

Thomas Donoghue, PhD

Postdoctoral Scholar
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Languages: English (native), French (proficient), Spanish (intermediate)

Areas of Specialization

Cognitive Neuroscience - Electrophysiology - Neural Oscillations - Data Science

Education

- 2014 - 2020 **PhD, Cognitive Science - Advisor: Prof. Bradley Voytek**
UC 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.

Research Experience

- 3/2021 - **Postdoctoral Research Scientist - Advisor: Dr. Joshua Jacobs**
present *Columbia University, Department of Biomedical Engineering*
Investigations of human electrophysiology, with intracranial recordings and single units.
- 10/2020 - **Postdoctoral Scholar - Advisor: Dr. 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: Dr. 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: Dr. Sylvain Baillet**
6/2014 *Montreal Neurological Institute, Department of Neurology & Neurosurgery*
Functional connectivity during sleep, using magnetoencephalography and polysomnography.
- 9/2012 - **Research Assistant - Advisor: Dr. Kris Onishi**
9/2014 *McGill University, Department of Psychology - McGill Infant Development Cluster (MIDC)*
Psycholinguistics & Developmental Psychology: language perception & statistical learning.

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).

Preprints & Articles Currently Under Review

- preprint* **Donoghue T** & Voytek B. Automated meta-analysis of the event-related potential (ERP) literature. *PsyArXiv*. DOI: 10.31234/osf.io/7ezmh. [LINK](#)
- preprint* Ostlund BD, **Donoghue T**, Anaya B, Gunther KE, Karalunas SL, Voytek B, Pérez-Edgar KE. Spectral parameterization for studying neurodevelopment: How and why. *PsyArXiv*. DOI: 10.31234/osf.io/btqyk. [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](#)

Journal Articles (Peer Reviewed)

Underlined are research assistants under my direct supervision.

- 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**, Schaworonkow N & Voytek B. Methodological Considerations for Studying Neural Oscillations. *European Journal of Neuroscience*. DOI: 10.1111/ejn.15361. [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, Shestyuk A & Voytek B. Parameterizing Neural Power Spectra into Periodic and Aperiodic Components. *Nature Neuroscience*, 23. DOI: 10.1038/s41593-020-00744-x. [LINK](#)
- 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](#)

Conference Proceedings (Peer Reviewed Papers - Selected)

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. *Conference on Cognitive Computational Neuroscience*. DOI: 10.32470/CCN.2019.1394-0. [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](#)

Conference Presentations

- 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.

Conference Workshops

- 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.

Research Presentations (Invited)

- 11/2018 **Simulation-Driven Methods Development** (Seminar Talk)
Cognition at the Shore Talk Series, Dept. of Cognitive Science, UC San Diego
- 08/2018 **Fitting Oscillations & One-Over F and Other Things** (Invited Seminar)
Interaxon, Toronto, Canada

Conference Abstracts & Posters (Selected)

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*, Chicago, IL, USA. [UPCOMING]
- 2020 **Donoghue T** & Voytek B. Considerations for Detecting & Measuring Neural Oscillations. *LiveM/EEG (Cutting EEG)*, Online 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. Large-Scale Topographical Analysis of Oscillations and 1/f Background Reveals Patterns of Spatial Variation Within and Between Subjects. [LINK](#) *International Conference on Biomagnetism*, Philadelphia, PA , USA.
- 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](#)
- 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 MEG. *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](#)

Honors & Awards

- 03/2017 **Graduate Student Award** - Cognitive Neuroscience Society Conference
\$500 travel award with recognition of a graduate student award winning poster.
- 1/2016 **Small Grants Award, Temporal Dynamics of Learning Centre (TDLC)**
2 200\$ Research 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.

Academic Activities: Reviewing

Journal Articles (Ad-Hoc Reviewer)

PLoS Computational Biology (2X); PLoS Biology (1X); NeuroImage (1X); Biological Psychology (1X); Behavior Research Methods (1X); Human Brain Mapping (*1X); Neurobiology of Aging (*2X); Journal of Neurophysiology (*1X); Developmental Cognitive Neuroscience (1X); Clinical Neurophysiology (1X); Mindfulness (1X); Journal of Open Source Software (#2X); Journal of Open Source Education (#2X); ReScience (#1X);

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

Conference Proceedings

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

Books

Columbia Press (1X);

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 Buvaresh	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	

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.

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

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

ByCycle: Cycle-by-cycle analysis of neural oscillations ([Github](#) - [PYPI](#) - [Documentation](#))
Maintainer - A package for analyzing cycle properties of neural oscillations.

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

Teaching Experience & Materials

- 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 científicas a problemas emergentes* (online, Aug. 2020)
- *Inteligencia Biológica & 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.
- Training in Teaching**, Teaching & Learning Commons, UC San Diego
- 2018 *Introduction to College Teaching*: course on evidence-based teaching (1 semester)
- 2017 *Equity, Diversity, & Inclusion in Postsecondary Education*: course on inclusive teaching (10 hrs)

Additional Teaching Materials

Data Science in Practice: open materials for learning data science. [LINK](#)
Python Boot Camp: open materials for a graduate student bootcamp. [LINK](#)
Electrophysiology Tutorials: Materials for getting started with M/EEG analyses. [LINK](#)

Science Outreach

- 2020 - **Mentoring & Assistance with Grad School Applications**
Organizations include: [Científico Latino](#), [neuromatch](#)
- 2018 - **Public Workshops & Presentations**
Data Wrangling & Web Scraping: 2 hr interactive workshop with [SCALE-SD](#) (Oct. 2018). [LINK](#)
- 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.