Functional Magnetic Resonance Spectroscopy of response inhibition

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Introduction

1H-MRS has demonstrated abnormalities in static glutamate (Glu) concentrations in a number of psychiatric disorders. However, dynamic glutamate measurements using functional MRS (fMRS) could potentially provide novel insight into glutamate fluctuations during task performance. Although fMRS using long block designs of motor and visual stimuli have been studied for over a decade (e.g. [1]), event-related fMRS of more complex cognitive tasks is still in its infancy [2]. Here, we present pilot data aimed at assessing the glutamate response during a response inhibition task (Go/NoGo task).

Methods

Three healthy subjects performed an adjusted version of a validated Go/NoGo task [3] during fMRS acquisition. FMRS data were acquired on a 7T whole-body MR system (Philips) with a dual-channel transmit coil and a 32-channel receive coil (Nova Medical) using an sLASER sequence (TR/TE=5000/36ms; band-width=4kHz; 2048 data-points; voxel-size=30x15x15mm; NSA=300). The voxel was placed in the paracingulate gyrus, the most consistently activated brain region during response inhibition according to the NeuroSynth database [5]. Data were pre-processed (spectral registration) using tools from FID-A [6]. Subsequently, averages were combined into blocks of 1,2,8 or 16 averages before analysis in LCModel (with parameters as in [7]). Raw Glu concentrations, Glu CRLB and FWHM were extracted.

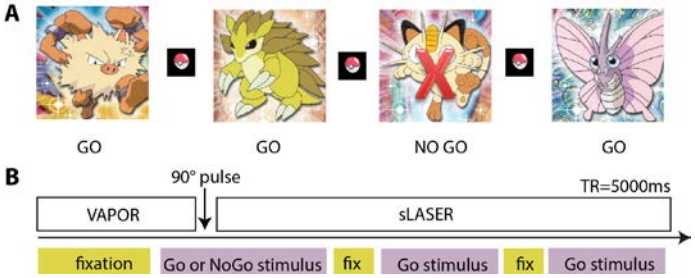

Fig1. Task design. A) Pokémon figures are used as Go and NoGo stimuli. B) The task is time-locked to the sLASER sequence with the Go or NoGo stimulus of interest presented as the first of three stimuli (2nd & 3rd always Go stimuli) at about 300 ms before 90° pulse, in order to capture the supposed peak of the Glu response [4]. This represents 1 trial. A total of 300 trials was acquired (150 NSA for 1st subject) of which 26% were Go and 74% were NoGo trials (but including stimuli of no interest 32% of stimuli was NoGo in order to create pre-potent response required for this type of task).

Results

CRLB of Glu started to show a plateau at 8 averages (Fig3), which was used for statistical comparison. We did not find significant changes in raw Glu concentration in NoGo vs Go trials, nor did we observe changes in FWHM of the peaks for the NoGo vs Go trials (as indicator of a possible BOLD effect on the peaks) (non-parametric tests: both p>0.05).

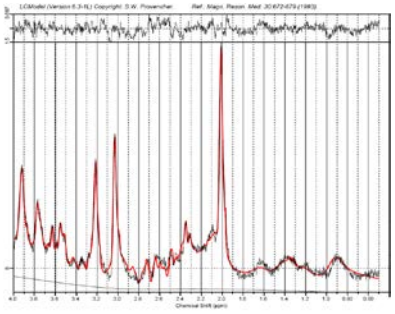

Fig2. Sample spectrum of NSA=8.

Discussion & Conclusion

Despite previous event-related fMRS studies showing an average Glu change of 13% [2], we do not observe Glu changes in this 7T study. This might be due to the small sample size or the task design. Currently, we are exploring different designs for optimal fMRS measurement of response inhibition.

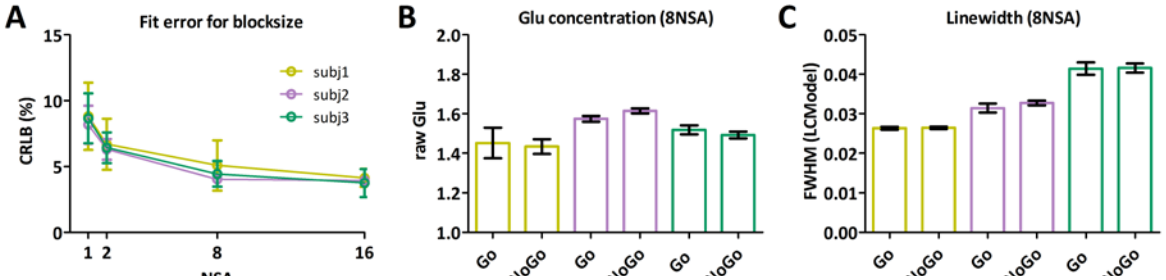

Figure3. Results. A) Fit error for the blocksizes 1,2,8 and 16. As expected, fit error decreases with blocksize and stabilizes at NSA=8. B) Glu concentration for blocksize 8. No differences between Go and NoGo. C) Linewidth for blocksize 8 (changes could reflect BOLD effect, affecting Glu concentration estimation in LCModel). No differences between Go and NoGo.

References 1. Mangia et al. 2007 2. Mullins 2018 3. Durston et al. 2002 4. Falkenstein et al. 1999 5. Yarkoni et al. 2011 6. Simpson et al. 2017 7. Bhogal et al. 2017.