Abstract

Bullier's integrated model (2001) proposes V1 and high-level regions interact recurrently to build-up finer representations, initially analysing low spatial frequencies (LSF) which guide later high spatial frequency (HSF) processing. Past evidence indicates that high-level face-selective regions process LSFs before HSFs, and that LSF content facilitates HSF processing. One straightforward but untested prediction of the integrated model is that early or late disruption of the LSF or HSF content of broadband images should increase V1 workload – more so if the respective SF is important for processing at that time. We expect increased workload to be reflected by higher V1 responses. We addressed this with a backward-masking fMRI experiment. Broadband faces were shown for 50ms/83ms/100ms/150ms, masked by their phase-scrambled LSFs (<2.6cpd / 11.5cpi) or HSFs (>2.6cpd / 11.5cpi). Interrupting early LSF processing prevented the guidance of HSFs and increased V1 responses. Allowing more time for LSF processing enabled quasi-normal guidance of HSFs, reducing V1 responses. Interrupting HSF processing behaved oppositely. Masking HSFs early, preserved LSF input but disrupted HSF processing, which resulted in a low response in V1. Masking HSF later introduced a misalignment with the original LSFs, again increasing V1 responses. Such response dynamics presumably result from recurrent interactions between V1 and high-level regions. Psychophysiological-interaction analysis indeed revealed stronger connectivity for normal faces compared to the control condition (contrast negated faces). Moreover, V1 activity tended to decrease in trials with stronger connectivity. This might reflect the sharpening of V1 representations under the guidance of high-level feedback. Taken together, we provide evidence for coarse-to-fine processing in V1 and its role in the progressive build-up of detailed representations of faces in the ventral visual pathway.