

## Changes in Glutamate levels after an fMRI experiment

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### Introduction

Magnetic resonance spectroscopy (MRS) measures of resting neurotransmitter levels have recently been correlated with several different measures of neural activity, and have been suggested to be predicative of mental state while recent functional MRS studies have that neurometabolite levels are dynamic and may be affected by external stimuli. For example Glutamate (Glu) levels have been shown to fluctuate in response to painful stimuli[1], visual stimuli[2], pharmaceutical[3] and other treatment interventions. As glutamate has also been implicated in the cravings associate with alcohol addiction we decided to investigate the possible effects an fMRI task aimed at detecting differential responses to alcohol related, appetitive, neutral, aversive and goal related images may have on Glu levels in heavy or light drinkers.

### Methods

Using a Philips 3T achevia system, 1H-MRS spectroscopy was acquired before and after a typical fMRI experiment in 13 healthy control subjects (PRESS acquisition, voxel size = 2x2x3 cm<sup>3</sup>, TR=2000 ms, TE= 40 ms, NA=128). The fMRI experiment comprised six experimental task runs of approximately 6 minutes duration. The results of the fMRI experiment are to be reported elsewhere. Spectra were acquired from the Anterior Cingulate Cortex (ACC) before and after the fMRI scans. Neurometabolite level estimates were generated using the QUEST quantification method in the jMRUI spectroscopy package using an unsuppressed water scan as a concentration reference. Concentration estimates for NAA, Cho, Cre, Glu and Gln were compared pre and post fMRI

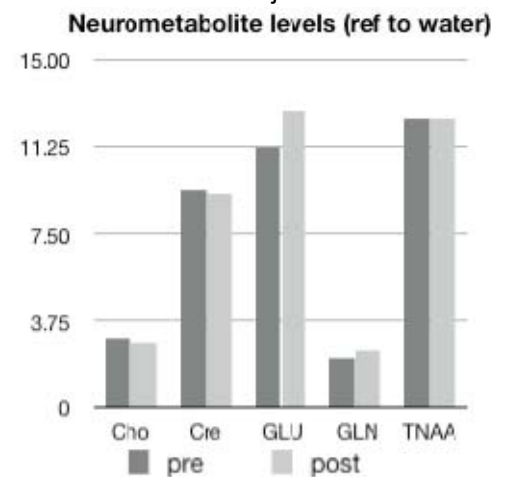
### Results

Repeated measures analysis for time demonstrated a univariate response for Glu across all subjects. No group effect was seen. Pairwise comparison of Glu levels before and after the fMRI experiment for all subjects showed an average increase in Glu after the fMRI task of 13% (p= 0.015, two tailed T-Test). No other metabolites exhibited an increase.

### Discussion

To our knowledge, this preliminary finding is the first MRS report of changes in resting Glu levels evoked by an fMRI task. The ACC is involved in several processes, and glutamatergic ACC activity has been implicated in drug and cue induced re-instatement of addictive behaviors[5, 6]. It is conceivable that changes in resting activity may have been induced by the stimuli shown in the fMRI runs, reflected in the increased Glu levels we report here.

Unfortunately, as more than one of the stimuli involved may have caused such a change we cannot disentangle them at this time. However this finding has several implications: *i)* Glu levels may be sensitive to changes in activity levels in certain regions of the brain, *ii)* Glu levels can be influenced by cognitive and emotional tasks as well as overt external stimuli, and *iii)* these changes may last for longer than the period of stimulation. These findings have implications for cognitive and behavioural therapies aimed at treating conditions with possible glutamatergic abnormalities and provide support for the use of MRS as a new way to probe cue related changes in neuronal activity.



**Figure 1:** Neurometabolite levels pre- and post the fMRI experiment showing the increase in Glutamate.

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