

# Thomas Donoghue, PhD

Postdoctoral Research Scientist  
Dept. of Biomedical Engineering  
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**Languages:** English (native), French (proficient), Spanish (intermediate)

## Areas of Specialization

Cognitive Neuroscience - Electrophysiology - Periodic & Aperiodic Activity - Data Science

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## Education

- 2014 - 2020 **PhD, Cognitive Science - Advisor: Prof. Bradley Voytek**  
*University of California, San Diego, La Jolla, California, USA*  
Thesis: Measuring and Investigating Periodic and Aperiodic Neural Activity
- 2011- 2014 **Bachelors of Arts and Sciences (BA&Sc) Honors Cognitive Science**  
*McGill University, Montreal, Quebec, Canada*  
Major: Cognitive Science. Minor: Philosophy. Graduated First Class Honors with Distinction

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## Research Experience

- 3/2021 - **Postdoctoral Research Scientist - Advisor: Prof. Joshua Jacobs**  
*present* *Columbia University, Department of Biomedical Engineering*  
Investigations of human electrophysiology, with intracranial recordings and single units.
- 10/2020 - **Postdoctoral Scholar - Advisor: Prof. Bradley Voytek**  
*2/2021* *UC San Diego, Department of Cognitive Science, Cognitive & Neural Dynamics Lab*  
Developing software tools for the analysis of electrophysiological recordings.
- 9/2014 - **Graduate Student Researcher - Advisor: Prof. Bradley Voytek**  
*9/2020* *UC San Diego, Department of Cognitive Science, Cognitive & Neural Dynamics Lab*  
Mechanisms of neural communication using human electrophysiological recordings.
- 5/2013 - **Research Assistant - Advisor: Prof. Sylvain Baillet**  
*6/2014* *Montreal Neurological Institute, Department of Neurology & Neurosurgery*  
Functional connectivity during sleep, using magnetoencephalography and polysomnography.
- 9/2012 - **Research Assistant - Advisor: Prof. Kris Onishi**  
*9/2014* *McGill University, Department of Psychology - McGill Infant Development Cluster (MIDC)*  
Psycholinguistics & Developmental Psychology: language perception & statistical learning.

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## Additional Training

- 2018 **Methods In Neuroscience at Dartmouth (MIND)**, *Dartmouth College, Hanover, NH, USA*  
Short course. Topic: Narratives & Natural Contexts. Competitive application (~20% acceptance).
- 2017 **Neurohackweek**, *eScience Institute, University of Washington, Seattle, WA, USA*  
Project-based course on neuro- & data science. Competitive application (~25% acceptance).
- 2016 **Advanced Scientific Programming in Python**, *G-Node & CINN, Reading, England, UK*  
Short course on scientific programming. Competitive application (9.9% acceptance).

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## Preprints & Articles Currently Under Review

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- preprint **Donoghue T** & Watrous A. How can we differentiate narrow-band oscillations from aperiodic activity? *PsyArXiv*. DOI: 10.31234/osf.io/k6nhd. [LINK](#)
- preprint He W, **Donoghue T**, Sowman PF, Seymour RA, Brock J, Crain S, Voytek B, & Hillebrand A. Co-Increasing Neuronal Noise and Beta Power in the Developing Brain. *bioRxiv*. DOI: 10.1101/839258. [LINK](#)

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## Journal Articles (Peer Reviewed)

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*Underlined are research assistants under my direct supervision.*

- 2022 **Donoghue T**, Schaworonkow N & Voytek B. Methodological considerations for studying neural oscillations. *European Journal of Neuroscience*, 55(11-12), 3502-3527. DOI: 10.1111/ejn.15361. [LINK](#)  
Project website: [oscillationmethods.github.io](https://oscillationmethods.github.io)
- 2022 **Donoghue T**, Voytek B, & Ellis S. Course Materials for Data Science in Practice. *Journal of Open Source Education*, 5(51), 121. DOI: 10.21105/jose.00121. [LINK](#)
- 2022 **Donoghue T** & Voytek B. Automated meta-analysis of the event-related potential (ERP) literature. *Scientific Reports*, 12(1). DOI: 10.1038/s41598-022-05939-9. [LINK](#)  
Project website: [erpscanr.github.io](https://erpscanr.github.io)
- 2022 Ostlund BD, **Donoghue T**, Anaya B, Gunther KE, Karalunas SL, Voytek B, Pérez-Edgar KE Spectral parameterization for studying neurodevelopment: How and why. *Developmental Cognitive Neuroscience*, 54, 101073. DOI: 10.1016/j.dcn.2022.101073. [LINK](#)
- 2021 Waschke L, **Donoghue T**, Fiedler L, Smith S, Garrett DD, Voytek B & Oblesser J. Modality-specific tracking of attention and sensory statistics in the human electrophysiological spectral exponent. *eLife*. DOI: 10.7554/eLife.70068. [LINK](#)
- 2021 **Donoghue T**, Voytek B, & Ellis S. Teaching Creative and Practical Data Science at Scale. *Journal of Statistics and Data Science Education*, 29(sup1), S27-S39. DOI: 10.1080/10691898.2020.1860725. [LINK](#)
- 2020 **Donoghue T**, Haller M, Peterson EJ, Varma P, Sebastian P, Gao R, Noto T, Lara AH, Wallis JD, Knight RT, Shestyk A & Voytek B. Parameterizing Neural Power Spectra into Periodic and Aperiodic Components. *Nature Neuroscience*, 23. DOI: 10.1038/s41593-020-00744-x. [LINK](#)  
Media coverage: [Quanta Magazine](#); reprinted in [Wired](#)
- 2020 **Donoghue T**, Dominguez J & Voytek B. Electrophysiological Band Ratio Measures Conflate Periodic and Aperiodic Activity. *eNeuro*, 7(6). DOI: 10.1523/eneuro.0192-20.2020. [LINK](#)
- 2019 Robertson MM, Furlong S, Voytek B, **Donoghue T**, Boettiger CA, & Sheridan MA. EEG Power Spectral Slope Differs by ADHD Status and Stimulant Medication Exposure in Early Childhood. *Journal of Neurophysiology*, 122(6). DOI: 10.1152/jn.00388.2019. [LINK](#)
- 2019 **Donoghue T**. LISC: A Python Package for Scientific Literature Collection and Analysis. *Journal of Open Source Software*, 4(41), 1674. DOI: 10.21105/joss.01674. [LINK](#)
- 2019 Cole S, **Donoghue T**, Gao R & Voytek B. NeuroDSP: A Package for Neural Digital Signal Processing. *Journal of Open Source Software*, 4(36), 1272. DOI: 10.21105/joss.01272. [LINK](#)

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## Book Chapters

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upcoming **Donoghue T** & Watrous A. How can we differentiate narrow-band oscillations from aperiodic activity? In *Intracranial EEG for Cognitive Neuroscience*. Editor: Nikolai Axmacher, New York (USA): Springer Press.

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## Conference Proceedings (Peer Reviewed Papers - Selected)

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*Underlined are research assistants under my direct supervision.*

2019 **Donoghue T**, Gao R, Waschke L & Voytek B. A Simulation-Based Comparison of Methods for Analyzing Aperiodic Neural Activity. *Cognitive Computational Neuroscience*. [LINK](#)

2018 Fox W, **Donoghue T**. Confidence Levels in Scientific Writing: Automated Mining of Primary Literature and Press Releases. *Proceedings of the Cognitive Science Society*. [LINK](#)

2017 Gao R, **Donoghue T** & Voytek B. Automated Generation of Cognitive Ontology via Web Text-Mining. *Proceedings of the Cognitive Science Society*. [LINK](#)

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## Conference Presentations

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12/2022 **Extracting neural signals from noise** (Workshop Talk) [upcoming]  
American Epilepsy Society Meeting, Nashville, TN, USA.

11/2018 **Parameterizing Neural Power Spectra** (NanoSymposium Presentation)  
*Society for Neuroscience Conference*, San Diego, CA, USA.

1/2016 **The Effect of Oscillatory Phase on Perception and Cognition** (Research Talk)  
*Temporal Dynamics of Learning Centre - All Hands Meeting*, San Diego, CA, USA.

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## Interactive Workshops

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6/2022 **Parameterizing periodic and aperiodic activity in neural time series** [upcoming]  
Neurotheory Workshop, Zuckerman Institute for Mind, Brain, & Behavior, NYC, NY, USA.

3/2019 **New Methods for Analyzing Periodic Oscillations and Aperiodic 1/f in Electrophysiology**  
*Cognitive Neuroscience Society Conference*, San Francisco, CA, USA.  
Developed & lead an interactive workshop covering software tools for neural data analysis.

2013 - **Brainstorm Software for M/EEG Analyses**  
2015 Assisted with interactive workshops for the [Brainstorm](#) toolbox [3 workshops]

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## Research Presentations (Invited)

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3/2022 - **Separating periodic and aperiodic activity to investigate physiology, cognition, & disease**  
Cognitive Brown Bag, Center for Cognitive Neuroscience, Dartmouth University [in person - 3/2022]  
Psychology Seminar Series, Psychology Department, University of Salzburg [virtual - 3/2022]

2020 - **Investigating Periodic & Aperiodic Neural Activity** (Guest Talks - University & Companies)  
University: invited talks to group meetings & journal clubs (virtual) [8 talks up to 03/2022]  
Company: Friday Talk Series, Beacon Biosignals (virtual) [10/2021]

11/2018 **Simulation-Driven Methods Development** (Seminar Talk - University)  
Cognition at the Shore Talk Series, Department of Cognitive Science, UC San Diego

08/2018 **Fitting Oscillations & One-Over F and Other Things** (Invited Seminar - Company)  
Interaxon, Toronto, Canada

## Conference Abstracts & Posters (Selected)

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*Underlined are research assistants under my direct supervision.*

- 2021 **Donoghue T**, Qasim SE, Patel A, Azab H, Smith EH, Mathura R, Myers J, Anand A, Atkinson J, Rey HG, Rolston JD, Behrens TEJ, Botvinich M, Sheth S, Jacobs J. Human single neuron activity encodes future trajectories. *Society for Neuroscience*, Virtual.
- 2020 **Donoghue T** & Voytek B. Considerations for Detecting & Measuring Neural Oscillations. *LiveM/EEG (Cutting EEG)*, Virtual Conference. [LINK](#)
- 2019 Farnan T, **Donoghue T**, & Voytek B. Evaluating Spectral Estimation Methods for Time-Resolved Measurement of Aperiodic Activity. *Society for Neuroscience*, Chicago, IL, USA. [LINK](#)
- 2019 Zhang F, **Donoghue T**, & Voytek B. Comparing the Effects of Pre-Stimulus Periodic and Aperiodic Activity on Post-Stimulus Event Related Potentials. *Society for Neuroscience*, Chicago, IL, USA. [LINK](#)
- 2019 Waschke L, **Donoghue T**, Smith S, Voytek B & Obleser J. Tracking of 1/f Stimulus Characteristics in the Human EEG. *Society for Neuroscience*, Chicago, IL, USA.
- 2019 **Donoghue T**, Gao R, Waschke L & Voytek B. A Simulation-Based Comparison of Methods for Analyzing Aperiodic Neural Activity. *Cognitive Computational Neuroscience*, Berlin, Germany. [LINK](#)
- 2019 Dominguez J, **Donoghue T**, & Voytek B. Electrophysiological Frequency Band-Ratio Measures Conflate Changes in Periodic and Aperiodic Features. *Cognitive Neuroscience Society*, San Francisco, CA, USA. [LINK](#)
- 2018 Mdanda L, **Donoghue T**, & Voytek B. Parameterization of Periodic and Aperiodic Human Electrophysiology Reveals Greater Between- Than Within-Subject Variability. *Society for Neuroscience*, San Diego, CA, USA. [LINK](#)
- 2018 **Donoghue T**, Sebastian P, & Voytek B. Topographical Analysis of Electrophysiological 1/f and Oscillations Reveals Patterns of Spatial Variation. *International Conference on Biomagnetism*, Philadelphia, PA , USA. [LINK](#)
- 2018 **Donoghue T**, Sebastian P, Noto T, Haxby S & Voytek B. Integrating Human Electrophysiology, Gene Expression and Functional Data. *Neuroinformatics*, Montreal, QC, Canada. [LINK](#)
- 2018 Fox W, **Donoghue T**. Confidence Levels in Scientific Writing: Automated Mining of Primary Literature and Press Releases. *Cognitive Science*, Madison, WI, USA. [LINK](#)
- 2018 **Donoghue T** & Voytek B. Alpha Power and 1/f Slope Provide Independent Decoding of Visual Spatial Attention. *Cognitive Neuroscience Society*, Boston, MA, USA. [LINK](#)
- 2018 Gao R, **Donoghue T** & Voytek B. Defining Cognition: Automated Generation of Cognitive Ontology by Text-Mining Literature. *Cognitive Neuroscience Society*, Boston, MA, USA.
- 2017 Waschke L, **Donoghue T**, Obleser J & Voytek B. Attention-Modulated Tracking of 1/f Stimulus Characteristics in Human EEG. *Signals & Noise in the Auditory Pathway*, Lübeck, Germany.
- 2017 **Donoghue T** & Voytek B. Assessing approaches for estimating the electrophysiological 1/f background spectrum. *Society for Neuroscience*, Washington DC, USA. [LINK](#)
- 2017 **Donoghue T** & Voytek B. Automated meta-analysis of event-related potentials and their correlates by text-mining. *Cognitive Neuroscience Society*, San Francisco, CA, USA. [LINK](#)
- Award: graduate student award winning poster including a 500\$ travel award

- 2016 **Donoghue T**, [Fox W](#), [Kim A](#), & Voytek B. The relation of oscillatory-phase to visual perception depends on attention & location of stimuli. *Society for Neuroscience*, San Diego, CA. [LINK](#)
- 2016 [Sebastian P](#), **Donoghue T**, Noto T, Haxby S, & Voytek B. Data mining to generate novel hypotheses for the genetic underpinnings and functional roles of cortical oscillations. *Society for Neuroscience*, San Diego, CA, USA. [LINK](#)
- 2016 **Donoghue T**, [Sebastian P](#), & Voytek B. Automated Analysis of Resting State Cortical Oscillatory Characteristics using Magnetoencephalography. *International Conference on Biomagnetism*, Seoul, South Korea. [LINK](#)
- 2015 Gougelet R, **Donoghue T**, Piper M, Althoff A, Urbach TP, & Voytek B. Influencing Visual Target Detection with Oscillatory Phase-Specific Stimulus Presentation. *Society for Neuroscience*, Chicago, IL, USA. [LINK](#)

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## Honors & Awards

- 2017 - **Travel Awards, UC San Diego**  
2019 Travel awards for conference attendance and travel costs.  
Awards from the Graduate Student Association (2X) and from departmental funds.
- 1/2016 **Small Grants Award, Temporal Dynamics of Learning Centre (TDLC)**  
2,200\$ USD funding for an EEG project on the temporal dynamics of perceptual learning.
- 3/2014 **Owens Scholar Award, Johns Hopkins University** (*declined*)  
18 000\$ USD additional funding over 3 years offered with admission to Johns Hopkins.
- 11/2013 **Samuel de Champlain Quebec Program for International Collaboration**  
Funds provided by my research supervisor (Dr. Baillet) for travel to NeuroSpin in France.

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## Academic Activities: Reviewing

*\*Includes article co-reviewed with a research supervisor. #Includes code review.*

### Journal Articles (Ad-Hoc Reviewer)

Behavior Research Methods (1X); Biological Psychology (1X); Clinical Neurophysiology (1X); Developmental Cognitive Neuroscience (1X); eLife (1X); eNeuro (1X); European Journal of Neuroscience (1X); F1000 Research (1X); Human Brain Mapping (\*1X); Journal of Neurophysiology (\*1X); Journal of Neuroscience (1X); Journal of Open Source Education (#3X); Journal of Open Source Software (#3X); Mindfulness (1X); Neurobiology of Aging (\*2X); Neurobiology of Disease (1X); Neurolmage (3X); Open Journal of Signal Processing (1X); PLoS Computational Biology (3X); PLoS Biology (1X); ReScienceC (#1X);

### Conference Proceedings

Affective Computing & Intelligent Interaction (ACII 2019: 1 paper);  
Cognitive Computational Neuroscience (CCN 2019: 6 papers);

### Books

Columbia Press (1X);

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## Research Mentorship

*Students under my direct mentorship. Awards are where I supervised the application and project.*

### Masters Student Research Assistants:

Sandra Maesta Pereira	09/2021 - current
Zhixian (Claire) Han	09/2021 - current
Tyler Farnan	01/2019 - 03/2021

### Undergraduate Research Assistants:

Fenglin (Allen) Zhang	01/2019 - 03/2021	
Julio Dominguez	06/2018 - 01/2020	TRELS Scholarship
Luyanda Mdanda	10/2016 - 01/2020	HDSI Undergrad Fellowship
Meyhaa Buvanesh	04/2019 - 06/2019	
Lakshmi Menon	04/2019 - 09/2019	
Fiona Cisternas	01/2019 - 06/2019	HDSI Undergrad Fellowship
Priyadarshini Sebastian	10/2015 - 06/2018	FISP Trainee Award
Aeri Kim	10/2015 - 12/2016	
Will Fox	06/2015 - 06/2018	

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## Computational Skills & Contributions

Languages Fluent in **Python**, **shell** scripting (bash) & **git**, intermediate in **Matlab** and **R**.

Packages **SpecParam**: Spectral Parameterization ([Github](#) - [PYPI](#) - [Documentation](#))  
*Lead Developer* - Python package for parameterizing neural power spectra (formerly 'fooof').

**NeuroDSP**: Neuro Digital Signal Processing ([Github](#) - [PYPI](#) - [Documentation](#))  
*Co-Developer* - Python package for analyze neural electrophysiological recordings.

**LISC**: Literature Scanner ([Github](#) - [PYPI](#) - [Documentation](#))  
*Lead Developer* - Python package for collecting and analyzing the scientific literature.

**spiketools**: Analysis of spiking data ([Github](#) - [Documentation](#))  
*Lead Developer* - Python package for analyzing single-unit neural data.

Github Code & open-source contributions are available on my [Github profile](#) and indexed [here](#).

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## Science Outreach

2022 - **Mentoring: Student Mentor for High-School Summer Internship**  
Mentor for the [Brainyac](#) program, offering intensive summer internships to young students.

2020 - **Mentoring: Project Guidance & Assistance with Grad School Applications**  
Organizations include: [Cientifico Latino](#), [neuromatch](#)

2018 - **Public Workshops & Presentations**  
10/2018: *Data Wrangling & Web Scraping*: 2 hr workshop with [SCALE-SD](#). [Materials](#) - [Media](#)

2013 - **Volunteer Tutoring & School Presenter**  
Tutoring, presentations, science fair judging, and miscellaneous volunteering.  
Organizations include: [Brain Awareness](#), [San Diego Science Fair](#), [San Diego Refugee Tutoring](#)

1/2014 - **Science Writer / Editor / Podcast Host, Useful Science Organization** ([usefulscience.org](#))  
1/2017 Writing clear, concise and useful summaries of scientific research for a general audience.



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## Training in Teaching

*Formal training in teaching and related topics.*

- 2018 **Introduction to College Teaching**, Teaching & Learning Commons, UC San Diego  
Semester long course on evidence-based teaching in university contexts.
- 2017 **Equity, Diversity, and Inclusion in Postsecondary Education**, UC San Diego Extension  
Course on best practices for inclusive & equitable teaching in university contexts (10 hrs).

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## Teaching Experience

- 2018 **Instructor-of-Record**, Department of Cognitive Science, UC San Diego  
COGS 18: *Introduction to Python* (30 hours lecture + coding labs; 200 undergrad students)  
Developed & taught a course teaching introductory Python programming. Materials: [LINK](#)
- 2017 - **Instructor (3X)**, Clubes de Ciencia Mexico  
2020 [Clubes de Ciencia](#) is a non-profit organization promoting science education across Mexico.  
1 week, hands-on research focused courses (25 hours of instruction; 12-18 students / year)  
- *CdeCMx Challenge: Soluciones cientificas a problemas emergentes* (online, Aug. 2020)  
- *Inteligencia Biologica & Artificial: Amigos o Enemigos?* (Ensenada, Mexico, Aug. 2019 )  
- *Bots on the Brain: Cognitive Science & Bio-Inspired Robotics* (Monterrey, Mexico, Aug. 2017)
- 2015 - **Instructor (3X)**, Academic Connections, UC San Diego  
2017 [Academic Connections](#) offers university-level courses to advanced high school students.  
Co-developed & taught a course introducing cognitive science. Materials: [LINK](#)  
*Introduction to Cognitive Science* (75 hours of instruction; 16-24 students / year)  
Ratings: Course {4.71, 4.80, 4.59}/5; Instructor: {4.86, 4.92, 4.92}/5; Years: {2015, 2016, 2017}.
- 2015 - **Teaching Assistant (7X)**, Department of Cognitive Science, UC San Diego  
2018 COGS 108: Data Science in Practice (Winter '18, Prof. Bradley Voytek, TA Evals: 4.31/5)  
COGS 108: Data Science in Practice (Spring '17, Prof. Bradley Voytek, TA Evals: 4.32/5)  
COGS 107B: Systems Neuroscience (Winter '17, Prof. Douglas Nitz, TA Evals: 4.60/5)  
COGS 17: Neurobiology of Cognition (Winter '16, Dr. Christine Johnson, TA Evals: 4.58/5)  
COGS 9: Introduction to Data Science (Fall '15, Prof. Bradley Voytek, TA Evals: 4.34/5)  
COGS 3: Introduction to Computing (Spring '15, Prof. Bradley Voytek, TA Evals: 4.54/5)  
Awarded *Excellence in Teaching* Award from the UCSD Cognitive Science Dept.  
COGS 107B: Systems Neuroscience (Winter '15: Prof. Douglas Nitz, TA Evals: 4.69/5)  
Awarded *Outstanding Teaching* Award from the UCSD Cognitive Science Dept.

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## Educational Materials

*Openly available educational materials that I have created and/or contributed to.*

**Introductory Python**, openly available online course  
Materials for learning introductory programming in Python ([Website](#) - [Source](#)).

**Data Science in Practice**, openly available online course  
Materials for learning introductory data science in Python ([Website](#) - [Source](#)).

**Tutorials**, openly available tutorial materials online course  
**Python Boot Camp**: Open materials for a graduate student bootcamp. [LINK](#)  
**Electrophysiology Tutorials**: Materials for getting started with M/EEG analyses. [LINK](#)