Analysis of the neuronal selectivity underlying low {fMRI} signals

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Abstract:

{BACKGROUND} A prevailing assumption in neuroimaging studies is that relatively low {fMRI} signals are due to weak neuronal activation, and, therefore, they are commonly ignored. However, lower {fMRI} signals may also result from intense activation by highly selective, albeit small, subsets of neurons in the imaged voxel. We report on an approach that could form a basis for resolving this ambiguity imposed by the low (mm range) spatial resolution of {fMRI.} Our approach employs {fMR-adaptation} as an indicator for highly active neuronal populations even when the measured {fMRI} signal is low. {RESULTS} In this study, we first showed that {fMRI-adaptation} is diminished when overall neuronal activity is lowered substantially by reducing image contrast. We then applied the same adaptation paradigm, but this time we lowered the {fMRI} signal by changing object shape. While the overall {fMRI} signal in category-related regions such as the face-related {pFs} was drastically reduced for non-face stimuli, the adaptation level obtained for these stimuli remained high. We hypothesize that the relatively greater adaptation level following exposure to "nonoptimal" object shapes is indicative of small subsets of neurons responding vigorously to these "nonoptimal" objects even when the overall {fMRI} activity is low. {CONCLUSIONS} Our results show that {fMR-adaptation} can be used to differentiate between neuronal activation patterns that appear similar in the overall {fMRI} signal. The results suggest that it may be possible to employ {fMR-adaptation} to reveal functionally heterogeneous islands of activity, which are too small to image using conventional imaging methods.

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