What can Markov-switching models of pupil dilation and EEG time courses reveal about the cognitive events in word recognition?

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Because of their high temporal resolution ERPs are often used to investigate word processing. The pupil dilation time course is assumed to instead be an indirect and delayed reflection of the latent cognitive events involved in word processing. This raises the question whether, despite these temporal differences, the same events leave a trace in both signals. Alternatively, these signals may carry information about different events in word processing.

Various deconvolution approaches have been proposed to determine which cognitive events triggered the pupil response. However, the conventional approach, applied to averaged pupil dilation time courses, neglects trial and event-level variability in the timing between events and the pupil response. Recently, Hidden semi-Markov models (HsMMs) have been used to recover latent events directly from trial-level EEG recordings, permitting an investigation into the influence of trial-level predictors (e.g., continuous word frequency) on the events.

We will present a novel unified method, which combines generalized additive models and HsMMs. This allows us to estimate cognitive events from co-registered trial-level EEG and pupil dilation time-courses, recorded during a lexical decision (LD) task. This new method reveals how changes in Google frequency have a different effect on every cognitive event involved in LDs.