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The role of the SMA and the Contingent Negative Variation in interval timing

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Abstract

Over the last decades, many studies have been published that have been interpreted in favour of the view that the Contingent Negative Variation (CNV) reflects the subjective experience of time. However, a number of papers have recently appeared that question this direct link, but at the same time new studies using new methodologies have solidified the original claims. In this symposium, both views will be presented. Frank Vidal and Laurence Casini will present the original literature and link the EEG findings to more recent fMRI data. Martin Wiener will discuss new data that demonstrates that supplementary motor area (SMA) activity reflects both the experience of the current trial and the perceived difference between the current and previous trials. Trevor Penney and Kwun Kei Ng will discuss the extend to which duration bisection tasks support and question the view that the CNV reflects the accumulator. Finally, Hedderik van Rijn and Tadeusz Kononowicz will present data that question the prominent role of the CNV in the subjective temporal experience. The titles and abstracts of the four talks are given below.

Keywords: Interval timing; Accumulation; CNV; TMS; Bisection; Auditory evoked potentions; Response caution

1. Is the SMA a neural substrate of the temporal accumulator? *by Franck Vidal and Laurence Casini*

One of the most widely cited models in time estimation literature is the “pacemaker-counter clock”, which

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consists of a pacemaker generating pulses and an accumulator in which pulses are stored. Finding specific brain areas behaving as a pacemaker and/or as an accumulator would indicate that this model is more than a good metaphor accounting for actual temporal processing mechanisms. In our presentation, we will give some evidence supporting the view that the supplementary motor area (SMA) could be a neural substrate of the accumulator. We will review electrophysiological arguments coming both from human and animal studies, which will be augmented by fMRI findings.

2. Perceptual carryover effects in climbing neural activity *by Martin Wiener*

Collected evidence over the past decade suggests that that SMA serves as an accumulator mechanism for time perception. Here, I will present evidence that the SMA activity does not just reflect the currently elapsed interval, but also the recent history of previously presented intervals. Furthermore, I will also present data suggesting that the SMA tracks the perceived difference between successive interval pairings, even when those intervals are not explicitly being compared. These findings will be discussed in the context of extant neural timing models.

3. The CNV in the duration bisection task *by Trevor B. Penney and Kwun Kei Ng*

Several recent studies have challenged the view that the CNV, an event-related potential (ERP) component, is an electrophysiological correlate of temporal accumulation. We examined the relationship between the CNV and interval timing using the duration bisection task. Across three experiments, measures of CNV slope, peak, and mean amplitude failed to provide consistent support for the temporal accumulation account. However, the CNV did appear to be modulated by temporal aspects of the bisection task. We will discuss the results in the context of alternate constructs (e.g., temporal attention) and current models of interval timing.

4. Decoupling interval timing and climbing neural activity *by Hedderik van Rijn and Tadeusz Kononowicz*

It is often argued that climbing neural activity, as for example reflected by the CNV in the electroencephalogram, is the signature of the subjective experience of time. According to this view, the resolution of the CNV coincides with termination of subjective timing processes and no other measure should outperforms the CNV in predicting subjective temporal performance. Paradoxically, behavioral data indicates that participants keep track of timing even after the standard interval (SI) has passed. Here, we will present new data that demonstrate that even after the CNV has deflected, temporal information continues to be processed, and that the amplitudes of auditory evoked potentials of the offset of a duration are better predictors for the subjective percept than the CNV amplitude.