Portfolio 8, Study Group 10

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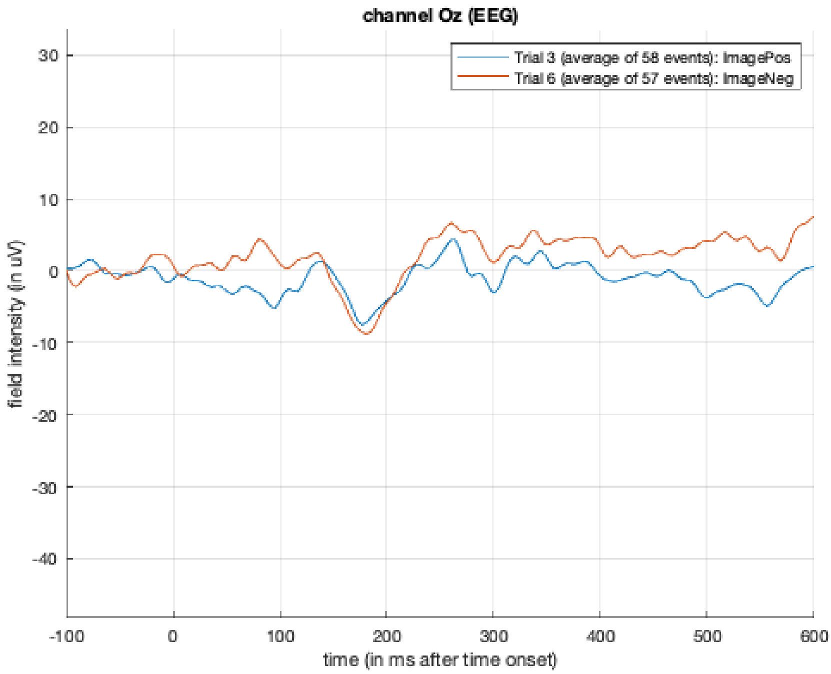
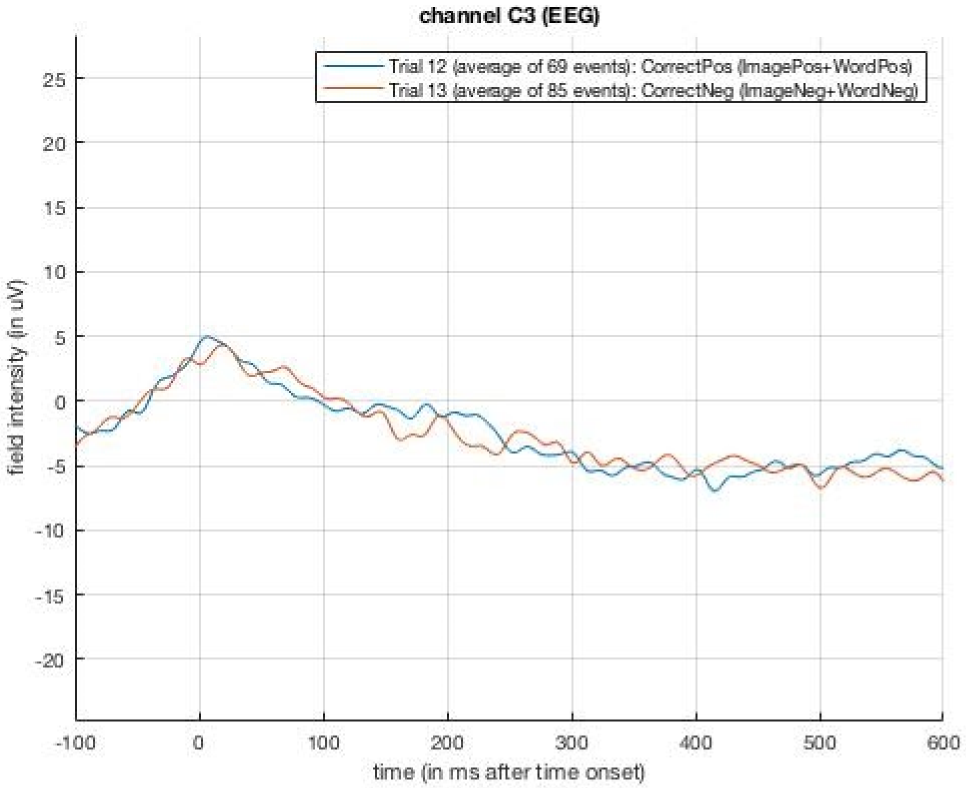
I. *Create and save a plot of your group's participant's ERPs to the ImagePos and ImageNeg from channel Oz.*
Given that we tend to pick up signals from visual cortex at occipital electrode sites, what well-known response does the negative deflections around 170 ms remind you of?

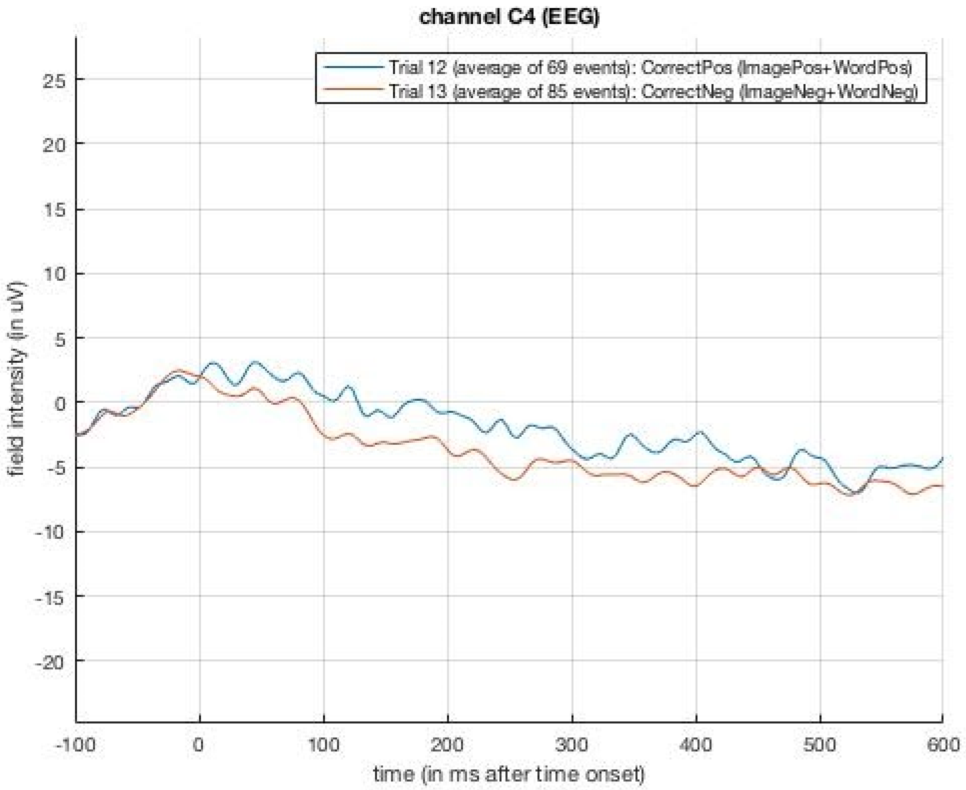


The negative deflections around 170 ms remind of us the N170 found on the surface of the occipito-temporal cortex in relation to object categorization of objects and faces.

II. *Create and save a plot of your group's participant's ERPs to the Correct responses to ImagePos (i.e. CorrectPos) and Correct responses to ImageNeg (i.e. CorrectNeg), respectively – only this time, you pick what channel to report from.*
Motivate your choice of channel for reporting the motor responses. After having looked around for the most "interesting" channel to report from – would it be okay to just focus our statistical analyses on this channel onwards?

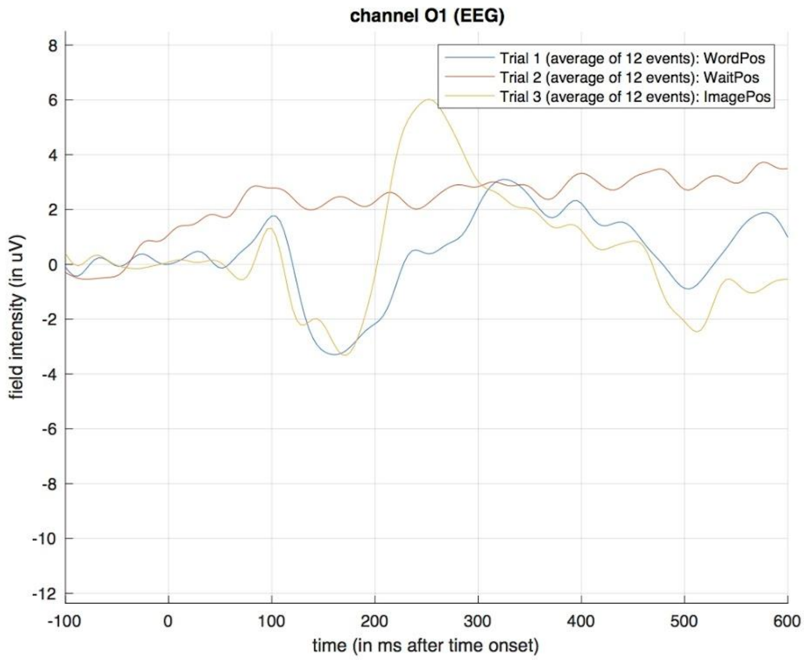
We chose to look at channel c3 because this channel should correspond to the motor cortex (M1) in the left side of the brain corresponding to the right hand which was used in the experiment. We also looked at c4 which should correspond to the left hand for comparison. Therefore we consequently investigate whether we can see the movement initiation of the participants hand at 0 ms (and a bit before), because this is when the participant responds physically to the facial stimuli. It would not be ideal to only focus on this channel onwards, because we would negate waves from different electrodes.

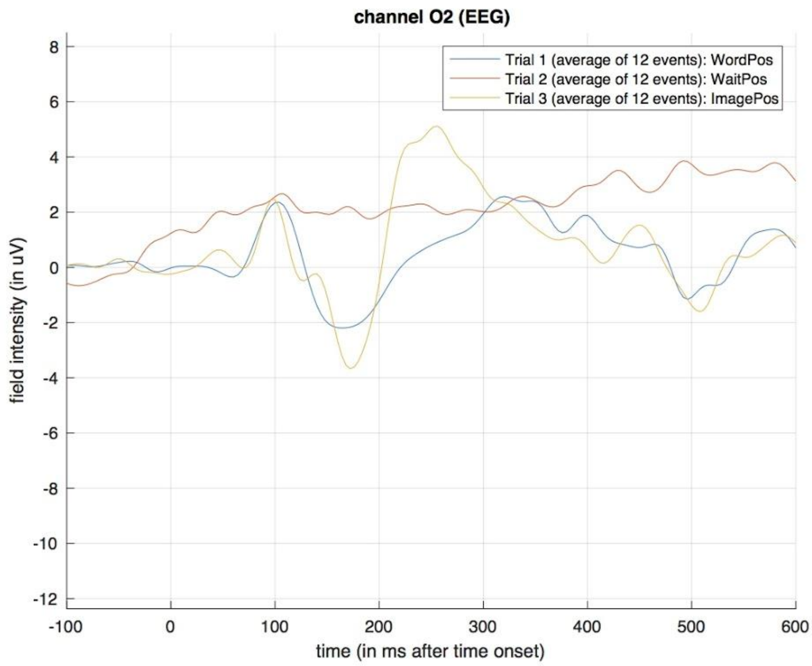




III. *Do the same for the lowpass-filtered group-average, and create and save a plot of the three first difference waves (aka. "contrasts") at O1 and O2.*
Reflection: In your view, what could some of risks be of only looking at/relying too heavily on difference waves when interpreting your data?

The risks of only taking contrasts into account is that one could miss some general tendencies in the data. Which could in the individual contrasts be misinterpreted as some kind of behavioral effect.


channel O1 (EEG)
Trial 1 (average of 12 events): WordPos
Trial 2 (average of 12 events): WaitPos
Trial 3 (average of 12 events): ImagePos
field intensity (in uV)
time (in ms after time onset)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-100
0
100
200
300
400
500
600



IV. *Report the stats output coordinate table (including the graphics) of your preferred contrast (default: ImagePos-Neg and diff-t).*
Reflection: Motivate the choice of your preferred contrast. Bearing in mind that we are using our one-sample t-test to test for when our difference wave is reliably different from zero, what kind of difference does the major effect(s) you see in your preferred contrast reflect (hint: what condition are you subtracting from which, and in that light, what might an effect in e.g. the "positive" contrast imply)?

We have been inspired from literature (Luck, 2014) to look for the N170 wave in V5/Fusiform face area (FFA) when participants process faces, familiar objects or words. Some evidence suggest that there might be a lateralization of whether a person is processing faces or words, in the occipital temporal electrodes, where faces have the greatest ERP amplitude in the left hemisphere and faces the greatest ERP amplitude in the right hemisphere (Rossion et al., 2003). We therefore first looked at two occipital electrodes (O2 and O1) and two electrodes from the occipital temporal electrocode (P8 and P7) on these electrodes we will look at timepoints where participants were either given a word or an image. Figure 1 shows the result, in both occipital electrodes and occipital-temporal electrodes there seems to be a N170 response. There seems to be no difference between images and words in the occipital electrodes, one might see a small effect of images in the right hemisphere occipital electrode. However in the occipital-temporal electrodes there seems to be a difference between words and images, most notably in the right hemisphere occipital electrodes. This distinction between words and faces can be made both temporally and with the amplitude of the ERP, because the ERP's for images appear earlier than for words, and they elicit a greater response.

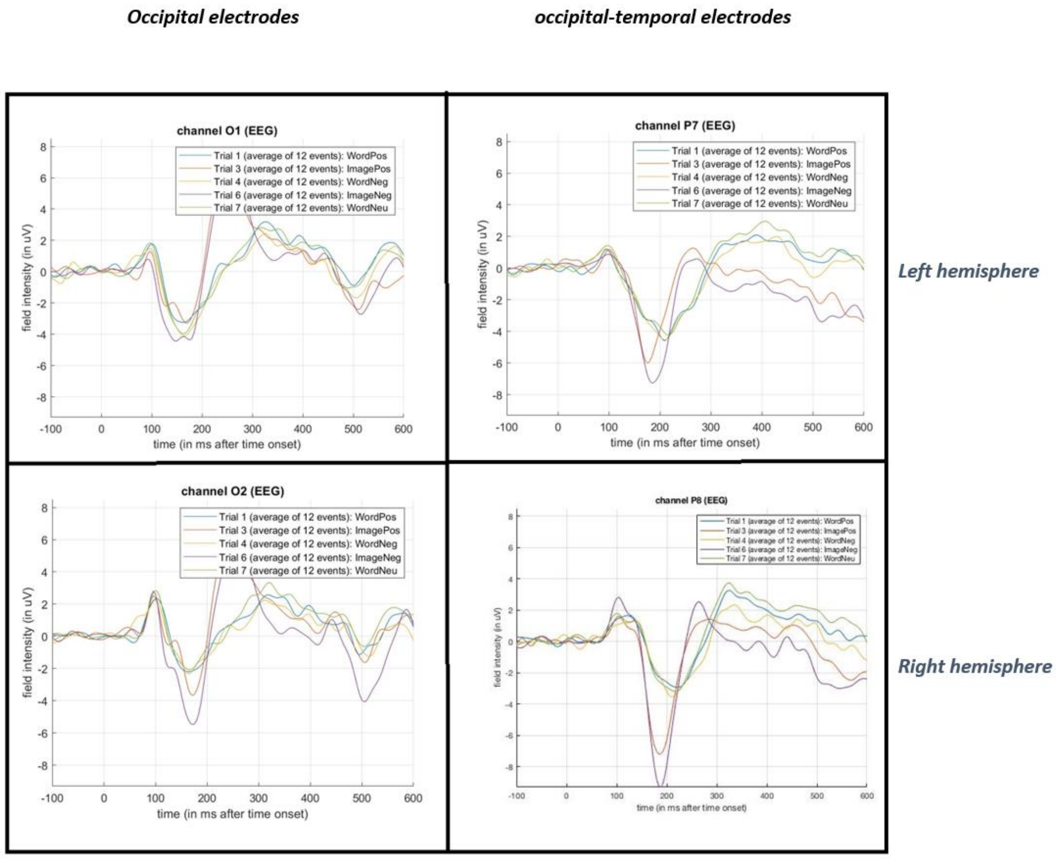


Figure 1, displays the two occipital electrodes to the left and the occipital temporal electrodes to the right. O1 and P7 is from the left hemisphere whereas O2 and P8 is from the right hemisphere.

To investigate these results further we made our own contrasts putting the two image conditions together and the three word conditions together, this contrast allows us to investigate whether there actually was a difference between the processing of words and images in the right occipital temporal electrode see figure 2.

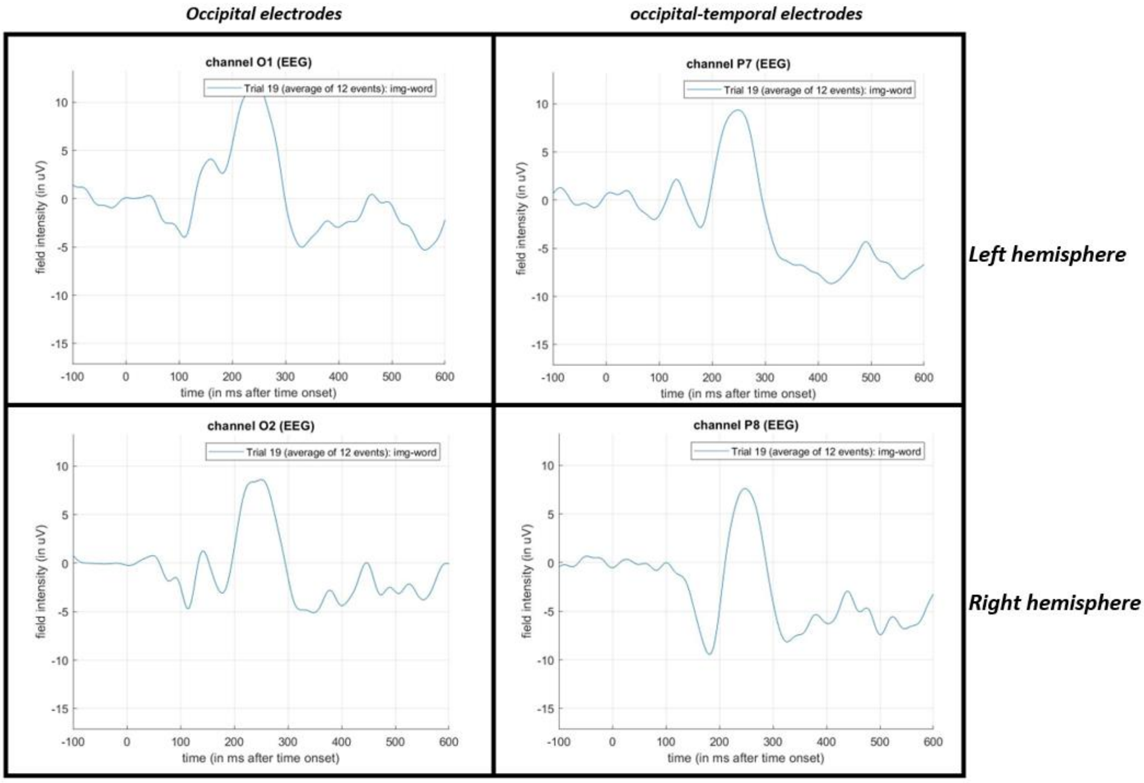
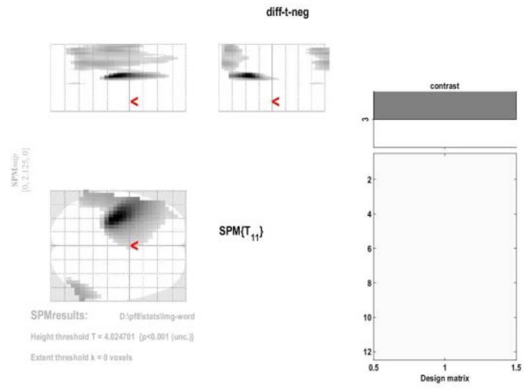


Figure 2 displays the two occipital electrodes to the left and the occipital-temporal electrodes to the right. O1 and P7 is from the left hemisphere whereas O2 and P8 is from the right hemisphere. The contrast used are images vs words.

As discussed previously we would expect the N170 response to elicit a greater response in the right occipital-temporal electrode compared to the occipital temporal electrode in the left hemisphere, which one can clearly see in figure 2. To test whether this response was statistically significant we conducted a one sample t-test. Here we looked at the contrast, *image vs words*, thereafter we decided to look at the contrast -1 on this one sample t-test to look for the places that are more negative because we expect a more negative response in the right occipital-temporal region, because of the greater amplitude of the N170 response.

Graphics output for the new contrast:



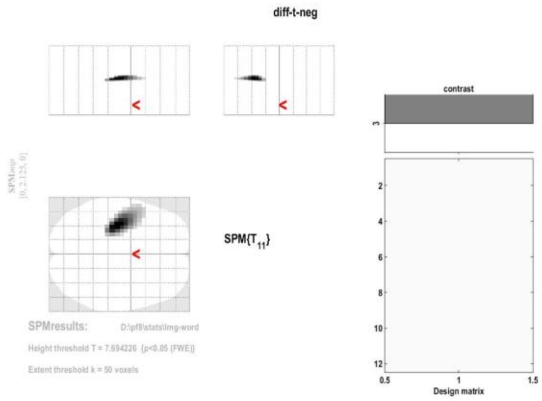
Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm ms
p	c	$p_{FWE-corr}$	$q_{FDR-corr}$	k_E	p_{uncorr}	$p_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_E)	p_{uncorr}	
0.291	3	0.000	0.000	5502	0.000	0.001	0.005	13.53	5.52	0.000	-30 -19 256
						0.001	0.005	13.51	5.52	0.000	-34 -14 264
						0.123	0.205	6.65	4.13	0.000	-60 -25 532
		0.018	0.014	735	0.009	0.150	0.205	6.42	4.06	0.000	68 -62 408
						0.151	0.205	6.42	4.06	0.000	68 -62 500
						0.154	0.205	6.39	4.05	0.000	55 -68 548
		0.719	0.675	18	0.675	0.663	0.618	4.54	3.34	0.000	51 -73 180

table shows 3 local maxima more than 8.0mm apart

Height threshold: T = 4.02, p = 0.001 (0.847)
Extent threshold: k = 0 voxels
Expected voxels per cluster, <k> = 96.995
Expected number of clusters, <c> = 1.88
FWEp: 7.694, FDRp: 13.513, FWEc: 735, FDRc: 735

Degrees of freedom = [1.0, 11.0]
FWHM = 51.3 63.9 46.9 mm mm ms; 12.1 11.9 11.7 {voxels}
Volume: 11772024 = 128832 voxels = 69.5 resels
Voxel size: 4.3 5.4 4.0 mm mm ms; (resel = 1684.65 voxels)



Statistics: *p-values adjusted for search volume*

cluster-level				peak-level					mm mm ms
$p_{FWE-corr}$	$q_{FDR-corr}$	k_E	p_{uncorr}	$p_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_E)	p_{uncorr}	
0.000	0.000	405	0.000	0.001	0.018	13.53	5.52	0.000	-30 -19 256
				0.001	0.018	13.51	5.52	0.000	-34 -14 264

table shows 3 local maxima more than 8.0mm apart

Height threshold: T = 7.69, p = 0.000 (0.050)
Extent threshold: k = 50 voxels, p = 0.056 (0.003)
Expected voxels per cluster, <k> = 13.634
Expected number of clusters, <c> = 0.00
FWEp: 7.694, FDRp: 13.513, FWEc: 405, FDRc: 405

Degrees of freedom = [1.0, 11.0]
FWHM = 51.3 63.9 46.9 mm mm ms; 12.1 11.9 11.7 {voxels}
Volume: 11772024 = 128832 voxels = 69.5 resels
Voxel size: 4.3 5.4 4.0 mm mm ms; (resel = 1684.65 voxels)

figure 3. The left output shows p-values uncorrected for multiple comparison with a p-value threshold of 0.001 and a voxel threshhold of 0. The right output shows p-values corrected for multiple comparison with a p-value threshold of 0.05 and a voxel threshold of 0.

These results show that there is a greater negative response around 180ms after stimuli onset in the right occipital temporal sites (V5/FFA), which we preceive to be the small cluster with 18 voxels in the left picture in figure 3, when looking at faces compared to words. This delay of 180ms after stimuli onset matches well our initial hypothesis, that there in the right occipital temporal site should be a greater negative response around 170ms after stimuli onset when watching faces compared to words. However this effect is only seen when not taking multiple comparison into account but with a p-value of 0.001. Our results also showed that there seems to be greater negative responses in the left parietal regions when looking at images compared to words. One might hypothesize that this response could have something to do with the lateralization of language to the left hemisphere.

V. *Collect all material and submit as a single file (pdf or html) to Blackboard. Reflection: List the two most surprising things you've learned about EEG during this workshop as well as the most interesting topic/question you'd like to pursue with EEG if you had unlimited resources (i.e. time, money and interest).*

1. We found it surprising how easy it is to set up an EEG experiment and how mobile it actually is. However, it was quite hard to properly activate the electrodes on a person's scalp.
2. But also how fragile the activity can be both from artefacts and how influenced it is by big electric fields from the surroundings.

We discussed that if we had unlimited resources, we would like to investigate the possibility to create an encoder/decoder. Where the encoder would be used to analyze a person's brain activity when sleeping and then matching this brain activity with what the person was dreaming about. Then you would possibly at some point be able to decode this person's brain activity and be able to infer what a person had been dreaming about solely based on the EEG data.

litterature:

Rossion, B., Joyce, C. A., Cottrell, G. W., & Tarr, M. J. (2003). Early lateralization and orientation tuning for face, word, and object processing in the visual cortex. NeuroImage, 20(3), 1609–1624. https://doi.org/10.1016/j.neuroimage.2003.07.010