# Individual assignment

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**Question 1a:**

*In the early visual cortex, we see the strongest correlations along a horizontal or vertical line, surrounded by a white dashed rectangle. How do you interpret this component of the response?*

MEG or EEG brain responses were extracted for time points tx and ty after stimulus onset. So, we can create a Time-time MEG decoding matrix. At each point it can extract a n\*n MEG decoding matrix. After that, another matrix with the use of human fMRI can be used to calculate the Spearman’s R at this point. After repeating all MEG matrix at time point combination tx and ty. So, this result demonstrates that neural activity for the time point combinations of ~100ms and ~100ms – 700ms correlated with EVC dissimilarity matrices. That means EVC only deal with the signal at ~100ms and its result or extracted pattern can be used from ~100ms to 700ms. This can be quite easy to understand. EVC is the first cortex to process the signal no matter the signal follows dorsal stream or ventral stream. It starts to extract some features like color and orientation. And all those features can be used in any stages of those visual pathways. So that is the reason why this graph represents the EVC and there is a strong correlation along a horizontal or vertical line. The feature map EVC extracted can be used in the whole process just like the x-coordinate of that rectangle area shows

**Question 1b:**

*In the inferior temporal cortex, we see the strongest correlations around a diagonal line, surrounded by a white dashed oval. How do you interpret this component of the response?*

Just like Question 1a, MEG or EEG brain responses were extracted for time points tx and ty after stimulus onset. So, we can create a Time-time MEG decoding matrix. At each point it can extract a n\*n MEG decoding matrix. After that, another matrix with the use of human fMRI can be used to calculate the Spearman’s R at this point. After repeating all MEG matrix at time point combination tx and ty. So, this result demonstrates that neural activity for the time between ~250ms and ~500ms correlated with IT dissimilarity matrices. We can explain the result in visual cortex aspect. Generally, we have two streams among our visual cortex, one is ventral stream and another is dorsal stream. In ventral stream, it follows as V1-V2-V4-IT. IT is the last cortex to process the data and find what the object is from about 250ms and end at around 500ms. Because this is the highest-level cortex among the ventral stream. Signal trained at this period can only be used or test at this period. The feature extracted by this cortex is not only just color, orientation and others. It’s more like a continuous representation of feature with orderly topological arrangement and can be used to classify the specific item. However, there is a strange point which is EVC can be test until about 700ms but why IT can only be test at about 500ms. I guess this is because the dorsal stream (V1-V2-V3-V5/MT-Parietal cortex) is slower than ventral stream. At around 500ms this cycle of ventral stream is about to end and dorsal stream will wait until 700ms.

**Question 2a:**

*In Figure 2, task can be decoded well both during the Task Cue Period and the Response Mapping Period. However, in Figure 3, we see that the responses in these periods do not generalize with each other: training on responses in the Task Cue Period doesn’t allow decoding in the Response Mapping Period. How can both findings be correct? In other words, how do you interpret both results together?*

First for figure 2, task has a very high decoding accuracy for almost all periods especially the Task Cue Period and Response Mapping Period which can evidence that task can be decoded well among those two periods. Because participants see the task for the first time in the first period, the task-related information rise rapidly in response to the task cue, peaking at 100 ms. This was followed by a slow decay of information that approached chance-level and remained significant until ~1200 ms after cue presentation. During the Response Mapping Period, the subject needs to recall the task processing information based on the content on the display, so the encoding accuracy of the task is improved again.

However, training in the Task Cue Period and testing in the Response Mapping Period do not have a high decoding accuracy. That is probably the task is different, we cannot use the output task after Task Cue Period as the input of the response mapping period. We can find the evidence in these 2 images. In figure 2, a task-related information starting 240 ms after object onset and peaking at 630 ms after object onset. And information about task then remained well above-chance until the presentation of the response-mapping screen. This shows that task context has limited impact on initial feedforward object processing, but points towards later modulation of object representations. The task processing after the second period is combined with object information and it is not just the same as task-information after the first period. Early decoding of task after task cue onset may reflect an early visual representation of the task cue that is maintained in short-term memory and accessed when the object stimulus appears in order to carry out the task. Alternatively, the task representation during object processing may reflect an abstract representation of the participant’s emerging choice. Finally, the visual information about the task cue may reflect a more abstract representation of task rule that has been formed after initial visual and semantic processing of the task cue and that is maintained and applied to the object stimulus representation.

**Question 2b:**

*Conversely, training on responses in the Object Stimulus Period allows decoding from the Response Mapping Period. How do you interpret this?*

The high accuracy in the figure means a shared representational format within the selected time period. As I mentioned in the previous question, during the task cue period, the task is in an early visual representation and stored in the short-term memory. During the second period, the task information is combined with several object information and translate to a more higher-level representation. So, if we train on responses in the Object Stimulus Period and decode from the Response Mapping Period, this can be in a high accuracy.

**Question 3:**

*Figure 4 shows that the amount of the Object Stimulus Period response pattern predicted by the task and the object differs between brain areas and changes in different ways in each area. What differences do you note as we move from brain areas involved in early vision to those involved in object recognition to those involved in action planning:*

*(a) In the relative amounts of these responses to object and task?*

*(b) In the timing of the peak responses to the object and task?*

(a).

(i). For object, for the relative amount of those four areas, it has a general trend as A>B>C>D. I think this is because higher-level cortex can extract higher-level feature instead of basic feature. At the same time, the basic feature appears in many similar images which can improve the commonality coefficient.

(ii). For task A≈B<C<D, after task information is visually detected, it will be processed and stored in the short-memory area. For the first two area, it mainly about Visual perception and processing which only process the visual signal. But for the latter two areas their function is combined with thinking and linguistic. They will combine the visual information and other information together. For image D, it is very clear because task is in a very high level while value for object is low.

(b).

For object I think the first two reach its peak value faster than the latter two, which means brain areas involved in early vision and object recognition is faster than those involved in action planning. For task, A≈B≈C<D, but I think time is almost the same for C and D. Maybe it because for all task brain process is very high there might only be a little different.