***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?*

In the EVC, both RT1 and RT2 are strongly correlated at the start of the epoch (e.g. ERP for EEG), hence the pattern in the EEG of RT1 and RT2 is very similar. The early onset latencies of 50-110ms do also fit the theoretical framework of the EVC (or V1), which characterizes the EVC as the first processing step of the visual system in the occipital lobe.

When the epoch continues, the pattern of RT1 is only very similar to the pattern in RT2 at 50-100ms, but not for any other EEG signals before or after this interval (horizontal axis), and vice versa for RT2 with RT1 at 50-100ms (vertical axis). Thus, similarity of the early response (50-110ms) of one response pattern (e.g. RT2) persist for a prolonged interval of 50-700ms (dashed rectangle) of the other response pattern. When considering the ventral visual stream as a hierarchical processing cascade with the visual cortex (EVC) and the inferior temporal (IT) region as the starting and end points of this cortical visual processing hierarchy, one possible interpretation of this persisting component of similarity in early visual processing over time suggests that the EVC maintains the derived representations of low-level features (e.g. edge analysis) over time to feed into later high level analysis of the ventral visual stream. A sustained visual representation of low-level features might be necessary, since higher-level visual processing drain on the earlier, more simple representations that are constructed in the EVC and later stages. This would allow to continue a more in depth-analysis of the visual scenery over time without having the visual input presented on the retina again.

***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?*

In the IT, both RT1 and RT2 are strongly correlated (or similar) between 100-170ms, that is somewhat later than in the EVC, and during a larger interval of 200 and 500ms with the degree of similarity fading when either one of the RT signal has continued further in time. Unlike the EVC, where predominantly early signals of one RT persistent over time, in the IT mostly later signals of both RTs seem to persist over time (kept similar; or were similar in their response). Again, a persistent similarity in response patterns can be found in the IT, but different from the EVC had later onsets latency (200ms), which might, again, suggest that there is some maintaining high-level representations (e.g. face processing related features) over time.

With a higher degree of similarity in their signal when measured at the same time, which decays when the measurement is more different in time.

***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?*

Although it is possible to accurately decode the task representation of the brain during the Task Cue Period (TCP) and the Response Mapping Period (RMP), the training the classifier on the TCP doesn’t allow decoding in the RMP above chance. Thus, this type of cross-period generalization is largely possible within a period but not across the different task periods, hence the signal the classifier is trained on in one period must be largely independent of the signal from another period. Thus, even within the task or object processing, the cognitive mechanisms (at that point in time) might differ for different periods, such that one cannot reliably predict the other. For instance, the cognitive process involved in constructing, manipulating and processing of the task representation during TCP might be a memory mechanism that retrieves the relevant information of what should be focused on in the consecutive period (or possibly an attention mechanism), whereas the latter might rather be attributed to decision and motor execution (button press) processes that rely on the task representation. Concluding, more dissimilar cognitive operations might be performed at the mental task representation, shaping or utilizing the task representation in such way that it is specific to the cognitive process(es) involved, which do not share any systematically variation (hence no generalization) with the cognitive processes involved at a later stage.

***Question 2b.*** *Conversely, training on responses in the Object Stimulus Period allows decoding from the Response Mapping Period. How do you interpret this?*

The generalization ability of the Object Stimulus Period (OSP) to the RMP might suggest that the signal on which the SVM is trained on varies systematically, hence both events might originate from the same source (or similar sources are involved) or there is some sort of (non-)linear dependency the SVM is able to pick up. On the contrary, the generalization ability is modest at most (~60% accuracy) and absent for the early phase (2000-2200ms) and some intermediate time points of the OSP and the RMP. One possible interpretation might be that the cognitive processes involved are similar or, at least, vary in a similar fashion. Similarly, the task representation might be abstracted in a similar way between the SVM and the OSP: the task representation might be shaped and prepared that is similar for high-level cognitive functions (memory and decision making) in general, as it is prepared for the output mapping. This might rather be a more abstract representation of the task, hence more generalizable between the OSP and the RPM

***Question 3a.*** *Figure 4 shows that the amount of the Object Stimulus Period response pattern predicted by the task and the object differ 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: In the relative amounts of these responses to object and task? How do you interpret this?*

Interestingly, all regions carry information about task and objects, indicating that task and object representations coexist in the same brain regions, albeit not necessarily at the same point in time. Importantly, brain regions dedicated to visual processing, such as the ECV, demonstrate a relatively high unique correlation to the object-hypothesis RDM (in red), while this relative amount of responses to objects are decreasing the further the measurements were taken up in the processing hierarchy (less in the LO, even more less in the pFS and almost absent in the IPFC). To the contrary the variance of the response pattern explained by the task increases when move from brain areas involved in early vision (EVC) to those involved in object recognition (LO, PFS) to those involved in action planning (IPFC). Ben Harvey slides explanation.

***Question 3b.*** *In the timing of the peak responses to the object and task? How do you interpret this?*

With respect to the OSP response pattern predicted by the object, the timing of the peak response shifts to later latencies, and the peak amplitude decreases with proximity form the EVC, while the input moves up in the process hierarchy of the ventral visual stream (lower for LO and pFS for object recognition) towards areas involved in higher-cognitive functions (lowest in the IPFC for decision making and response planning).

* In particular the early visual processing features important for the object representations have an earlier peak timing (~150-200ms after the stimulus was shown), since the EVC is the entry point and first processing level for visual information in the neocortex, and as the information is processed every consecutive and more distant area, the peak-timing increases in the up to 400ms in the IPFC.
* Similarly, the peak amplitude of the variance explained (R2) decreases with every area further in the processing hierarchy, as the representation of the object becomes more abstracted and specific (e.g. face recognition in the FFA), while diverging and being integrated with other computations and input from other modalities to ultimately inform decision-making and output mapping.

With respect to the OSP response patterns predicted by the task, the peak timing gradually shifts towards earlier latencies, while the amplitude increases slightly, however, both change in a reversed fashion when being compared to the object representation (earlier peak timing and higher amplitude in high-level areas and vice versa for low level areas).