Spatiotemporal Analysis of Event-related fMRI to Reveal Cognitive States[1]

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Abstract

Cognitive science has a rich history of developing theories of processing that characterize the mental steps involved in performance of many tasks. Recent work in neuroimaging and machine learning has greatly improved our ability to link cognitive processes with what is happening in the brain. This paper analyzes an HSMM-MVPA methodology that we have developed for inferring the sequence of brain states one traverses in the performance of a cognitive task. The method is applied to an fMRI experiment where task boundaries are known that should separate states. The method is able to accurately identify those boundaries. Then, applying the method to synthetic data, we explore more fully those factors that influence performance of the method: signal to noise ratio, numbers of states, state durations, and numbers of underlying experimental conditions. The results indicate the types of experimental tasks where applications of the HSMM-MVPA method are likely to yield accurate and insightful results.

Keywords: cognitive states, fMRI experiment, HSMM-MVPA method.