

Abstract

The spatial frequency (SF) spectrum is one of the most fundamental visual properties; it has profound effects on how a stimulus is processed throughout the visual system. Despite visual input being broadband by nature, past studies have investigated SF processing mainly by presenting observers with stimuli containing either one single frequency or a narrow band of frequencies. How and when distinct SFs contribute to the visual processing of natural broadband input is therefore largely unknown. Using EEG recordings and multivariate decoding techniques we were able to trace the processing of individual frequency bands during the processing of broadband images. We presented 21 participants with images of human and monkey faces, as well as their phase scrambled versions. Images were filtered to contain either low SF only, high SF only, or the sum of both resulting in a broadband spectrum. We trained support vector machine classifiers to differentiate high SF from low SF trials using the narrowband trials as training data. We then evaluated those classifiers on trials in which participants saw broadband stimuli containing both high and low SFs. We found a distinctive pattern of SF dominance over time that differed between intact and scrambled images and human and monkey faces with stronger low SF dominance for intact images and particularly for human face images, within the latency range of the N170 event-related potential. This finding provides evidence for SF specific processing of broadband stimuli, consistent with predictive coding models of vision. Interestingly, stimulus category modulates the pattern of SF dominance indicating a high-level influence on fundamental visual processing stages. With this study, we demonstrate for the first time, that multivariate decoding techniques can be used to track SF processing in naturalistic broadband stimuli.

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