How does the brain assess the potential “interest” of a visual scene? Our research is aimed at understanding the neural basis of the motivational system underlying visual information acquisition that maximizes the intake of novel, but interpretable information. As a way of investigating this system, we have been measuring subjects’ preferences for a variety of full color scenes and the effects of repeated exposure on their preference ratings. Previously, we reported that visual preference declines with repeated presentation for a wide variety of scenes of different initial preferences (OPAM, 2001). Our working hypothesis is that the gradient of µ-like opiate (endomorphin) receptors in the ventral visual pathway (sparse in V1, dense in IT; Lewis et al., 1981) mediates visual and cognitive pleasure, producing a preference for those scenes that richly activate new associations in the anterior regions of the ventral visual stream. Competitive learning in these latter stages would result in less neural/endomorphin activity as a stimulus is repeated (see Miller et al., 1993), and thus reduce preference. In this study, we use event-related fMRI to investigate the changes in neural activity associated with initial scene preference and the decrease in preference over repeated exposure. Subjects were asked to view a set of 60 images presented for one second separated by a variable ISI. Each image was shown a total of five times over the course of the experiment. Using preference ratings collected from another set of subjects outside the magnet, we grouped the scenes into high, medium, and low preference sets. We observed differential activity in occipitotemporal regions of the cortex associated with both preference level and exposure. We discuss these results in the context of whether visual preference is computed locally, and how this signal might be used to guide selective attention to areas of the visual world which contain novel, but interpretable information.

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METHODS

Subjects: 7 right handed subjects, mean age 26.6 (5 male, 2 female).

Task: Subjects passively viewed a sequence of scenes similar to that used in the behavioral experiments, and were instructed to pay attention to the scenes for the duration of the scan.

Stimulus Sequence: Images were shown for 1 second, with 75% probability of an image, 25% fixation per TR (average presentation rate: 1 stimulus every 3.33 sec.)

The sequence consisted of blocks of 20 TR, composed of 5 fixations, and 15 (3 x 5) experimental trials, intermixed and optimized for an event related analysis. Images were shown on a Macintosh running the Matlab Psychophysics Toolbox.

Imaging/Analysis Methods: Field Strength: 3T TR: 2.5 S

Coplanar anatomical images were registered to the motion corrected functional images and normalized into Talairach space using AFNI. A linear deconvolution with an ideal impulse response function was then used to generate intensity maps for each of the 15 conditions. These intensity maps were smoothed (FWHM = 8.0 mm) and subjected to a 2-way (3 x 5) 3D voxelwise ANOVA. All statistical maps are displayed on a single subject’s high resolution anatomical image normalized into Talairach space using AFNI.

Tentative Conclusions Pending Replication

Generally, initial Preference (high vs. low) and Repetition (1-5) produced effects in different regions.

Initial Preference had its most pronounced effect in the parahippocampal region. This is an area that would be rich in endorphin activity according to Lewis, et al. (1981).

Effects of Repetition could be seen in several areas, including LO, the fusiform gyrus, and a parahippocampal region posterior to that activated by Preference.

Scenes that had low initial Preferences resulted in increased activity in areas (occipital-parietal cortex, frontal cortex) that are involved in attentional control. Perhaps additional effort was required to attend to scenes that were not preferred.

The operations employed to localize LO (presentation of intact vs. scrambled objects), also resulted in differential activity in a parahippocampal region near where highly preferred scenes produced their maximal activity. It is possible that the intact images were more interesting than the scrambled images.

As a general methodological point in neural imaging, variables presumed to affect only perceptual/cognitive processes might be also affecting motivational processes.

References:


