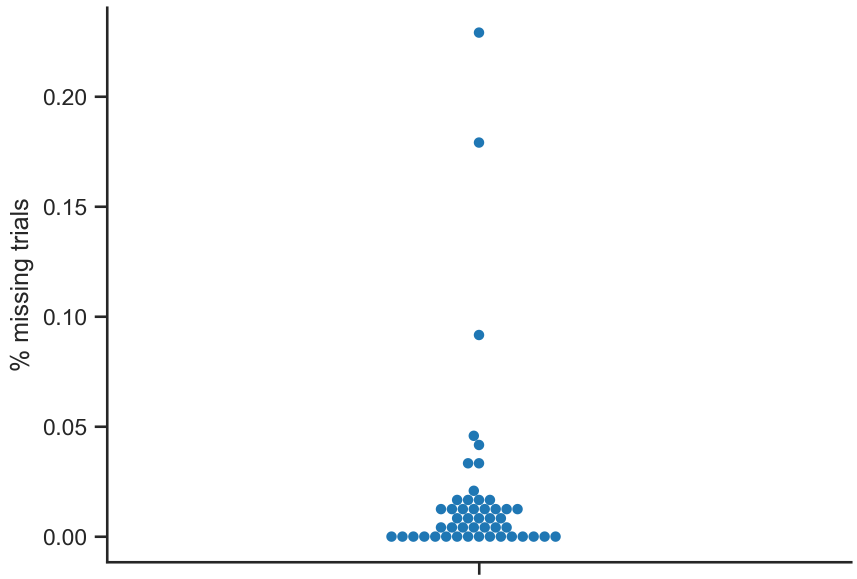
fearmem_report

recognition memory

non-responses

Starting with rigorous outlier detection. We had previously identified some subjects to exclude, but that was over a year ago so I wanted to start from scratch.

First, I started by looking at the % of missing data for each subject - trials they didn't actually respond.



```
subject  missing
 20      0.179167
110      0.091667
120      0.229167
```

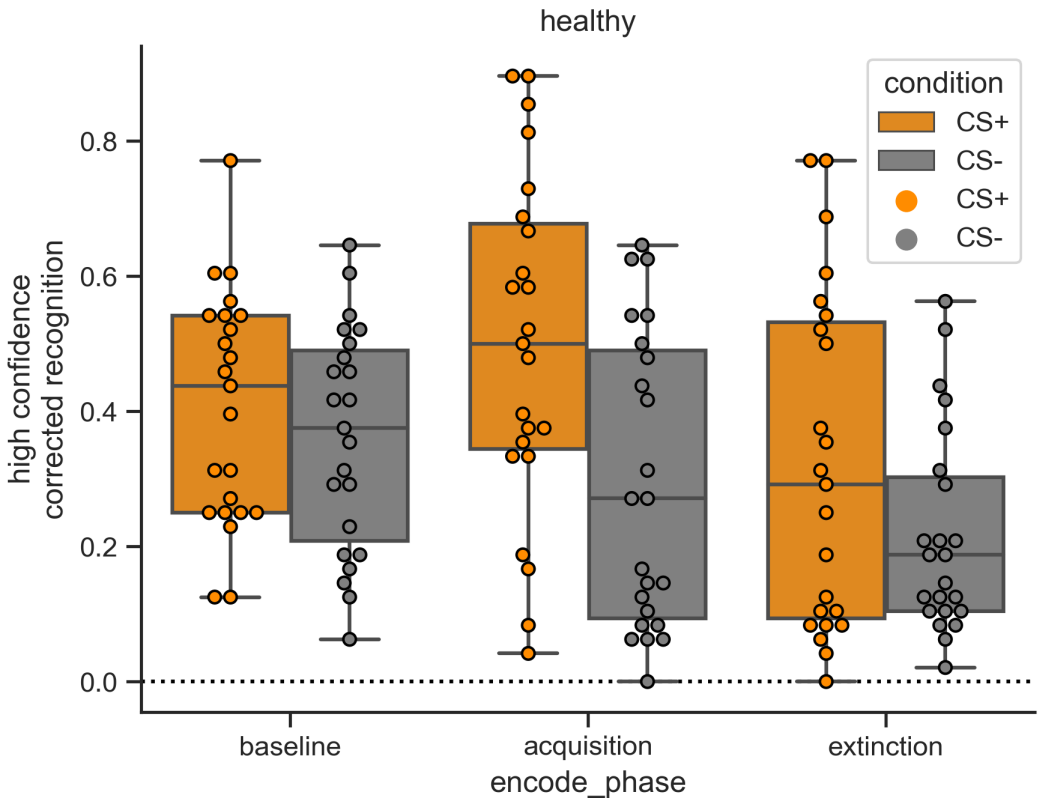
Above are the subjects who had >5% missing data.

Based on this info, I am excluding subjects `20` and `120`. These subjects are not present in any further data or graphs

poor memory

Next, I examined the corrected recognition for each group individually for outliers

Using boxplots, there were no outliers in the healthy group

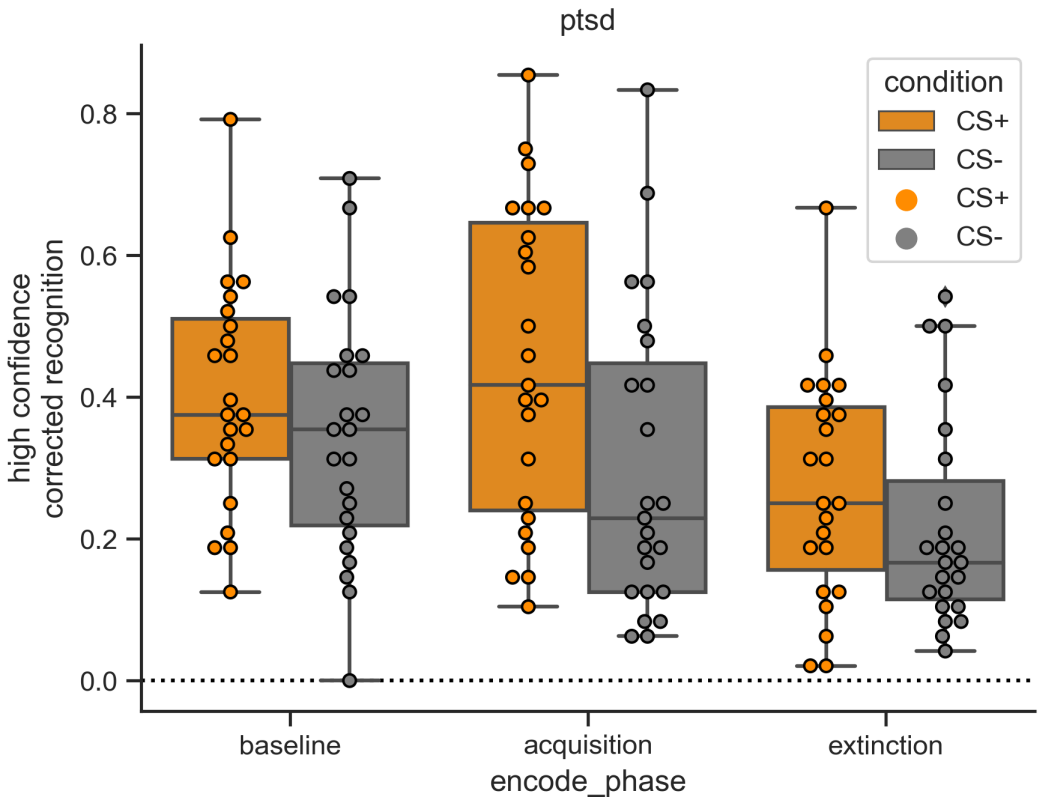


Below are all points <.05 corrected recognition. The only thing that stands out to me is subject `18` , as they have poor memory for `CS+ acquisition`, should be the best memory for the entire experiment. Based on this, subject `18` is also excluded.

```
  group  subject  condition  encode_phase        cr
healthy       18        CS+   acquisition  0.041667
healthy        3        CS-   acquisition  0.000000
healthy       13        CS+    extinction  0.041667
healthy       23        CS+    extinction  0.000000
healthy       16        CS-    extinction  0.020833
```

PTSS group

Looking at our ptsd group I did not find any more suspect data



There were participants with low CR, but nothing to warrant exclusion.

```
group  subject condition encode_phase        cr
 ptsd      101       CS-     baseline  0.000000
 ptsd      102       CS+   extinction  0.020833
 ptsd      116       CS+   extinction  0.020833
 ptsd      116       CS-   extinction  0.041667
```

This leaves us with `N=22` in the healthy group, and `N=23` in the PTSS group.

Normality of the data

Before running statistics, I checked the assumption of normality for corrected recognition in both groups separately, using a Shapiro-Wilk test.

```
  group         W      pval  normal
healthy  0.961719  0.000910   False
ptsd     0.960665  0.000533   False
```

Both groups were determined to be non-normal, so I will be employing non-parametric statistics to analyze the recognition memory data.

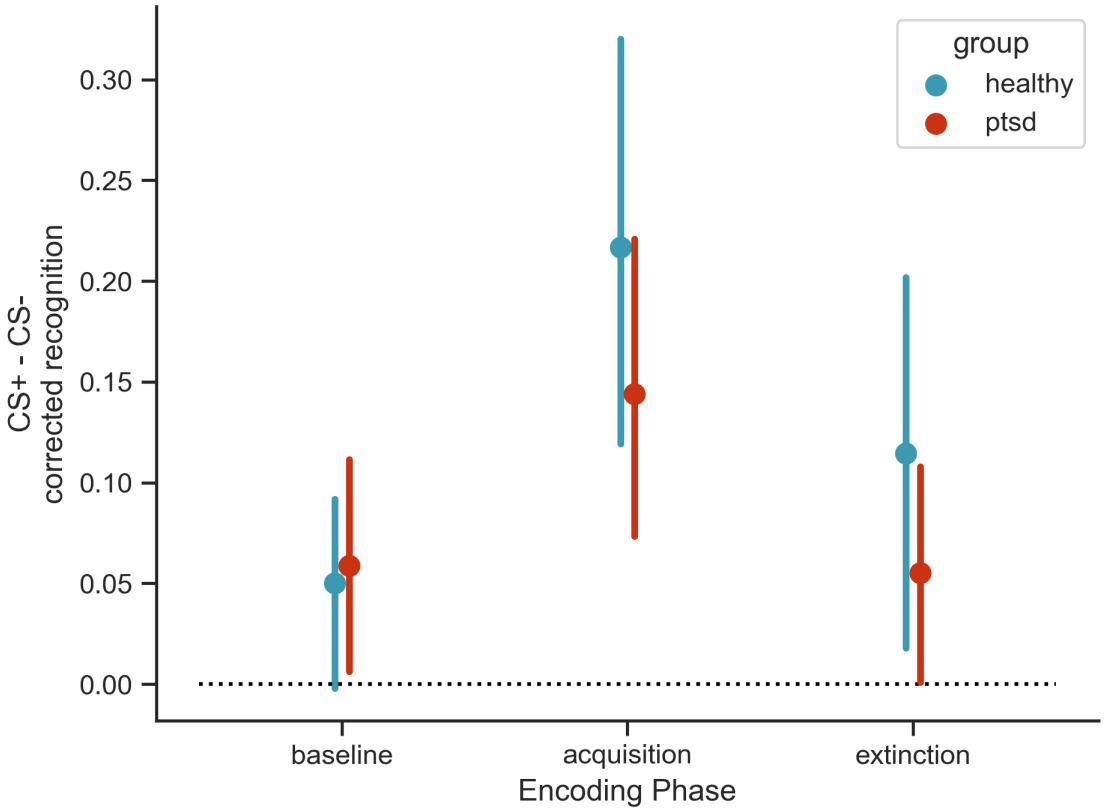
Analysis

I started with a full mixed ANOVA, using permutation tests to obtain p-values with 10,000 iterations, with a minimum possible p-value of 0.0001

Group was entered as a between-subjects factor, and Condition (CS+/-) and Encoding Phase were entered as within-subjects factors.

As previously reported, there were significant main effects of Condition (F (1,43) = 28.95, Pperm = 0.0001) Encoding Phase (F (2,86) = 19.28, Pperm = 0.0001) and a Condition X Encoding Phase interaction (F (2,86) = 9.15, Pperm = 0.0005)

Next, I investigated the emotional enhancement (CS+ > CS-). I've graphed it here as a difference score just for ease of seeing the enhancement effect - publication graphics will be full data.



For follow up comparisons, I used wilcoxon signed-rank tests, which is a non-parametric version of a paired t-test

As we have a very specific directional hypothesis, I used 1-sided p-values.

RBC = non-parametric effect size (rank-biserial correlation)

CLES = common language effect size

Retroactive effect: Baseline CS+ > CS-

```
          W-val     tail     p-val       RBC      CLES
Healthy   183.0  greater  0.009903  0.584416  0.584711
PTSD      194.0  greater  0.045647  0.405797   0.60397
```

Emotional enhancement: Acquisition CS+ > CS-

```
         W-val     tail     p-val       RBC      CLES
Healthy  209.0  greater  0.000613  0.809524  0.747934
PTSD     229.0  greater  0.000464  0.810277  0.689981
```

Proactive effect: Extinction CS+ > CS-

```
         W-val     tail     p-val       RBC      CLES
Healthy  179.5  greater  0.013642  0.554113  0.606405
PTSD     196.5  greater    0.0388  0.423913  0.608696
```

Thus, when using appropriate statistics (i.e. non-parametric and motivated by *a priori* hypothesis), we find that there is increased memory for CS+ relative to CS- for all phases and in both groups.

source memory

Carrying over our exclusions from the recognition memory, we have `N=17` in the healthy group and `N=17` in the PTSD group. We technically have the data from the 3 subs we excluded, since the source memory is self-paced they did answer everything. It could be interesting to see what they guessed, but for now just keeping them out.

normality

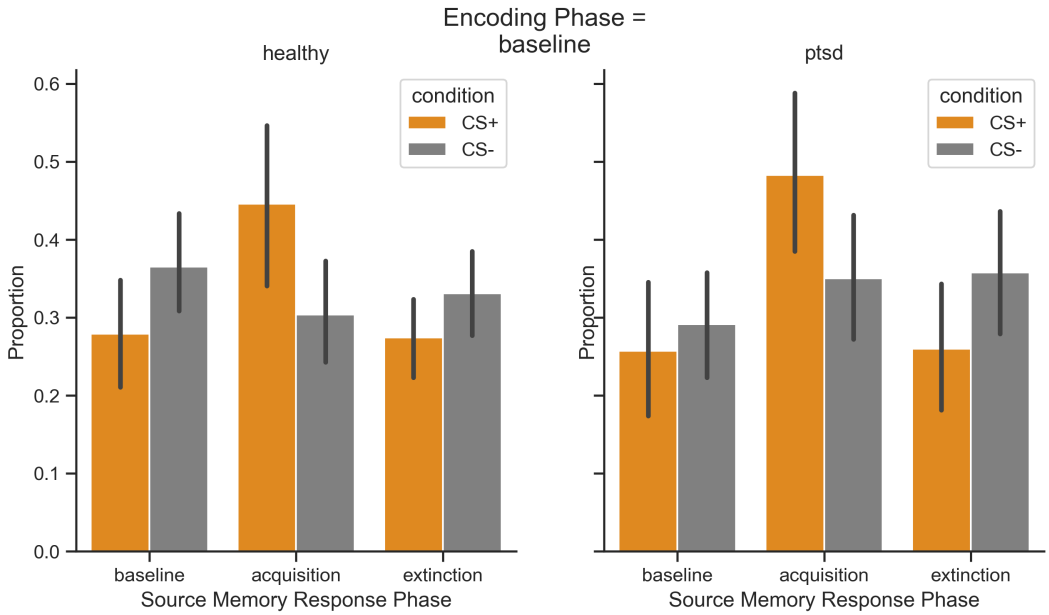
Again before analysis I checked the overall normality of the source memory data.

```
                W          pval  normal
healthy  0.965078  9.845692e-07   False
ptsd     0.964084  7.086799e-07   False
```

Again, we are dealing with non-normal data.

analysis

Here is source memory for items that were encoded during Baseline, broken down by CS type and Response Phase (the phase they said during the source memory test)



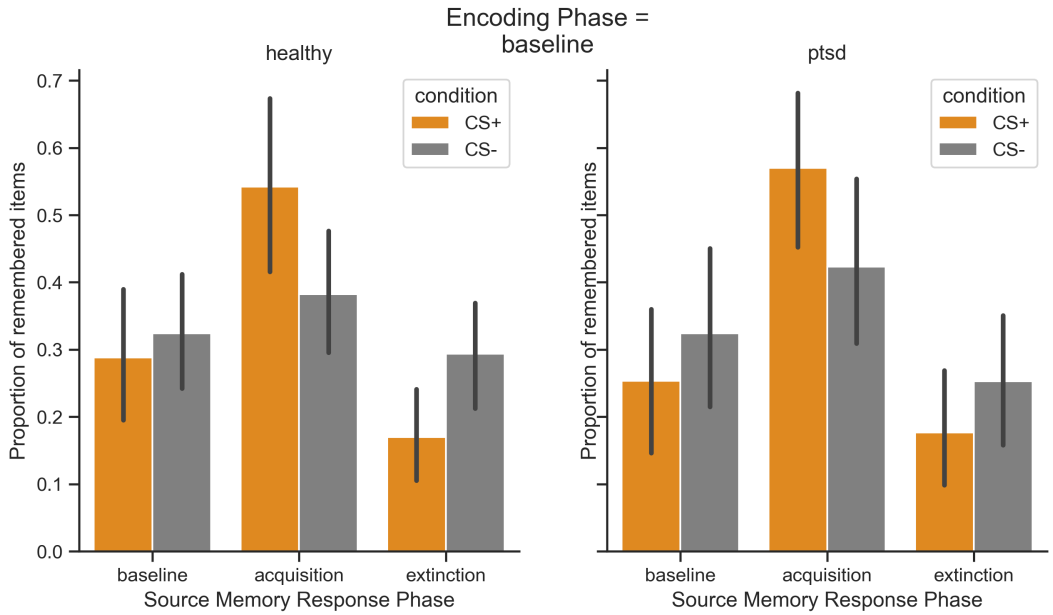
Running a full mixed ANOVA as before, we find there is a significant main effect of Response Phase (F(2,64) = 3.39, Pperm = 0.0422) and a Condition by Response Phase interaction (F(2,64) = 10.29, Pperm = 0.0001)

I again using 1-sided Wilcoxon tests to determine if the proportion of CS+ items mis-sourced to acquisition was higher than CS- in each group.

```
          W-val     tail     p-val       RBC      CLES
Healthy   117.0  greater  0.006044  0.720588  0.688581
PTSD      114.0  greater  0.009209  0.676471   0.65917
```

In both groups CS+B were misplaced as being from acquisition more compared to CS-B

BUT - How does memory factor in? Here is the same graph, but now `Proportion` refers to the proportion of remembered items, which varies per subject.



Again main effect of Response Phase, and significant interaction of Condition X Response Phase

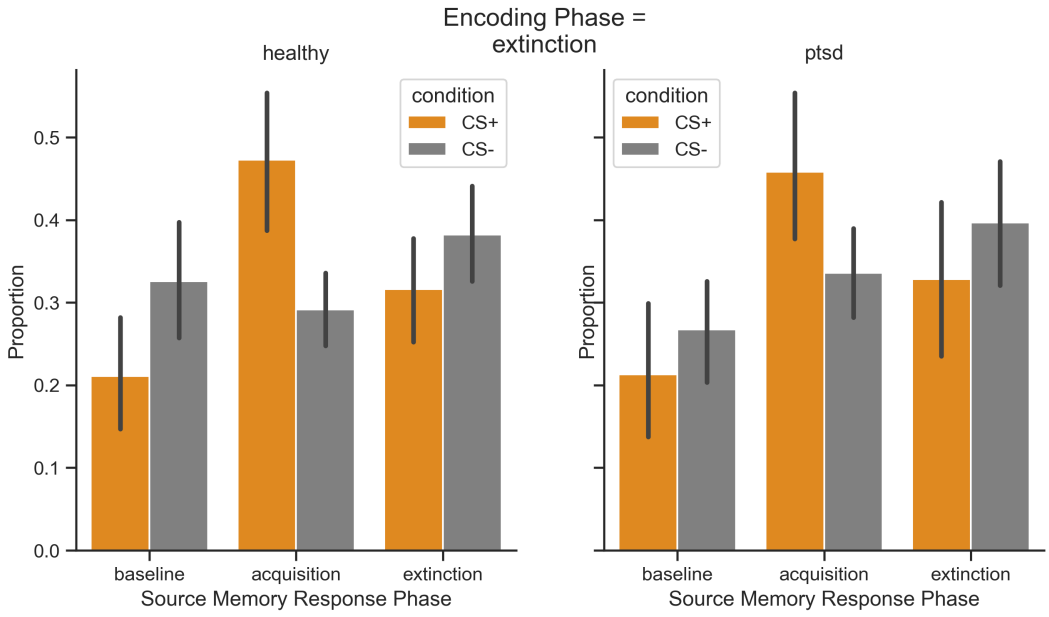
Follow up comparisons CS+B vs. CS-B responded to as from acquisition

```
          W-val     tail     p-val       RBC     CLES
Healthy   121.0  greater  0.003317  0.779412  0.66436
PTSD      111.0  greater  0.053754   0.45098 0.653979
```

So the effect is still significant for Healthy, but NOT for PTSS. Although it is trending.

We know that each subject has different hit rates for each condition and phase, so a more rigorous analysis should incorporate mixed effect modeling. But I'm really not sure how to approach it with this data, as we have binary memory status (hit vs. miss) and then three alternate choice data. I've spent a while thinking about this but there is not an "obvious" model to me. Please let me know what you think

Next we can do the same things but for extinction, looking at the proactive effect



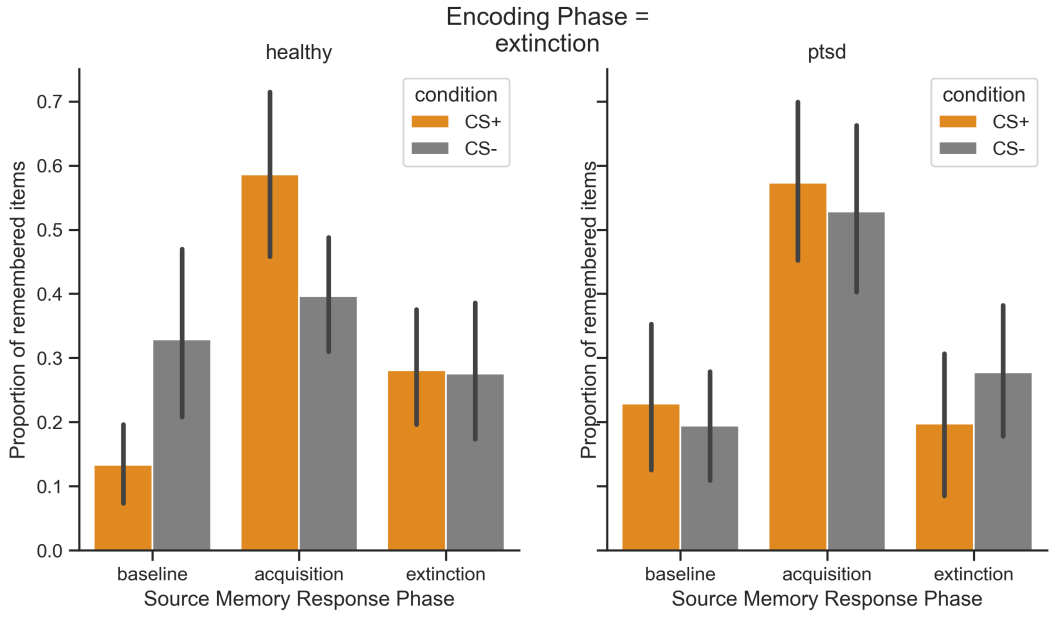
Main effect of response Phase, Condition by Response Phase interaction

Again the critical comparisons here are CS+E vs CS-E that people endorse as being from acquisition

```
        W-val     tail     p-val       RBC      CLES
healthy 119.0  greater  0.004481      0.75  0.780277
  PTSS   61.0  greater  0.045778  0.564103  0.704152
```

Significant in both groups, but only just barely in PTSS

Lets look at just the items that were remembered:



Main effect of response phase only

Follow up tests:

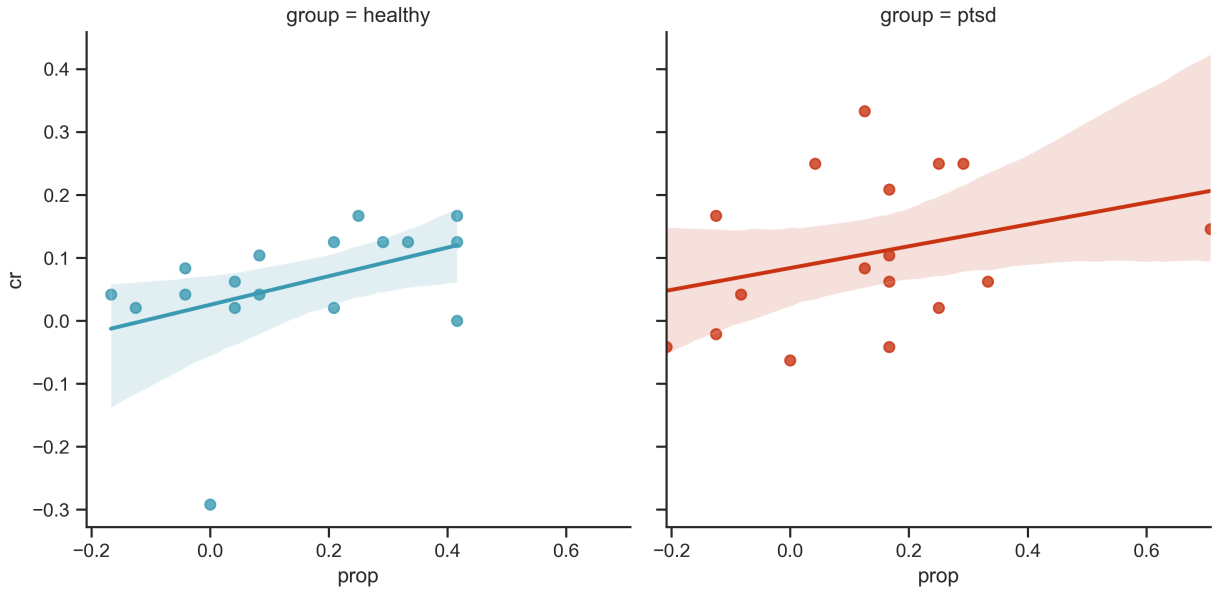
```
          W-val     tail     p-val      RBC      CLES
Healthy   116.0  greater  0.032395  0.51634   0.67474
PTSS       76.5  greater  0.339533    0.125  0.544983
```

Effect is significant for healthy, but definitely NOT for PTSS. First major group difference. Although important to note that this is definitely being driven by PTSS endorsing more CS-E as being from acquisition. I didn't run any tests, but I'd bet good money there is no difference in the CS+E being endorsed as acquisition between the two groups in the above graph.

Recognition X Source memory

Correlations seeing if differential (CS+ > CS-) source memory predicts differential recognition memory. I'm not sure if restricting analysis to just remembered items is really appropriate here or not, so I'm showing it both ways.

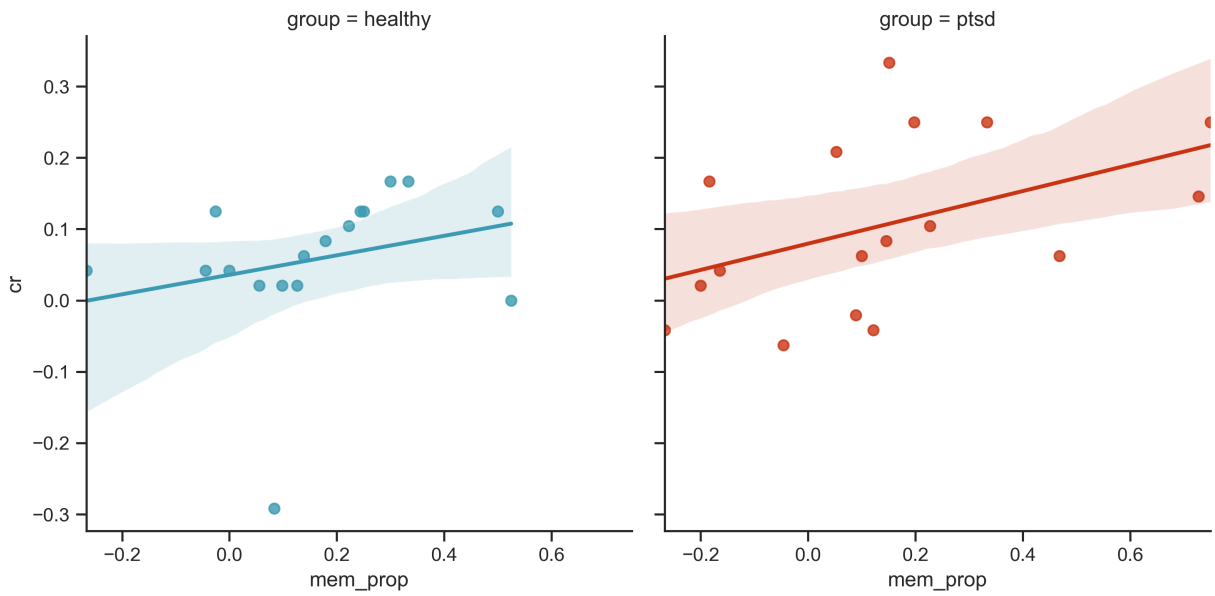
Starting with Baseline. X-axis is the difference in CS+B - CS-B endorsed as being from acquisition, against differential corrected recognition for all of baseline on the Y-axis




```
healthy: r = 0.41, p = 0.09
  ptss:  r = 0.31, p = 0.22
```

Trending in Healthy, NS in PTSS

Here is the same thing, using the difference in proportion of remembered items:



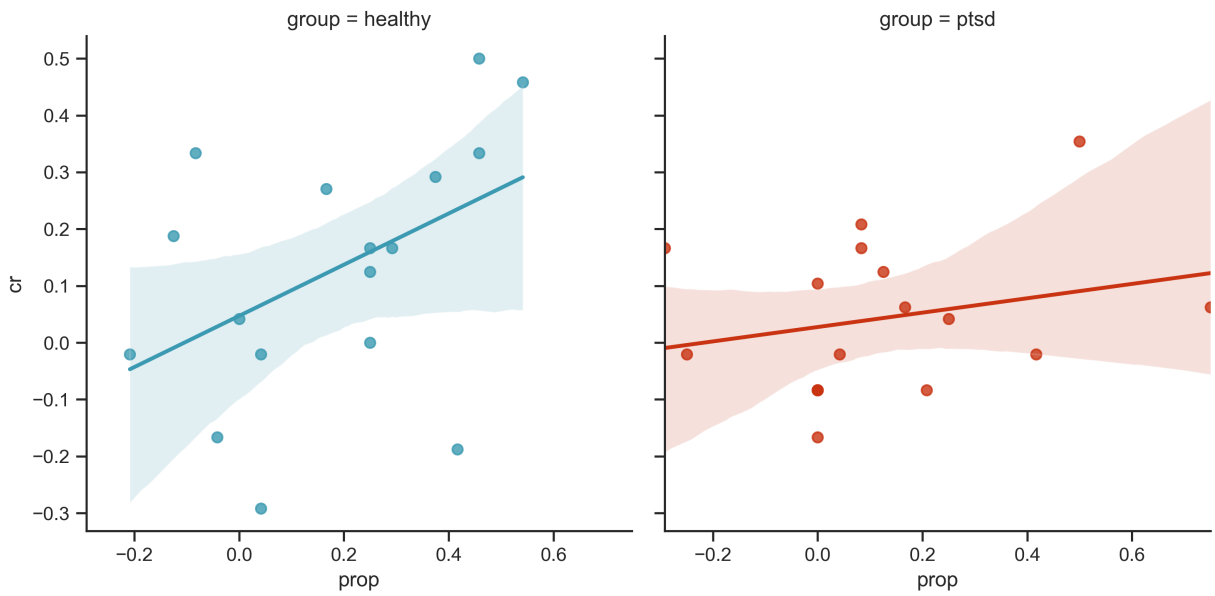

```
healthy: r = 0.25, p = 0.32
  ptss:  r = 0.45, p = 0.069
```

So here, NS in healthy, trending in PTSS

What this tells me is that there is probably something interesting going on with recognition memory here, but we need a more direct test to tease it out.

Lastly for now, here is the same gambit for extinction.

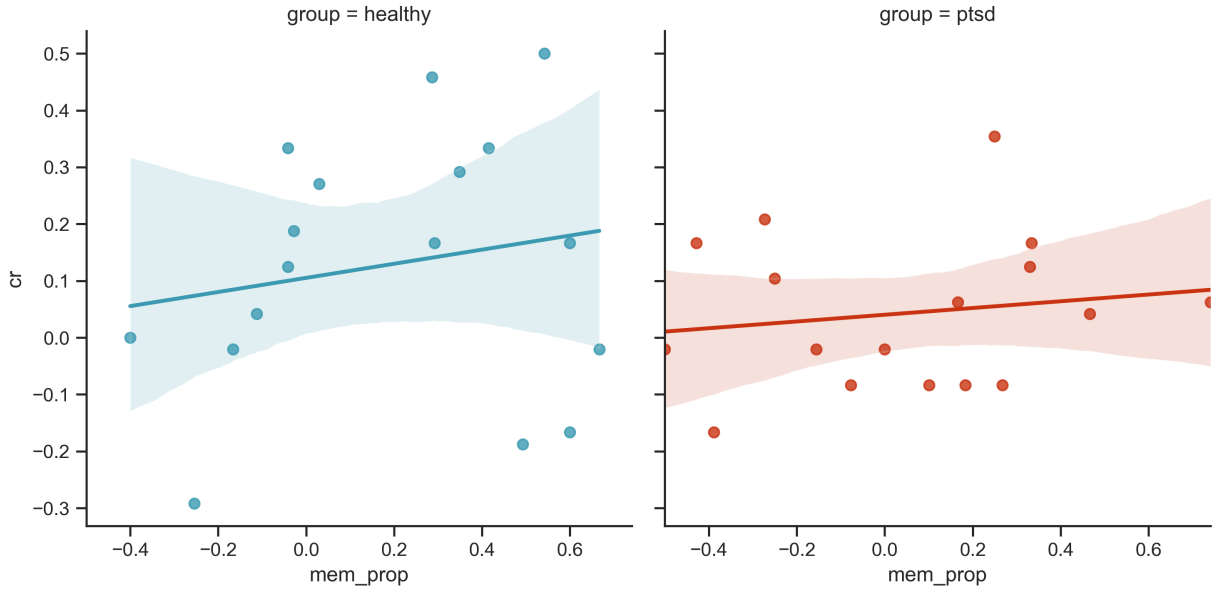
X-axis is the difference in CS+E - CS-E endorsed as being from acquisition, against differential corrected recognition for all of extinction on the Y-axis




```
healthy: r = 0.46, p = 0.095
  ptss:  r = 0.24, p = 0.35
```

So trending in Healthy, NS in PTSS

Finally, same as above but using only remembered items for the source memory:



```
healthy: r = 0.18, p = 0.48
  ptss:  r = 0.15, p = 0.55
```

Neither group is significant.

So in sum, I think we need to run a multinomial logistic regression in order to better relate performance on the 3-AFC source memory test to recognition memory performance.