Pierre-Olivier Boucher

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Profile

Master of Science in biomedical engineering candidate with over 10 years of research experience across several neuroscience labs. Adept in analyzing multiple forms of neurophysiological (i.e. single unit, population dynamics, EEG, LFP, MEG), neuroanatomical (e.g. MRI, sectioning and staining) and neurostimulation data (i.e. DBS, TMS, HD-tDCS). Seeking to apply my extensive experience with MATLAB, Python, and electrophysiological analyses to advance BCI research.

Skills

- Proficient in experiment planning, troubleshooting and participant recruitment
- Comfortable in terminal across Windows, Linux, and Mac machines
- Proficient in Microsoft Office (Word, Linux, Outlook, Excel, Powerpoint)
- Proficient in signal processing (e.g. filtering, convolution, measuring phase synchrony) in MATLAB
- Proficient in statistical analyses (e.g. t-tests, ANOVAs) using MATLAB, R, and SPSS
- Proficient in using machine learning (e.g. Naïve Bayes, KNN) in Python, Tensorflow and MATLAB
- Adept in neurophysiological analysis of population dynamics, LFPs and EEG using MATLAB
- Skilled in visualization using Adobe Illustrator, Adobe Photoshop, and GIMP
- Comfortable using psychophysical software programs: E-Prime, Qualtrics, PsychoPy, & Presentation

Education

Boston University, Boston, MA Sep 2019 - Dec 2021
Masters of Engineering, Biomedical Engineering

University of Waterloo, Waterloo, ON Sep 2012 - Dec 2014
Masters of Arts, Psychology and Cognitive Neuroscience

University of Toronto Mississauga, Mississauga, ON Sep 2007 - Jun 2011
Honours Bachelor of Science, Psychology

University of Copenhagen, Copenhagen, Denmark Jun 2010 - Jun 2010
Study Abroad Exchange Program

Professional Experience

Boston University, Boston, MA Nov 2020 - Present
Graduate Student

- Uncovered evidence of prestimulus population dynamics associated with speed of response using a principal components analysis of 996 neurons and linear regression in MATLAB
- Demonstrated that prestimulus neural dynamics and spiking activity change as a function of the previous trial's outcome using a principal component analysis and a decoder
- Synthesized findings on a dynamical systems perspective in decision-making, prepared figures using Illustrator, and preparing a first author publication

Beth Israel Deaconess Medical Centre, Boston , MA Jun 2017 - Aug 2019
Clinical Research Coordinator

- Recruited, screened, scheduled and conducted over 20 participants in a 24 participant TMS-EEG study to determine if TMS can be used to reliably evoke brain activity across visits and within several brain regions
- Cleaned, processed, and analyzed ERPs and MEPs from over 30 participants worth of TMS-EEG data employing EEGLAB and TESA in MATLAB
- Wrote a first-author publication based on findings from MEPs evoked from motor cortex
- Designed and implemented a 120-participant research protocol to further understand TMS-EEG test-retest reliability
- Trained 5 research assistants to operate a TMS-EEG study and to process the resulting data

The Hospital for Sick Children, Toronto, ON Aug 2015 - Jun 2017
Research Technologist

- Led a reward seeking experiment, in Dr. Jose Velazquez's lab, with rats trained to press a bar to receive rewarding intracranial electrical stimulation
- Performed stereotaxic surgery to implant 2 recording and 1 stimulating electrode(s) in 11 rats
- Processed 2 channels of LFP data from the nucleus accumbens to measure synchrony hypothesized to precede and predict bar presses in MATLAB
- Developed function in MATLAB to automatically mark stimulation artifacts to facilitate data analysis
- Procured an exemption to handle a controlled substance as well as ordered supplies and animals

The Hospital for Sick Children, Toronto, ON Apr 2015 - Aug 2015
Research Assistant

- Sectioned and mounted mouse brain tissue to examine lateral amygdala neurons
- Differentiated lateral amygdala cell types via immunohistochemistry

The Hospital for Sick Children, Toronto, ON Sep 2014 - Aug 2015
Research Technologist

- Recruited and ran 16 participants in a study which tested the performance of participants across different cognitive and motor tasks in Dr. Doug Cheyne's lab

- Measured brain activity via MEG while participants received HD-tDCS
- Coded the tasks in Presentation and PsychoPy
- Planned a large-scale clinical project of children with cerebral palsy

University of Waterloo, Waterloo, ON Sep 2012 - Dec 2014
Graduate Student
- Designed and gathered data from an online study of facial expression perception of over 200 participants and analyzed their data in R and Excel
- Ran and preprocessed data for 19 participants in an EEG experiment of face perception
- Conducted 2 in class mind-wandering studies and amassed data from over 200 participants resulting in two peer-reviewed publications

University of Toronto, Toronto, ON Aug 2011 - Aug 2012
Research Assistant
- Conducted computer-based experiments of memory across older and younger participants in Dr. Lynn Hasher's lab
- Updated and verified the lab database of participants in Microsoft Access
- Compiled background information of potential participants over the phone while maintaining confidentiality
- Administered and scored the MoCA, MMSE, and Raven's Progressive Matrices

University of Toronto, Mississauga, ON May 2011 - Mar 2012
Research Assistant
- Coded several behaviors exhibited by genetically modified mice across two experiments using Noldus Observer in Dr. Melissa Holmes lab
- Implemented an extra level of analysis which was instrumental in one of the findings

McLean Hospital, Boston, MA Jul 2009 - Sep 2009, Jul 2010 - Sep 2010
Research Analyst
- Traced and partitioned the corpus callosum on structural MRI images of 19 participants for analysis in Dr. Mike Rohan's lab
- Correlated the voxel sizes of the seven sections of the corpus callosum with previously collected questionnaires of peer adolescent bullying
- Explored the relevant literature and prepared a summary of my findings

Scholarship

Peer-reviewed publications

Boucher, P. O., Ozdemir, R. A., Momi, D., Burke, M. J., Jannati, A., Fried, P. J., Pascual-Leone, A., Shafi, M. M., & Santarnecchi, E. (2021). Sham-derived effects and the minimal reliability of theta burst stimulation. *Scientific Reports*, 11: 21170. https://doi.org/10.1038/s41598-021-98751-w

Klooster, D., Vink, J., van Mierlo, P., Boon, P., Cooke, D., Gedankien, T., Roberts, A., **Boucher, P.**, Pascual-Leone, A., Fox, M., & Shafi, M. (2019). Propagation of TMS pulses versus functional brain connectivity. *Brain Stimulation*, 12: 450. https://doi.org/10.1016/j.brs.2018.12.461

Luedke, A. C., **Boucher, P. O.**, Niel, L., & Holmes, M. M. (2013). Altered anxiety and defensive behaviors in Bax knockout mice. *Behavioural Brain Research*, 239: 115–120. https://doi.org/10.1016/j.bbr.2012.10.056

Momi, D., Ozdemir, R. A., Tadayon, E., **Boucher, P.**, Domenico, A. D., Fasolo, M., Shafi, M. M., Pascual-Leone, A., & Santarnecchi, E. (2022). Phase-dependent local brain states determine the impact of image-guided transcranial magnetic stimulation on motor network electroencephalographic synchronization. *The Journal of Physiology*, 0: 1–17. https://doi.org/10.1113/JP282393

Momi, D., Ozdemir, R. A., Tadayon, E., **Boucher, P.**, Shafi, M. M., Pascual-Leone, A., & Santarnecchi, E. (2021b). Network-level macroscale structural connectivity predicts propagation of transcranial magnetic stimulation. *NeuroImage*, 229: 117698. https://doi.org/10.1016/j.neuroimage.2020.117698

Ozdemir, R., Tadayon, E., **Boucher, P.**, Momi, D., Karakhanyan, K., Fox, M., Halko, M., Pascual-Leone, A., Shafi, M., & Santarnecchi, E. (2020a). P67 transcranial magnetic stimulation induced perturbations of resting-state-networks are reproducible markers of causal network-to-network dynamics. *Clinical Neurophysiology*, 131: e50. https://doi.org/10.1016/j.clinph.2019.12.178

Ozdemir, R., Tadayon, E., **Boucher, P.**, Sun, H., Ganglberger, W., Westover, B., Pascual-Leone, A., Santarnecchi, E., & Shafi, M. (2020b). P66 cortical fingerprinting using spatial-temporal evolution of TMS evoked EEG responses. *Clinical Neurophysiology*, 131: e50. https://doi.org/10.1016/j.clinph.2019.12.177

Ozdemir, R., Tadayon, E., **P. Boucher**, Momi, D., Karakhanyan, K., Pascual-Leone, A., Shafi, M., & Santarnecchi, E. (2019). EEG network-specificity of response to fMRI-guided TMS perturbation of the default mode and dorsal attention networks is correlated with cognition. *Brain Stimulation*, 12: 467. https://doi.org/10.1016/j.brs.2018.12.521

Ozdemir, R. A., **Boucher, P.**, Fried, P. J., Momi, D., Jannati, A., Pascual-Leone, A., Santarnecchi, E., & Shafi, M. M. (2021a). Reproducibility of cortical response modulation induced by intermittent and continuous theta-burst stimulation of the human motor cortex. *Brain Stimulation*, 14: 949–964. https://doi.org/10.1016/j.brs.2021.05.013

Ozdemir, R. A., Tadayon, E., **Boucher, P.**, Momi, D., Karakhanyan, K. A., Fox, M. D., Halko, M. A., Pascual-Leone, A., Shafi, M. M., & Santarnecchi, E. (2020c). Individualized perturbation of the human connectome reveals reproducible biomarkers of network dynamics relevant to cognition. *Proceedings of the National Academy of Sciences*, 117: 8115–8125. https://doi.org/10.1073/pnas.1911240117

Ozdemir, R. A., Tadayon, E., **Boucher, P.**, Sun, H., Momi, D., Ganglberger, W., Westover, M. B., Pascual-Leone, A., Santarnecchi, E., & Shafi, M. M. (2021b). Cortical responses to noninvasive perturbations enable individual brain fingerprinting. *Brain Stimulation*, 14: 391–403. https://doi.org/10.1016/j.brs.2021.02.005

Wammes, J. D., **Boucher, P. O.**, Seli, P., Cheyne, J. A., & Smilek, D. (2016a). Mind wandering during lectures I: Changes in rates across an entire semester. *Scholarship of Teaching and Learning in Psychology*, 2: 13–32. https://doi.org/10.1037/stl0000053

Wammes, J. D., Seli, P., Cheyne, J. A., **Boucher, P. O.**, & Smilek, D. (2016b). Mind wandering during lectures II: Relation to academic performance. *Scholarship of Teaching and Learning in Psychology*, 2: 33–48. https://doi.org/10.1037/stl0000055

Poster presentations

Boucher, P. O., & Itier, R. J. (2014). Modulation of facial expression perception in body context. *Canadian Society for Brain, Behavior, and Cognitive Sciences.*

Boucher, P. O., Ozdemir, R. A., Tadayon, S., Santarnecchi, E., Pascual-Leone, A., & Shafi, M. (2019). Inter individual variability and reliability of cortico-spinal excitability modulation across intermittent, continuous and sham theta burst stimulation in humans. *Society for Neuroscience.*

Manuscripts in preparation

Boucher, P. O., Wang, T., Carceroni, L., Kane, G., Shenoy, K. V., & Chandrasekaran, C. (2022). The initial condition of neural population dynamics predicts RT but not choice during perceptual decisions.