Investigating the timing and causal role of LOC in object recognition (#25404)

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1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
We have the ability to recognize objects within a split-second, regardless of the location, visual angle, or whether an object is partially occluded. Even in a blurred image, contextual cues from the surrounding scene help us to identify an object (Oliva & Torralba, 2007).

In a fMRI-MEG study, Brandman & Peelen (2017) revealed significantly better decoding accuracy for degraded objects in scenes compared to degraded objects alone and scenes alone, from 300 ms after stimulus onset, which could be traced to activity in the the lateral occipital complex (LOC). It was proposed that this effect reflects scene-related predictions arriving at the LOC, disambiguating the degraded object. Here, we test the causal contribution of LOC at different time points by applying disruptive double-pulse transcranial magnetic stimulation (TMS) over the right LOC at an early (after 60-100 ms), middle (after 160-200 ms), and late time point (after 260-300 ms). While TMS is applied, participants have to indicate the correct category for degraded objects within scenes and isolated intact objects. The scenes will also be presented without the object in order to observe how predictive the scene itself is to the object category (no specific predictions are made for this condition).

We will test the following two hypotheses: 1) object recognition will be disrupted when TMS is given at the middle time point, particularly for the object presented alone as this condition fully relies on processing in LOC. 2) Recognition of (degraded) object in scenes will be disrupted more strongly than recognition of isolated objects at the late TMS time point, since this is the time at which scene-related information is integrated with object-related information in the LOC.

To test these hypotheses, an adapted version of the visual recognition task by Brandman & Peelen (2017) will be used. Previous studies have indicated that the efficacy of TMS is subject to inter-individual variation and is limited by depth of this area within the brain, skull thickness and orientation of axons within an area. Additionally, TMS parameters, such as intensity, coil shape, coil orientation and pulse waveform, can determine whether TMS will be effective or not. Therefore, we will perform an initial study, a replication of Dilks et al. (2013), which will be used to select participants that are sensitive to TMS over LOC. These subjects will be included in the main study, which will be conducted in a separate experimental session.

3) Describe the key dependent variable(s) specifying how they will be measured.
Participants will be asked to indicate which out of eight object categories was represented in the picture (object in scene or object alone). If a scene alone was shown, participants have to indicate which object was removed from the picture. The aim is to answer with the correct object category. The main dependent variable is the percentage of correct trials in object alone, scene alone, and object in scene conditions. A secondary variable is reaction time.

4) How many and which conditions will participants be assigned to?
The experiment adopts a 3x3 repeated-measures design. The first factor, TMS timing, has 3 conditions: early, middle and late. The second factor, stimulus type, has 3 conditions: (intact) object alone, scene alone, and (degraded) object in scene. All conditions have an equal number of trials and are presented in random order.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
We will conduct a 3x2 repeated-measures ANOVA with TMS timing (early, middle, late) and stimulus type (intact objects, degraded objects in scene) as within-subject factors. Accuracy and reaction time will serve as dependent variables in separate ANOVAs. We predict a significant interaction, with TMS timing differentially affecting the two stimulus types. For intact objects, a planned pairwise t-test is predicted to show decreased performance for TMS middle compared to TMS early. For degraded objects in scenes, a planned pairwise t-test is predicted to show decreased performance for TMS late compared to TMS early.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
Participants will be excluded who do not complete the experimental procedure. Furthermore, participants whose accuracy falls below 2.5 SDs of the overall mean across conditions will be excluded.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
A sample size of n = 24 will be collected. This number is based on a medium effect size and behavioral data from Brandman & Peelen (2017).

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

As mentioned before, susceptibility to TMS effects vary inter-individually. Therefore, in an exploratory analysis the main analysis will be repeated with the addition of some covariates: First, the phosphene threshold. Second, the effect size of object recognition reduction in the initial experiment, that is, the replication study of Dilks et al. (2013).