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EVENT ABSTRACT

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Lateral Occipital cortex responsive to local correlation structure of natural images

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It is clear from behavioral experiments that subjects can rapidly access information about visual scenes (Potter, 1976) and that different types of scenes (such as beaches and mountains) differ in terms of low level image statistics (Torralba & Oliva, 2003). Furthermore, the distribution of local contrasts in natural images adheres to the Weibull distribution (Geusebroek & Smeulders, 2005), which is a family of distribution deforming from power-law to normal with two free parameters, beta and gamma. The beta parameter indicates the scale of the distribution, whereas the gamma parameter represents its shape. Spatially coherent scenes with one or a few objects tend to have a low gamma value, i.e. the distribution of their local contrast values approximates a power-law. In contrast, cluttered scenes with many uncorrelated visual structures typically have a high gamma values corresponding with a Gaussian distribution. We recently showed that the brain is capable of estimating the beta and gamma value of a scene by summarizing the X and Y cell populations of the LGN (Scholte et al., 2009). Here we investigated to what degree the brain is sensitive to differences in the global correlation (gamma) of a scene by presenting subjects with a wide range of natural images while measuring BOLD-MRI. Covariance analysis of the single-trial BOLD-MRI data with the gamma parameter showed that only the lateral occipital cortex (LO), and no other areas, responds stronger to low gamma values (corresponding to images with a power-law distribution) than high gamma values (corresponding to images with a normal distribution). The analysis of the covariance matrix of the voxel-pattern cross-correlated single-trial data further revealed that responses to images containing clear objects are more similar in their spatial structure than images that do not contain objects. This data is consistent with a wide range of literature on object perception and area LO (Grill-Spector et al., 2001), and extends our understanding of object recognition by showing that the global correlation structure of a scene is (part of) the diagnostics that are used by the brain to detect objects.

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