NeuroImage Human Brain Mapping 2002 Meeting

Order to appear: 250
Poster No.: 10312

SPOKEN CUED-RECALL DURING EVENT-RELATED fMRI

Richard Henson, Oliver Josephs

Wellcome Department of Imaging Neuroscience, University College London

Subject: Memory and Emotion

Abstract
Overt speech during fMRI image acquisition is problematic because it introduces movement artefacts. A previous solution used long SOA event-related fMRI and discarded scans during which speech occurred [1]: Because of the protracted nature of the BOLD response, the remaining scans still contained measurable signal.

A problem with this approach is that speech-related movement during multislice EPI can cause misalignment of slice-selection relative to the brain, potentially disturbing the nuclear spin equilibrium. For example, if movement exceeds the inter-slice gap during sequential slice acquisition, the same region of tissue can be excited more than once within a scan, while other regions are not excited. This can produce differential spin history effects, which decay according to the T1 relaxation time. Thus even if scans containing speech are discarded, movement-related effects can still influence subsequent scans. Furthermore, the slice misalignment caused by within-scan movement can produce image deformations that are not correctable using conventional rigid-body image realignment techniques.

Our solution to this problem was to not acquire EPI data during the speech event. Participants performed a cued-recall memory task, in which a visual cue-word prompted covert retrieval of a target-word that had been paired with the cue-word in a previous study phase. Between 8-12s after the cue-word, participants were prompted to speak aloud the retrieved word. This visual speech prompt was timed to coincide with a 1.2s gap between scans (TA=2.8s, TR=4s for all scans, to maintain equilibrium). Speech was recorded by via an airtube positioned close to the mouth. The digitised speech signal was displayed together with the scanner slice-selection pulses for on-line monitoring (to detect any scans into which speech extended).

The absence of scanner noise during speech also improved its intelligibility, allowing participants to whisper their response, in turn reducing head movement. The jittered timing between the cue and speech reduced the correlation between the effect of interest (the covert retrieval event) and any residual movement effects (eg, gradual head relaxation that was sometimes observed over the several seconds after speech). As a final precaution, the movement parameters determined from rigid-body realignment of the scans were included in the statistical model in order to covary out (linear) residual movement effects.

Statistical analysis revealed several brain regions that showed effects of memory retrieval (indeed, differences were detected according to the degree of proactive interference associated with each cue [2]). This method thus allows a new range of memory experiments, which have traditionally been restricted to recognition tasks (which may reflect a mixture of episodic recollection and nonepisodic familiarity) or covert recall tasks (with no objective measure of correct retrieval during scanning).

In summary, our precautions 1) prevent differential spin-history effects, 2) reduce non-rigid-body

movement, 3) remove scanner noise (allowing quieter speech and hence less movement), 4) decorrelate residual movement effects from events of interest and 5) covary out linear residual movement effects. The downside is reduced statistical efficiency owing to longer SOAs and fewer total scans.

1. Birn,Bandettini,Cox & Shaker (1998). Proc.ISMRM 6th Meeting,p.159
2. Henson,Shallice,Josephs & Dolan (submitted)

Go to Main Abstract page