**Supplementary Information for:**

**Emotional learning retroactively enhances item memory but distorts source attribution**

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**Supplementary Results.**

**Analysis of Group Differences.**

*Recognition memory.* For purposes detailed in Hennings et al., (2020), our sample contained a group of psychologically healthy adults and a group of individuals with PTSS. In our initial analysis of recognition memory (**Figure 1**), we tested for any group differences. A 3-way mixed ANOVA with Group, CS Type, and Temporal Context revealed that there was no main effect of Group (*F*1, 43 = 0.46, *Pperm* = 0.49) on corrected recognition. In addition, there was no significant Group by CS type interaction (*F*1, 43 = 1.08, *Pperm* = 0.31) or Group by Temporal Context interaction (*F*2, 86 = 0.06, *Pperm* = 0.94). Finally, the three-way Group by CS Type by Temporal Context interaction was also not significant (*F*2, 86 = 1.01, *Pperm* = 0.37). In the same model, our main effects and interactions of interest were still significant (main effects of CS Type and Temporal Context, and CS by Context interaction). From this analysis we concluded that PTSS did not impact performance in episodic recognition memory.

*Temporal context memory.* Even though we did not observe any behavioral differences between healthy and PTSS for recognition memory, we assessed the possibility that the groups differed in their temporal context memory. A 4-way mixed ANOVA with Group, CS Type, Temporal Context, and Source Memory Response revealed that there was no main effect of Group (*F*1, 32 = 0.13, *Pperm* = 0.98), nor were there any significant interactions (Group by CS: *F*1, 32 = 1.73e-4, *Pperm* = 0.68; Group by Context: *F*2, 64 = 0.14, *Pperm* = 0.97; Group by Response: *F*2, 64 = 0.35, *Pperm* = 0.71; Group by CS by Context: *F*2, 64 = 0.02, *Pperm* = 0.96; Group by Context by Response: *F*4, 128 = 1.15, *Pperm* = 0.33; Group by CS by Response: *F*2, 64 = 1.25, *Pperm* = 0.29; full 4-way interaction: *F*4, 128 = 2.16, *Pperm* = 0.073). In this model, our main effects and interactions interest retained significance (main effect of Source memory response, CS by Response interaction, Context by Response interaction, and CS by Context by Response interaction).

**Psychophysiology**

Here we report skin-conductance responses and shock expectancy for the subset of participants who completed the source context memory and typicality rating tasks (N = 34). Full behavioral results may be found in Hennings et al., (2020). Results confirm that this subset acquired conditioned SCRs during fear conditioning, as differential SCRs (CS+ - CS-) were greater than 0 (t33 = 5.38, *P* = 6e-6, d = 0.92). Successful extinction was evidenced by a significant reduction in differential SCRs from fear conditioning to late extinction (t29 = -3.61, *P* = 0.0011, d = 1.03; note that 4 subjects were missing SCR from extinction, as previously reported). The same pattern was observed in shock expectancy; significant differential expectancy (CS+ - CS-) was observed for fear conditioning (t33 = 12.39, *P* = 3.89e-14, d = 2.12) and these responses diminished from fear conditioning to late extinction (t33 = 4.62, *P* = 5.60e-5, d = 1.24).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Temporal Context | CS Type | | Mean | 95% CI | Std. Error |
| Corrected Recognition | pre-conditioning | CS+ | 0.4106 | | [0.3648, 0.4579] | 0.0239 |
|  |  | CS- | 0.3560 | | [0.3079, 0.4051] | 0.0251 |
|  | fear conditioning | CS+ | 0.4819 | | [0.4153, 0.5477] | 0.0343 |
|  |  | CS- | 0.3023 | | [0.2417, 0.3639] | 0.0319 |
|  | post-conditioning | CS+ | 0.3023 | | [0.2426, 0.3644] | 0.0311 |
|  |  | CS- | 0.2181 | | [0.1769, 0.2616] | 0.0224 |
| False Alarm Rate | - | CS+ | 0.1403 | | [0.1037, 0.1810] | 0.0199 |
|  | - | CS- | 0.1218 | | [0.0861, 0.1611] | 0.0194 |

**Supplementary Table 1. Mean corrected recognition memory and false alarm rate.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Temporal Context | CS Type | DO | MO | MN | DN |
| Pre-conditioning | CS+ | 0.551 | 0.226 | 0.134 | 0.089 |
|  | CS- | 0.478 | 0.257 | 0.172 | 0.093 |
| Fear conditioning | CS+ | 0.622 | 0.227 | 0.094 | 0.056 |
|  | CS- | 0.424 | 0.254 | 0.217 | 0.106 |
| Post-extinction | CS+ | 0.443 | 0.268 | 0.181 | 0.109 |
|  | CS- | 0.34 | 0.276 | 0.24 | 0.144 |
| Novel lures | CS+ | 0.14 | 0.217 | 0.289 | 0.354 |
|  | CS- | 0.122 | 0.199 | 0.307 | 0.372 |

**Supplementary Table 2. Mean proportion of recognition memory responses.** DO, definitely old; MO, maybe old; MN, maybe new; DN, definitely new.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temporal Context | CS Type | Response | Proportion | 95% CI | P |  |
| pre-conditioning | CS+ | pre | 0.2684 | [0.2145, 0.3235] | 0.0252 | \* |
|  |  | cond. | 0.4645 | [0.3946, 0.5343] | 0.0001 | \*\*\* |
|  |  | post | 0.2672 | [0.2194, 0.3186] | 0.0146 | \* |
|  | CS- | pre | 0.3284 | [0.2819, 0.3775] | 0.8544 |  |
|  |  | cond. | 0.3272 | [0.2757, 0.3787] | 0.8370 |  |
|  |  | post | 0.3444 | [0.2978, 0.3934] | 0.6678 |  |
| fear conditioning | CS+ | pre | 0.2108 | [0.1605, 0.2647] | 0.0001 | \*\*\* |
|  |  | cond. | 0.5821 | [0.5086, 0.6556] | 0.0001 | \*\*\* |
|  |  | post | 0.2071 | [0.1569, 0.2659] | 0.0004 | \*\*\* |
|  | CS- | pre | 0.3125 | [0.2537, 0.3701] | 0.5046 |  |
|  |  | cond. | 0.3309 | [0.2745, 0.3897] | 0.9252 |  |
|  |  | post | 0.3566 | [0.3039, 0.4105] | 0.3950 |  |
| post-conditioning | CS+ | pre | 0.2120 | [0.1618, 0.2647] | 0.0001 | \*\*\* |
|  |  | cond. | 0.4657 | [0.4069, 0.5270] | 0.0001 | \*\*\* |
|  |  | post | 0.3223 | [0.2671, 0.3811] | 0.7158 |  |
|  | CS- | pre | 0.2966 | [0.2488, 0.3456] | 0.1416 |  |
|  |  | cond. | 0.3137 | [0.2770, 0.3505] | 0.3032 |  |
|  |  | post | 0.3897 | [0.3419, 0.4375] | 0.0170 | \* |

**Supplementary Table 3. Mean temporal context source memory data.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temporal Context | CS Type | Response | Beta | 95% CI | P |  |
| pre-conditioning | CS+ | pre | 0.0869 | [-0.2138, 0.3861] | 0.5656 |  |
|  |  | cond. | 0.4801 | [0.2004, 0.7620] | 0.0014 | \*\* |
|  |  | post | -0.5671 | [-0.8346, -0.3007] | 0.0001 | \*\*\* |
|  | CS- | pre | -0.1373 | [-0.3929, 0.1263] | 0.2936 |  |
|  |  | cond. | 0.3453 | [0.1346, 0.5645] | 0.0018 | \*\* |
|  |  | post | -0.2080 | [-0.4173, 0.0030] | 0.0546 | ~ |
| fear conditioning | CS+ | pre | -0.1794 | [-0.4909, 0.1294] | 0.2634 |  |
|  |  | cond. | 0.6525 | [0.4102, 0.9041] | 0.0001 | \*\*\* |
|  |  | post | -0.4731 | [-0.7714, -0.1895] | 0.0012 | \*\* |
|  | CS- | pre | -0.2703 | [-0.6053, 0.0628] | 0.1180 |  |
|  |  | cond. | 0.6773 | [0.3748, 0.9787] | 0.0001 | \*\*\* |
|  |  | post | -0.4070 | [-0.7058, -0.1144] | 0.0052 | \*\* |
| post-conditioning | CS+ | pre | -0.1695 | [-0.4961, 0.1404] | 0.2990 |  |
|  |  | cond. | 0.5461 | [0.234, 0.8563] | 0.0004 | \*\*\* |
|  |  | post | -0.3766 | [-0.6921, -0.0679] | 0.0154 | \* |
|  | CS- | pre | -0.1893 | [-0.4694, 0.0792] | 0.1666 |  |
|  |  | cond. | 0.4660 | [0.2659, 0.6884] | 0.0001 | \*\*\* |
|  |  | post | -0.2766 | [-0.5447, -0.0186] | 0.0354 | \* |

**Supplementary Table 4. Temporal context memory logistic regression data.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temporal Context | CS Type | Mean | | 95% CI | P |  |
| pre-conditioning | CS+ | | 0.0796 | [-0.0033, 0.1597] | 0.0576 | ~ |
|  | CS- | | 0.1181 | [0.0212, 0.2221] | 0.0142 | \* |
| fear conditioning | CS+ | | 0.1666 | [0.0732, 0.2591] | 0.0006 | \*\*\* |
|  | CS- | | 0.0937 | [0.0004, 0.197 ] | 0.0488 | \* |
| post-conditioning | CS+ | | 0.1741 | [0.0733, 0.2764] | 0.0002 | \*\*\* |
|  | CS- | | 0.1293 | [0.0182, 0.2622] | 0.0202 | \* |

**Supplementary Table 5. Typicality logistic regression data.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Temporal Context | CS Type | Response | Mean | Std. Error |
| pre-conditioning | CS+ | pre | 0.5571 | 0.0336 |
|  |  | cond. | 0.6517 | 0.0245 |
|  |  | post | 0.3945 | 0.0332 |
|  | CS- | pre | 0.4291 | 0.0303 |
|  |  | cond. | 0.5506 | 0.0305 |
|  |  | post | 0.4128 | 0.0294 |
| fear conditioning | CS+ | pre | 0.5 | 0.0382 |
|  |  | cond. | 0.6968 | 0.0211 |
|  |  | post | 0.426 | 0.0382 |
|  | CS- | pre | 0.3412 | 0.0297 |
|  |  | cond. | 0.5741 | 0.0301 |
|  |  | post | 0.3127 | 0.0272 |
| post-conditioning | CS+ | pre | 0.3642 | 0.0367 |
|  |  | cond. | 0.5421 | 0.0256 |
|  |  | post | 0.3194 | 0.0288 |
|  | CS- | pre | 0.2934 | 0.0293 |
|  |  | cond. | 0.4453 | 0.0311 |
|  |  | post | 0.2767 | 0.0251 |

**Supplementary Table 6. Mean high confidence hit rate for the recognition memory test split by temporal context, CS type, and source memory response.** Note that only subjects that completed both tasks are included here.

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**Supplementary Figure 1.** Aversive learning enhances perceived typicality for stimuli. Mean difference in typicality for each stimulus (CS+ - CS-). This difference constitutes a between groups analysis in which we subtracted the mean typicality response for each exemplar (e.g., a rabbit) when it was used as a CS+ versus a CS-, and is intended for illustration purposes only. All 144 stimuli used during memory encoding are shown (unlabeled) and arranged by the difference in typicality between when the same exemplar was used as a CS+ or a CS-. The particular encoding phase (pre-conditioning, fear conditioning, post-conditioning) each exemplar was presented was counterbalanced across subjects. Values reflect % difference of the 7-point scale (14% = 1 point difference).