

# How skill expertise shapes the brain functional architecture: an fMRI study of visuo-spatial and motor processing in professional racing-car and naïve drivers.

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## Abstract

The present study was designed to investigate the brain functional architecture that subserves visuo-spatial and motor processing in highly skilled individuals. By using functional magnetic resonance imaging (fMRI), we measured brain activity while eleven Formula racing-car drivers and eleven 'naïve' volunteers performed a motor reaction and a visuo-spatial task. Tasks were set at a relatively low level of difficulty such to ensure a similar performance in the two groups and thus avoid any potential confounding effects on brain activity due to discrepancies in task execution. The brain functional organization was analyzed in terms of regional brain response, inter-regional interactions and blood oxygen level dependent (BOLD) signal variability. While performance levels were equal in the two groups, as compared to naïve drivers, professional drivers showed a smaller volume recruitment of task-related regions, stronger connections among task-related areas, and an increased information integration as reflected by a higher signal temporal variability. In conclusion, our results demonstrate that, as compared to naïve subjects, the brain functional architecture sustaining visuo-motor processing in professional racing-car drivers, trained to perform at the highest levels under extremely demanding conditions, undergoes both 'quantitative' and 'qualitative' modifications that are evident even when the brain is engaged in relatively simple, non-demanding tasks. These results provide novel evidence in favor of an increased 'neural efficiency' in the brain of highly skilled individuals.