Face Grating Sternberg Experiment

Marieke van Vugt

December 21, 2006

1 Introduction

The experiment is a sequel to the Sternberg recognition memory paradigm (Sternberg, 1966), about which many thousands of papers have been written. However, only a small part of these papers concerns non-verbal versions of this paradigm. We use non-verbalizable stimuli (fig 1), to examine how behavioral and electrophysiological variables are changing due to different difficulty manipulations.

2 Setup

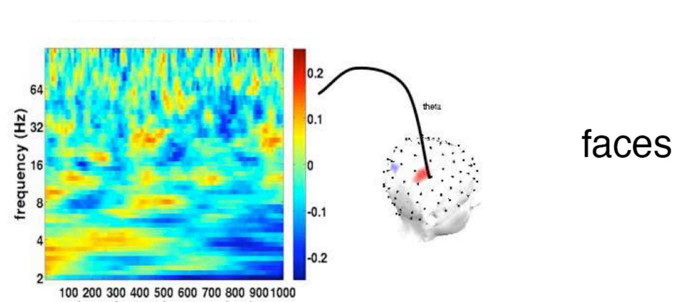
While you were doing the experiment, your brain activity was recorded using an electroencephalogram. This records a manifestation of the cumulative electrical activity of many brain cells (neurons). We have run a study similar to this in which we recorded data from scalp electrodes in undergraduates of the University of Pennsylvania. Because scalp EEG has a relatively poor localization of brain activity, we are now repeating it using intracranial EEG (iEEG).

In our lab we are mainly interested in how oscillations in this EEG activity at different frequencies, which are a measure of the dynamics of the electrical field, affect cognition. Some earlier, representative studies of our lab in the function of oscillations during recognition memory in iEEG patients are Raghavachari et al. (2001) and Howard et al. (2003).

3 Experimental manipulations and analyses

The first manipulation we use is list length; obviously lists with more items are harder to remember. We expect brain regions involved in active maintenance of items to be more activated if they have to hold more items in mind. The second manipulation is called “recent negatives”. Maybe you noticed that whenever an item was not part of the current list, it always came from one, two or three lists back. Obviously, when the lure came from a recent list, you are more likely to say YES, and this is what we found behaviorally. However, nobody has yet determined the electrophysiological correlates of this so-called proactive interference effects, which many fMRI (functional magnetic resonance imaging) studies have find to appear in the prefrontal cortex (left inferior frontal gyrus).

The third and most important manipulation for my purposes is that of the similarity of items. Sometimes items were more similar to one another than other times. In fact we believe, based on decades of behavioral research (Nosofsky, 1991), that people base their decision on this similarity information. When they see a probe,



they compute its similarity to every list item (where the similarity is high if those items are very similar), and adds those up. If this *summed similarity* exceeds a certain decision threshold, the subject will say YES, otherwise she will say NO. The formalization of the model we're using is called NEMO (Kahana & Sekuler, 2002). Preliminary analyses indicate oscillatory correlates in EEG activity of summed similarity that is predicted by the model (figure 1). The future goals of this research project are to further characterize and understand this relation between a purely theoretical construct and actual brain activity.

In conclusion, the study you have participated in hopes to help in our understanding of visual recognition memory, especially when the task is made difficult, and tries to marry mathematical modeling approaches to cognition to electrophysiological analyses of brain activity.

4 Contact Information

For more information, feel free to contact me.
e-mail: mvugt@mail.med.upenn.edu
website: http://memory.psych.upenn.edu/∼mvugt

References

Howard, M. W., Rizzuto, D. S., Caplan, J. C., Madsen, J. R., Lisman, J., Aschenbrenner-Scheibe, R., et al. (2003). Gamma oscillations correlate with working memory load in humans. *Cerebral Cortex*, *13*, 1369–1374.

Kahana, M. J., & Sekuler, R. (2002). Recognizing spatial patterns: A noisy exemplar approach. *Vision Research*, *42*, 2177-2192.

Nosofsky, R. M. (1991). Tests of an exemplar model for relating perceptual classification and recognition memory. *Journal of Experimental Psychology: Human Perception and Performance*, *17*(1), 3-27.

Raghavachari, S., Rizzuto, D. S., Caplan, J. B., Kirschen, M. P., Bourgeois, B., Madsen, J. R., et al. (2001). Gating of human theta oscillations by a working memory task. *Journal of Neuroscience*, *21*, 3175-3183.

Sternberg, S. (1966). High-speed scanning in human memory. *Science*, *153*, 652–654.