David St-Amand

Duke University

**Statement of purpose**

I’ve always been fascinated about understanding how the brain and mind work. To fulfill this curiosity, I pursued degrees in the fields of psychology and neuroscience. The more I learned about these topics, the more amazed I became at how complex and fascinating the brain is. However, I also learned how distant we are from understanding the computations performed by neural circuitry. While the brain is very intricate and we don’t have general theories of how the brain works, the field of neuroscience is thriving and I believe how the brain solves complex tasks won’t remain a mystery forever. I’m curious to see what such theories will look like, and I want to study theoretical neuroscience so I can help us get there. My PhD will teach me the computational skills I need and help me become a proficient theoretician in neuroscience.

My goal has always been to be a scientist, which is why I’ve dedicated a lot of my academic training into researcher. My first real taste of research was in my third year of undergraduate studies, where I was given the opportunity to be in charge of my own research project. My work afforded me a first-author publication in the Journal of Cognitive Neuroscience titled **“Modulating episodic memory alters risk preference during decision-making”**, where we found that engaging episodic memory processes increased preferences towards risky decisions. This work in cognitive psychology made me realize that my curiosity would be better fulfilled by understanding the brain at the systems level than at the cognitive level. For this reason, I started my Master’s in Curtis Baker’s lab at McGill University, where I used machine learning to predict recorded responses from the primary visual cortex. This research granted me a first-author paper in the Journal of Neuroscience, entitled **“Model-based approach shows ON pathway afferents elicit a transient decrease of V1 responses”**. This project helped me develop my expertise in both visual neuroscience and machine learning. It also made me realize that while I am passionate about vision and systems neuroscience, experimental work is not enough to satisfy my curiosity of how the brain works.

To fulfill this curiosity, I started my PhD in Neurobiology under the supervision of John Pearson at Duke University.

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My master’s thesis, “**Transient inhibition to light explains stronger V1 responses to dark stimuli”**, aimed to study the mechanisms behind stronger responses to dark than light stimuli in the primary visual cortex. We used machine learning to do system identification of recorded V1 neurons. We discover the stronger dark responses found by previous research (Jin et al., 2008; Shapley et al., 2009) to only occur at early latencies, and to be due to slower intracortical inhibition to dark than light stimuli. During this research project, I greatly improved my machine learning skills, learning how to use Tensorflow to build my own custom, biologically-inspired convolutional neural network. I also developed a solid expertise in both visual neuroscience and electrophysiology, on top of learning how to review and understand the literature to relate my results to it. The preprint of this work is currently available as a BioRxiv, and we are working to get it published in a peer-reviewed journal.

During my master’s, I published a paper entitled **“Visual perception of texture regularity: conjoint measurements and a wavelet response-distribution model”** where I created the extension to an advanced statistical method to analyze our experimental data. This psychophysics project studies the effect of jitter, texture size and texture spacing on the regularity perception of stimulus pairs using Maximum-Likelihood Conjoint Measurement (MLCM). While MLCM was previously used to study two variables when comparing stimulus pairs, our study was the first to simultaneously estimate the effect of three different variables. As the group’s statistical expert, I designed a new statistical framework to extend MLCM to test for two and three-way interactions in an experiment with three variables. We found the effect of jitter on regularity perception to be strongest at small element spacing and large texture element size, suggesting the visual system uses the edge-to-edge distance between elements as the basis for regularity judgements. This work was published in PL0S Computational Biology, and received compliments from Kennett Knoblauch, who invented MLCM.

We are rich in knowledge about how neuroplasticity works at the cellular level, but there is still little we understand about how these rules allow neural circuitry to solve complex problems. To make a difference, I want the next step in my research career to be studying computational models of neuroplasticity. An example project I am interested in would be to study how Spike-Timing-Dependent Plasticity (STDP) shapes the receptive field of primary visual cortex neurons. I dream of being given the opportunity to obtain my PhD at Duke University, as it has some of the best researchers in computational neurobiology. This includes Dr. Nicolas Brunel, who does amazing theoretical research on network dynamics and neuroplasticity, and Dr. Gregory Field who does great work at studying the early visual system. I am certain doing research for such supervisors would be both fascinating and propel my research career to the next level.