Michael X Cohen

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Basic information

Date of birth	24 May 1979
Internet	mikexcohen.com
Pubmed	pubmed.com/?term=cohen-mx
Gscholar	http://goo.gl/k7sKWU
Current positions	Assistant professor, Radboud University Medical Center, CNS dept. Associate professor, Radboud University, science faculty
Current funding	ERC Starting grant ("THETA 2.0") Hypatia fellowship, Radboud UMC
Lab members	Two postdocs Three PhD students (one shared with Dr. Bernhard Englitz) Full-time research technician

Topical scientific expertise

Midfrontal theta and response conflict

"Response conflict" happens when you quickly select one of several competing actions to avoid making a mistake. My collaborators and I discovered that response conflict elicits a specific pattern of brain electrical activity, characterized by oscillations at around 6 cycles per second (the "theta" band).

The significance of midfrontal theta for how neural microcircuits recognize and avoid imminent errors is unknown. The goal of our research is to use humans, animals, and computer models to understand what midfrontal theta is telling us about how neural computations underlying response conflict.

Representative publications

Cohen MX (2014). *A neural microcircuit for cognitive conflict*. Trends in Neurosciences.
This paper reviews the findings about midfrontal theta and response conflict, and proposes neural microcircuit that might produce conflict computations and the theta oscillations we measure with EEG.

Cohen MX, van Gaal S. (2013). *Dynamic interactions between large-scale brain networks predict behavioral adaptation after perceptual errors*. Cerebral Cortex.
We found that frontal theta and posterior alpha networks interact in dynamical ways to support behavioral adaptation before and after response errors.

Cohen MX, Donner TH. (2013). *Midfrontal conflict-related theta-band power reflects neural oscillations that predict behavior*. Journal of Neurophysiology.
We demonstrated that midfrontal theta is band-limited and non-phase-locked to stimulus-onset or response; two criteria often used to support the interpretation of "oscillation." We also showed that non-phase-locked theta was more closely related to behavior than was the time-domain average signal.

van Driel J, Sligte IG, Linders J, Elport D, Cohen MX (2015). *Frequency band-specific electrical brain stimulation modulates cognitive control processes*. PLoS One.
External brain electrical stimulation modulated conflict adaptation, but only when stimulation was delivered in the theta band, not in the alpha band.

Methodological expertise

Electrophysiology data analysis methods

The literature linking neural and network oscillations to cognition and behavior is nascent, and the optimal data analysis methods and approaches are not entirely established. An important part of my research involves developing, evaluating, and teaching data analysis techniques. The focus is on time-frequency, synchronization, and multivariate analyses of electrophysiology data.

Representative publications

Cohen MX (2014). Analyzing Neural Time Series Data: Theory and Practice. MIT Press.
This monograph textbook explains the conceptual, mathematical, and implementational (via Matlab programming) aspects of time-, time-frequency- and synchronization- based analyses of MEG, EEG, and LFP recordings. It contains over 180,000 words and 244 figures in 38 chapters (600 pages), and comes with over 11,000 lines of Matlab code and sample EEG data.

Cohen MX (2015). *Effects of time lag and frequency matching on phase-based connectivity*. Journal of Neuroscience Methods.
There are several classes of phase-based connectivity methods; this paper examined effects of violating assumptions of time lag and frequency characteristics on resulting estimates of connectivity strength.

Teaching resources

mikexcohen.com/lectures.html
A growing list (currently around 50) of recorded video lectures, with accompanying Matlab code, that explains concepts in time-frequency and synchronization-based electrophysiology analyses. Most lecturelets are 20-30 minutes long.

groups.google.com/forum/#!forum/analyzingneuraltimeseriesdata
A Google forum where people can ask or discuss data analysis or Matlab questions. I answer most questions within a day.