

SYNAPSE



PURSUIT OF ACADEMIC EXCELLENCE

We believe the interdisciplinary Neuroscience Center plays a role in fulfilling the vision of **President Spencer W. Kimball**, who in his address titled “**The Second Century of Brigham Young University**” he stated the following:

“... Your interaction of disciplines **across** traditional departmental lines, and the creation of new research institutes here on this campus - all are evidences that the captain and crew are doing much to keep the BYU Vessel seaworthy and sailing. I refer to the **centers** of research that have been established on this campus, ranging from family and language research on through to research on food, agriculture... **Much more needs to be done**, but you must ‘not run faster or labor more than you have strength and means provided’... There must always be a **heavy and primary emphasis on transmitting knowledge** - on the quality of teaching at BYU... Carry these over into BYU’s second century!”

“We must be patient, however, in this effort, because just as the city of Enoch took decades to reach its pinnacle of performance in what the Lord described as occurring ‘in process of time,’ **so the quest for excellence at BYU must also occur ‘in process of time.’**”

2024

SYNAPSE

BYU Neuroscience



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Welcome to our newest members of the Neuroscience Faculty



TRACE STAY



SETH TAYLOR



PRESTON
MANWARING

Thank you to our retiring Neuroscience Faculty
for all your contributions, support,
and dedication to our Neuroscience students.



MONA HOPKINS

FOR THOSE AT HIGH RISK, PTSD MAY BE TREATABLE BEFORE TRAUMATIC EVENTS EVEN OCCUR

BY CHRISTIE ALLEN; BYU BA 2008, BYU MS 2010

When people experience trauma, medication can help prevent or reduce post-traumatic stress disorder, softening overly strong memories that cause debilitating flashbacks and nightmares. But this treatment works only if the pills are taken promptly after a traumatic experience.

New BYU research published in the [International Journal of Molecular Sciences](#) shows the potential for an improved method that could block PTSD-strength memories from forming to begin with.

“We were really curious about whether some of those drugs used to reverse PTSD could be given to people we know have high risks — such as first responders or people in the military — before they experience stress, to prevent some of the cellular-level brain changes that are damaging in PTSD,” said BYU neuroscience professor Jeff Edwards, who led the study. Edwards first became interested in studying PTSD when his barber, a Vietnam War veteran, described going to a war movie and finding himself standing in the theater shouting, experiencing combat all over again.

To see if PTSD pretreatment is worth pursuing in human trials, Edwards and his team used rats for a proof of concept. The researchers first injected some of the rats with propranolol and mifepristone, the drugs commonly used to treat PTSD retroactively. They then generated PTSD-inducing chronic and acute stress by exposing the rats to constant light for two weeks and subjecting them to “social defeat,” periodically introducing a dominant rat into the space to frighten the rat subjects.

A week later, they tested the rats for anxious behavior and then examined the amygdala and hippocampus, the areas associated with emotion and memory, in each rat’s brain. They were looking for how stress affected the degree of long-term potentiation (LTP) — the strengthening of synapses or junctions between neurons that facilitates memory formation. The higher the LTP, the stronger the memory; excessively high LTP would indicate a PTSD-like effect.

As expected, rats undergoing stress without drug pretreatment showed huge increases in LTP, a 30–40% enhancement. But the rats treated with the drugs before undergoing social defeat had the same levels of LTP as the control group rats that didn’t undergo any stress.

“The drugs brought the brain back to normal levels, how it should be working in memory formation, eliminating some of those maladaptive memories that create overly strong recall,” Edwards said.

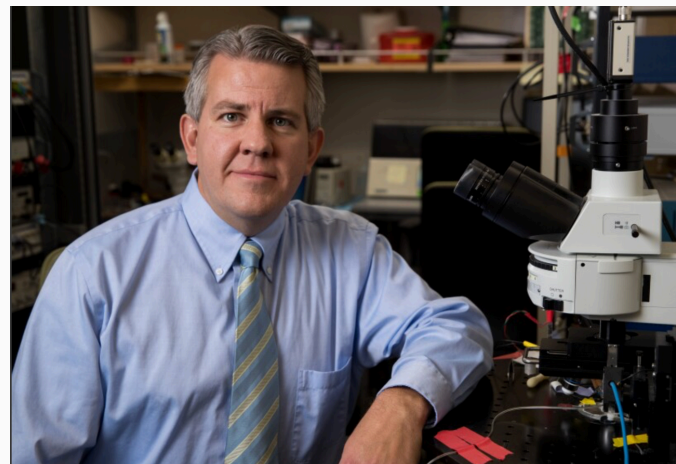
The scientists also found that the pretreated rats’ stress receptors were normal after experiencing trauma, while the stress receptors of the rats that didn’t receive treatment were 80% less functional.

“Preventative treatment strategies like this are often much more effective,” said Eric Winzenried, who worked on the project as a BYU undergraduate and is now a neuroscience Ph.D. student at Washington State University. “You can think of the adage, ‘An ounce of prevention is worth a pound of cure.’ Although our work is very preliminary and in rodents, it is a piece in the puzzle that we hope will lead to better treatments for the prevention of PTSD in high-risk individuals.”

The next steps before a human trial include developing a more fine-grained understanding of how the medications work to reduce PTSD-like effects in the rats. For example, the researchers may try giving the rats either propranolol or mifepristone instead of both, to see if just one will suffice.

As they work toward broader applications, doing proof-of-concept studies is giving BYU students valuable research experiences. “At BYU, I was surrounded by faculty members and classmates who pushed and inspired me to fulfill my potential as a scientist,” said Anna Everett, who participated in the research as an undergraduate and is now pursuing a neuroscience Ph.D. at Harvard.

“I think BYU creates a unique environment where undergraduates can really learn the ropes of research, which often involves a lot of time and failures,” Winzenried added. “Many larger research institutions allow undergraduates to perform research, but it is an afterthought in their programs. At BYU, there is a deliberate emphasis on mentored undergraduate research that I believe has allowed me and many others to build the toolkit necessary to succeed in graduate school.”



EXPLORING THE MIND: BRYNLEE CARDALL'S LITERATURE REVIEW ON THE CONNECTION BETWEEN DEPRESSION AND ADDICTION

BY PARKER SMITH; BYU BA 2025

This semester's author highlight is Brynlee Cardall (NEURO, 25), who compiled a literature review titled "Addiction's Sister, Depression: How Stress Impacts Reward Learning in Depression." The paper provides insights into how addiction and depression share similar neural response mechanics, and how an understanding of these systems could provide relief for those afflicted with depression.

Cardall first got interested in this research when she read about a relationship between addiction and stress; she then started thinking about how stress impacts depressive episodes. After parsing through various secondary research, Cardall realized depression and addiction share similar mechanisms: depression's circuitry centers around receptors responding to serotonin, while addiction's focuses on receptors responding to dopamine.

Cardall also discovered via her research a potential link for depression to an area of the brain called the habenula. The habenula interprets reward signals, anxiety, and stress, which all impact depressive symptoms. The habenula is also close to the pineal gland, and both regions are active during meditative practices. Meditation helps regulate the number of serotonin receptors in the brain and can help combat depression. Cardall wants to add to existing research on how the habenula impacts depression to find if depression is not a serotonin issue, but rather a circuitry or reward learning issue. Proving this theory could change a reliance on medication to treat depression.



In her career, Cardall not only wants to continue to look into the causes and neural links to depression, but also wants to conduct research to help those with autism. She is currently considering neuropsychiatry and autism studies for her master's degree. She worked at an autism unit where she coached and helped patients with behavior and connection. She wants to understand autism's biological basis and end reliance on Pavlovian systems of encouragement to help people on the autism spectrum.

As she has worked at BYU, Cardall has found that she has "an inner drive, like an inner fight that when something is hard I push back even stronger." She continues with how she has used this inner drive to help with her research, "there's a lot I don't understand, and there's a lot that makes me feel very small. Getting that fire and drive to work even harder and try to understand these huge concepts has given me a greater sense of purpose." In addition to her publication in *Chiasm*, Cardall also presented at the Snowbird neuroscience conference. The conference featured undergraduate research in labs across the state of Utah. Cardall presented research from her time in Dr. Parrish's lab studying depolarization in zebrafish (depolarization is similar to migraines).

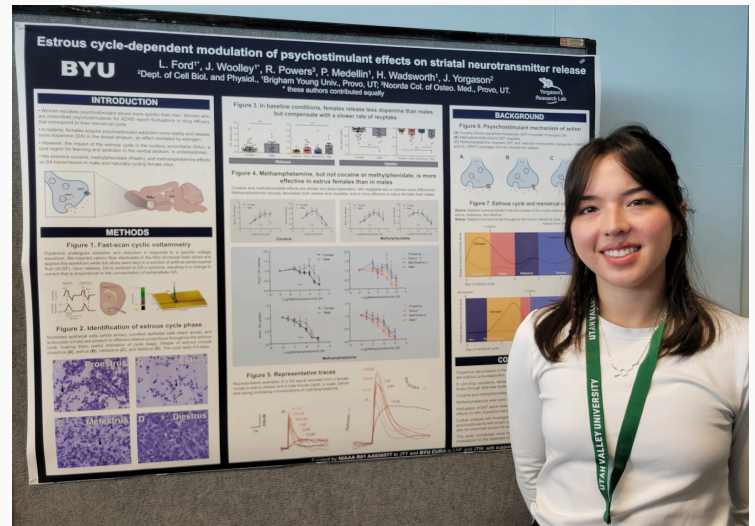
Outside of neuroscience, Cardall enjoys playing tennis, hiking, rock climbing, painting, and learning languages (she is fluent in Slovak and Czech, but is also learning American Sign Language, Spanish, and Russian). This upcoming summer break Cardall will return to the Czech Republic to teach psychology in a local school.

In her own personal battle with depression, Cardall has found comfort in the gospel of Jesus Christ. "I feel I had a testimony before all of this struggle, but I really didn't have a connection with Christ. I'm getting to know Him in a more personal way," she says. "That's where the Atonement actually applies to me, where it's not repentance, but it's that He experienced everything that I experience."

UTAH CONFERENCE ON UNDERGRADUATE RESEARCH

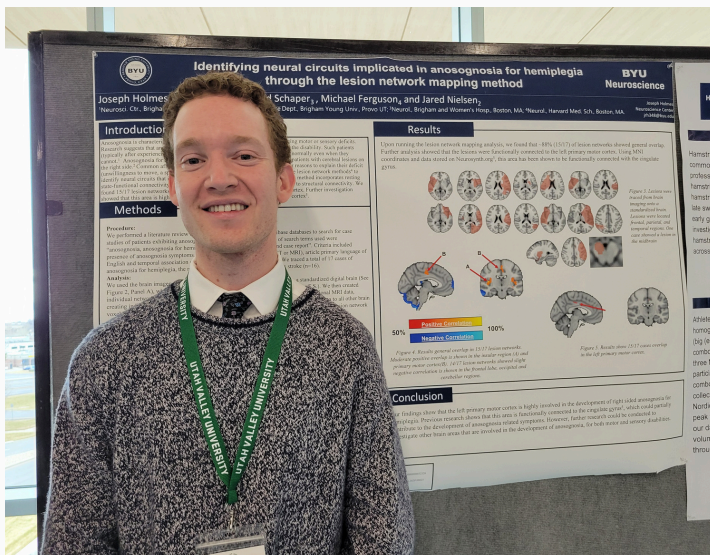
Lauren Ford

Women prescribed psychostimulants like amphetamine (Adderall) and methylphenidate (Ritalin) for ADHD have self-reported fluctuations in drug efficacy that correspond to their menstrual cycle. In addition, abuse of other psychostimulants such as cocaine and methamphetamine tends to escalate more quickly in women than in men. In rodents, females similarly experience a stronger behavioral response to psychostimulants than males; this effect has been linked to changes in striatal dopamine (DA) transmission due to the presence of female sex hormones estrogen and progesterone. However, the specific regions within the striatum involved in this effect have not been clearly identified, and it is unknown how DA transmission fluctuates across the endogenous estrous cycle—nor whether different psychostimulants produce varying effects. We thus utilized fast-scan cyclic voltammetry to characterize the effects of three different psychostimulants across the estrous cycle in the core of the nucleus accumbens (NAc), a key region for DA-mediated learning and reward. From our data, I discovered that methamphetamine-induced DA release in the NAc fluctuates distinctly with the estrous cycle and peaks when estrogen levels are at their highest. In contrast, cocaine and methylphenidate effects were minimally sex- or cycle-dependent, suggesting that their observed behavioral sex differences are driven by other regions of the brain. I also found that females and males maintain similar baseline DA levels but do so through different regulatory strategies, which likely contributes to overall sex differences in drug susceptibility. Taken together, this work refines our understanding of DA transmission in females and has broad implications for the treatment of ADHD and psychostimulant abuse in women.



Joseph Holmes

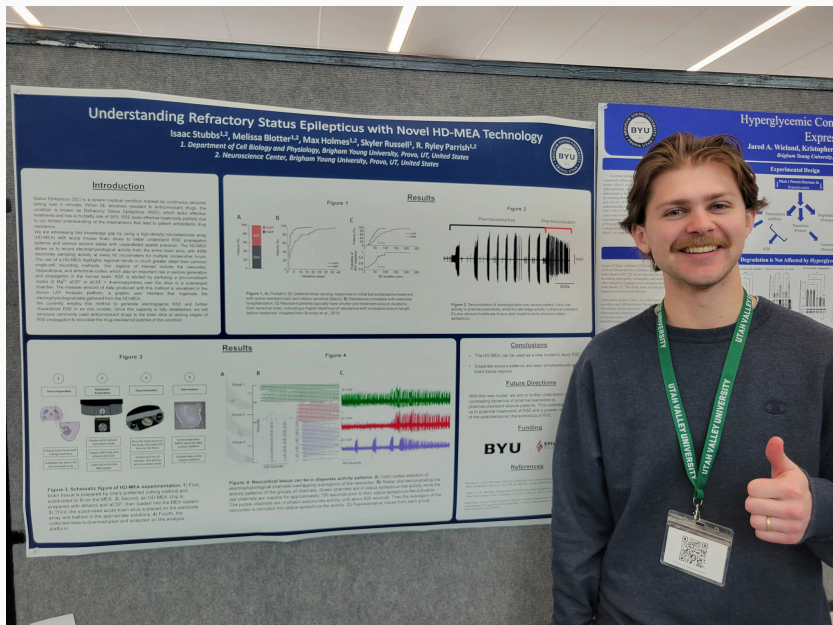
My project was titled: "Identifying neural circuits implicated in anosognosia for hemiplegia through the lesion network mapping method." I am part of Dr. Jared Nielsen's Lesion Network Mapping team. Students on this team pick neurological disorders/diseases that develop from a stroke. I choose the disorder "anosognosia for hemiplegia," which is characterized by a patient's inability to comprehend that they are experiencing hemiplegia. I researched case studies that have documented this disorder and aggregated around 49 from the databases PubMed and PsychInfo. 32 studies were removed from consideration due to missing scans, missing information, etc. The 17 cases that were kept were analyzed and the lesions were traced using a brain imaging software called 3D Slicer. The tracings were then compiled and analyzed using other software to identify overlapping lesion networks--areas that are functionally connected to the same lesion network. We found that there was overlap in 15/17 lesion networks in the primary motor cortex. Using Neurosynth.org, we found this brain region to be functionally connected to the cingulate gyrus, which could play a role in the development of the symptoms of anosognosia. However, further research should be conducted to identify other brain regions that contribute to anosognosia.





Justin Webb

Understanding the mechanisms underlying depotentiation in the context of previously induced long-term potentiation (LTP) is crucial for unraveling the processes of memory consolidation and forgetting. Our research is focused on synaptic plasticity in the hippocampus, the primary brain region responsible for mediating learning and memory. Using electrophysiology and neuropharmacological techniques, our goal is to elucidate the cellular mechanisms behind depotentiation, a reversal of the increase in postsynaptic response and overall synaptic strength characteristic of LTP. By doing this research, we hope to both fill existing gaps and resolve conflicting views about the processes and receptors involved in depotentiation. Experiments were performed on hippocampal brain slices of young mice. We induced LTP in hippocampal CA1 neurons using high-frequency electrical stimulation, and then elicited depotentiation in the same neurons via low-frequency electrical stimulation. This creates a cellular event analogous to learning and subsequently forgetting a new memory trace. Our preliminary findings show that depotentiation still occurs in the presence of MPEP, a metabotropic glutamate receptor (mGluR5) antagonist, suggesting that the depotentiation mechanism is independent of mGluR5. Additionally, because female rodent models have largely been ignored in prior electrophysiology experiments involving LTP and depotentiation, we investigated and observed gender-related differences, which show female mice exhibiting more pronounced depotentiation than their male counterparts, particularly later in development. Building on these findings, our research will continue to identify gender-related differences in both juvenile and adolescent mice, as well as explore the role of NMDA receptors on depotentiation. This research aims to shed light on the intricate mechanisms of synaptic plasticity and its implications for learning, memory, and potential therapeutic modulation of these processes in the context of conditions like Alzheimer's disease, post-traumatic stress disorder (PTSD), and other disorders of learning and memory.

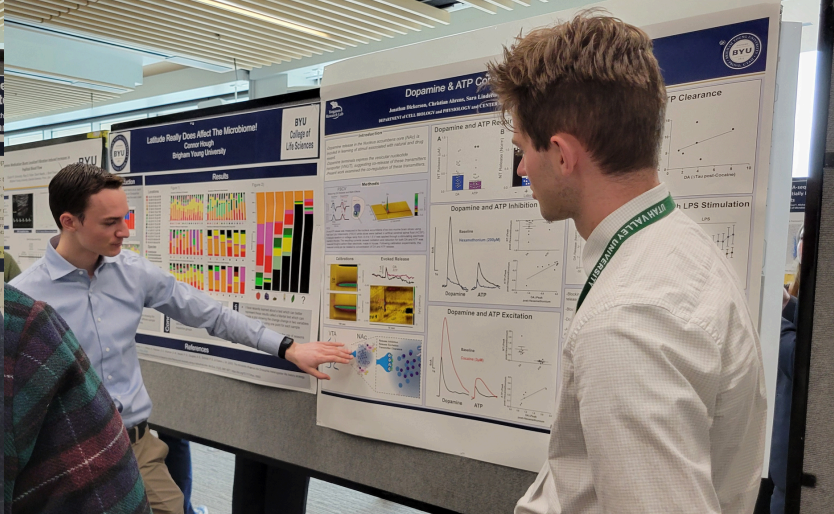
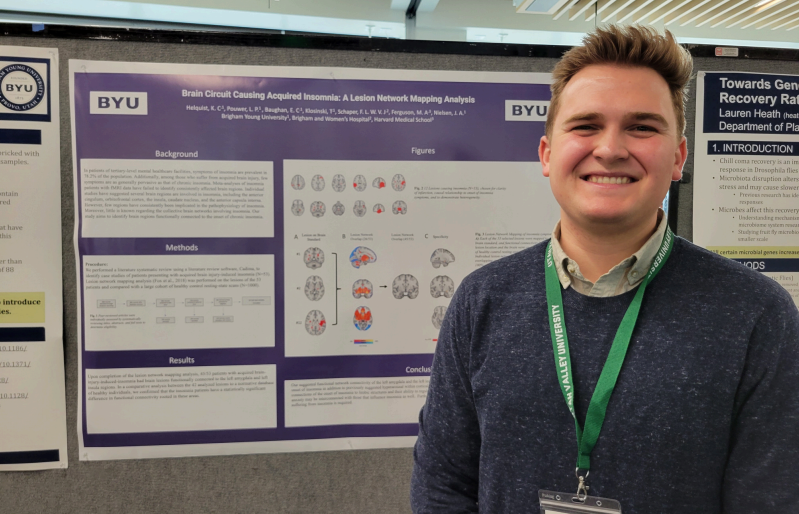
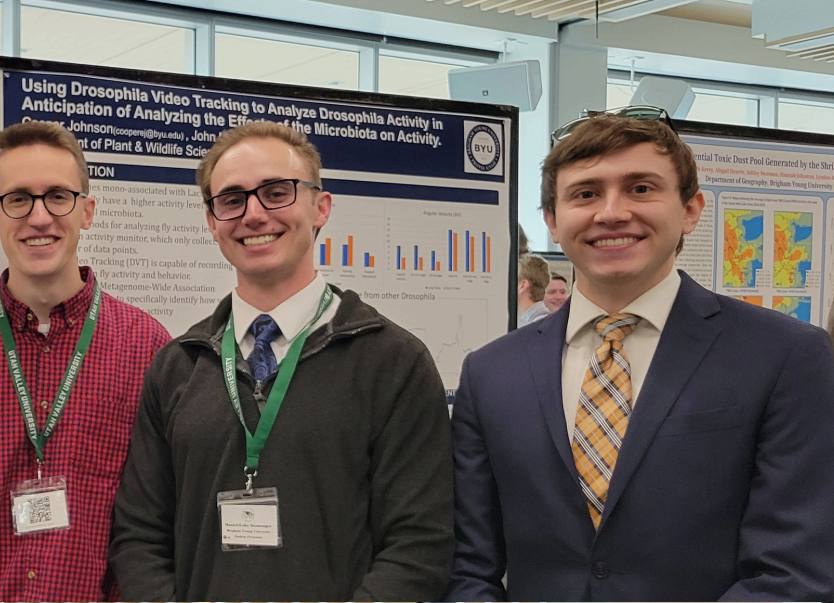
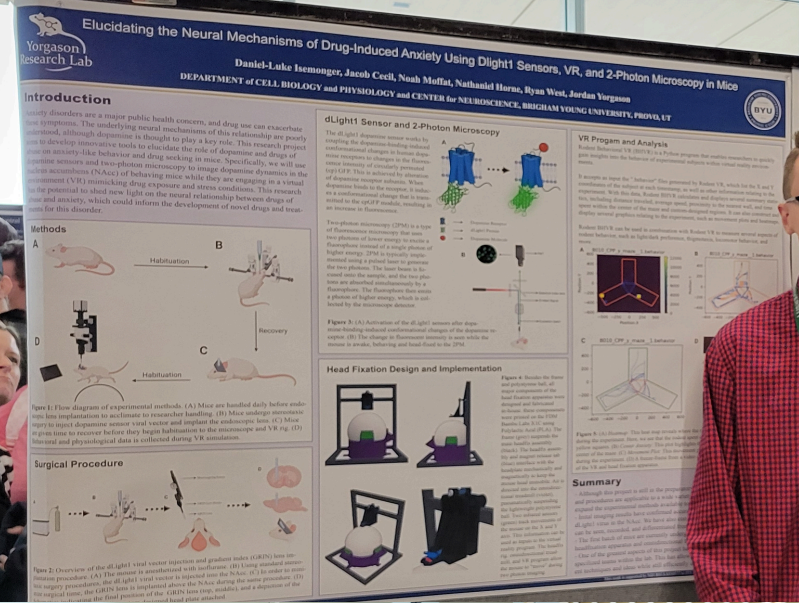
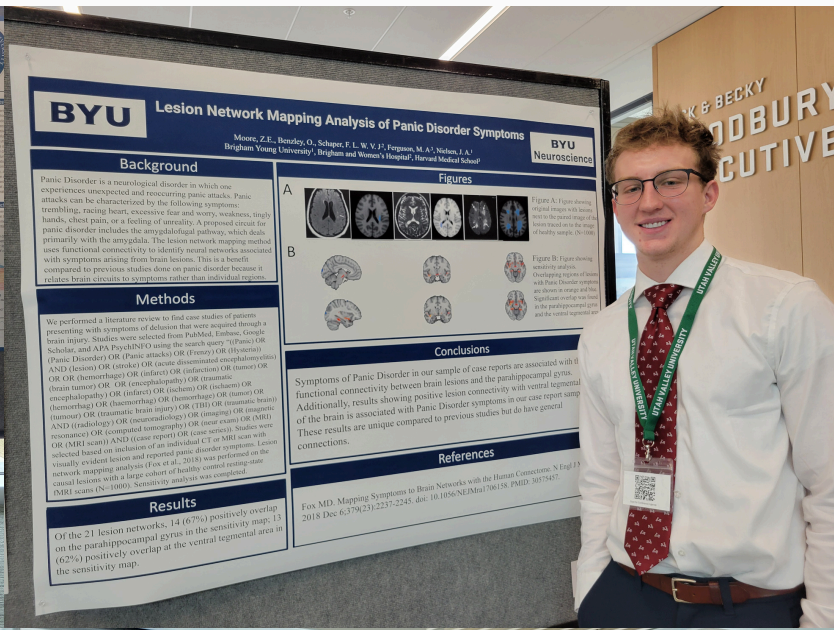
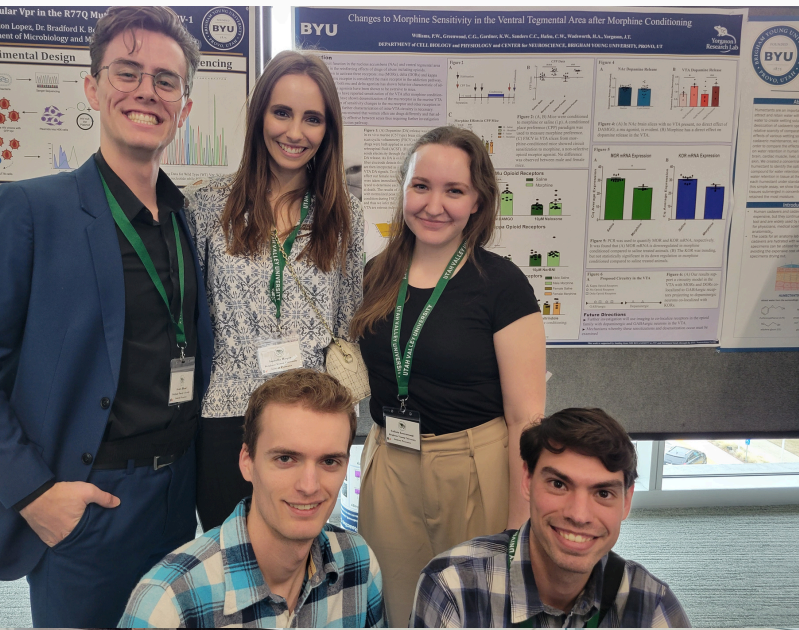


Isaac Stubbs

This research poster displays novel data related to refractory status epilepticus, a clinical seizure condition characterized by 5 minutes or longer of continuous epileptic activity and drug resistance, and the methods used to obtain such data. We employ a high-density microelectrode array to capture electrical activity from acute mouse brain slices with a high degree of spatial resolution. Past experiments with this method have revealed an interesting spatiotemporal dynamic during which different brain regions experience disparate electrical activity patterns simultaneously. In the future, we plan to characterize this unique dynamic with more experiments, see how it responds to antiepileptic drugs, and implement potentially therapeutic treatments on our model.

Isaac also participated in the BYU College of Life Sciences Undergraduate Poster Session and won 3rd place for his Oral Presentation.

UTAH CONFERENCE ON UNDERGRADUATE RESEARCH



Neuroscience 3 Minute Thesis Competition Winner

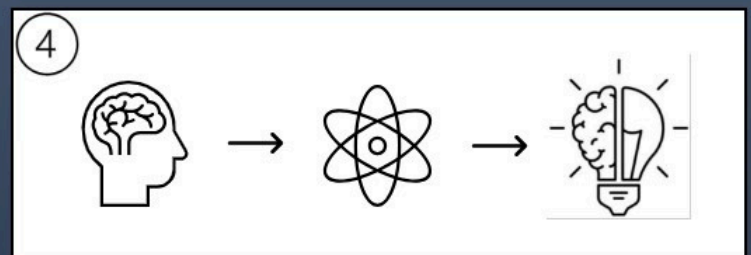
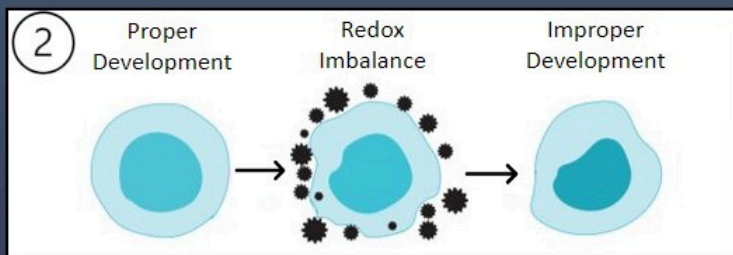
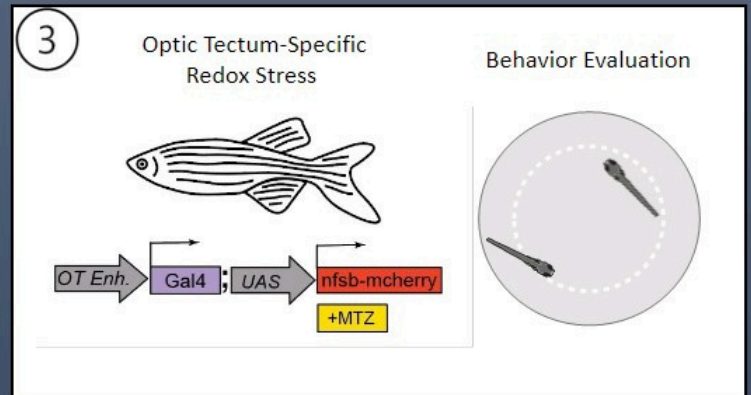
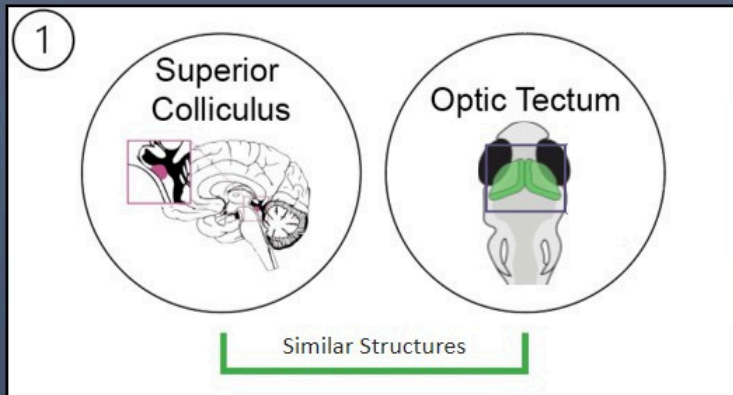
The 3 Minute Thesis (3MT) competition challenges graduate students to present their research in just three minutes using only one slide. Participants must distill complex ideas into clear, engaging presentations accessible to an intelligent non-specialist audience. Kevin Gray represented Neuroscience at the College of Life Sciences competition, where he won 2nd place! Here is a synopsis of his research:

“Arguably our most remarkable tool, the human brain allows us to interact with our world and respond to it appropriately. My research focuses on understanding the human superior colliculus, which is deep within our brains, by studying its zebrafish counterpart, the optic tectum. These structures are vital for sensory processing and coordinating certain behaviors, such as reflexes and directing attention. By exploring their development and mediated behaviors, particularly through the lens of changing redox states, I am to uncover their role in neurological disorders such as autism spectrum disorder. This research holds promise to advance our understanding of such disorders and developing more effective treatment strategies.”

-KEVIN GRAY



The Effects of Redox Changes on Optic Tectum Development and Behavior



RAWLINSON SCHOLARSHIP RECIPIENTS



Hillary Wadsworth

As a fourth-year Neuroscience Graduate student, I've greatly benefited from the Rawlinson Family scholarship award. Being the youngest of eight siblings, all of whom attended Brigham Young University, my passion for fitness and academics has always been evident through my dedication to conducting research on the immune system's molecular impacts on motivation. With aspirations to become a professor and establish my own laboratory, I've been actively involved in teaching neuroscience laboratory classes for undergraduates and spearheading various research projects. This scholarship has provided me with essential financial support during a challenging period, allowing me to focus more on my studies and attend scientific conferences to enhance my presentation and networking skills. I'm sincerely grateful for the Rawlinson Family's generosity and the opportunity to advance my educational and professional pursuits with their support.



Michael Von Gunten

I'm immensely grateful for the scholarship as it is far more than just financial support. It's a validation of my chosen path and a boost to my determination to excel academically. With recent family changes, such as my wife pausing her work after having our new baby, this scholarship has alleviated a significant amount of stress. Currently, I'm immersed in my PhD studies in neuroscience, particularly focusing on opioid addiction's effects on the brain and potential treatments. This scholarship is crucial in furthering this research and my ambition to become a researching professor. It not only eases the financial strain of graduate school but also reinforces my commitment to making a positive impact in academia and society. Despite challenges, this scholarship motivates me to persist in my efforts to combat opioid addiction through research. I'm dedicated to making the most of this opportunity, fueled by gratitude for the belief placed in me and a desire to give back to the community in the future, just as generously as I've been supported.



Jared McFarlane

Having obtained IRB approval over the summer for my research project, I'm thrilled to begin data collection this year. My dissertation project aims to explore the correlation between social media usage patterns and attention span and memory retention. I believe these findings will offer valuable insights for individuals navigating their interactions with social media platforms. The financial assistance provided by this award has been invaluable, particularly amidst the challenges my family faced with medical bills and other expenses this past year. Your generosity has not only lightened this financial burden but also inspired me to pay it forward in supporting future students. Thank you for this opportunity to pursue my academic and research endeavors with greater ease and focus.



Suehelen Garcia

I am currently embarking on my journey in the BYU Neuroscience Master's Program. I'm driven to further my education, aspiring towards either a PhD program or medical school. This scholarship is instrumental in easing financial burdens. In Dr. Arminda Suli's lab, where I've been researching multisensory integrating neurons in larval zebrafish for about a year, I've found immense fulfillment. Being a first-generation college graduate and the first in my family to pursue graduate studies, I see this scholarship not only as a personal support but also as a beacon of hope for my younger family members, inspiring them to dream big and pursue higher education. This scholarship underscores the accessibility and possibility of higher education, not just for me but for generations to come. Thank you profoundly for your support and generosity; it means the world to me.



SHIN SCHOLARSHIP



The Samuel Injae Shin fellowship was established to honor the memory of Samuel Shin, who graduated with bachelor and master degrees in Neuroscience from BYU, but died tragically in a climbing accident in 2016. The Samuel Injae Shin Scholarship is a way to continue his legacy of life-long learning in neuroscience.

RECIPIENTS

Elijah Davis
Zach Fiore
Michael Forvil
Kase Haas
Chase Seiter

Jeong Woo Kim
Afton Beard
Zana Taylor
Haley Benson
Jared Wieland

Erika Blaine
Kiziah Pugmire
Tabitha Teny
Andrew Mills
Talon Anderson





CONTRIBUTE TO THE NEUROSCIENCE ENDOWMENT FUND

Imagine getting to help BYU Neuroscience students achieve their educational goals and learn through experience. By donating to the Neuroscience Endowment Fund, we are able to provide funding for scholarships, internships, and experiential learning experiences.

All funds go directly to our students. We are asking for your help as we cannot do this without you. Please join us in supporting students in their neuroscience education.

If you wish to donate, please scan the QR code below.

INSTRUCTIONS

- Search: "Select other funds" box and choose "BYU" under "Other Funds"
- Scroll down to "Neuroscience Annual Fund" and hit "Select" (this will add the Neuroscience Fund Option)
- Enter an amount and then scroll down to the Frequency and Method of Payment sections
- In the section "Add Comment or Memoriam Information," select the "Comments or instructions" box and enter the Neuroscience Endowment Fund to which you would like to donate

We want to thank you for all your generous donations that have changed the lives of so many students and families. We could not do it without you!



"I'm dedicated to making the most of this opportunity, fueled by gratitude for the belief placed in me and a desire to give back to the community in the future, just as generously as I've been supported."

MICHAEL VON GUNTEN



2024 NEUROSCIENCE ART CONTEST WINNERS



1st Place “Synaptic Drift” by Emily Wilde

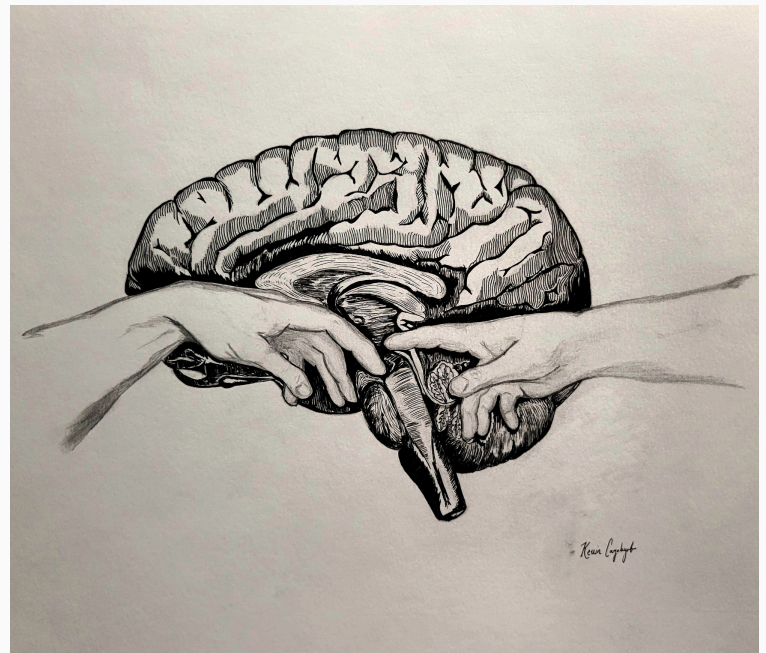
Medium: Embroidery on canvas with watercolor

This piece depicts a dandelion where the tufts are neurons. The number of neurons (and brain cells in general) that we get in life is limited. This is a commentary on the beautiful fragility that exists in life. Our time on earth is limited, and we need to make the best of it. The goal isn't to keep the flower together, but to spread the seeds in meaningful ways. Our neurons will die anyway, so we need to make the most of our fleeting time.

2nd Place “Veni Creator, Anima” by Kevin Cayabyab

Medium: Pencil & ink on paper

The concept of a cerebral soul calls my attention to Michaelangelo fresca, “The Creation of Adam.” There we see God imparting unto Adam life (soul) which is what I tried to capture by focusing on their hands. Doctrine and Covenants 11:13 says, “... I will impart unto you my spirit, which shall enlighten your mind, which shall fill your soul with joy.” The brain is the receptacle of thoughts and inspiration and as such cannot be separated from the creator which animates it.



2024 NEUROSCIENCE ART CONTEST WINNERS



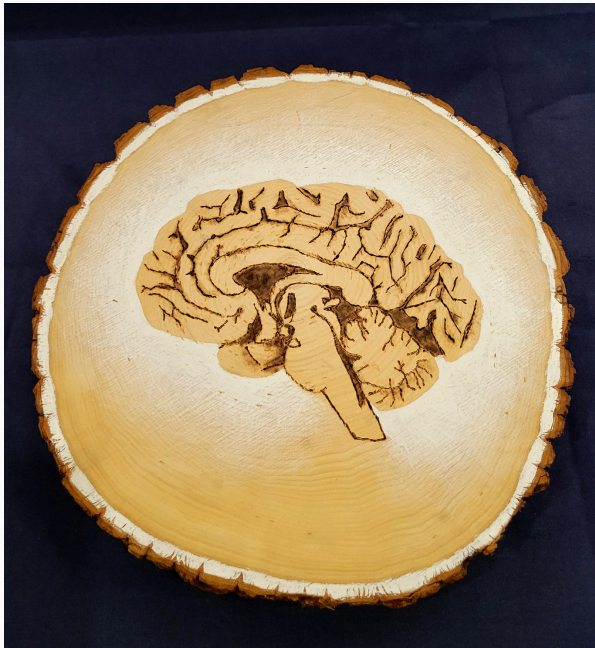
3rd Place

“Conscious Convergence” by Olivia Hansen

Medium: Digital

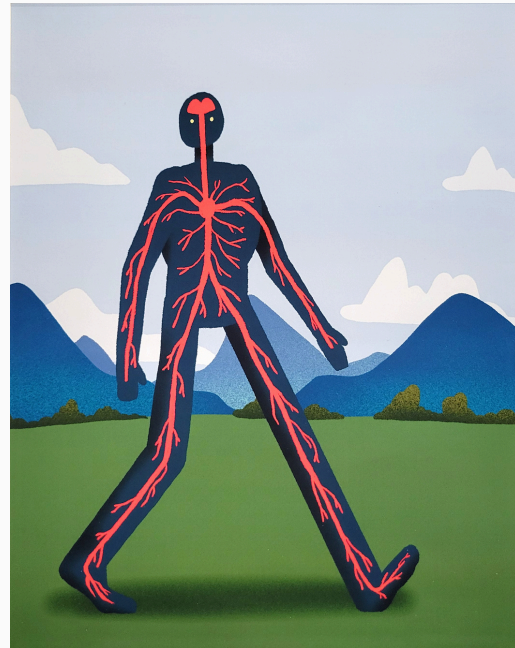
This artwork portrays the brain as a bridge between physical and spiritual realms, acknowledging that while the science behind the connection of brain and soul may remain elusive, its significance is undeniable. Butterflies symbolize transformation and new beginnings and are included to show the miraculous transition between merely existing as with a physical body and truly living as a conscious individual. Their presence conveys the intertwining of mind, body, and soul, reflecting on the profound unity and birth and inevitable separation at death.

Honorable Mentions



“The Soul of Life” by Jase Wanlass

Medium: Wood burning & Colored pencil



“Walking” by Julian “Beck” Seamons

Medium: Digital



THANK A PROFESSOR

To Mike Brown:

Professor Brown is incredible! He had time for everyone and gave the best explanations. He is everything I hoped from a BYU professor: the best teacher for classes and also strengthened my relationship with God.

From Alexa Larsen



To Rebekka Matheson:

It is so hard to articulate how much you have impacted my testimony, future career, and life. I am closer to God because of your example, and more compassionate because of your classes and wisdom! Thank you for everything!

From Alexa Larsen

To Rebekka Matheson:

Thanks for applying neurobiology to help me believe more in myself and worry less about my imperfections!

From Anonymous

To Rebekka Matheson:

She was always student-focused in her approach to her classes and the way that she taught the material. She created an environment in her classroom that allowed for each of us to find our own intrinsic motivation and seek out learning while treating us with respect and working with us as adults. She was always receptive to questions and concerns and was willing to help in any way that she could.

From Garrett Vickery

To Jeff Edwards:

Thanks for teaching us that excellence is more about keep trying and not so much about performing flawlessly.

From Anonymous

