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SPATIOTEMPORAL DYNAMICS OF A COHERENT PATTERN OF ACTIVITY IN A NETWORK OF DIPOLAR SOURCES IN HUMAN ELECTROPHYSIOLOGICAL EXPERIMENTS FOLLOWING INCORRECT SPEEDED MOTOR RESPONSES.

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The error related negativity (ERN or Ne) is a brief negative-going potential observed in event-related potential averages of EEG data trials at human frontal midline scalp sites following self-recognized speeded motor response errors. Here we report a complex dynamic of brain activity arising in association with such errors but not well captured in the ERP average. Seven subjects performing a speeded forced-choice visual response experiment were penalized monetarily for responding to the central letter (H or S) of five-letter stimuli either with the wrong hand (incorrect) or later than an unmarked deadline (late). We decomposed the concatenated 800, 2-second, 128-channel, response-locked EEG data trials from each subject, after removing atypically noisy trials and channels, using independent component analysis (ICA) (scn.ucsd.edu/eeglab). A subset of the identified maximally independent sources were well fit by cortical dipoles. Using time/frequency analysis and event-related coherence measures we analyzed the dynamics of activity in networks of 8-18 near-dipolar sources. A striking result was the emergence of transient theta band power and coherence peaking about 100 ms after incorrect responses. The transient coherence remained significant even after removing common phase-locked (ERP) activity. The coherent activity was widely distributed, whereas the theta power increases were maximal in dorsal frontal midline sources. Transient theta coherence may be a signature of the brain's top-down response to significant external or internal events.

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