

# final (ish) fearmem fMRI report

## Univariate analyses

### ANOVA type analysis

The most broad univariate analysis conducted as a linear mixed effects model. We can interpret the fixed effects as a repeated measures ANOVA, so for our purposes we can have main effects and interactions with `Encoding phase`, `CS condition`, `Source memory response`.

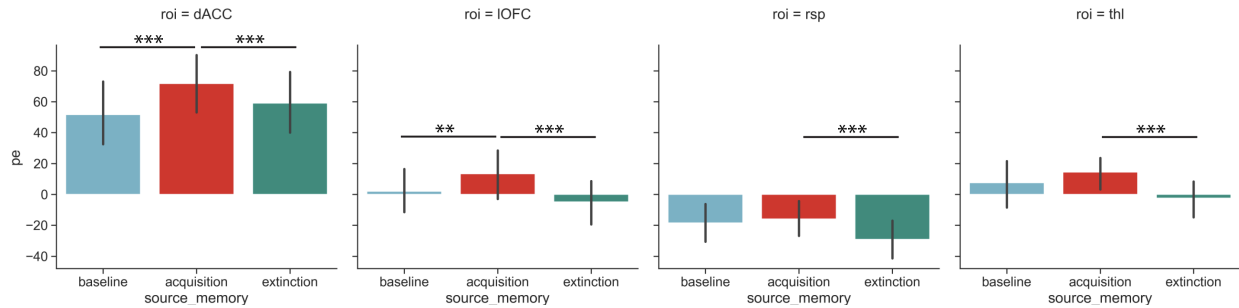
With a voxel wise threshold of `p=0.005`, and a clusterwise threshold of `p=0.05`, there were significant clusters for `CS condition`, `Source memory response`, and an interaction of `CS condition X Source memory response`.

To start, I am not really pursuing the `CS condition` main effect and interaction, as most of these results are in visual cortex.

Moving on to the main effect of `Source memory response`. 4 significant clusters were identified: dACC, IOFC, thalamus, and retrosplenial cortex. Next, I performed post-hoc tests only at the level of `Source memory response` to determine the source of the main effect.

Contrasts were performed within the LME framework, using the `emmeans` package in R. So the post-hoc here isn't exactly a t-test, but a general linear test within the mixed effects model. The difference is here we don't have to drop subjects with missing data.

Again this is contrasting neural activity based on the response give *later* during the source memory test.



In the dACC and IOFC, activity is higher for acquisition compared to both baseline and extinction responses. In retrosplenial and thalamus, acquisition responses are higher than extinction. I did NOT consider the baseline vs. extinction, as that is not really a contrast of interest.

So the interpretation here is that, at least in the dACC and IOFC, there was more activity for items that you later source as being from acquisition compared to other contexts. This was regardless of when you actually encoded those items, or what CS type they were.

## Contrasts of interest - retro and proactive memory effects

Even though we are missing the appropriate interactions at the upper level, I wanted to consider some more fine grain contrasts that are directly related to our behavior. Specifically, I wanted to look for differences in activity between correctly sourced CS+ vs. incorrectly acquisition-sourced CS+.

The first one is CS+s encoded during baseline that were correctly sourced to baseline, vs. CS+s encoded during baseline that were incorrectly sourced to acquisition. **CSpB\_B vs. CSpB\_A**

This was not significant in any of the above clusters.

The second is CS+s encoded during extinction that were correctly sourced to extinction, vs. CS+s encoded during extinction that were incorrectly sourced to acquisition. **CSpE\_E vs. CSpE\_A**

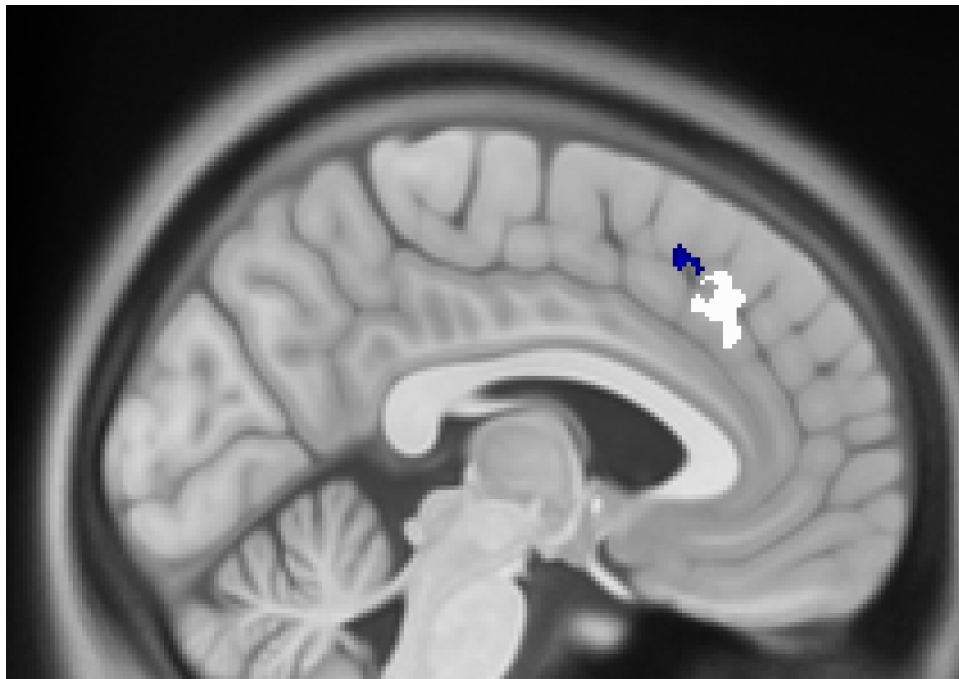
roi	t-ratio	p
10FC	2.0554770	0.0400 *

Significant in 1 cluster, but probably not something to hang a hat on.

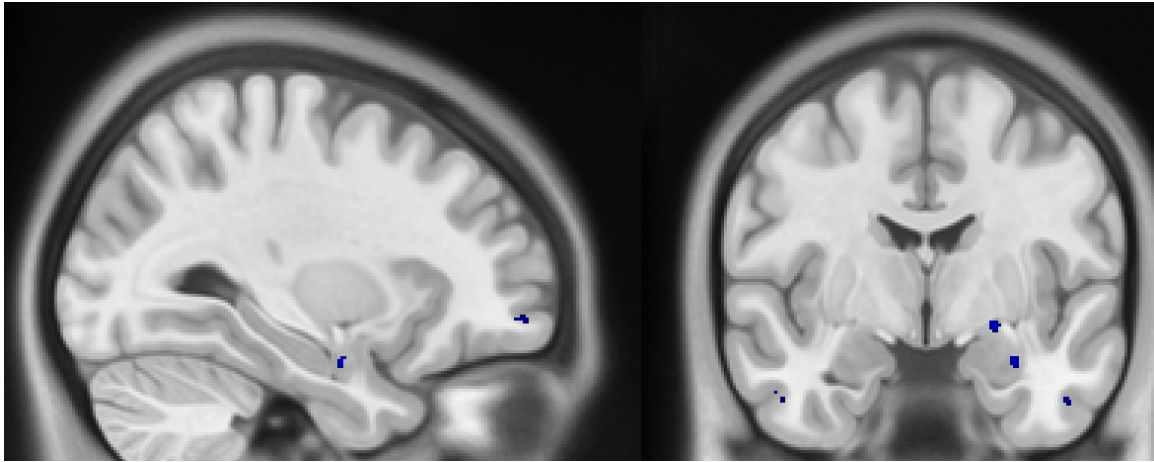
I was kind of surprised by these results, and seeing as how differences in these conditions are such a huge part of our behavior, I wanted to do a whole brain contrast for these effects. So I went back and ran the LME with these post-hoc contrasts.

**No significant clusters were observed at the same thresholds. HOWEVER, there are some very interesting effects visible at a voxel wise threshold of  $p=0.005$ , one sided.**

For the baseline comparison, we see activity in the dACC and amygdala! The dACC activity is next to the cluster identified above, which is shown here in white.



and amygdala:



Nothing really to report for the extinction contrasts. Maybe if it was higher powered idk, but I really don't think it could pan out.

BUT for the baseline contrast above, the amygdala be significant with small volume correction. That is really the only actionable item so far. I haven't done this, but if it interests us I can. I don't know how to handle the dACC one without going into double dipping territory.

**So big takeaway from the univariate is that there are some regions that signal very generally when the perceived temporal context is emotional.**

## Multivariate

Ok so, the high level take away is that there is no consistent pattern of multivariate results that support the univariate results. There is a hodge-podge of RSA and encoding-retrieval overlap findings. The problem is that a lot of things either won't survive multiple comparisons corrections, or just don't fit with

anything else (such as the vmPFC findings). I have given it a good try, run a lot of analyses, but I just don't see any way to meaningfully bring it into the paper. If Joey/Jarrold want to go over the multivariate results in detail I would be happy to in a meeting.