CQ3	M	NR	NR	NR	F = 8.6	p = 0.014 ^p
(2)	n = 21	CQ4	M	NR	NR	>3 SD	F = 8.88	p = 0.007
(5)	n = 32	CQ5	F	<0.1 uS	NR	'screen' ^s	NR	p = 0.004

Figure 1. Conditioning Multiverse Findings

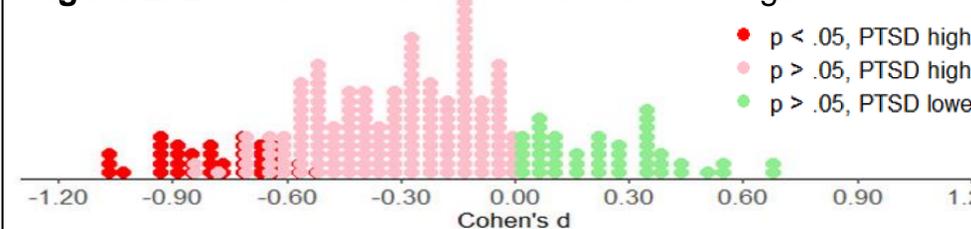


(2) Extinction Retention

Table 2. Extinction Retention Literature Review Findings

Study Info			Inconsistent Methodologies					Results	
Citation	Sample Size by Group		ERQ	Sex	Non-Responder	CAPS	Outlier	Effect Size	p value
	PTSD	TENC							
(1)	n = 16	n = 15	ERQ1	F+M	NR	NR	NR	t = 2.9	p < 0.02
(3)	n = 31	n = 25	ERQ1	F+M	NR	Yes	NR	t = 0.9	p = 0.14 ^p
(4)	n = 24	n = 20	ERQ1	F+M	NR	NR	NR	t = 1.79	p = 0.09
(7)	n = 7	n = 7	ERQ2	M	NR	NR	NR	F = 3.0	p = 0.12 ^p
(5)	n = 16	n = 16	ERQ3	F	<0.1 uS	NR	'screen' ^s	B = -.15	p = 0.20
(5)	n = 16	n = 16	ERQ4	F	<0.1 uS	NR	'screen' ^s	B = -.04	p = 0.74
(6)	n = 24	n = 23	ERQ5	F+M	<0.05 uS	Yes	NR	NR	p = 0.13
(3)	n = 31	n = 25	ERQ5	F+M	NR	Yes	NR	F = 1.18	p = 0.28
(1)	n = 16	n = 15	ERQ5	F+M	NR	NR	NR	F = 4.99	p = 0.03
(3)	n = 31	n = 25	ERQ5	F+M	NR	Yes	NR	F = 1.25	p = 0.12
(2)	n = 12	n = 11	ERQ6	M	NR	NR	>3 SD	F = 6.38	p = 0.02
(7)	n = 7	n = 7	ERQ7	M	NR	NR	NR	NR	p > 0.1 ^p

Figure 2. Extinction Retention Multiverse Findings



(1) Conditioning: all 6 analyses in the reviewed literature (**Table 1**) and all 180 analyses in the Conditioning Multiverse (**Figure 1**) found significant differential SCR (CS+ > CS-).

The mean effect size in the Conditioning Multiverse was medium-to-large (mean Cohen's d = 0.77, SD = 0.12).

(2) Extinction Retention: 3 out of 12 (25%) analyses in the reviewed literature (**Table 2**) and 38 out of 252 (15.1%) analyses in the Extinction Retention Multiverse (**Figure 2**) found a significant group difference in fear extinction retention. Contrary to theory, all significant multiverse results suggested enhanced fear extinction retention in PTSD relative to control.

The mean effect size in the Extinction Retention Multiverse was small and in the opposite direction of theory (mean Cohen's d = -0.26, SD = 0.35).

Conclusions

- Multiverse analysis is a useful tool to explore the impact of methodology on results.
- Evidence from a literature review and multiverse analysis in this new sample demonstrate a lack of consistent evidence to suggest a relationship of PTSD with fear extinction retention.
- Inconsistent methods may contribute to inconsistent findings in this literature.

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