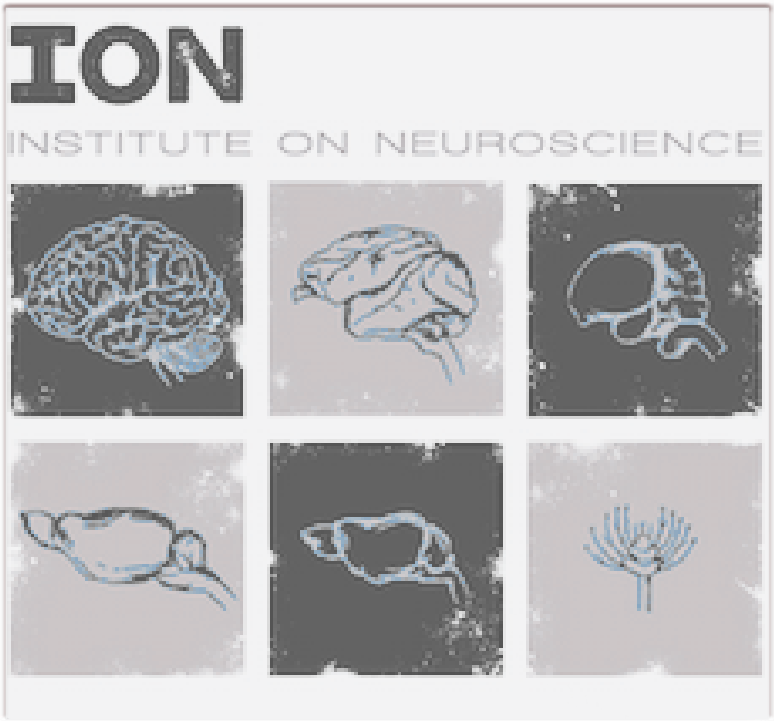
2024

Institute on Neuroscience (ION) Research Symposium

Wednesday, August 7, 2024, 5:30 pm - 9:00 pm
Georgia State University, Atlanta Campus
Student Center East
Speaker's Auditorium


ION
INSTITUTE ON NEUROSCIENCE

Schedule

OPENING REMARKS | 5:30 PM

Erica Tracey, PhD - ION Co-Director

SESSION ONE | ION INTERNS

Brianna Cobb
Jaywon “Daniel” Jang
Shivangi Panda
Brent Henry
Elizabeth Plis
Pragnya Kamalapuri

BREAK WITH REFRESHMENTS | 7:00 PM

KEYNOTE ADDRESS | 7:15 PM

Debra Bangasser, PhD

SESSION TWO | ION INTERNS

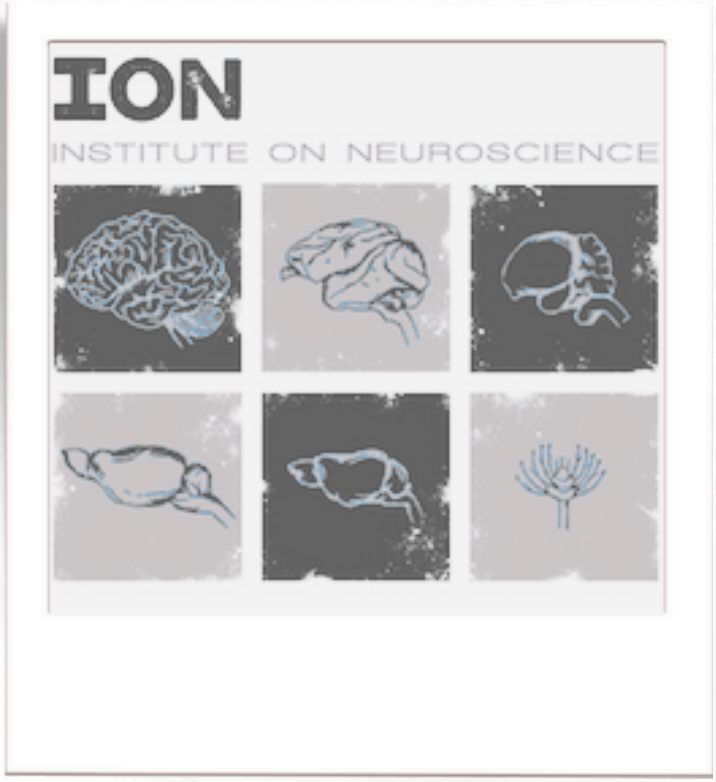
Madison Lee
Jaide Venzen
Ayesha Hanifa
Sydney Apraku
Gabriella Salandy
Camille Hardy

CLOSING REMARKS | 8:50 PM

Kierra McInnis - AEOP Outreach Specialist
Kyle Frantz, PhD - ION Director

Program Summary

ION is a ten-week summer program for outstanding high school students. The aim of the program is to develop skills in problem-solving, critical thinking, hypothesis formation, laboratory experimentation, and scientific communication. The program combines a formal workshop series with a laboratory apprenticeship. ION interns are initially immersed in an intense basic neuroscience curriculum, which is enhanced by hands-on demonstrations and intern-guided discussions. Subsequently, interns are mentored in active university research laboratories where they engage in authentic and exciting experimentation. Intermittent workshops on special topics in neuroscience, scientific ethics, STEM career pathways, science writing, and oral presentation strategies familiarize interns with opportunities and expertise for academic and professional advancement in the scientific community. The program culminates in a Summer Research Symposium and additional venues to disseminate research outcomes.



2024 Interns

Brianna Cobb

Kell High School, Marietta, GA

Brianna Cobb is a rising senior at Carlton J. Kell High School. She is an active National Honor Society inductee and the inaugural and long-standing President of Pre-Med Club where she has led several mock labs, suture practices, surgical techniques and research amongst her fellow peers that are also interested in pursuing science/medical field. She is also Vice President of Black Student Union. This allows her to love and appreciate her culture while educating others about it through projects and community service.

She serves as the secretary of National Social Studies Honor Society, member of Kell Asian American and Student Allies Club, 2023 Women's Basketball AAAAA State Champion, Member of Delta GEMS and 2024 Debutante sponsored by the Marietta Roswell Alumnae Chapter of Delta Sigma Theta Sorority, Inc., member of DECA, member of Kells Angels: a community service-based organization at Kell High School, and member of LinkedUp Church. Brianna aspires to embark upon new and forward-thinking research in neuroscience with the goal of answering her many curiosities when discovering the intricate functions of the brain and its extensive abilities. She is ecstatic that ION gave her the incredible opportunity to join its esteemed program this summer at Georgia State University.

Cymbalyuk Lab

Dynamics of Episodic Bursting

B. Cobb, G. Cymbalyuk

Episodic bursting is a phenomenon where trains of rapid bursts are followed by periods of silence in an episodic fashion. The change in parameters of the system is what causes transition between different dynamic behaviors and could be explained by the bifurcation theory. Characterized by three voltage-gated currents (sodium, non-inactivating potassium, and hyperpolarization-activated currents), a Hodgkin-Huxley style neuronal model serves as the foundation for understanding neuronal dynamics. Critical parameters influencing this model are the negatives of the half-activation values of K+ current (θK2) and hyperpolarization-activated current (θh), which control burst duration (BD) and interburst interval (IBI), respectively. This study aims to investigate whether it is possible to develop 2D models implementing a spike generating mechanism complementing the 4D model representing a pattern generating mechanism and effectively stack them into a single model. Using computational software, MATLAB, we identified the parameters θh and θK2, utilizing a map of activity regimes to narrow down the domain of interest. We implemented equations representing the activations of fast potassium current (IK) and fast sodium current (INa). We hypothesize that the 2D model will introduce a spike generating mechanism allowing us to test for effects induced by overlaying spike generating mechanisms on the pattern generating mechanism described by non-local saddle-node bifurcations for stationary states and periodic orbits. This research contributes to the understanding of neuronal dynamics underlying episodic bursting regimes.

Jaywon “Daniel” Jang

East Coweta High School, Sharpsburg, GA

Daniel Jang is a rising senior at East Coweta High School who is passionate about STEM, especially neuroscience and aspires to pursue a career in the medical field. In school, he is involved in the STEM Academy, Debate Club, Math Club, Science Olympiad, Beta Club, National Honor Society, and the varsity Swim Team. There, he holds leadership roles that allow him to foster collaboration and achieve results through effective communication and decision-making, thus honing his leadership skills. He has served as an officer in the STEM Academy for three years (two years as Webmaster and one as Class Representative), founder and president of the Debate Club, an officer in the Math Club, and a Junior Marshall. Outside of school, he is a member of the Emory Math Club. Additionally, he has received awards in his journey to enhance his STEM skills, winning 1st place in the KSEA NMC math competition 2023, 2nd place in the KSEA NMC math competition 2024, 2-time 2nd place in the MAPP math competition, 4th place in regional Science Olympiad competition (Forensics) and qualified for entry to NMSP from PSAT NMSQT. Aside from academic pursuits, he also serves as the vice president for his church’s Youth Council, a Praise Team member, and is a part of the Mission Team overseas where he had the chance to go to the Dominican Republic to help displaced Haitian refugees in need. Daniel’s interest in neuroscience was sparked by personal experiences, notably his family’s medical history and the vivid insights from Dr. Jill B. Taylor’s book, My Stroke of Insight. Through the research program, he aims to take a step closer to his goal of helping individuals overcome brain anomalies while honing his expertise in neuroscience. He has been very enthusiastic about the ION program.

Shi and Xue Lab

The Pollutant 2-Naphthol, a Low-Molecular-Weight Polycyclic Aromatic Hydrocarbon, Promotes Lipid Accumulation in White Adipocytes Through Aryl Hydrocarbon Receptor

J. Jang, Z. Liu, J. Jing, J. Chen, T. Cao, Z. Ding, B. Xue, H. Shi.

Obesity is a pressing worldwide epidemic that has more than tripled in rates in the last 50 years. A study released by The Lancet establishes that, in 2022, more than 1 billion people in the world were living with obesity, with increasing rates. 2-naphthol is a low-molecular-weight (LMW) polycyclic aromatic hydrocarbon (PAH) and air pollutants associated with childhood obesity. We have previously shown that 2-naphthol promotes lipid accumulation in 3T3-L1 white adipocytes(fat cells). However, the mechanism mediating 2-naphthol's effects is ambiguous. It was reported that the ligand-activated transcriptional factor aryl hydrocarbon receptor (AHR) mediates some of the impact of PAH. Thus, to further study mechanisms mediating 2-naphthol's effects on adipocyte lipid accumulation, we have utilized a gene silencing approach to knock-down AHR in 3T3-L1 white adipocytes and further treated cells with or without 2-naphthol. We found that 3T3-L1 adipocytes treated with 2-naphthol accumulated significantly more lipids than cells treated with vehicles, similar to our previous observations. However, in 3T3-L1 adipocytes with AHR knock-down, 2-naphthol's effects on lipid accumulation were attenuated. In conclusion, our data suggest that 2-naphthol stimulates lipid accumulation in 3T3-L1 white adipocytes, and this effect is primarily mediated through the ligand-activated transcriptional factor AHR.

Shivangi Panda

Lambert High School, Suwanee, GA

Shivangi is a rising senior at Lambert High School with a 4.35 GPA. She is an active participant of FBLA, Speech & Debate (Varsity PF Debater), Human Rights Campaign (President), VT Seva (Vice President), The Writer's Block (Poet), and Data Science Initiative (Data Ethics Officer). Shivangi enjoys challenging herself in academics, volunteering, activism, and various extracurriculars. She has achieved 1st place twice and 2nd place once at national and international debate competitions. As officer of 3 clubs, she has plenty of leadership experience and takes pride in helping people accomplish their goals. In her role of presidency in HRC, she has held workshops for countless activism events, including sending handwritten letters to US and Local Representatives. Shivangi has even been recognized by teachers for her passion and dedication to advocating for human rights.

Shivangi has spent 300+ hours volunteering over the last 2 years with VT Seva, being awarded with 3 Presidential Service Awards. She has led projects in healthcare ranging from creating/shipping food bags for CHOA to making and donating masks to Atlanta hospitals. She is semi-fluent in Spanish and fluent in English and Odia. Shivangi is also an active member of National Honor Society, Mu Alpha Theta, and Spanish Honor Society. Shivangi's interest in neuroscience first sparked as a child, where she always wondered how such a small brain could handle so many human behaviors. Her curiosity only strengthened in high school when she took AP Biology and AP Psychology, providing her with a solid foundation in science. She has taken this summer opportunity to apply her academic science knowledge and expand her skills in a laboratory setting with this research program, making valuable contributions to the field of neuroscience.

Kumar Lab

Modulation of GAPDH Expression and phenotypic alteration of neuronal cells by all trans retinoic acid

S. Panda, A. Newman, M. Kumar

Neuroblastoma is a highly resistant and aggressive form of cancer in need of treatments. It was discovered that SK-N-SH cells can act as a model for neuroblastoma treatment with retinoic acid. The SK-N-SH cell line is a neuroblastoma cell line isolated in 1970. Like all cells, it contains the housekeeping gene: Glyceraldehyde-3-Phosphate Dehydrogenase (GAPDH). We quantified GAPDH by quantitative Reverse Transcriptase Polymerase Chain Reaction (RT-qPCR). RT-qPCR is a molecular biology technique used to transcribe cDNA from an RNA template. The process uses a special enzyme, Reverse Transcriptase, to convert RNA to cDNA. To perform this technique, we lysed cells, extracted RNA with the Qiagen RNA plus kit, and produced cDNA with a cDNA synthesis kit. Our cDNA transcript permits us to quantify the amount of a particular gene via qPCR. Knowing that the cell line responds to all trans retinoic acid (ATRA) by expressing a neurite phenotype, we treated SK-N-SH cells with ATRA for 24h, 48h, 72h, and 96h time points; then, we recorded cell changes by imaging. ATRA acts by binding to Retinoic Acid Receptor (RAR). After ATRA and RAR bind, it moves to Retinoic Acid response elements (RARE) in the nucleus. This results in ROR1 receptor production and stimulation of the Wnt5a/Synaptophysin pathway to induce neurite maturation and differentiation. Despite the discovery of RA driven differentiation, cancers often become resistant to RA treatment. Future directions will seek to eliminate this resistance.

Brent Henry

Paulding Country High School, Dallas, GA

Brent Henry graduated from Paulding County High School where he attended the Academy of Science, Research, and Medicine provided there. At his school, Brent participated in a multitude of clubs, including the Science National Honors Society, Beta Club, Black Student Union, and National Honors Society. Through the National Honors Society, Beta Club, and Academy of Science, Research, and Medicine, Brent was able to volunteer for his school and around the community. Brent played for the school's varsity tennis team, and his team was awarded Regions Runner-up in 2024. They made it to state two years consecutively, and he consistently played tennis outside of school with his teammates.

While in high school, Brent took 11 AP classes and four dual enrollment classes through Chattahoochee Technical College. He had a 4.0 GPA and completed the biotechnology and digital technology pathways, even earning the HTML and CSS, Premiere Pro, and Biotechnician Assistant (BACE) Certificates. Brent also received a University of Georgia Certificate of Merit for academic excellence and performing in the top 5% of his class. While attending the Academy of Science, Research, and Medicine, Brent designed and conducted research projects using the labs at his school. He helped research the bird species in his area by placing bird boxes around campus and collecting data from captured birds. He also cultivated and maintained the school courtyard with a group of like-minded peers. Brent has been accepted into the Georgia Institute of Technology to study computer engineering and gain valuable knowledge and connections. Brent is grateful for his selection as an ION Scholar and has been excited about the professional experience that neuroscience research provides.

Mabb Lab

How brain activity is expressed in the dorsal CA1 region of the hippocampus using G-CatchER+ in Arc-WT mice

B. Henry, B. Parra, A. Mabb

In humans, spatial reversal learning decline is linked to age-related deficits in the hippocampus. To understand the CA1 region in spatial reversal learning deficits, we used GCaMP6f, a genetically encoded calcium indicator, to detect neural activity in the cytoplasm of hippocampal neurons. While effective at indicating calcium in the hippocampus, GCaMP6f does not indicate calcium in the endoplasmic reticulum (ER). This is important because of the complex networks at dendritic branch points and how they are vital in releasing calcium within neurons. G-CatchER+ allows us to measure activity in the CA1 region of the hippocampus by indicating the calcium flow from the ER of neurons. Understanding how neural mechanics occur during learning reveals how calcium levels in the ER affect spatial reversal learning. Specifically, we want to observe activity in the CA1 to look at its role in neurons in spatial reversal learning. Since G-CatchER+ indicates calcium directly in the ER, it allows for increased fluorescence and accuracy during behavior compared to GCaMP6f. Based on previous studies showing increased calcium release and decreased spatial strategy use in ArcKR mice (a breed where the protein Arc is prevented from ubiquitination), I hypothesize that due to the learning deficits compared to Arc-WT mice (a breed containing a wild-type version of the Arc protein that is naturally occurring), there is a correlation between ER and behavioral strategy usage. We surgically injected six Arc-WT mice with G-CatchER+, then sectioned their brains to image them to determine if there was expression. We found GCatchER+ had expression in the dorsal CA1 region, similar to GCaMP6f. We wanted to confirm the expression of GCatcher+ for future projects as a fluorescent tool to look at hippocampal activity during the Barnes maze. G-CatchER+ will provide insight into mechanics taking place in the hippocampus during spatial reversal learning.

Elizabeth Plis

Dunwoody High School, Dunwoody, GA

Elizabeth Plis is a rising senior at Dunwoody High School. Elizabeth enjoys studying science and learning more about how things work. She is interested in neuroscience and how the brain handles tasks like solving complex math problems or switching between languages in bilingual individuals. She has taken various advanced STEM courses, as well as other AP classes, involving advanced math and hands-on work like growing bacterial colonies and building a hydraulic robotic arm. In addition to her interest in science, Elizabeth enjoys playing piano, reading, and making art using digital and traditional mediums. She has been interested in how her talents can be applied to neuroscience in areas such as digital brain imaging and molecular neuroscience. In the future she is committed to pursuing a career in a STEM field, although she's still exploring what specific path to take.

Murphy Lab

Role of oxytocin in the immune response following early life pain in adult male and female rats

E. Plis, M. Gomez, R. Bond, and A. Z. Murphy

The majority of premature infants are admitted to the Neonatal Intensive Care Unit (NICU), where they experience upwards of 15 painful procedures each day. Routine procedures such as heel lances, IV placement, intubation, and gastric suctioning are often done without the benefits of anesthetics or analgesics. Previous studies in our lab have shown that early life pain (ELP) affects the response to pain and stress later in life, and alters the febrile response to an immune challenge. Oxytocin (OT) is a hypothalamic nonapeptide with hormone and neurotransmitter properties produced primarily in the paraventricular nucleus (PVN) and supraoptic nucleus (SON). In addition to its well-characterized role in reproduction, OT has also been shown to have anti-inflammatory and antioxidant properties. In this study, we investigated the role of OT in the PVN and SON brain regions of ELP rats after lipopolysaccharide (LPS) induced fever. Male and female rats were exposed to a short-term inflammatory insult induced by intraplantar administration of 1% carrageenan on the day of birth (P0). In adulthood (P60-P90), LPS was injected to elicit an immune response and rats were sacrificed 2 hours later. The tissue samples were processed via immunohistochemistry to label OT-producing cells. OT cell counts and mean gray value was evaluated to determine if ELP impacted the number of cells expressing OT in response to LPS. We hypothesize that ELP rats launch a greater immune response following LPS than no pain controls, resulting in fewer OT cells. These results will provide the foundation for future investigations on how early life pain affects the production of OT in response to immune challenges.

Pragnya Kamalapuri

West Forsyth High School, Cumming, GA

Pragnya graduated from West Forsyth High School and will be attending the University of Georgia in the fall of 2024 to major in Biochemistry and Molecular Biology. She was the team captain for her school's Science Olympiad team and earned several medals in events such as Chemistry Lab (3rd place), Environmental Chemistry (2nd place), and Cell Biology (3rd place) at the regional level. She was also the secretary in her school's Science National Honors Society where she coordinated science awareness events and lectures. She also took AP courses in Psychology, Biology, Chemistry, Human Anatomy and Physiology, Physics, and Calculus. She was awarded the certificate of honors by her school in Honors Chemistry, AP Chemistry, Computer Science, and in Web Development. As the head choreographer of her school's dance club, she created performances that provided a fusion of Bollywood and Hip Hop. She also took part in the Science Fair exploring the impact of Vitamin K on Alzheimer's Disease. Her extreme involvement in her school's science department allowed her to be recognized as the Icon of the Month. Having volunteered at the Grady Hospital in the summer of 2023, Pragnya hopes to be a part of the medical field and pursue neurology and oncology.

The effects of sex chromosome complement on novel object location memory and open field locomotor activity in the rat Sry-TG model”

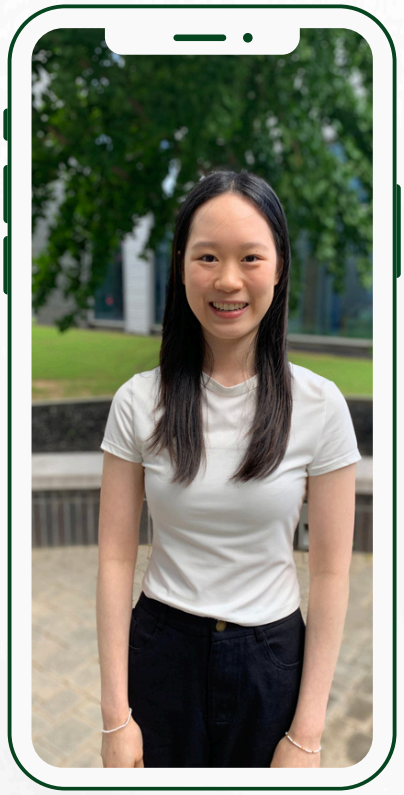
P. Kamalapuri, E. P. Harris, X. Yang, A. P. Arnold, D. A. Bangasser

Gonadal sex hormones affect spatial memory, however, the role of sex chromosomes (XX vs. XY) is not yet clear on spatial memory. Therefore, we used the transgenic rat model, based on the “Four Core Genotypes” mouse model, to disentangle the effects of sex chromosomes vs. gonadal sex hormones. In this model, the XY male rats have the testes-determining genetic factor, Sry, inserted as a transgene. Breeding them with the wildtype XX females produces wildtype XY male offspring, wildtype XX female offspring, and SryTG+ XX rats with male gonads. We placed the rats of each genotype in an arena and allowed them to habituate for 5 minutes. Then, 2 objects were placed in the arena for a novel object location test. The rats were observed for 5 minutes each for a familarization trial and a novel trial where one of the objects was moved to a new location. It is known that rats have a preference for novelty-paired environments, so they should spend more time investigating the novel object. However, none of the genotypes were able to discern between the novel and familiar object locations. This indicates that our behavior test needs troubleshooting so the rats can develop spatial memory. Fine-tuning this behavior test will allow us to understand the different roles gonadal sex hormones and sex chromosomes play in spatial memory.

Madison Lee

North Gwinnett High School, Suwanee, GA

Madison Lee is a rising senior at North Gwinnett High School. Her curiosity for neuroscience was sparked by her journey of lowering her cholesterol and her passion for personal health. By changing her diet she experienced herself the effects external factors can have on the brain's cognitive efficiency. In addition to tracking the trends in her cholesterol through a self-built data visualization she also likes to research methods to improve hair and skin problems (including washing her hair with beer or rice water) then record the results and progress. For her, it's fun to explore and learn how seemingly disparate subjects actually intertwine and influence each other. At school Madison is involved in Beta Club, National Honor Society, and Girls Who Code Club. She has been a club officer for Girls Who Code for 2 consecutive years, first Public Relations Officer and is currently the President. Currently, one of her goals is to explore her interest in the different subject areas in healthcare which might help her decide a career path for the future. She has been very enthusiastic to learn more about neuroscience and contribute to important research in this field.



Krause and de Kloet Lab

Investigating the pattern of activation of angiotensin type 2 receptor expressing neurons in the anterior cingulate cortex during thirst in mice.

M. Lee, F.E. Mowry, K. Elsaafien, A.D. de Kloet, E.G.Krause

The anterior cingulate cortex (ACC) has recently emerged as a cortical structure involved in thirst sensation. However, the underlying neural mechanisms are not well understood. This study investigates the pattern of activation of angiotensin type 2 receptor (AT2R) expressing ACC neurons during dehydration and rehydration in transgenic mice expressing an inducible AT2R green fluorescent protein (AT2R-eGFP). Animals were divided into three groups: a control group that was offered access to water (Euhydrated+Water Access), a dehydrated group with access to water (Dehydrated+Water Access), and a dehydrated group that was denied access to water (Dehydrated+NO Water Access). Fixed brains from transcardially perfused (4%PFA) mice were sectioned and processed for c-Fos immunohistochemistry, an indirect marker of neuronal activation. Sections were then imaged on a laser-scanning confocal microscope and c-Fos immunofluorescence (IF) was quantified using FIJI. Dehydrated mice had significantly higher activation of AT2R-expressing neurons in the ACC compared to the control group, with those given access to water exhibiting the highest level of activation. This indicates that AT2R-expressing neurons in the ACC are sensitive to both dehydration and rehydration. Furthermore, these results suggest a role for the ACC in thirst sensation and fluid homeostasis through neurons expressing AT2R. Understanding the neuronal mechanisms underlying thirst is essential for developing therapeutics that target disorders of fluid homeostasis, such as dehydration and polydipsia.

Jaide Venzen

Marietta High School, Marietta, GA

Jaide Venzen is a rising senior at Marietta High School in Marietta, Georgia. She takes a mixture of AP and IB classes and is involved in Student Council, National Honor Society, and National Art Honor Society. Jaide actively participates in her district's theater programs as a sound designer for both her high school and her district's elementary and middle schools. Jaide has also been active in her school's HOSA chapter for two years; she attended last year's Student Leadership Conference and won second place in the forensic science category. She plans to attend ILC this summer. Her passion for neuroscience began as a kid and has been further cultivated through her healthcare science pathway classes, hospital volunteer experience, and her personal experience with ADHD and depression. Jaide hopes the ION internship will equip her with the skills and resources for a lifetime of helping others understand their mental and physical health.

Krause and de Kloet Lab

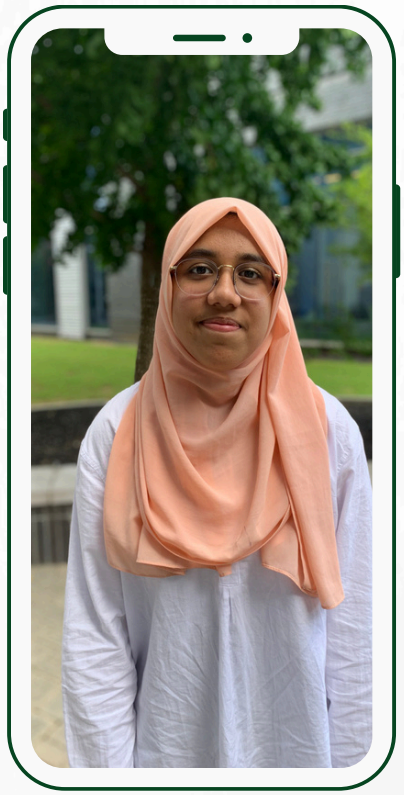
Interrogating the balance between excitation and inhibition in the anterior cingulate cortex during thirst in mice

J. Venzen, F.E. Mowry, K. Elsaafien, E.G. Krause, A.D. de Kloet

The anterior cingulate cortex (ACC) is a cortical brain region involved in emotive pain processing. Recently, it emerged as a region that plays a role in thirst. However, the underlying neural mechanisms remain unclear. This study investigates the role of an ACC neuronal population that expresses angiotensin type 2 receptor (AT2R) in thirst. Mice with the expression of a green fluorescent protein (GFP) directed to cells that express AT2R (AT2R-eGFP) were subjected to either euhydration and allowed access to water (EU + water access), dehydration with access to water (DE + water access) or no access to water (DE + NO water access). Mice were then perfused with 4% PFA and brains were collected for further processing. Immunohistochemistry was performed to label C-Fos (a marker of neuronal activation), and RNAscope *in situ* hybridization was used to label the mRNAs of glutamatergic (vGlut1) or GABAergic (vGAT) neurons. Subsequently, brain sections were imaged on a confocal microscope and analyzed using FIJI. We found that AT2R expressing neurons in the ACC are either excitatory or inhibitory neurons. Thus, we assessed the pattern of activation in inhibitory and excitatory AT2R expressing neurons during euhydration and dehydration. We did not observe any significant differences in the GABAergic population of AT2R expressing neurons in the ACC among groups. Interestingly, we did observe a significant increase in the percent of glutamatergic AT2R expressing neurons in the dehydrated group that was denied access to water, but not in the dehydrated group that was given access to water, nor the control euhydrated group. This suggest that AT2R expressing neurons in the ACC respond to thirst by activating the excitatory population, potentially signaling to increase water intake. Understanding the neurobiological mechanisms of thirst and fluid homeostasis is key to treating diseases associated with fluid dysregulation, such as diabetes.

Ayesha Hanifa

Denmark High School, Alpharetta, GA



Ayesha is a rising senior at Denmark High School. She is an avid follower of developments in the scientific field, with special interest in the growth and improvement of genetic engineering and modification strategies related to curing disease. She enjoys challenges and has taken six AP courses, such as AP Chemistry, AP Seminar, and AP Calculus AB. In fact, she has already completed AP Biology, earning the highest score of 5. Ayesha has some lab experience from her AP Biology and AP Chemistry, performing experiments ranging from genetically engineering E. coli to extracting different elements from chemicals to examine their compounds and reactivity.

Ayesha launched a school-wide initiative to improve the mental health of high schoolers in her community, a social media page known as “Train of Thought.” Currently, she is working closely with her school’s HOSA advisor and two of her friends to expand this venture into a nationwide non-profit dedicated to mental health advocacy and support. She also serves as an officer in her school’s iGEM, Doctors Without Borders, and Women in STEM.

Beyond school, Ayesha is actively engaged as a current volunteer and former graduate of Alpharetta Tamil School, where she studied for five years to claim mastery of her native language and attain both the Georgia and Global Biliteracy Seal. Finally, she helps out at her local mosque and has recently been elected to serve as a member of the 2024 YM Shura, a prestigious organization for young Muslim leaders working to empower the religious community.

Bolton Lab

Early-life adversity in the form of limited bedding and nesting causes fragmented maternal care

A. Hanifa, F.H. Mroue-Ruiz, J. Shehu, U. Kar, M. Garvin, and J.L. Bolton

Early-life adversity (ELA) is a known risk factor for developing neuropsychiatric disorders like depression. However, the mechanism of how ELA affects the development of the nervous system is not fully understood. To approach this, we use the limited bedding and nesting model (LBN) to mimic a low-resource environment. This consists of supplying the dams, or mouse mothers, with half the amount of bedding material and half of a cotton nestlet compared to that of a standard cage. Additionally, a wire mesh prevents the dams from accessing the bedding to supplement their nest. To understand how ELA affects maternal behavior, we compared the maternal care provided by dams in the control condition (n=10) and LBN (n=12). The results indicated that dams in the LBN condition display fragmented and unpredictable maternal care, as shown by higher entropy values. Among the various maternal care behaviors, the total amount of licking and grooming (LG) was not altered. However, the dams presented a higher frequency of LG in shorter bouts, contributing to an increased entropy score. These results indicate the importance of robust and predictable maternal care for the proper development of the nervous system, and validate this model as a tool to understand the impact of ELA on brain development.

Sydney Apraku

Duluth High School, Duluth, GA

Sydney graduated from Duluth High School where she challenged herself by taking AP and Honors courses. She especially enjoys learning about the natural and social sciences and serving her community. She was involved in numerous extracurricular activities including the National BETA Club, Student Advisory Council, Science Olympiad, and Robotics. She also engaged in leadership, biomedical, and computational programs at Emory University and UC Berkeley, which have contributed to her intellectual pursuits and extracurricular leadership roles. Her interest in neuroscience was enhanced by taking AP Psychology, as she learned about how areas of the brain function and control human behavior and thoughts. Being someone who has struggled with stuttering and who has relatives who stuttered as well, Sydney is intrigued by the neurogenetic aspects of language, along with clinical and computational neuroscience. She is preparing for a career in healthcare. She has enjoyed neuroscience research this summer with ION and will be starting her undergraduate studies at the University of Georgia in a few weeks.

Dhamala Lab

Theta band neural oscillations in tactile perceptual decision making

S. Apraku, M. Dhamala

Theta band (3-7 Hz) neural network oscillations in the brain are known to support spatial navigation, memory, and decision-making processes. Frontoparietal theta oscillations, in particular, are associated with conflict resolution, intentional actions, and decision-making. However, their role in goal-directed perceptual decision making across various sensory domains remains unclear. This study aims to investigate the timing and extent of theta oscillations from electroencephalogram (EEG) recordings during a tactile discrimination task. In an EEG experiment, thirteen participants felt a linear three-dot array presented electromechanically under computer control and reported whether the central dot was offset to the left or right. We analyzed task-phase locked theta oscillations from scalp EEG recordings using wavelet spectral analysis of trial-averaged EEG data. The average theta oscillations differed significantly between correct and incorrect decisions. Both correct and incorrect decision trials showed peak theta band activities in electrodes over the prefrontal and parietal lobes, with correct decisions exhibiting more prominent theta power over the prefrontal areas. These results suggest that theta band neural oscillations engage the frontoparietal network in making tactile perceptual decisions and play a role in spatial acuity and orientation.

Gabriella Salandy

Cardinal Newman High School, West Palm Beach, FL

Gabriella Salandy is a rising junior at Cardinal Newman High School. There, she is a member of the National Honor Society, the Drama Club, the Green Club, the chorus and Mass Ensemble, and the JV volleyball team. Outside of school, Gabriella has played beach volleyball since 2019. As a member of the chorus, she participated in Disney's Imagination Campus workshop where she worked with a Broadway performer. She also leads the chorus' alto section, performs in concerts, and is currently the co-president. Her freshman year of volleyball, she received the Crusader/Coach's Award. More recently, Gabriella has begun to listen to neuroscience podcasts and watch neuroscientific videos. Georgia State University's ION Program has been her first real experience in neuroscience.

Arrington Lab

Brain regions associated with reading

G. Salandy, A. Herrera Diaz, F. Heydari, N. Moquete, and C.N. Arrington

Reading is the process of interpreting characters with significance by using phonemic decoding, fluency, pattern recognition, vocabulary, and comprehension. The brain utilizes a left-lateralized network of cortical regions that support reading. The reading network consists of three distinct pathways: 1) the ventral pathway, which assists with word recognition, 2) the dorsal pathway, which assists with phonological decoding and language processing, and 3) the anterior pathway, which is involved in higher level processing such as reading comprehension. The occipitotemporal gyrus (OTG), superior temporal gyrus (STG), and middle temporal gyrus (MTG) are associated with the ventral pathway, while the supramarginal gyrus (SMG) and the angular gyrus (AG) are associated with the dorsal pathway. The inferior frontal gyrus (IFG) is associated with the anterior pathway. The current study consisted of 28 subjects with typical reading skills. Each subject completed the Test of Word Read Efficiency (TOWRE-2) to assess single-word reading skills and abilities to phonetically decode words. Anatomical MRI scans were also obtained and processed using Freesurfer to obtain volumetric measurements of brain areas of interest. Reading scores and volume for brain regions of interest (OTG, SMG, IFG, STG, MTG, and AG) were correlated. Results indicated that the IFG and brain regions associated with the ventral pathway were correlated with sight-word efficiency, while brain regions associated with the dorsal pathway were correlated with phonological decoding. Findings from this study could impact the treatment of reading impairments in patients with neurological trauma such as stroke or developmental reading disabilities, as they provide information about their brain-based reading deficits.

Camille Hardy

Decatur High School, Decatur, GA

Camille Hardy graduated from Decatur High School. She will be attending the Georgia State University Honors College in fall 2024, where she plans to major in neuroscience. During this school year she has held an internship at Seamless Recovery Med Spa in Decatur, shadowing a nurse practitioner and learning about the aesthetics field of medicine. This year Camille will graduate from a certified nursing assistants' program at Georgia Piedmont Technical College and plans to take the state exam. She has goals to earn a phlebotomist certification and aspires to work as physician in the future. Camille is also a dual enrollment student at Georgia Piedmont Technical College and has taken several Advance Placement courses such as AP Psychology and AP World History.

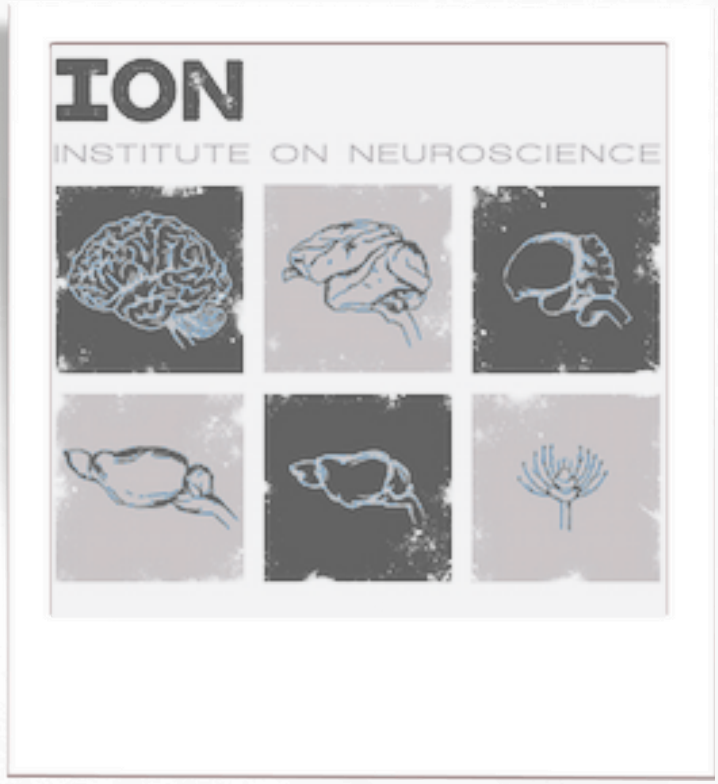
Despite facing a last-minute school-change before her senior year, she has remained active in her former school community. Camille is a leader in the school organization called Girls In Focus To Succeed (G.I.F.T.S.) and is on the Economic Development Committee for First Ladies Youth Leadership as well. On the EDC, she has led and continuously helped develop the first Junior Conyers-Rockdale Economic Development Committee, which launches this fall. She has also been a leader in BETA Club and other clubs and organizations, such as the Black STEM Student Union, Rockdale Youth Leadership, and Health Occupations Students of America (HOSA). Camille is a member of Mount Calvary Baptist Missionary Church where she is in the Media Ministry. She is honored to have been selected as a research intern for the Institute of Neuroscience Summer Research Program.

Dotson Lab

Stress in excess? An analysis of stress in undergraduates assigned to a brain health intervention

Hardy, C.A, Fyffe, M., Burnette, J., Misiura, M, Hemphill, A., Tone, E., Dotson, V.M., Aycock, D., Ellis, R., King, T.Z., Calhoun, V.

Obtaining an undergraduate degree can be a stressful experience. Meeting new people, living away from home, and academic pressure all can contribute to stress and anxiety which negatively impact students' mental health and academic success. In the framework of the longitudinal Healthy Student Brain study, we look at how an exercise intervention and online brain health training affects anxiety and stress in GSU (Georgia State University) undergraduate students. Participants were GSU undergraduate students who did not routinely exercise. The participants were randomized and assigned to one of the four intervention groups: control, exercise, online brain health training, and exercise + online brain health training. Participants were then administered a Fitbit to track exercise and sleep activity for 8 weeks. Before and after these 8 weeks participants came in person for data collection, including cognitive testing, online surveys, and biometric data collection. For our analysis, data only included participants who completed the 8-week study period and who had completed exercise and mood survey data (N=36). We used the self-report PROMIS-Anxiety and the Perceived Stress Scale short forms to measure anxiety and stress. We performed t-tests comparing changes in anxiety and stress between exercise and non-exercise participants and between intervention and control groups. We also performed an ANOVA comparing changes in stress and anxiety among the 4 groups. We did not identify a significant difference between intervention and control groups or between exercise and non-exercise groups for change in anxiety. We did identify a marginally significantly different change in stress between exercise and non-exercise groups ($t(34) = -1.59$, $p=0.1$). Exercise and online brain training intervention resulted in a greater reduction in stress after the * week period. Exercise may be a beneficial method of stress reduction and future studies will include more participants to verify our results.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Directors, Instructors, Staff, and Speakers

Kyle Frantz, PhD, ION Director

Dr. Frantz is a Professor and Science Educator in the Neuroscience Institute and Department of Biology at Georgia State University. Dr. Frantz received her BA in Psychology from the University of Pennsylvania, her PhD from the University of Florida, and conducted post-doctoral research at The Scripps Research Institute. Her laboratory research addressed adolescent sensitivity to drugs of abuse. Dr. Frantz coordinates science education programs and conducts science education research as Director of Science Education for the Center for Behavioral Neuroscience. She works on campus-wide initiatives in undergraduate student advancement into medical school, law school, and PhD programs as Director of the Center for the Advancement of Students and Alumni (CASA) at Georgia State.

Erica Tracey, PhD, ION Co-Director

Dr. Tracey is a Senior Lecturer in the Neuroscience Institute at Georgia State University. She received her BS in Biology from the Honors College at the College of Charleston and her PhD in Neuroscience from Emory University, where she was awarded funding for both her research on the peripheral nervous system and her training in introspective and team-building tools. She brought these passions to Georgia State where she teaches neuroscience and professional development, while establishing community internships and professional licensures. Through these roles she teaches her students that fulfillment comes from intentionally building one's career alongside things that bring them joy.

Chris Goode, PhD, ION Co-Director

Dr. Goode is a Principal Lecturer in the Department of Psychology at Georgia State University. He received his BA in Psychology from Wake Forest University and his PhD in Neurobiology and Behavior from the University of Washington. His neuroscience research background is primarily in sensory systems, specifically the development of the vestibular system. Currently, Dr. Goode's primary focus is on teaching, science education, teaching effectiveness, and the use of technology in the classroom. He is particularly interested in how research experiences benefit undergraduates.

Directors, Instructors, Staff, and Speakers cont'd

Jennifer Walcott, ION Program Coordinator

Ms. Walcott is the Project Coordinator for the Center for Behavioral Neuroscience at Georgia State University. She earned her BA in Philosophy from Sweet Briar College, a women's school in Virginia, and her Master of Divinity from the Candler School of Theology at Emory University. In addition to serving as the ION Program Coordinator, Jennifer coordinates all the educational programs and resources offered by the Center for Behavioral Neuroscience, such as the Atlanta Regional Brain Bee, The Neuroscience School Summer Short Courses, and the Lending Library of Learning Resources, which includes brain models, tissue specimens, and other teaching tools.

Debra Bangasser, Keynote Speaker

Dr. Bangasser is a Professor in the Neuroscience Institute at Georgia State University. She received a BA in Psychology from San Diego State University, and PhD in Biopsychology and Behavioral Neuroscience from Rutgers University. She also serves as Associate Director of the Center for Behavioral Neuroscience and is a distinguished investigator with the Georgia Research Alliance. Her laboratory research investigates how sex differences in stress responses may bias males and females toward different resultant pathologies. With funding from the National Institute on Drug Abuse and the National Institute of Mental Health, she combines techniques from the subfields of behavioral neuroscience, neuroendocrinology, and molecular neuroscience.

Kierra McInnis, Closing Remarks

Ms. McInnis is the Outreach Specialist for AEOP Internships and Fellowships at the Rochester Institute of Technology. She received her BS in Biology from the State University of New York at Brockport, with undergraduate studies at Monroe Community College and research experience at SUNY Binghamton and Syracuse University as well. Her work with AEOP apprentices in high school and college emphasizes comprehensive mentoring and the opportunity to be the kind of mentor that has made her own career trajectory so exciting.


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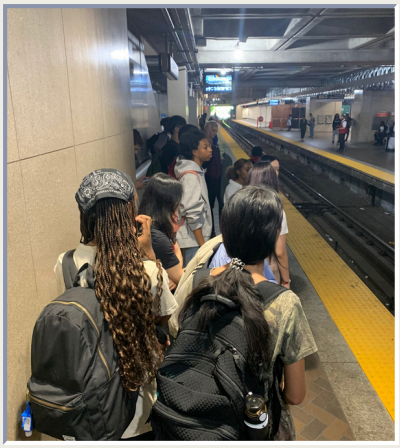

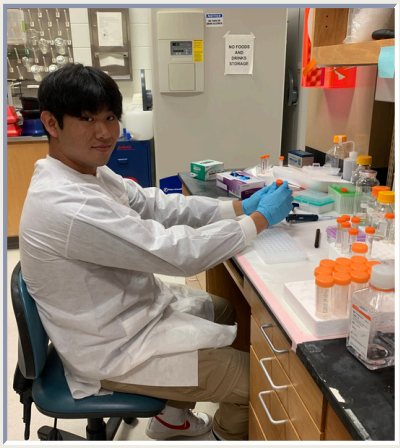

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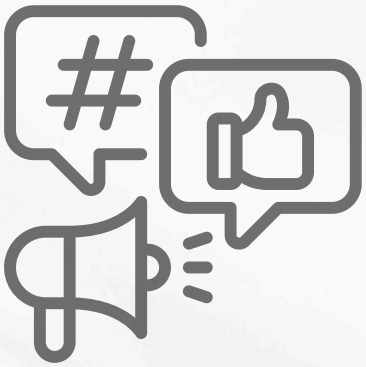

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