

Neural Signatures of Visual Memorability: Memory in the First Perception of an Image

Wilma A. Bainbridge (1) and Aude Oliva (2)

1 – Department of Brain and Cognitive Sciences, MIT

2 – Computer Science and Artificial Intelligence Laboratory, MIT

Whereas some places or people leave a memorable first impression, others are immediately forgotten. Recent work has shown that memorability of scene and face pictures is highly consistent across people, providing a basis to predict later memory behavior (Bainbridge, 2013; Isola, 2011). Here, we investigate the neural signatures of memorability during the first perception of an image. In two fMRI experiments, participants were shown blocks of novel images grouped by stimulus type (face or scene) and memorability level (high or low memorability). Stimuli were carefully controlled for attributes including gender, race, attractiveness and emotional content for faces, and indoor/outdoor, natural/manmade and category type for scenes, as well as a range of low-level image statistics for both. To validate the robustness of the findings, different sets of participants performed a 1-back task in Experiment 1 (N=24), and a perceptual task in Experiment 2 (N=13). None were told about the memory-related nature of the study. For each participant, independent functional localizers were used to localize perceptual regions, and regions in their medial-temporal lobe (MTL) were segmented using anatomical landmarks. Whole-brain analyses, multivariate analyses, and region of interest analyses pinpointed areas of responsiveness to memorable versus forgettable images. In both experiments, signatures of memorability were not found in low-level visual areas, but were consistently found in several perceptual regions specific to faces and scenes. Different regions in the MTL (e.g., the perirhinal cortex) also show preferential activity for memorable images, regardless of the stimulus type. Multivoxel pattern analyses reveal pattern encoding of more memorable items, after a single exposure, in the hippocampus. These results show that signatures of memorability of an image can be found both in ventral neocortical and medial temporal lobe regions, questioning to which extent perception and memory representations are separated in the brain.

Funded by the DoD NDSEG Program to W.B. Thanks to the Athinoula A. Martinos Imaging Center at the McGovern Institute for Brain Research, MIT.