Thomas Donoghue, PhD

Postdoctoral Research Scientist
Dept. of Biomedical Engineering
Columbia University
New York City, New York, USA

Email: tdonoghue.research@gmail.com
Web: tomdonoghue.github.io
Code: github.com/TomDonoghue
ORCiD: 0000-0001-5911-0472

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

Areas of Specialization

Cognitive Neuroscience - Electrophysiology - Periodic & Aperiodic Activity - 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 - *present* **Postdoctoral Research Scientist - Advisor: Dr. Joshua Jacobs**
Columbia University, Department of Biomedical Engineering
Investigations of human electrophysiology, with intracranial recordings and single units.

10/2020 - 2/2021 **Postdoctoral Scholar - Advisor: Dr. Bradley Voytek**
UC San Diego, Department of Cognitive Science, Cognitive & Neural Dynamics Lab
Developing software tools for the analysis of electrophysiological recordings.

9/2014 - 9/2020 **Graduate Student Researcher - Advisor: Dr. Bradley Voytek**
UC San Diego, Department of Cognitive Science, Cognitive & Neural Dynamics Lab
Mechanisms of neural communication using human electrophysiological recordings.

5/2013 - 6/2014 **Research Assistant - Advisor: Dr. Sylvain Baillet**
Montreal Neurological Institute, Department of Neurology & Neurosurgery
Functional connectivity during sleep, using magnetoencephalography and polysomnography.

9/2012 - 9/2014 **Research Assistant - Advisor: Dr. Kris Onishi**
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
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

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. *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

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.

Interactive 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.

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

Research Presentations (Invited)

1/2022 **Development and applications of spectral parameterization** (Seminar Talk - University)
Cognitive Brown Bag, Center for Cognitive Neuroscience, Dartmouth University [UPCOMING]

2020 - **Investigating Periodic & Aperiodic Neural Activity** (Guest Talks - University)
Invited presentations to group meetings & journal clubs (virtual) [6 talks up to 11/2021]

10/2021 **Investigating Periodic & Aperiodic Neural Activity** (Invited Seminar - Company)
Friday Talk Series, Beacon Biosignals (virtual)

11/2018 **Simulation-Driven Methods Development** (Seminar Talk - University)
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 - Company)
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*, Virtual Conference.

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. 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
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

Honors & Awards

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 (#3X); 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 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	

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.

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.

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 - 2020 **Instructor (3X)**, Clubes de Ciencia Mexico
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 - 2017 **Instructor (3X)**, Academic Connections, UC San Diego
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 - 2018 **Teaching Assistant (7X),** Department of Cognitive Science, UC San Diego
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: 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 - 1/2017 **Science Writer / Editor / Podcast Host, Useful Science Organization** (usefulscience.org)
Writing clear, concise and useful summaries of scientific research for a general audience.