2014

The BOLD and the Beautiful: Neural responses to natural scene statistics in early visual cortex

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Abstract

Abstract presented at The Asia-Pacific Conference on Vision (APCV) 2014 19-22 July 2014, Takamatsu, Japan

Keywords

statistics, scene, natural, responses, early, neural, visual, beautiful, bold, cortex

Disciplines

Education | Social and Behavioral Sciences

Publication Details

Isherwood, Z., Schira, M. M. & Spehar, B. (2014). The BOLD and the Beautiful: Neural responses to natural scene statistics in early visual cortex. i-Perception, 5 (4), 345.

P2-31: The BOLD and the Beautiful: Neural responses to natural scene statistics in early visual cortex

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Natural scenes are known to share a specific linear distribution of spatial frequencies and associated luminance intensity variations known as the 1/f amplitude spectrum (with a slope around -1.2). We sought to investigate the response profile of early visual areas to random noise images with varying 1/f slopes (-0.25, -0.75, -1.25, -1.75 and -2.25) across two contrast levels (10% and 30%) and two viewing conditions (aesthetic rating and an unrelated central visual search task). The aesthetic condition was chosen as images sharing natural scene characteristics have been frequently reported as more aesthetically pleasing compared to images that do not. The two viewing conditions were directly compared to identify brain areas related to aesthetics. Participants (n = 12) underwent fMRI scanning whilst viewing these images. In each visual area analysed (V1 to V4) BOLD responses were 1.5 to 2.5 times higher for natural slopes (-1.25) compared to unnatural slopes (-0.25 or -2.25) across both contrasts and tasks. Only during the aesthetic condition the putamen and mOFC were found to be active. Together, our results show that early visual areas are optimally tuned toward processing images with natural scene statistics, potentially contributing to their aesthetic appeal.

Supported by Australian Research Council DP120103659 (to B. Spehar).