INSIGHTS INTO FUNCTIONAL CONNECTIVITY DURING A DRIVING SIMULATION BEFORE AND AFTER EFFECTS OF MARINOL INTOXICATION ON FMRI ACTIVATION AND COGNITIVE PERFORMANCE

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This study examines the effects of marinol (a synthetic THC derivative) on the performance and brain activity of subjects performing a realistic, complex, driving-related task. Functional MRI (fMRI) imaged brain activity and performance measures were assessed both before and after administration of oral Marinol.

Five subjects participated in the study. Using a Philips NT 1.5 T scanner, whole-brain functional scans were acquired (EPI, TR=1s, TE=39ms, fov=24cm, 64 x 64, st=5.5 mm, 18 slices) for a total of 600 scans/run. The 10 min. paradigm consisted of 1-min. epochs of 1) a black screen, 2) playing a driving game using a standard game controller (active), or 3) watching the driving game while moving their hands (passive). The driving and passive epochs were randomly alternated to control for order effects. Subjects were trained to asymptote performance, scanned (no drug), given Marinol, and then re-scanned 2 hours later (drug).

SPM99 [1] was used to compare active vs. passive epochs. Additionally, we employed a data-driven method, independent component analysis (ICA) to look at each type epoch individually [2]. This method searches for maximally spatially independent activation patterns. Task performance data were assessed to quantify driving performance. Subjects self-rated intoxication and we measured the blood-levels.

SPM results indicate increased activation in cerebellum, thalamus and superior parietal regions during the no drug condition. Following drug, there was more pre-frontal and supplemental motor activation, although this varied somewhat across subjects.

ICA results on the driving epoch demonstrated a difference in both activation pattern and time course of activation. In both conditions, visual (including area MT), frontal-eye fields, cingulate, cerebellar, and primary and supplemental motor areas were identified in different components. The drug condition demonstrated decreased anterior cingulate activity and overall lower time course frequency relative to non drug.

Driving performance results indicated significantly increased duration of lane deviation and tendencies toward increased lane deviations, number of times speeding, and vehicle near-collisions during the drug condition.

When comparing active and passive driving the cerebellum demonstrated increased global activation during the no drug condition. This seems to contradict results found with PET data [3]. However it is consistent with fMRI ceiling effects since activity is determined by observing differential activation. Thus greater cerebellar activity during the drug condition leads to a decreased difference between active and passive driving. This interpretation also agrees with the ICA result, that there is cerebellar activity in both conditions when examining the driving epoch alone.

This study aims to understand the effect of THC on driving performance. Several other simpler tasks were performed during the scan session but are not reported in this abstract. This study demonstrates the feasibility of scanning subjects while performing a driving-related task and may help understanding of the neuro-anatomic processes affecting driving performance compromised after THC administration.

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