

Abstract

Visual images contain redundant information across spatial scales. Previous research suggests that the visual system makes use of those redundancies to facilitate efficient processing. In this framework, a fast initial analysis of low-spatial frequency (LSF) information informs the slower and later processing of high spatial frequencies (HSF). We hypothesized that LSF-guided processing is implemented through LSF-informed feedback from higher-order regions to facilitate the integration of HSF information in early visual cortex. To test our hypothesis, we analyzed magnetoencephalography responses to the passive viewing of images of either intact faces or their phase-scrambled version filtered to contain LSF, HSF or LSF + HSF information (broadband). Importantly, only in the intact broadband condition are LSF and HSF correlated (i.e. containing redundant information). We observed a reduction in the markers of HSF processing for the intact compared to the scrambled condition using a cross-classification approach. This reduction was accompanied by a decrease of power in the gamma frequency band response in a region of interest centered on the calcarine sulcus. However, contrary to our hypothesis we found no evidence for a correlation with response power or phase in the feedback associated beta frequency range response in either fusiform gyrus or frontal cortex. Instead, Bayesian analysis favored the null hypothesis that higher level beta band activity is statistically independent from early visual cortex gamma power. Our findings call into question whether higher-level feedback to early visual cortex is necessary for cross-spatial frequency redundancy to be beneficial to visual perception. Instead we propose that early visual cortex itself can take advantage of the statistical regularities of natural images for the economical processing of redundant information.

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