fearmem 8-5

relating source memory to recognition memory

The hypothesis motivating this analysis is that people are more likely to remember an item from any phase of the experiment (baseline, acquisition, extinction) if they incorrectly place that item in the "acquisition" context. This might be a little bit of a stretch of interpretation as for what the retroactive and proactive memory enhancement, but its something we can test using the source memory data.

The idea is that for an item during the source memory test, if subjects endorsed that item as being from Acquisition, then that should be related to better memory that item. Technically we collected source memory first but the testing is a lot cleaner this way.

The way we are going to do this is using a logistic regression predicting binary hit or miss using high confidence accuracy. So in binary terms, 1 = definitely old response during the recognition memory, and 0 = everything else.

The source memory responses are not continuous, so in order to make them useful for the logistic regression I transformed them into a one-hot coding scheme.

For example, on two trials a person might have responded:

```
trial response
    1 acquisition
    2 baseline
    3 extinction
```

this gets turned into:

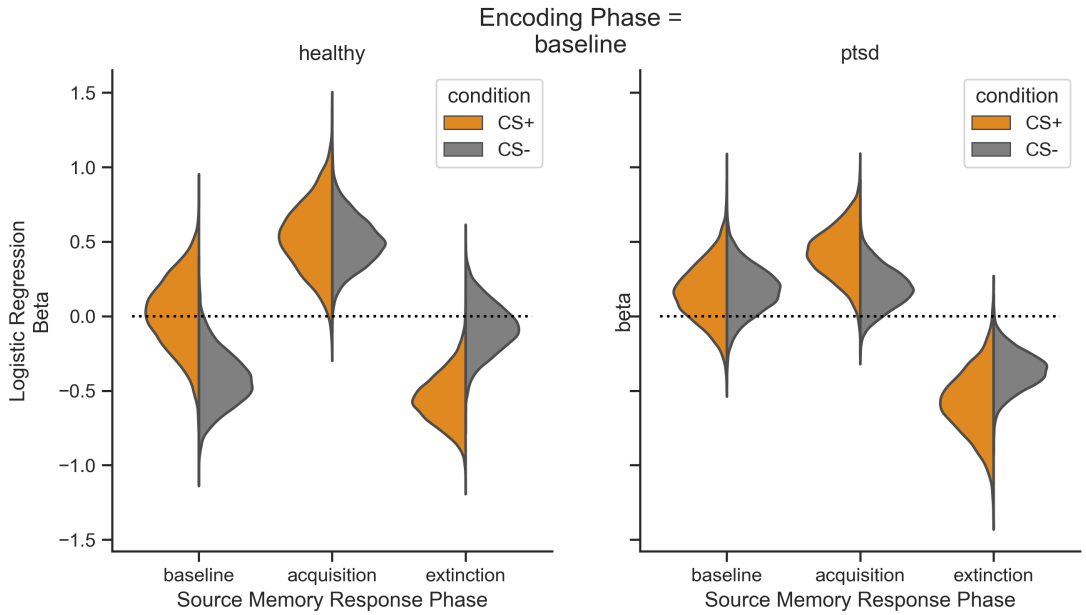
```
trial    baseline    acquisition    extinction
    1        0             1             0
    2        1             0             0
    3        0             0             1
```

We can then evaluate the different Betas (coefficients) for each of the columns. If these betas are significantly different from 0, we can interpret them as having positive or negative impacts on recognition memory (above and below 0 respectively).

Again this data set is very sparse when broken down into the different conditions (e.g. CS+ encoded during baseline that are remembered). So in order to increase power, and to test reliability across subjects, I used the `super-subject` bootstrapping approach. This means that I ran each logistic regression 10,000 times, sampling whole subjects with replacement.

Violin plots show the distribution of beta coefficients. P values were taken as two-sided since we have less directionality-prediction here. Significant and trending values are reported below each graph. "Tail" here is a little bit of a misnomer, as it refers to if the test is significant as being above or below 0. Again all are two-tailed tests

Baseline




```
HEALTHY GROUP, ENCODING PHASE = BASELINE
condition response_phase       p     tail
     CS+B    acquisition  0.0190  greater   *
     CS+B     extinction  0.0018     less   **
     CS-B    acquisition  0.0010  greater   ***
     CS-B       baseline  0.0306     less   *
```

```
PTSD GROUP, ENCODING PHASE = BASELINE
condition response_phase       p     tail
     CS+B    acquisition  0.0154  greater   *
     CS+B     extinction  0.0088     less   **
     CS-B     extinction  0.0054     less   **
```

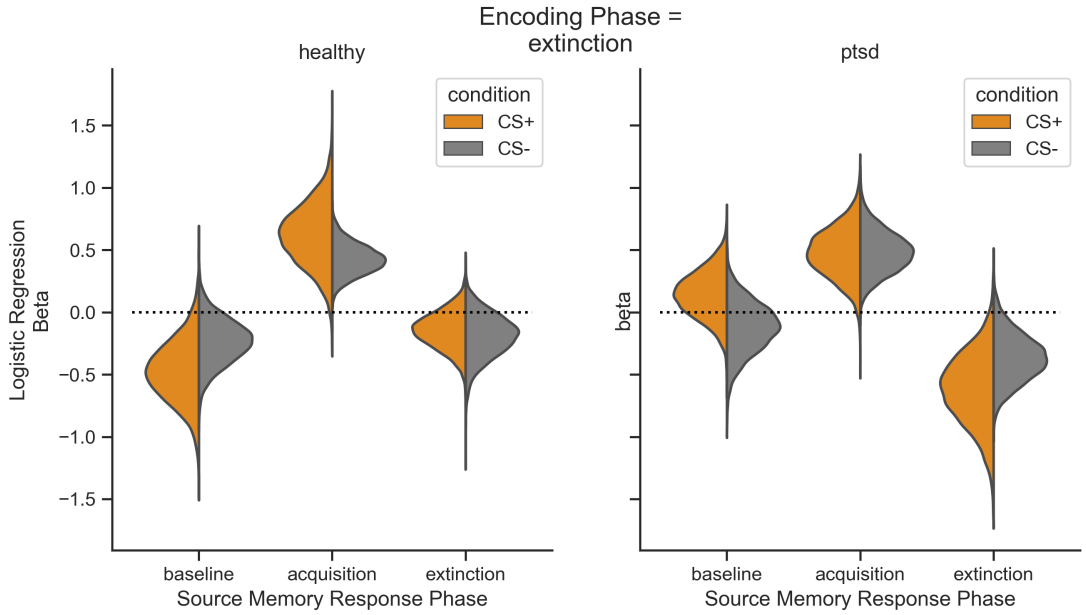
As we can see, responding that an item is from acquisition is significantly associated with it being remembered. This is significant for both CS+B and CS-B in healthy, and CS+B in PTSS.

Also, we see that endorsing something as being from extinction is associated with *worse* that item being forgotten. This is significant for both CS+B in healthy, and CS+B and CS-B in PTSS.

Finally, we also see that endorsing CS-B as being from baseline is associated with poor memory in the healthy group only.

Extinction

Going in order of cool results, lets look at extinction next.




```
HEALTHY GROUP, ENCODING PHASE = Extinction
condition response_phase       p     tail
     CS+E    acquisition  0.0140  greater   *
     CS+E       baseline  0.0664     less   ~
     CS-E    acquisition  0.0002  greater   ***
```

```
PTSD GROUP, ENCODING PHASE = Extinction
condition response_phase       p     tail
     CS+E    acquisition  0.0202  greater   *
     CS+E     extinction  0.0244     less   *
     CS-E    acquisition  0.0010  greater   ***
     CS-E     extinction  0.0716     less   ~
```

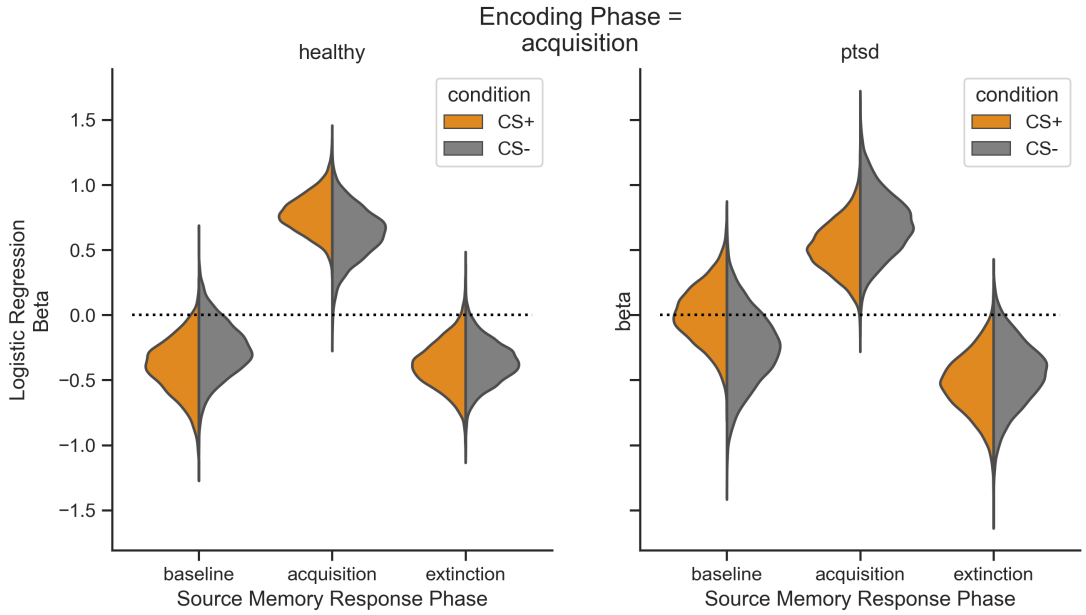
As in baseline, we see that endorsing items as being from acquisition predicts those items being remembered. This is significant for CS+E and CS-E in the healthy group, and CS+E and CS- in the PTSS group.

Also we see that in the PTSS group only, endorsing a CS+E as being from extinction predicts forgetting.

There are also two trending effects in the tables.

Acquisition

Finally, maybe just as sanity check, here is items encoded during acquisition




```
HEALTHY GROUP, ENCODING PHASE = ACQUISITION
  condition response_phase       p     tail
       CS+A    acquisition  0.0000  greater   ***
       CS+A       baseline  0.0380     less   *
       CS+A     extinction  0.0388     less   *
       CS-A    acquisition  0.0054  greater   **
       CS-A     extinction  0.0292     less   *
```

```
PTSS GROUP, ENCODING PHASE = ACQUISITION
  condition response_phase       p     tail
       CS+A    acquisition  0.0040  greater   **
       CS+A     extinction  0.0114     less   *
       CS-A    acquisition  0.0006  greater   ***
       CS-A     extinction  0.0618     less   ~
```

As we could expect, for both groups endorsing CS+A and CS-A as being from acquisition predicts successful memory.

In the healthy group, we see that endorsing CS+A as being from either baseline or extinction predicts forgetting. The same is true for CS-A endorsed as extinction.

In the PTSS group, we see that for both CS+A and CS-A endorsing as extinction predicts forgetting. No effect of endorsing as baseline.

All in all, I think this analysis really helps cement the relationship between the source memory and the emotional memory enhancement effect. The lack of differences between CS+ and CS- is interesting, it would be cool if it was more selective but I think we have a lot to go off of already. I will probably look at CS+ vs. CS- and healthy vs. PTSS in some of these bins, but didn't want to choke us with p-values yet.