

The effect of repeated stress on excitatory neurons in the female rat dorsomedial hypothalamus.

Background

Over the past five years, people worldwide have experienced significant stress and uncertainty. In these times, people often turn to comfort foods, potentially as a coping mechanism (Dallman, 2003). Prolonged stress is known to trigger eating disorders (Auger et al., 2023). Davies et al. (2023) found females were at higher risk for pandemic stress-induced binge eating, and females ages 10 to 19 showed the greatest increase in eating disorder related hospitalizations (Auger et al., 2023) during this time.

Sex differences in food intake are also observed in rodent models of emotional stress-induced binge eating. A study by Anversa et al. (2019) found that female rodents with unrestricted food access, and no previous history of food restriction, ate 72% more when subjected to chronic stress than their unstressed controls. This change was not seen in male rodents with the same unrestricted food access (Anversa et al., 2019). Although there is a clear link between stress and appetite in rodents and humans, the mechanisms are poorly understood. The dorsomedial hypothalamic nucleus (DMH) is an ideal brain region to study the link between stress and appetite for two reasons. **1)** cells in the DMH have receptors that allow them to respond to stress hormones (Myers et al., 2014) and **2)** the DMH is very important in appetite and body weight regulation (Bellinger and Bernardis, 2002). The primary objective of our study is to determine the effect of repeated stress on DMH neurons of female rats.

Experimental Design

Once approval from the Mount Allison Animal Care Committee is obtained, female Sprague-Dawley rats will be separated into two groups, **i)** unstressed controls, and **ii)** repeated stress. Groups will have unrestricted food access, and the repeated stress group will undergo five consecutive days of 30-minutes of physical restraint, a well-established stressor (Patchev and Patchev, 2006). In both groups, we will measure food intake and take blood samples to measure levels of corticosterone (the stress hormone in rodents). Following the fifth day, both groups will be anesthetized and euthanized, then their brains will be removed. The brains will be sliced, and their neurons will be kept alive in oxygenated artificial cerebrospinal fluid. Using patch clamp electrophysiology, we will study **i)** the amplitude and frequency of action potentials (to observe the effects of stress on neuron excitability), and **ii)** excitatory and inhibitory currents (to understand how stress affects communication between neurons in the DMH). A total of ~8-10 neurons/group and ~2 neurons/brain will be used for each experiment.

Expected Outcome

The relationship between stress and appetite is complex, with chronic stress both increasing and decreasing food intake in rodents and humans (Torres et al., 2007). Because DMH neurons can stimulate appetite, it is possible that repeated stress will increase their excitability and enhance neuronal communication in a way that could lead to increased food intake.

Impact & Significance

Electrophysiology studies commonly use rats to gain insight into human brain function, but the majority of studies use male rats, despite clear sex differences in stress related changes in appetite. Our research aims to answer the question how does repeated stress in young female rats affect the synaptic transmission of neurons in the DMH that regulate appetite? By addressing this question, we will enhance our understanding of how stress affects neurons that regulate appetite in rats. Given the similarities between the human and rat brain, this research could have important implications for human health.

References

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STATEMENT OF PREPARATION

Relevant Experiences

Physiology and neurology have captivated me since neuropathy (damage or dysfunction of nerves) began impacting my life at 12 years old. In the years since, I have been decoding data from electromyography (EMG: measures the activity of sensory and motor nerves) and reading journal articles to learn about neurotransmitters and how neurons communicate with other cells. I further became interested in how external factors (medication, stress, and appetite) influence this communication. Taking my history into account, it is no surprise that at 17-years-old, I sat in the front row of Dr Crosby's Foundations of Biology (BIOL-1001) lecture where I learned about her research and realized that I wanted to research neurophysiology with Dr Crosby for my eventual Honours project.

My passion for physiology and healthcare is reflected in my work as a MtA student athletic therapist, lifeguard, and first aid instructor. Through these experiences, I have seen first-hand the observable effects of the nervous system, and how it responds to stress, and developed problem solving and communication skills. Through my experience as a peer tutor and teaching assistant for the Biology, Chemistry & Biochemistry, and Math Departments, I have been able to practice laboratory skills and scientific communication. To balance these roles and their responsibilities, I utilize effective organization and time management skills, which will contribute to my success in managing the multifaceted demands of research.

Relevant Courses

My education here at MtA has already prepared me to be successful in my Honours project. In Environmental Physiology & Biochemistry of Animals (BIOL-4201), I learned about adaptations of various systems, including the nervous system, under extreme conditions, and dedicated time both inside and outside of class to analyzing and understanding scientific journal articles. In Enzymology & Metabolism (BIOC-2001) and Protein Biochemistry (BIOC-3521), I practiced a variety of laboratory techniques, such as preparing solutions and assays. In Environmental Microbiology (BIOL-3111), I developed, conducted, and analyzed data for a term project on antibiotic resistant bacteria in Sackville Waterfowl Park. This project allowed me to take the next step in lab work and become more self-directed, independent, and taught me the importance of open research and audit trails. Animal Form and Function (BIOL-2401) taught me about the structure, function, and evolution of the animal nervous system, from sponges to humans, as well as dissection skills I will need for this project. Intro Design & Statistical Analysis (BIOL-2701) taught me how to interpret and apply statistics in biology, and how to use the software I need to analyze data for my Honours thesis.

I am currently taking Human Physiology (BIOL-3211) and Human Anatomy (BIOL-3221), both of which have units focusing on the brain and nervous system, providing a strong foundation on the human brain, which provides the rationale to this research. In Research in Neuroscience (BIOL-4591), an independent study supervised by Dr Crosby focusing on the effects of cold stress on neuronal communication, I have begun learning the laboratory techniques that I will use for my Honours research, and I have already completed the Canadian Council on Animal Care's module as part of Animal Ethics Training at Mount Allison. This independent study will allow me to practice sharing my findings in new formats, such as in a poster during the 2025 Biology Honours Day.

Connection to Long Term Goals

Not only have my experiences and interests led me to this point, but they have allowed me to acquire the skills, background knowledge, and determination I need to be successful in this work. This independent research will be the start of my Honours Bachelor of Science in Biology (to be completed during the 2025 – 2026 academic year), supervised by Dr Crosby, during my fourth and final year. I ultimately plan to become a family medicine physician. My experience with this research and scientific communication will prepare me to be a healthcare provider who will help Canadians manage stress and appetite. I hope to be able to use research that I contribute to, for the benefit of my future patients.

Muzzatti
Surname

Ruby
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Bachelor of Science With Major in Biology
Degree Program

Add. Major(s)

Biochemistry
Minor(s)

Certificates(s)

2025 Jan 31

Date Issued

0291766

Person Id

National Student Id

	Course	Title	Grade	Repeat	Cred Att	Cred Cmpt	Grade Points
Fall Term - 22/FA							
	BIOL-1001	Foundations of Biology	A		3.00	3.00	12.00
	BIOC-1001	Introductory Biochemistry	A+		3.00	3.00	12.90
	CHEM-1001	Introductory Chemistry I	A		3.00	3.00	12.00
	MATH-1151	Applied Calculus	A+		3.00	3.00	12.90
	PSYC-1001	Introduction to Psychology I	A-		3.00	3.00	11.10
22/FA		Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
		0	15	15	60.9	4.1	15
Winter Term - 23/WI							
	BIOL-1501	Cell Biology	A+		3.00	3.00	12.90
	CHEM-1021	Introductory Chemistry II	A+		3.00	3.00	12.90
	PHYS-1041	Physics for the Life Sciences	A		3.00	3.00	12.00
	RELG-1991	Cults and New Relg Movements	A+		3.00	3.00	12.90
23/WI		Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
		0	12	12	50.7	4.2	12
22/SFW		Pass/Fail	Cred Att	Cred Comp	Grade Points	Session GPA	Total Credits
		0	27	27	111.6	4.1	27
Academic Standing at the end of 22/SFW : Dean's List							
Session - 23/SS							
	POLS-1001	Foundations of Politics	A+		3.00	3.00	12.90
	PSYC-2431	Child & Adolescent Dev	A+		3.00	3.00	12.90
	RELG-1641	Religion, the Body, Sexuality	A-		3.00	3.00	11.10
	VMCS-1201	Intro to Visual Culture	A+		3.00	3.00	12.90

	VMCS-2521	Archaeology of Daily Life	A-		3.00	3.00	11.10	
23/SS			Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
			0	15	15	60.9	4.1	15
Fall Term - 23/FA								
	BIOL-2101	Introduction to Ecology	A		3.00	3.00	12.00	
	BIOL-2701	Intro Design & Stat Analysis	A+		3.00	3.00	12.90	
	CHEM-2111	Organic Chemistry I	A+		3.00	3.00	12.90	
	MATH-2211	Discrete Structures	B-		3.00	3.00	8.10	
	WGST-1001	Intro to Women and Gender Stud	A		3.00	3.00	12.00	
23/FA			Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
			0	15	15	57.9	3.9	15
Winter Term - 24/WI								
	BIOL-2201	Form and Function: Microorgani	A+		3.00	3.00	12.90	
	BIOL-2401	Form and Function: Animals	A+		3.00	3.00	12.90	
	BIOL-2811	Genetics and Evolution	A+		3.00	3.00	12.90	
	BIOC-2001	Enzymology and Metabolism	A+		3.00	3.00	12.90	
24/WI			Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
			0	12	12	51.6	4.3	12
23/SFW			Pass/Fail	Cred Att	Cred Comp	Grade Points	Session GPA	Total Credits
			0	42	42	170.4	4.1	42
Academic Standing at the end of 23/SFW : Dean's List								
Fall Term - 24/FA								
	BIOL-3111	Environmental Microbiology	A-		3.00	3.00	11.10	
	BIOL-4201	Enviro. Phys & Bioc of Animals	A+		3.00	3.00	12.90	
	BIOC-3041	Nucleic Acids Biochemistry	A+		3.00	3.00	12.90	
	BIOC-3521	Protein Biochemistry	A+		3.00	3.00	12.90	
	PSYC-1011	Introduction to Psychology II	A+		3.00	3.00	12.90	
24/FA			Pass/Fail	Cred Att	Cred Comp	Grade Points	Term GPA	Total Credits
			0	15	15	62.7	4.2	15
Winter Term - 25/WI								
	BIOL-3031	Molecular Analyses	CIP					
	BIOL-3211	Human Physiology	CIP					
	BIOL-3221	Human Anatomy	CIP					
	BIOL-3991	Oxygen Cascade Biology	CIP					
	BIOL-4951	Research in Neuroscience	CIP					
			Cred	Cred	Grade		Total	

25/WI	Pass/Fail	Att	Comp	Points	Term GPA	Credits
	0	0	0	0.0	0.0	0
24/SFW	Pass/Fail	Cred Att	Cred Comp	Grade Points	Session GPA	Total Credits
	0	15	15	62.7	4.2	15
CUM TOTALS	Pass/Fail	Cred Att	Cred Comp	Grade Points	Cum GPA	Tot Credits
	0	84	84	344.7	4.100	84

P_/CP_ Pass/Conditional Pass first used during COVID 19