Debriefing for ‘Color Similarity’

There was no deception in the experiment that you just completed. This study is a pilot study designed to inform us about the neural basis of color perception, and how it may be subserved by mechanisms common to spatial cognition and memory. In the initial behavioral study in Tobin Hall, we asked you to rate the similarity of 24 colors so that we could visualize your perceptual color space using a technique called Multidimensional Scaling (MDS). Using this technique, we can take your similarity ratings and transform them into a set of (in this case, 2) dimensions along which your data can be said to vary – this is called the MDS solution. Your MDS solution was used to screen you as a valid participant for the fMRI study, and it will be used in the analysis of your neural data collected today in the fMRI experiment.

Colors were picked from a two-dimensional, isoluminant (same perceptual brightness) space called Derrington-Kraupf-Lennie (DKL) Space, which is based on the early retinal processing of light, and serves as a model of the color representation sent to primary visual cortex. We drew a circle in the space, and picked 24 evenly spaced colors along the perimeter. Those were the colors you rated in the behavioral experiment.

Today, you participated in a functional Magnetic Resonance Imaging (fMRI) experiment. The purpose of the fMRI experiment was to test an integrative model of memory, spatial navigation and neural processing. One prediction of the model relates to so-called ‘grid cells’ – neurons in the brain which respond along a grid when an animal moves around a physical space. The finding of grid cells and their implication in spatial navigation has been considered so important that it won the 2014 Nobel Prize in Medicine or Physiology. Our lab has developed a model whereby grid cells are the result of memory-cued hippocampal feedback, reflecting optimal memory consolidation. Our prediction is that this consolidation algorithm is used for other types of cognitive spaces; thus, we predict that there are grid cells for ‘navigation’ in other perceptual spaces – such as the color space used in this experiment.

To test the model’s prediction, we used a special technique for detecting the presence of grid cells in the Blood-Oxygen-Level-Dependent (BOLD) signal of fMRI. In this technique, participants view “navigations” in a space of interest, such as a virtual arena, or in this case, color space. The navigations are designed in a certain way to exploit the firing properties of ensembles of neurons underlying the spatially coarse BOLD signal. Thus, you were shown 24 trajectories in color space, navigating from a central gray point radially to one of 24 colors. We asked you to detect changes in color only to keep you attentive, so as to ensure a strong BOLD signal.

If the model is correct, it has huge implications for the study of spatial navigation and memory across species. Furthermore, the work has the potential to uncover mysteries underlying the neural processing of different perceptual phenomena, such as color and faces.

If you have further questions about this research, please contact undergraduate independent study student Nicholas Blauch, [nblauch@umass.edu](mailto:nblauch@umass.edu), or the principal investigators, David Huber and Rosie Cowell. If you would like to receive a report of this research when it is completed (or a summary of the findings), please contact David Huber, [dehuber@psych.umass.edu](mailto:dehuber@psych.umass.edu). The chair of the department, Hal Grotevant, [hgrotega@psych.umass.edu](mailto:hgrotega@psych.umass.edu), can also be contacted if you have additional questions. If you have any questions or concerns about your rights as a research participant, you can contact the Human Research Protections Office, [humansubjects@ora.umass.edu](mailto:humansubjects@ora.umass.edu), (413) 545-3428.