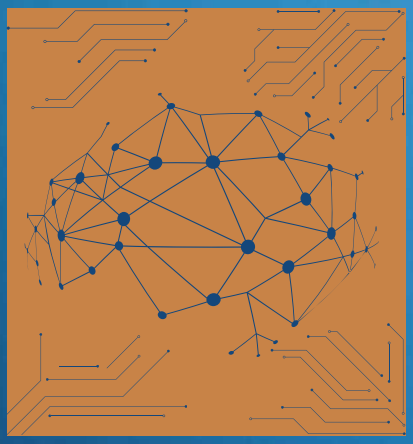
THE BRAIN BLAST

EDITION 4 - ARTIFICIAL INTELLIGENCE

2/1/24
UBC Undergraduate Program in Neuroscience Newsletter

Welcome to the fourth edition of the The Brain Blast! This month we're talking all about artificial intelligence. This edition, we have two computational neuroscience themed interviews, one from Dr. Nicholas Swindale, the instructor for NSCI 303, and one with third year neuroscience student Advitja Hajela talking about his experience working in computational neuroscience.



THIS MONTH'S THEME:
ARTIFICIAL INTELLIGENCE

Be sure to fill out this months AI themed polls, and check out the responses from the last Christmas edition! From the insightful interviews, to research and media highlights, to two AI articles written by your NSCI 302 peers, and more, this newsletter is jam-packed, so go ahead and dig in!

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THIS MONTH IN NSCI 201: FUNDAMENTALS OF BEHAVIOURAL AND COGNITIVE NEUROSCIENCE

This month in NSCI 201, we've had two lectures, one on movement and movement disorders, and one on sleep and circadian rhythms. In our first lecture, Dr. Soma brought in guest speaker Dr. Silke Cresswell to speak about the clinical side of Parkinson's Disease, building upon the learned mechanisms responsible for movement. We took a closer look at the divisions of the motor cortex, acetylcholine signaling, and the lateral and medial corticospinal tracts. In the second lecture, we walked through some of the past research on crickets that established evidence for the idea that we have an internal clock, or circadian rhythm. We then moved onto the different phases of sleep, and the different EEG distinguishable brain waves they generate. In our tutorial, each student has picked out a paper from a behavioral neuroscience researcher here at UBC, to later present an infographic suitable for a general audience.

THIS MONTH IN NSCI 301: NEUROSCIENCE, ETHICS AND SOCIETY

We began the term with a broad introduction to bioethics and neuroethics by Dr. Robillard. The following week we spent some time exploring meaningful patient engagement in neuroscience research, discussing topics like informed consent, data privacy, and the role of industry in neuroscience research. Dr. Reina Nadler gave a very thought provoking guest lecture on the duality of neuroscience and law, where we explored topics like the implication of neurotechnology on law, free will and punishment, and neuroimaging as courtroom evidence. In our tutorial, we took on the perspectives of the jury majority and dissent in a real-world neurolaw case. To finish off the month, our TA Viorica discussed the ethical considerations of cognitive enhancement, where we discussed parallels to the use of performance enhancing drugs in sports in our tutorial.

THE NEURO REVIEW @ UBC

THIS MONTH IN PSYC 371: BEHAVIOURAL NEUROSCIENCE II

Building on what we learned last term, we are finally learning about how the sensory stimuli perceived by our bodies are integrated and modified to produce a motor output. We started off learning about behaviour selection and motor planning by diving into the hierarchy of motor regions in regions in the brain and its parallels to sensory area hierarchies. We took a close look at areas in the frontal lobe like the orbitofrontal cortex, dorsolateral prefrontal cortex, parietal and premotor cortex, and primary motor cortex and how these areas are involved with higher cognitive functions and motor behaviour. We finished off the month with our first test!

THIS MONTH IN BIOL 372: PRINCIPLES OF NEUROBIOLOGY II

To start off BIOL 372, Dr. Gordon gave us an overview of the variety of senses we had, the patterns in which neurons fire and what different patterns of neural firing can indicate. We then focussed on somatosensation, the variety of touch sensations we get and how our touch sensation is patterned onto a somatotopic map. Dr. Gordon gave us an interesting assignment where we had to apply the knowledge we learned in class. This week, we focused on hearing and the variety of structures/mechanisms that are needed to facilitate different frequencies of sound that we hear. To top everything off, we are now learning about how bats are able to 'see' using their ears and their mouth.

Meet: Professor Nicholas Swindale

Professor Swindale is the instructor for one of the new third-year courses, NSCI 303, Foundations to Computational Neuroscience. Read down below to get to know more about Professor Swindale's interests and hobbies!

WHAT MADE YOU WANT TO GO INTO NEUROSCIENCE?

It was many years ago when I was an undergraduate. I was studying physics but had also taken a course in physiology and I became intrigued by the similarity between digital electronic circuits and nerve cells. I also thought it might be smarter to figure out how the thing that was doing physics worked!

WHAT IS YOUR FAVOURITE THING ABOUT COMPUTATION NEUROSCIENCE?

I have to confess I am addicted to programming - I just like getting machines to do interesting things. But being able to explain how things might work is also a strong motivation.

WHAT ADVICE WOULD YOU GIVE TO STUDENTS WHO ARE PURSUING A CAREER IN COMPUTATIONAL NEUROSCIENCE?

Learn as much applied maths and statistics and physics as you can and join a lab with people in it that you like and who do experimental work.

WHAT DO YOU THINK ARE THE KEY CHALLENGES IN COMPUTATIONAL NEUROSCIENCE TODAY, AND HOW DO YOU THINK THEY WILL CHANGE IN THE FUTURE?

Probably the biggest challenge is the difficulty in getting information from the brain - most of it is inaccessible, so for that we need better technology. That seems to be constantly improving but there may be limits. After that is the difficulty of thinking of ideas to test against the data. For that we need creativity. We know that AI can do remarkable things but we don't know if the brain works in a similar way.

OUTSIDE OF NEUROSCIENCE, WHAT ARE SOME THINGS YOU ENJOY?

Music, hiking and, increasingly, finding out more about the various bugs, birds, sea life and plants that surround us in BC.

STUDENT SPOTLIGHT

Featuring: Advitya Hajela

TELL US A LITTLE BIT ABOUT YOURSELF?

My name's Advitya Hajela, and I'm a 3rd year Neuroscience Undergraduate Student, also pursuing a minor in math. I have a strong interest in Computational Neuroscience (hence the math), and I'm hoping to pursue a career in ML in the healthcare industry, prosthetics, and neuro robotics. For the not-so-nerdy part of my personality, I like playing basketball, soccer, tennis, and the guitar!

WHAT ENTICED TO BE A PART OF THE INTERACTIVE MIND AND MOVEMENT (IMM) LAB?

The Work Learn position at the IMM lab first caught my attention as soon as I saw the slightest mention of the use of machine learning with EEGs and one of the few MEG machines available on the West Coast for academic use. I jumped at the opportunity to apply; it seemed like the best place to start for the path that I wanted to pursue. And lo and behold, it was. Dr. Hee-Yeon Im, my PI, further elaborated on what they did in this lab, talking about how we'd dip our feet in social neuro robotics and interpretations of brain signals in response to stimuli, to eventually make predictions on what they're thinking. In essence, mind reading. The lab was, and is, wondrous to be a part of.

WHAT ADVICE WOULD YOU GIVE SOMEONE WHO WANTED TO GET MORE INVOLVED IN THE COMPUTATIONAL ASPECTS OF NEUROSCIENCE?

I think the best advice I can give to start getting involved with computational neuroscience is to start looking to volunteer in computational labs. There's nothing better than getting hands on experience with coding in this department; it's very niche, and you'll develop the necessary, specific skills for the field. Don't even worry about not knowing anything about coding, linear algebra, or even neuroscience and psychology; most Principal Investigators are very helpful and will be patient while teaching you (Dr. Hee-Yeon Im being a prime example)! Before delving deep into the computational aspects of neuroscience though, you should read up on some papers on the topic, even if you don't understand them too well.

WHAT IS SOMETHING YOU LEARNED THROUGHOUT YOUR TIME AT THE IMM LAB THAT YOU HAVE IMPLEMENTED IN YOUR DAY TO DAY LIFE?

The first thing that comes to mind when asked this question is adaptability. You don't stick to one thing in the IMM lab; you gotta learn how to adapt to the task you're given, whether it's coding on Python or MATLAB, participant recruitment and scheduling, or even interpreting behaviour with respect to neuroanatomy. I think being part of this lab has allowed me to learn to be flexible and understand that the number of skills you use for a job aren't static, and there's always a opportunity to learn. Day to day, I make sure that I'm adaptable and open minded towards anything that comes my way, which could be cooking up a storm to make a new curry (ruining my kitchen in the process), or trying out a new instrument. Messing up the kitchen turned out to be great for neuroplasticity, just saying.

WHERE DO YOU SEE THE FUTURE OF COMPUTATIONAL NEUROSCIENCE HEADING?

I've only started to dip my toes in this field, so my understanding of it's future would be a little lacking to say the least. In fact, I think no one can predict the impact of AI on the evolution of computational practices. However, neuroscience professionals are increasingly making a deep impact on the health and lives of many people and by extension making the the world better and safer. As the population continues to age, the demand for neuroscience professionals will grow as this discipline finds immense use in the treatment of age-related disorders like Alzheimer's or other types of dementia. The ongoing research in neural networks combined with robotics is sure to give rich dividends to total amputees, allowing them to live better lives. For example, brain wave based devices are being made for paraplegics and stroke patients that aren't able to move parts of their body, having them be able to use robotic prosthetics by only thinking of moving!

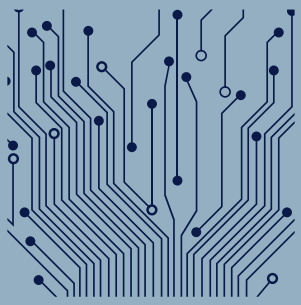
THE BRAIN BLAST

THE IMPLICATIONS OF NEUROSCIENCE DEVELOPED AI

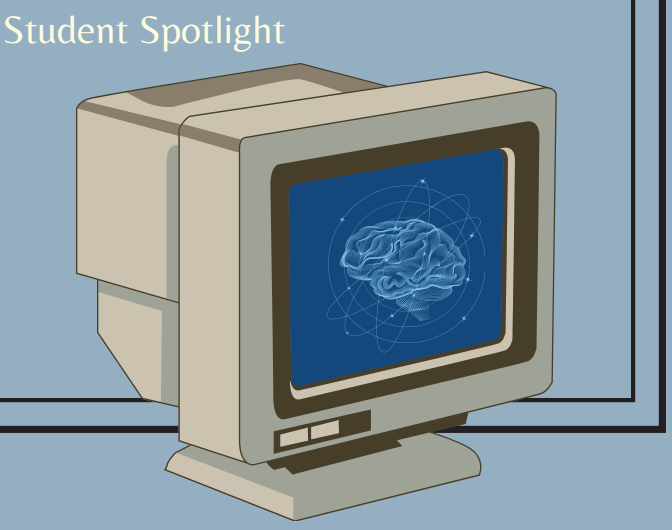
Written by: Georgia Crawford, Editted by Ainsley Needham, Designed by: Ashika Kamboj for NSCI 302

Artificial Intelligence (AI) has transformed society–from optimizing task efficiency to expanding understandings of space. These achievements, however, become lackluster when met with the fear that these machines may replace human careers, or even humans. Given this, I was interested in how neuroscience intersects with AI, specifically, the connectome's role in developing Deep Neural Network models (DNNs). DNNs are a type of computer model trained to mimic human learning through artificial representations of biological neural networks (Sarker, 2021). To examine how this fear of 'human replacement' by AI may transpire, it is crucial to understand how these systems function.

Parallels between the connectome responsible for human behavior and DNNs make us akin to the machines we create. Layers of 'nodes', the AI equivalent of neurons, comprise DNNs (Ullman, 2019). The first network component, the input layer, is responsible for receiving data like how a stimulus activates a neuron (Reyes, 2023). The network computes this data into a signal and transmits it to a deeper layer of the network, connecting nodes (Reyes, 2023). Increased connectional strength corresponds to that signal activating more nodes in corresponding layers. These signals culminate in the final layer to construct an output (Ullman, 2019). After appropriate training, we can use DNNs in image identification, object classification, language translation, and to make medical diagnoses (Ullman, 2019; Makino et al., 2022). Thus, DNNs have potential rewards for humans' development, but we must consider the ethics of machine learning first.



Perceiving DNNs as replicas of the human connectome given their advancements may feel like a fast-approaching reality that needs to be regulated by ethics. These concerns become apparent in Kazuo Ishiguro's contemporary fiction novel, "Klara and the Sun" (Ishiguro, 2021). Ishiguro discusses how AI technology may evolve to mimic human behavior through the relationship of Klara–a solar powered "artificial friend"–with a young girl, Josie, who is ill (Ishiguro, 2021, p.4). Like how we train a DNN, Klara's training allows her to mimic Josie's human qualities to construct a replica of her if she passed. Ishiguro's writing shows the nuances of how humans may use human replication technology to foster the identities of deceased loved ones, what it means to be human and whether machines can impersonate people without becoming them. While DNNs are far off from engaging in consciousness (Ullman, 2019), we have a moral responsibility, as humans experimenting with these technologies, to consider the worth of developing these machines.

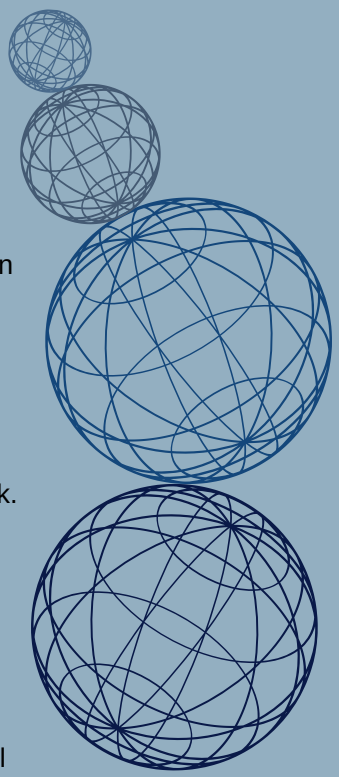


BRAIN-COMPUTER INTERFACES AS THE FUTURE OF SPEECH RESTORATION

Written by: Georgia Crawford, Editted by Ainsley Needham, Designed by: Ashika Kamboj

Humans are the only known species to actively engage in language through exchanges of morphemes, phonemes, syntax, semantics, and pragmatics in communication. Verbal speech enables self-expression, an opportunity to learn and make meaningful connections, and a chance to impart our own unique change on the world. Unfortunately, those who lose their voices to nervous system dysfunction lose this ability. With the emergence of brain-computer interfaces (BCIs) coupled with enriched neuroscience understandings, however, lies the possibility of improving these individuals' lives.

Willett et al. examined BCI implications in restoring speech to an individual (Willett et al., 2023). The study participant exhibited limited control over oral and facial (orofacial) muscles and produced incoherent speech due to a disorder affecting speech efferent neurons in the brainstem (Willett et al., 2023; Green et al., 2013). Willett et al. first had to determine another brain region responsible for producing single sounds, words, and orofacial movements. To test this, they inserted microelectrodes into the ventral premotor cortex (PMv) to measure action potential spikes resulting from speaking certain sounds, words and making orofacial expressions. A computer classification algorithm interpreted these neural signals where it decoded 92% of the orofacial movements correctly, 62% of the phonemes, and the words with 94% accuracy. PMv's relevance to language production led researchers to use this area when developing the BCI.



To create a speech BCI, researchers trained a natural speech decoding device called the recurrent neural network (RNN) to collect neural activity from microelectrodes implanted in the brain resulting from the participant attempting to speak. The RNN reviews the neural inputs repeatedly until it outputs the same words the researchers instructed the participant to speak. After extensive training, the RNN predicted the participant's words from a vocabulary of 125,000 words with only a 23.8% error rate, at the fastest recorded speech BCI rate. Furthermo, the researchers found that the neural activity registered by the RNN matched the order of word articulation by the participant–indicating that participants could communicate sentences of speech through this interface.

Willett et al.'s research is promising. However, the technology is still in its preliminary stages (Willett et al., 2023). While these devices may not be fully functioning at this time, Willett et al.'s findings will inspire development of this technology, making speech restoration a fast-approaching reality.

RESEARCH ARTICLES

Dive into this month's two highlighted research articles covering brain health and the effects of social media.

BRAIN HEALTH CONSEQUENCES OF DIGITAL TECHNOLOGY USE

In an era where technology has encompassed every dimension of our life, it is vital that we consider how it affects our health, particularly the health of the brain. This paper presents evidence on how our increased consumption of technology is impacting our attention, emotional intelligence, social intelligence, social isolation, sleep, brain development, and some of the possible benefits to our brain health. Some of these benefits include, memory ability, multitasking skills, fluid intelligence, reaction time, and more. The study uses a combination of behavioural methods, imaging techniques and review of the literature.

DEBATE: SOCIAL MEDIA CONTENT MODERATION MAY DO MORE HARM THAN GOOD FOR YOUTH MENTAL HEALTH

Published by undergraduate students in the NEST Lab, this article (also highlighted by Dr. Robillard in NSCI 301!) discusses the potential negative consequences of mental health content censorship on social media. Emphasizing the need for evidence-based regulation of social media content, the article outlines how exposure to mental health content can benefit youth mental health by promoting healthy coping strategies, a sense of belonging, and online support resources.

PODCASTS AND MEDIA

STUDY EXPLORES HOW TO MASTER A SKILL YOU'VE ONLY PRACTICED IN YOUR MIND

Is it possible to master a task that you haven't physically performed? A Stanford study published in Neuron reveals the shocking power of mental rehearsal, the act of imagining yourself performing an action to improve its real, physical outcome. The study used intracortical brain computer interfaces to investigate kinesthetic learning and covert rehearsal.

NEUROSCIENCE LABS OF THE MONTH

DR. HEE YEON IM

The Interactive Mind & Movement (IMM) Laboratory seeks to understand the complex relationship between visual perception and goal-directed action. Dr. Im's research explores topics like visuomotor coodrination in different contexts, links between neurodevelopmental disorders and visuomotor abilities in children, and how different parts of the brain coordinate and interact to turn our ever changing perceptions of the world into movement.

DR. IPEK OCUR

Dr. Ipek Ocur works at the NOVA Lab which is focused on advancing the understanding of brain processes regarding visual recognition. These visual health issues are tackled through computational techniques, data science, imaging and artificial intelligence.

EVENTS OF THE MONTH

JANUARY'S NEUROSCIENCE RESEARCH COLLOQUIUM

FEB 2

Dr. Daniela Palombo: Neural Correlates of Emotional Memory: Basic Findings and Implications for PTSD.

Dr. Catharine Winstanley: Applying metabolomics to explore origins of sex differences in risk-taking caused by D2/3 agonists.

Dr. Ipek Oruc: Automated detection of Alzheimer's Disease from retinal fundus images using deep learning.

FEB 9

Dr. Harriet de Wit, University of Chicago

FEB 16

Dr. Emily Liman, University of Southern California

FEB 23

Dr. Ramon Diaz-Arrastia, University of Pennsylvania

NEUROSCIENCE UNDERGRADUATE RESEARCH CONFERENCE ABSTRACT SUBMISSIONS:

DUE DATE:

FEB 12
11:59PM

For more details see:

APPLY

NURC 2024 is in commence! 🧠 If you are an undergraduate who is involved with neuroscientific research, submit your abstract to share your research at UBC's annual Neuroscience Undergraduate Research Conference! ✨

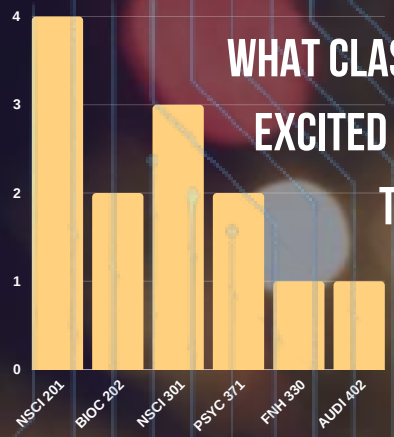
NURC has previously attracted over 200+ attendees and includes keynote speakers and workshops. Presenters will have the option to share their research orally or through a poster on March 23. Submissions will require a fee of $5 (poster) or $10 (oral). Selected applications may also have the chance to publish your work in our new Undergraduate Neuroscience Journal (UNJ). This is a great opportunity to build up your CV and develop your research communication skills!

VOTE IN NEXT MONTH'S POLLS **HERE!!**

FAVOURITE PROFESSOR OF TERM 1?

- GLENN SAMMIS
- ANGIE O'NEIL
- GLEN SAMMIS
- CLAUDIA KREBS
- STEVEN BARNES
- DR. CHEN (BIOL200)

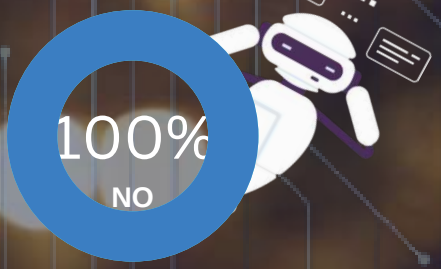
WHAT CLASS ARE YOU MOST EXCITED FOR GOING INTO TERM 2?



WHAT IS SOMETHING YOU WILL MISS FROM TERM 1?

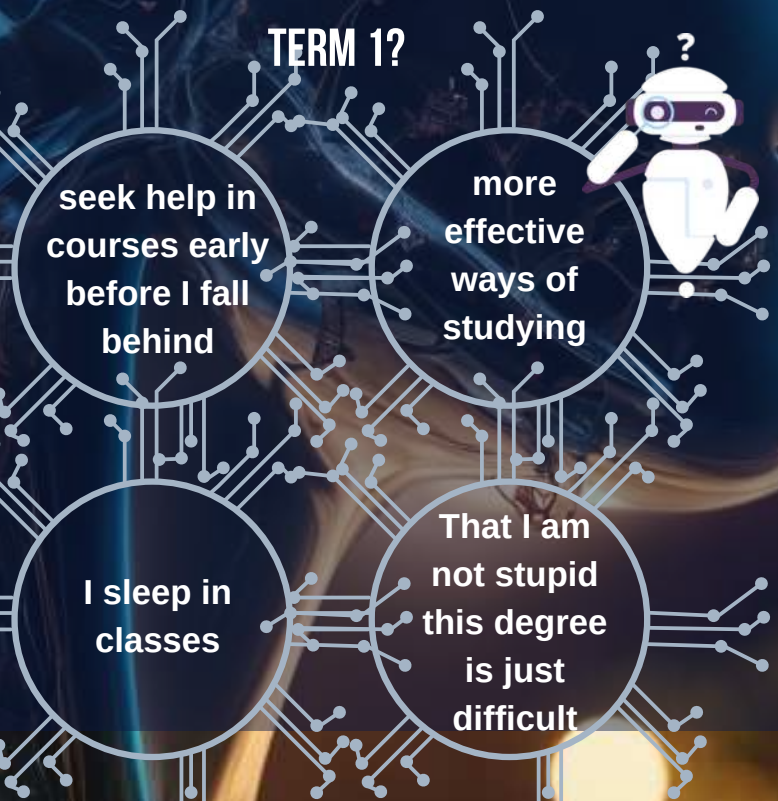
- CHEM 233
- PSYC 277 readings
- Tim and Angie
- my fun classes
- NSCI 311
- Angie

IF AN ARTIFICIAL INTELLIGENCE SYSTEM DISPLAYED SIGNS OF SELF-AWARENESS AND CLAIMED TO HAVE CONSCIOUSNESS, SHOULD IT BE GRANTED RIGHTS SIMILAR TO THOSE OF HUMANS?



RESULTS: DECEMBER STUDENT POLLS

WHAT IS SOMETHING YOU LEARNED ABOUT YOURSELF/REFLECTED ON IN TERM 1?



CLASSIC CHRISTMAS CAROLS OR MODERN CHRISTMAS SONGS?

CRANBERRY SAUCE OR GRAVY?

IF THERE WERE A SAFE AND WIDELY ACCEPTED METHOD TO ENHANCE COGNITIVE ABILITIES, SUCH AS MEMORY AND INTELLIGENCE, WOULD YOU CONSIDER USING IT? WHAT WOULD YOU ENHANCE?

- Hmmm I would consider using it but may avoid doing so due to the potential health side effects.
- Yes, make myself more funny.
- Yes I would, I would enhance memory for sure
- Yes, long term memory
- I would not as I do not trust this technology

UNTIL NEXT TIME!

GET TO KNOW YOUR NEUROSCIENCE PEERS!

fill out our

NEUROSCIENCE STUDENT POLLS

THANKS FOR READING!

Do you have any questions, feedback, or suggestions about the Neuroscience Newsletter or the Neuroscience Program? Want to be featured in the next Neuroscience Newsletter?

LET US KNOW IN THE

NEUROSCIENCE NEWSLETTER FEEDBACK FORM

OFFICE HOURS:
RYAN BOUMA

If you have any program-related questions, please direct them to Ryan, the program advisor at advising@neuro.ubc.ca

RESOURCES:

WELLNESS RESOURCES

SEXUAL ASSAULT RESOURCES

EQUITY/HUMAN RIGHTS RESOURCES

THE NEUROSCIENCE RESEARCH BAY

WRITTEN AND DESIGNED BY

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References