Cortical activity during tactile exploration of objects in blind and sighted humans

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Abstract:

(PURPOSE) Recent studies show evidence of multisensory representation in the functionally normal visual cortex, but this idea remains controversial. Occipital cortex activation is often claimed to be a reflection of mental visual imagery processes triggered by other modalities. However, if the occipital cortex is genuinely active during touch, this might be the basis for the massive cross-modal plasticity observed in the congenitally blind. (METHODS) To address these issues, we used (fMRI) to compare patterns of activation evoked by a tactile object recognition (TOR) task (right or left hand) in 8 sighted and 8 congenitally blind subjects, with several other control tasks. (RESULTS) TOR robustly activated object selective regions in the lateral occipital complex (LOC/LOtv) in the blind (similar to the patterns of activation found in the sighted), indicating that object identification per se (i.e. in the absence of visual imagery) is sufficient to evoke responses in the LOC/LOtv. Importantly, there was negligible occipital activation for hand movements (imitating object palpations) in the occipital cortex, in both groups. Moreover, in both groups, TOR activation in the LOC/LOtv was bilateral, regardless of the palpating hand (similar to the lack of strong visual field preference in the LOC/LOtv for viewed objects). Finally, the most prominent enhancement in TOR activation in the congenitally blind (compared to their sighted peers) was found in the posterior occipital cortex. (CONCLUSIONS) These findings suggest that visual imagery is not an obligatory condition for object activation in visual cortex. It also demonstrates the massive plasticity in visual cortex of the blind for tactile object recognition that involves both the ventral and dorsal occipital areas, probably to support the high demand for this function in the blind.

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