AB076. Prototypical spatial patterns of activation from common experience

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Background: The guiding principle of functional brain mapping is that the cortex exhibits a spatial pattern of response reflecting its underlying functional organization. We know that large-scale patterns are common across individuals—everyone roughly has the same visual areas for example, but we do not know about small patterns, like the distribution of ocular dominance and orientation columns. Studies investigating the temporal aspect of brain-to-brain similarity have shown that a large portion of the brain is temporally synchronized across subjects (Hasson *et al.*, 2004), but spatial pattern similarity has been scarcely studied, let alone at a fine scale. In the current study, we investigated fine-scale spatial pattern similarity between subjects during movie viewing and generated a map of prototypical patterns spanning the visual system. Characteristics of the map, such as spatial pattern size and distribution, reveal properties of the underlying structure and organisation of the visual cortex. These results will guide future brain mapping studies in decoding the informative spatial patterns of the visual cortex and increasing the resolution of current brain maps.

Methods: We had 56 subjects watch two movie clips from "Under the Sea 3D:IMAX" during an fMRI scan. Each clip was 5 minutes in length and was presented in 2D and 3D, in random order. We calculated the intersubject correlation of the spatial pattern inside predefined searchlights of diameter 3, 5, 7, 9 and 11 mm, covering the entire brain. A single threshold permutations test was used to test for significance: we generated 1,000 permutations made from scrambling the spatial patterns inside each searchlight of every subject, pooled these permutations together to generate a large distribution and used the 95th percentile to threshold the actual measurements. We compared these spatial pattern correlations to convexity variance between subjects to determine whether spatial pattern correlation could be explained by differing degrees of alignment across the cortex. We also compared spatial pattern correlation during 2D and 3D movie presentation.

Results: We found significant correlations in spatial pattern between subjects in the majority of early visual cortex, as well as higher visual areas. We found that mean spatial pattern similarity in a visual area tended to decrease as we move up the visual hierarchy. Spatial pattern correlation showed significant positive correlation with convexity variance for most visual areas, meaning that as anatomical misalignment increased, patterns became more similar. Spatial pattern correlation therefore cannot be explained by anatomical misalignment. Lastly, spatial pattern correlations tended to be higher for 3D movie presentation compared to 2D.

Conclusions: Our results suggest that many processes in early visual areas and even higher visual areas process visual information the same way in different individuals. Our results expand past studies by exploring spatial patterns instead of temporal patterns and studying at a fine-scale. This is the first study, to our knowledge, exploring fine-scale spatial patterns across the visual system. Our results show that fine-scale structures underlying activation patterns may be highly similar across subjects, pointing to a more ingrained organisation of the visual system than previously believed. This map we termed the "protoSPACE map", may one day result in the detection of more subtle abnormalities that arise only during realistic vision in situations such as schizophrenia or mild traumatic brain injury, where traditional anatomical MRI scans report no changes.

Keywords: Functional brain mapping; imaging; perception

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